PRACTICAL WIRELESS

OCTOBER 1968

3'0

TRANSISTOR POWER OUTPUT STAGE on P.C. Board (with diagram). 5¼in. x 2in. x 1¼in. high. Tested and working. OC71, OC81D and 2 x OC81 and Heat Sinks. With O.P. Trans. for 35 ohm speaker. Requires 5K Pot, Speaker and 9v. supply. Price **27/6** Post paid. 5K Log Pot + Switch **4/-**. 8in. x 2½in. 35 ohm. Speaker **16/6**.

1½W MAINS GRAMOPHONE AMPLIFIERS. EZ80, ECL82, O.P. Transformer (3 ohm). Vol./On-off and Tone Control. Double wound mains transformer. 2⅝ x 2½in. x 2¼in. separate but wired to chassis, 4in. x 2¼in. x 4¾in. over valves, **65/-** post paid including 6½in. Speaker. (**52/6** less speaker.)

NEW F.M. TUNER. Range 87 to 107 MHz Attractively finished metal container with cast front escutcheon. Case size 13in. x 7in. x 3¾in. high. Mains transformer. Metal Rectifier and Valves ECC85, EF89, EF80, ECC82 as cathode follower. EM84 tuning indicator, 2 x AF117 and 2 diodes. **A really fantastic performer. Price £17.17.0,** tax paid and carr. paid or with Stereo Decoder. **£22.10.0.** Terms available this item.

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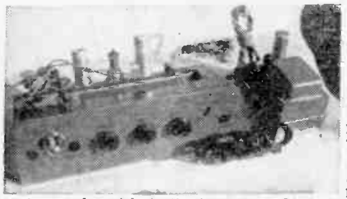
2 x 4 WATT STEREO AMPLIFIER. Printed circuit. Separate power pack and separate control panel. Metal rectifier. ECC83 and 2—EL84. Negative feedback. Vol., base, treble each channel. Muting switch and on/off. **Printed circuit** 4¾in. x 4¾in., Power Pack 7½in. x 4½in. x 3½in. and control panel 4in. x 5in., with output transformers for 3-ohm speakers on power pack. **£5.10.0** (7/6 P. & P.).

TAPE AMPLIFIER FOR MAGNAVOX TAPE DECKS — 2 or 4 TRACK



Chassis 12½ x 5½ x 4½in. high. Front panel "gold" finish—12½ x 4½in. 200–250 A.C. Record/Playback amp. switch Off/On-Tone; Vol./Mic.; Vol./Gram; Mic. Input; Gram. Input; Monitor; Speaker Socket Valves 6BR7; 12AX7; EM84; EL84; 6X4 Separate power pack, **2 Track £8.19.6; 4 Track £10.4.6** (6/- post each). Rexine covered cabinet (tan) 15½ x 17 x 9½in. high with sloping front for amp; complete with two tweeter speakers, and special adapting brackets for Magnavox Deck **85/-** (8/- carr.) 3 speed Magnavox 4 track tape deck, Type 363. **£16.10.0, carr. paid.**

"SUPER SIX" L.W. and M.W. TRANSISTOR RADIO KIT, Mark 2. Complete set parts **£4.2.6** (5/- post). PP6 batt. 2/9 extra. Instructions and list 2/- (free with kit). Superhet; ferrite rod; wooden cab. 9½ x 7½ x 3in. Celestion 4½in. speaker, 6 transistors, diode, etc.

SPEAKERS IN CABINETS. 20 x 15 x 6½in. Finished Vynair and Rexine, various colours. With E.M.I. 13 x 8in. 3 or 15 ohm speaker **90/-; with 12in.** Elac 15-ohm 15W speaker. **£8.10.0** (post 10/- on either). **Top quality speakers** 6 x 4in. (3 or 15 ohm), **14/6**; 5in. (3-ohm), **12/6**; 4½in. (3 or 10 ohm), **12/6d.**; 7 x 3½in. (3 ohm), **16/6**; 13 x 8in. (3 or 15 ohm) **41/-** (post 3/6) all others post 1/6 each. 12in. heavy duty Elac Loudspeaker 15 ohm, 20 watt, **£6.6.0,** carr. paid.

8 WATT. PUSH-PULL OUTPUT AMPLIFIER, 200-250 Volts A.C. EZ80, ECC83, 2—EL84, Bass, treble, vol/on-off. £7.17.6 (post paid). Size 12 x 3½ x 5in. high. For Record Player, Radio Tuner, etc.

RADIOGRAM CHASSIS unused but very slightly tarnished. Size 13½ x 5½ x 7in. Dial 13 x 4in. gold and brown. Controls beneath dial, Tone, Volume/on/off, MW/LW/Gram · Tuning. Ferrite rod aerial. Valves **UY85** rect., **UCL82, UBF89, UCH81.** Limited quantity. **£7.7.0,** carr. paid.

EX GOVERNMENT AVO METER, Model 7. Excellent condition, fully checked, with leather carrying case. List price new over £29. Our price **£18.** Carr. paid.

CLEAR PLASTIC PANEL METERS D.C. Type KA/38C. 1½in. sq. 50 microA **30/-**; 500 microA **27/6**; 1mA (S-meter) **27/6**; 5mA **27/6**; 100mA **25/-**; 300V **27/6.** Post 1/6d.

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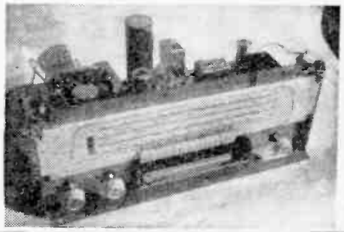
6 PUSH-BUTTON STEREOGRAM CHASSIS



M.W.; S.W.1; S.W.2; V.H.F.; Gram: Stereo Gram Two separate channels for Stereogram with balance control. Also operates with two speakers on Radio. Chassis size: 15 x 7 x 6½in. high. Dial silver and black 15 x 3in. 190-550M; 18-51M; 60-187M; VHF 86-100 Mc/s. Valves: ECC85, ECH81, EF89, 2x ECL86, EM84 and Rect. Price **£19.19.0,** carr. paid or **£6.13.0** deposit and 5 monthly payments of **56/6.** Total H.P. price **£20.15.6.** Cream moulded escutcheon included.

GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT, Hants.

(2 mins. from Station and Buses). FULL GUARANTEE. Aldershot 22240
CLOSED WEDNESDAY AFTERNOON. CATALOGUE 6d.

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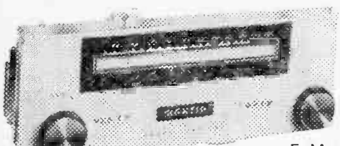
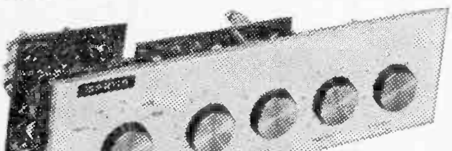
The first and still the most satisfactory unit assembly system



F. M. TUNER



STEREO CONTROL ASSEMBLY

For many years now Martin Electronics have been producing highly efficient and dependable prefabricated module-type units for simple assembly into reasonably priced high fidelity systems. Many purchased at the time of the introduction of the Martin Audiokit system are in regular use to this day, completely justifying our claims for years of trouble-free service. No system gives you wider flexibility in the choice of units available than Martin and all equipment conforms precisely to stated specification. When new units are introduced, they are designed for adding to those produced so far, making it easy and economical to extend and improve your existing Martin Audiokit set-up. Anyone can assemble Martin equipment with ease and the foreknowledge that when finished, he will be in possession of a true hi-fi assembly of the very best kind which looks and sounds completely professional in every way—and MARTIN AUDIOKITS remain as ever, the units that have true add-on ability.

AMPLIFIER SYSTEMS • TUNERS • RECORDERS

MARTIN HIGH-FIDELITY AUDIOKITS
cover the widest possible range of requirements. They are available for Mono, and can be doubled up for conversion to stereo, or as complete stereo units. 3 ohm and 15 ohm systems. Special pre-amp for low output pick-ups—escutcheon panels to suit the arrangement you choose. Tuner is styled to match.

UNITS INCLUDE:

- 5-stage input selector
- Pre-amp tone controls
- 10 watt amp. (3 ohms)
- 10 watt amp. (15 ohms)
- Mains power supply
- F.M. Tuner

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Please send Audiokit Hi-Fi/F.M. Tuner/Recordakits Leaflets. (Strike out items not wanted)

Name ....

Address ....

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PW.10

SENSATIONAL R.S.C. HIGH FIDELITY STEREO PACKAGE OFFERS

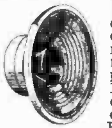
"PACKAGE 3" 30 WATT SYSTEM
★ Goldring Transcription Turntable on Plinth
★ Shure Magnetic Pick-up Cartridge
★ Super 30 Amplifier in Teak veneer housing
★ Pair of Stanton Loudspeaker Units
Special inclusive price. Fully wired units ready to "plug-in". Saving substantially on total cost **82 Gns.** Carr. 35/-

"PACKAGE 2" 30 WATT SYSTEM
★ Garrard SP25 Mk II Turntable on Plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ Super 30 Amplifier in Teak veneer housing
★ Pair of Stanton Loudspeaker Units
Special inclusive price. Fully wired units ready to "plug-in". Saving substantially on total cost. **72 Gns.** Carr. 35/-

'PACKAGE 1' 13 WATT SYSTEM
★ Garrard SP25 Mk II 4 speed Player Unit
★ Goldring CS90 Ceramic P.U. Cartridge
★ TA12 Amplifier in Teak veneer housing
★ Pair of Dorset Loudspeaker Units
Special inclusive price. Saving £9 on total cost. Perspex cover 59/9 extra. Or Dep. £8.7.0 and 9 mthly pmts £5.3.0. (Total £54.14.0). **47½ Gns.** Carr. 35/-

TERMS AVAILABLE
Matched for optimum performance and comparing favourably with equipment of almost twice the cost. Send S.A.E. for leaflet

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

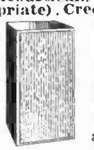


Heavy cast construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range. Impedance 3 or 15 ohms. Please state choice. Response 40–18,000 c.p.s. Exceptional performance at low cost. Prices include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

HF501	5"	10W	59/9	HF120	12"	15W	69/9
HF801D	10"	8-10W	59/9	HF120D	12"	15W	79/9
HF811D	8"	10W	4 gns.	HF126	12"	15W	89/9
HF100D	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 HF800D speaker. Impedance 3 or 15 ohms. **£7.10.0** Inc. Carr.

STANTON IIIS Size 18 x 11 x 10in. Rating 10 watts. Incorporating Audiotrine HF 815 speaker with roll rubber surround and 15,000 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.** Inc. carr.

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.**

INTEREST CHARGES REFUNDED

on Credit Sales settled in 3 months.

EXTENSION LOUDSPEAKERS 29/9

Cabinet size 12 x 8 x 5in. Attractive Grey Lizard Skin finish. Fitted high flux 4–5 watt. 6½in. 3 ohm speaker.

E.M.I. MAINS RECORD PLAYER TURNTABLES

4 Speed, with P.U., T/O Cartridge. Limited number. Mail Order only. Mono 79/9. Stereo 89/9.

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. 9¼ x 2¾ x 5½in. Attractive brushed silver finish facia plate 10¼ x 3¼in. 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.**

EXTREMELY ATTRACTIVE AND VERSATILE PLINTHS

finished in Satin Teak veneer. Tinted Perspex hinged cover with satin chrome handle.

RECORD PLAYING UNITS

Money saving 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. Mounted on Plinth Perspex Cover 3 gns. extra. **19 Gns.**

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Perspex Cover 3 gns. extra. Carr 15/-. ONLY **24½ Gns.**

AUDIOTRINE PLINTHS

for Record Playing units. Teak finish cut for Garrard 1000, 2000, 3000, AT6, AT60, SP25 or Goldring GL68. Available with clear Perspex cover as ill. Inc. Carr. **£5.19.9** **59/9** Perspex cover sold separately at 3 Gns. Limited number of covers slightly damaged but repaired by makers. 39/9

PHONE AMPLIFIERS

Speak and listen with both hands free. Standard dry battery operated. **59/9**

RECORD PLAYING TURNTABLES COMPLETE

Fully wired. Fitted phono plugs and mounted on baseboard. Substantial saving on normal prices. Garrard SP25 MkII with Goldring CS90 Cartridge. **17½ Gns.**
Goldring GL68 with CS90 Cartridge.................... 23 Gns.

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) 50m V (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.). Or in Teak veneer housing 18 Gns. **12 GNS.** Carr. 7/9

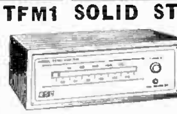
AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.** Carr. 5/9
Or **Senior 15 watt** inc. HF 126 15,000 line Speaker 6 Gns. Carr. 6/6

HI-FI 'SPEAKER ENCLOSURES

Teak veneer finish. Modern design. Accoustically lined and ported.
JE8 Size 16 x 11 x 9in. Gives pleasing results with any 8in. Hi-Fi 'speaker. Carr. 7/9 **4 Gns.**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Carr. 7/9 **£4/19/9**
SE10 For outstanding results with 10in. Hi-Fi 'spkr Size 24 x 15 x 10in. **5 Gns.**
SE12 For excellent performance with 12in Hi-Fi 'spkr and Tweeter. Size 25 x 16 x 10½in. **6 Gns.**

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



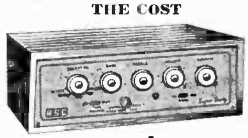
Total cost of parts with detailed wiring diagrams & instructions. Carr. 10/- **12½ Gns.** Or factory built 16½ gns. Or in Teak finished cabinet as illustrated 19½ gns. Terms: Deposit £5 and 9 monthly payments £2. Total £23.

★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 18 gns. Carr. 10/-. Assembled 22½ gns. inc. carr.

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

SOLID STATE CONSTRUCTION
SPECIFICATIONS COMPARABLE WITH UNITS AT ALMOST TWICE THE COST

FULLY TRANSISTORISED 200/250v. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3–4 ohms.
LATEST TRANSISTORS. NKT275, NKT275, NKT274, NKT713, NKT217, NKT217, NKT717, NKT403, NKT403.
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. 0·1%.
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 in Teak veneer housing as illustrated. 19 Gns.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.



R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components. **CROSS TALK:** –52dB at 1,000 c.p.s.
CONTROL: 5 position Input Selector, Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Facia 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/- **19½ Gns.**
Unit factory built 27 Gns. or deposit £6.2.0 and 9 monthly payments 56/3. (Total £31.8.3). Or in Teak veneer housing 30 Gns. Carr. 15/– or Deposit £6.2.6 and 9 monthly paymts 64/- (Total £34.18.6). *Send S.A.E. for leaflet.*

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R·S·C HI-FI CENTRES LTD.

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

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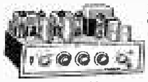
THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ Moderate size, only
★ Response 30-20,000 c.p.s. Impedance 15 ohms.
★ Performance comparable with units costing over £40.

Complete Kit **18 Gns.** Carr. 12/6

Consists of (1) 12 in. 20 watt Bass unit with cast chassis. Roll rubber surround for ultra low resonance, powerful 2in. diam. pole pieces and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5 in. high flux middle range 'speaker. (4) High efficiency tweeter. (5) Measured weight of woollen acoustic damping material. (6) Teak veneered cabinet. (7) Circuit and full instructions. DEMONSTRATIONS AT ALL BRANCHES.

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



PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. Frequency Response: ±2dB 30-20,000 c.p.s. Hum Level: 65dB down. Sensitivity: 20 millivolts max. Harmonic Distortion: 0·2% ★Four-position tone compensation and Input Selector Switch. ★Stereo/Mono switch. ★Neon panel indicator. ★Handsome Perspex Frontplate. ★Separate Bass and Treble controls. Output transformers are high quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts, point-to-point wiring diagrams and instructions. Or factory assembled with our usual 12 mths' gntee 19gns. Or Dep. £4.10.0 and 9 monthly payments £2 (Total £22.10.0). *Send S.A.E. for leaflet.*

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 **13 Gns.** Twin-handled perforated cover 25/-. Supplied factory built with EL34 output valves. 12 months' guarantee for 16 gns. TERMS: Deposit £5.14.0 and 9 monthly payments of 28/9 (Total £18.12.9). Send S.A.E. for leaflet.

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

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with associated controls allowing mixing of "mike" and gram, etc. etc. High sensitivity. 5 valves—ECC83 (2), EL84 (2), EZ81. High quality sectionally wound output transformer. FOR BASS AND TREBLE CONTROLS. Frequency response ±3dB 30-20,000 c/s. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic PUs. all types "mikes". For Musical Instruments such as String Bass, Electronic Guitars, etc. Size approx. 12 x 9 x 7 in. For AC mains 200-250v. 50 cps. **9 Gns.** Output for 3 and 15 ohm spkrs. Send SAE for leaflet. Full instructions and point-to-point wiring diagrams. Carr 11/6 (or factory built 12 Gns.) Twin handled metal cover 25/-. TERMS ON ASSEMBLED UNITS. Deposit 87/6 and 9 monthly payments of 22/- (Total £14.5.6).

RSC A11T TRANSISTORISED VERSION of above complete kit 9 Gns (Assembled 13 Gns)

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" 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 5½x4½x2in.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 2⅝ × 2⅝ × 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

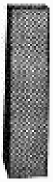
0-110/120v.-200-230-250v. 50-80 watts	14/9
150 watts, 29/11; 250 watts 49/9; 500 watts	99/9

OUTPUT TRANSFORMERS

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

SMOOTHING CHOKES 150mA, 7-10H, 250 Ω 12/9; 100mA, 10H, 200 Ω 9/11; 80mA, 10H, 350 Ω 7/9; 60 mA, 10H, 400 Ω 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 65/- and 9 mthly pmts 34/9 (Total £18.17.9) Carr. 10/-. **15 Gns.**

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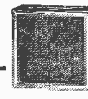
30 WATT HI-FI AMPLIFIER

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

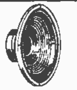
10 Watt 12,000 lines 3 or 15 ohms **5 Gns.** 20 Watt 12,000 lines 3 or 15 ohms **8 Gns.**

LOUDSPEAKERS

Limited number of heavy duty units 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. 30 watt DUAL CONE	15in. 30 watt DUAL CONE
59/11	£5.15.0	Normally appr. £13 **£6.19.9**	Normally appr. £15 **9 gns.**

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. ONLY **49/11** Circuit etc. supplied.

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**

HIGH QUALITY 8" x 3" LOUDSPEAKERS 10000 Gauss 3 ohm only **12/9**

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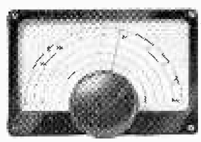
Catalogue No. 598 epicyclic dial

This full vision dial incorporates an epicyclic, ball-bearing drive mechanism of improved design and giving a reduction ratio of approximately 10 to 1. The movement is smooth and free from backlash. Dial escutcheon measures 6" long by 4¼" wide, finished ripple black. Four lines are provided on the semi-circular scale for individual calibrations, the outer line being marked from 0 to 100 over 180°. Supplied complete with black instrument knob 2¼" diameter.



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A high grade assembly for precision instrument applications. Gear driven, flywheel-loaded mechanism, with a reduction ratio of 110 to 1, giving smooth, positive control.

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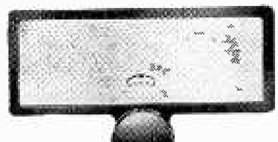

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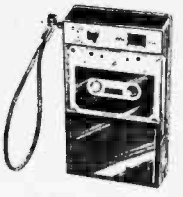

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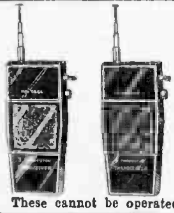

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MATCHING AM/FM STEREOPHONIC FM TUNER
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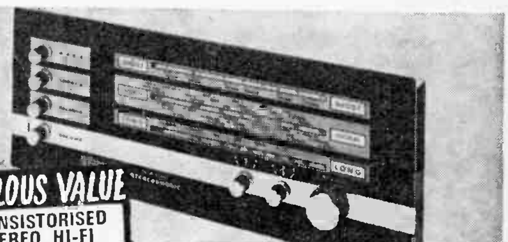

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Advanced solid state amplifier only 4½" deep, 14 transistors plus 4 diodes, separate Bass and Treble—10 watts total power. Frequency response 50-15,000 c/s.

EASY TO INSTALL
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H. P. terms available. Deposit £7.1.9. & 12 monthly payments of 40/- (Total H. P. £31.1.9.). Send £7.19.3. today.

Amplifier available separately at only **16 Gns.**

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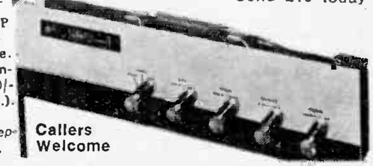

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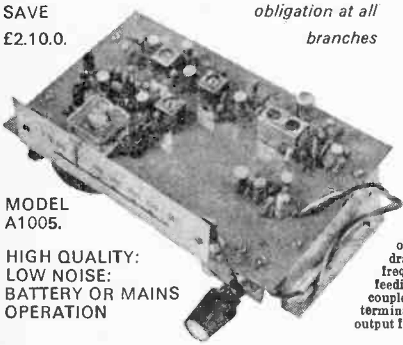

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HIGH QUALITY: LOW NOISE: BATTERY OR MAINS OPERATION

STEREO DECODER

Model A1005M. Simple instructions to convert any FM tuner. Max input 100 m volts. Power supply 8–14 volts. Mains or batt. (5mA at 12V.) Output 1·5 x input. 4 transistors (2 each) 2SB–202; 2SB–186. 7 idiodes IN34 (six) IN60 SAVE 34/- **5 Gns.**

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This beautifully compact 6 transistor machine (size 6 x 4 x 2½in.) will give quieter, more interference free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise freq. changer. Smooth 2 gang tuning feeding no less than three I.F. stages coupled to a double-tuned discriminator terminating in an L.F. stage giving ample output for all quality amplifiers.

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R.F. Kits OC44, OC45 (2) 3 transistors. **11/-**

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FANTASTICALLY POPULAR ★ TAPE ★

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4in.	300ft.	4/6	4in.	450ft.	5/6
5in.	600ft.	7/6	5in.	900ft.	10/6
5¾in.	900ft.	10/6	5¾in.	1,200ft.	13/-
7in.	1,200ft.	12/6	7in.	1,800ft.	18/6
Double Play			**Triple Play**		
3in.	300ft.	4/-	4in.	900ft.	13/-
4in.	600ft.	8/-	5in.	1,800ft.	25/-
5in.	1,200ft.	15/-	5¾in.	2,400ft.	34/-
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7in.	2,400ft.	27/-	**Quadruple Play**		
			3in.	600ft.	8/6

Postages 1/- *reel.*
Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE. *Large tape stocks at all branches*

STEREO PORTABLE CABINETS

Latest black and silver metal finish. Consisting of centre cabinet size 16½in. x 13in. x 8in. deep with lift up lid together with two 10 x 6 speaker cabinets which clip on ends of main cabinet size 4½in. x 13in. x 8in. making overall size of 25½ in. x 13 in. x 8 in. High quality chrome fittings. Will take almost any autochanger or tape deck. Approx. half price at **£3.19.0**

Ditto, but less chrome. takes 7 x 4 speaker. **£2.19.9**

MONO PORTABLE CABINETS. B.S.R. tape deck or single record player, new, attractive finish, half price. **19/6**

AUTOCHANGE PORTABLE CABINETS. As used on 18 gns. record player. Due to fortunate purchase we offer complete with motor board and all fittings. at only **49/-**

PLEASE NOTE. *A wide range of cabinets to callers at all branches.*

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1% to 5% 100Ω to 5 mΩ.
CO-AX, low loss. 6d. yd., 25 yds. 11/6; 50 yds. 22/-; 100 yds. 42/6. Plugs 1/3.

100 RESISTORS 6/6
SIZES—⅛–3 watt.
MICROPHONE CABLE. Highest quality, black, grey, white, 9d. per yard.

100 CONDENSERS 9/6
Miniature Ceramic, Silver, Mica etc., 3pF to 5μF. LIST VALUE OVER £4.

25 ELECTROLYTICS
Assorted 2 to 500 mfd 6 to 400 volt. LIST VALUE OVER £5. 9/6

50 TAG STRIPS 7/6
Mixed sizes 2 to 15 way.

25 POTENTIOMETERS
Including with switch, long and short spindle, pre-sets, log and lin. unused, 1k–2mΩ. 9/6 LIST VALUE APPROX. £4.

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GUARANTEED ★ VALVES ★

BY RETURN OF POST—GUARANTEED 3 MONTHS

Satisfaction or Money Back Guarantee on goods if returned unused within 14 days
ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valve 9d. 2-11 6d. per valve. Free over 12

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5Z4G	7/6	6X4	4 6	30PL13	16/-	ECC88	8/6	KTW61	6/9	U37	19/-
5Z4GT	8/9	6X5G	5/6	30PL14	16/-	ECF80	8/6	KTW63	6/-	U191	14/-
6/30L2	13/-	6X5GT	6/6	35A5	11/-	ECF82	7/6	MU14	8/-	U281	8/6
6AK5	5/6	7B6	11/6	35L6GT	8/6	ECH42	11/6	N37	10/6	U282	12/6
6AQ5	6/-	7B7	7/6	35W4	5/6	ECH81	7/-	N78	14/-	U301	13/6
6AT6	5/6	7C5	16/-	35Z5	9/6	ECL80	7/-	PC86	10/6	U404	7/6
6AU6	6/-	7C6	7/-	35Z4GT	6/9	ECL82	7/6	PC88	10/6	U801	20/-
6BA6	6/-	7H7	6/6	42	6/6	ECL83	10/6	PC97	8/6	UABC80	7/6
6BE6	6/-	7Y4	7/6	50L6GT	8/6	ECL86	9/-	PCC84	6/9	UAF42	9/6
6BH6	7/6	10C1	9/-	80	8/6	EF39	7/-	PCC85	7/-	UB41	9/6
6BJ6	7/6	10C2	12/-	185BTA	20/6	EF40	9/6	PCC88	12/-	UBC41	9/6
6BR7	10/-	10F1	9/6	807	9/6	EF41	10/6	PCC89	11/-	UBC81	8/6
6BR8	9/-	10F9	9/6	955	3/6	EF42	7/6	PCC189	11/-	UBF80	7/6
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6F15	9/6	12BE6	5/6	DK92	8/6	EL33	13/-	PCL86	9/6	UCL83	10/6
6F23	12/6	12J7GT	7/6	DK96	8/6	EL34	12/6	PL36	12/-	UF41	9/6
6F24	12/6	12K7GT	6/6	DL92	5/9	EL41	9/9	PL81	9/-	UF42	9/-
6J5G	4/6	12K8GT	8/6	DL94	7/-	EL42	10/6	PL82	7/6	UF80	8/-
6J5GT	5/6	12Q7GT	6/6	DL96	8/3	EL81	9/-	PL83	7/-	UF85	8/6
6J7G	5/-	14S7	17/6	DY86	7/-	EL84	7/6	PL84	7/6	UF86	9/-
6J7GT	8/6	19AQ5	5/6	DY87	7/6	EM80	7/6	PY31	7/6	UF89	7/6
6K7G	3/6	20D1	9/-	EABC80	7/-	EM81	8/6	PY32	9/9	UL41	11/6
6K7GT	5/6	20F2	9/6	EAF42	9/-	EM84	8/-	PY33	10/6	UL84	7/9
6K8GT	8/6	20L1	15/-	EB41	6/-	EM85	11/-	PY80	6/6	UM80	7/-
6L1	9/6	20P3	12/-	EB91	8/6	EM87	10/-	PY81	6/6	UU9	7/6
6L6G	9/6	20P4	15/-	EBC33	8/6	EY51	8/-	PY82	6/6	UY41	8/-
6L18	7/6	25L6GT	7/-	EBC41	10/6	EY86	8/6	PY83	6/6	UY85	7/-
6LD20	7/6	25Z4G	7/6	EBC81	7/9	EY88	8/6	PY88	8/6	VR105	7/6
6P25	13/-	30C15	14/-	EBF80	7/6	EZ40	9/-	PY800	9/-	VR150	7/6
6Q7G	6/6	30C17	14/-	EBF83	8/-	EZ41	9/-	PY801	9/-	X66	7/6
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FOR THIS SPECIFICATION

¼ track stereo or mono record and playback at 7½, 3¾ and 1⅞ips. 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 thumbwheel 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 5in. speakers. Operates on 230V a.c. supply.

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

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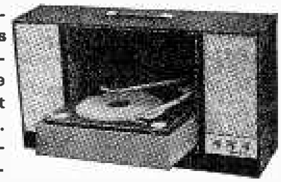

Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250V ac mains operation. Overall cabinet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

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

KIT £28.6.0 incl. P.T. **Ready-to-Use £35.4.0.** P.P. 10/6

Latest STEREO AMPLIFIER, TSA-12

12 x 12 watts output.

Kit £30.10.0 *less cabinet.* P.P. 10/6

Cabinet £2.5.0 extra

Ready-to-Use £38.0.0. P.P. 10/6.

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.

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RADIOS for Luxury Listening

"OXFORD" PORTABLE UXR-2

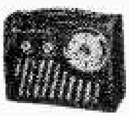
Oxford

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 P.P. 6/–

Ready-to-Use £17.10.0 P.P. 6/-

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).

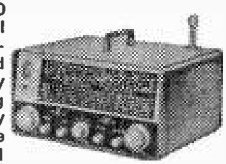
KIT £12.8.0 colour case. P.P. 4/6

Ready-to-Use £14.8.0 P.P. 4/6

KIT £13.8.0 real leather. P.P. 4/6

Ready-to-Use £15.10.0 P.P. 4/6

"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.** P.P. 10/6.

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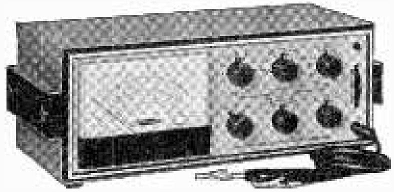
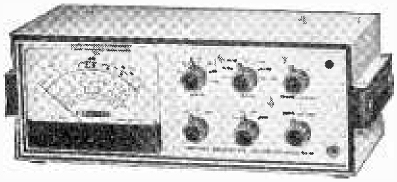


Kit IM-25 **£48.10.0** Ready to use **£59** P.P. 7/6

New Solid-State, High-Impedance Volt-Ohm-Milliammeter . . . IM-25

● 9 AC and 9 DC voltage ranges from 150 millivolts to 1500 volts full scale ● 7 resistance ranges, 10 ohms centre scale with multipliers x1, x10, x100, x1k, x10k, x100k, and x1 meg . . . measures from one ohm to 1000 megohms ● 11 current ranges from 15 μA full scale to 1·5 A full scale ● 11 megohm input impedance on DC ● 10 megohm input impedance on AC ● AC response to 100 kHz ● 6in. 200 μA meter with zero-centre scales for positive and negative voltage measurements without switching ● Internal battery power or 120/240 VAC, 50 Hz ● Circuit board construction for extra-rugged durability.



Kit IM-16 **£28.8.0** Ready to use **£35.8.0** P.P. 6/-

New Solid-State Volt-Ohm-Meter . . . IM-16

● 8 AC and 8 DC ranges from 0·5 volts to 1500 volts full scale ● 7 ohm-meter ranges with 10 ohms at centre scale and multipliers of x1, x10, x100, x1k, x10k, x100k, and x1 megohm ● 11 megohm input on DC ranges, 1 megohm on AC ranges ● Operates on either built-in battery power or 120/240 VAC, 50 Hz ● Circuit-board construction.

Kit IP-17 **£37.4.0** Ready to use **£46** P.P. 10/6

IP-27 not illustrated, but similar in styling.

New Variable Control Regulated High Voltage Power Supply . . . IP-17

● Furnishes 0 to 400 volts DC at 100 mA maximum with better than 1% regulation for 0 to full load and ± 10 volt line variaton ● Furnishes 6 VAC at 4 amperes and 12 VAC at 2 amperes for tube filaments ● Provides 0 to —100 volts DC bias at 1 milliampere maximum ● Features separate panel meters for continuous monitor for output current and voltage ● Terminals are isolated from chassis for safety ● High voltage and bias may be switched "off" while filament voltage is "on" ● Modern circuit board and wiring harness construction ● 120/240 VAC, 50 Hz operation.

New Improved Version of the Famous Heathkit Solid-State, Voltage-Regulated, Current-Limited Power Supply . . . IP-27

● New zener reference ● New improved circuitry is virtually immune to overload due to exotic transients ● 0·5 to 50 volts DC with better than ± 15 millivolts regulation ● Four current ranges 50 mA, 150 mA, 500 mA and 1·5 amperes ● Adjustable current limiter: 30 to 100% on all ranges ● Panel meter shows output voltage or current ● "Pin-ball" lights indicate "voltage" or "current" meter reading ● Up-to-date construction ● Unequalled performance in a laboratory power supply.

Kit IP-27 £46.12.0. Ready to use £55. P.P. 9/-.

FULL SPECIFICATION ON ANY MODEL AVAILABLE ON REQUEST

New Solid-State Volt-Ohm-Meter, IM-17

● Just right for the home owner, boater, model builder, hams, sophisticated enough for even radio and TV servicing ● Solid-state circuit ● FET input ● 4 silicon transistors, 1 diode circuit ● 4 AC voltage ranges ● 4 DC voltage ranges 4 ohm ranges. 11 megohm input DC, 1 megohm input AC, 4½in. 200 μA Meter ● Self powered ● Rugged polypropylene case with self cover and handle. Storage space for own flex leads. PCB construction.

Kit £12.12.0. Ready to use £17.10.0. P.P. 4/6.

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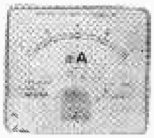

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10mA 37/6	15V. A.C. 37/6
50mA 37/6	300V. A.C. ...37/6
100mA 37/6	8 Meter 1mA .39/6
500mA 37/6	VU Meter 59/6
1 amp. 37/6	1 amp. A.C.*..37/6
5 amp. 37/6	5 amp. A.C.*..37/6
10V. D.C. 37/6	10 amp. A.C.*.37/6
20V. D.C. 37/6	20 amp. A.C.*.37/6
50V. D.C. 37/6	30 amp. A.C.*.37/6

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

50µA 37/6	750mA 25/-
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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/-	8 meter 1mA .29/6
	VU meter 39/6

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
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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
1-0-1mA 49/6	8 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.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	8 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.65P. 3½in. × 3½in. fronts.

50µA 65/-	50V. D.C. 39/6
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100-0-100µA .49/6	15V. A.C. 39/6
500µA 45/-	50V. A.C. 39/6
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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
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Type MR.52P. 2½in. square fronts.

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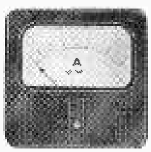
100µA 49/6	1mA 37/6

BAKELITE PANEL METERS



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	

*Moving iron, all other moving coil.

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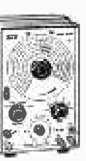
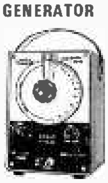
100 microamp.....55/-	300 volt A.C. 45/-
100-0-100 microamp52/6	VU meter 62/6
200 microamp.....52/6	Post extra.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s—500 Mc/s on 6 bands. Directly calibrated. Variable RF. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. **£15.** Carr. 7/6. Size 140 x 215 x 170 mm.

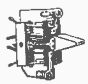
TY75 AUDIO SIGNAL GENERATOR



Sine Wave 20 CPS—200 Kc/s. Square Wave 20 CPS—30 Kc/s. High and low impedance output. Output variable up to 6 volts. 220/240 volts A.C. Brand new with instructions. **£16.** Carr. 7/6. Size 210 x 150 x 120 mm.

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

T.M.C. 1000 SERIES KEY SWITCHES

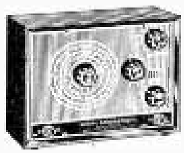


Brand new with knobs as follows:

1 way, 2 c/o, **7/6**; 1 way, 2 c/o 2b, **7/6**; 1 way 4 c/o, **8/-**; 2 way, 3m, 3m, **8/6**; 2 way, 2 c/o, 2 c/o, **8/6**; 2 way, 2 c/o, 4 c/o, **10/-**.
Post extra Quantities available.

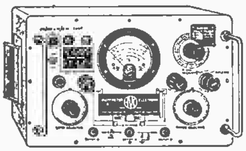
NOMBREX TRANSISTORISED TEST EQUIPMENT

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

AVO CT.38 ELECTRONIC MULTIMETERS



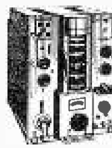
High quality 97 range instrument which measures A.C. and D.C. Voltage. Current, Resistance and Power Output. Ranges D.C. volts 250mV–10,000V. (10 megΩ–110 megΩ input). D.C. current 10µA–25 amps. Ohms: 0–1,000 megΩ. A.C. volt 100 mV–250V. (with R.F. measuring head up to 250 Mc/s). A.C. current 10µA–25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

TYPE 13A DOUBLE BEAM OSCILLOSCOPES

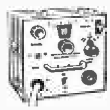
An excellent general purpose D/B oscilloscope. T.B. 2cps–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. **£22.10.0.** Or complete with all accessories, probe, leads, lid, etc. **£25.** Carriage 30/-.

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. O/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/-.

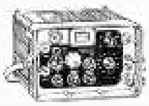


CLASS D WAVEMETERS



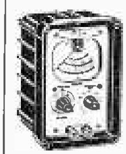
A crystal controlled hetrodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. **£5.19.6.** Carr. 7/6.
Or brand new with accessories. **£7.19.6.** Carr. 7/6.

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/CW/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/-.

MARCONI CT44/TF956



AF Absorption Wattmeter

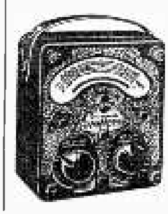
1 µ/watt to 6 watts.

£20. Carr. 10/-

COSSOR DOUBLE BEAM OSCILLOSCOPES

Type 1035. General purpose. A.C. Coupled. **Type 1049.** L.F. D.C. Coupled. **£35** each. Carr. 30/-.

AVOMETERS



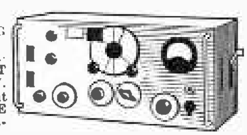
Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions.

Model 47A **£9.19.6.**

Model 8 **£18.**

P. & P. 7/6 each.

MARCONI TEST EQUIPMENT



EX-MILITARY RECONDITIONED. TF.144G STANDARD SIGNAL GENERATORS, 85 Kc/s–25 Mc/s, **£25.** Carr. 30/-. T.F.885 VIDEO OSCILLATOR 0–5 Mc/s, **£45.** Carr. 30/-. TF.195M BEAT FREQUENCY OSCILLATOR 0–40 Kc/s, 200/250 V. A.C. **£20.** Carr. 30/-. All above offered in excellent condition, fully tested and checked. **TF.1100 VALVE VOLTMETER,** Brand New, **£50.** TF.1267 TRANSMISSION TEST SET, Brand New, **£75.**

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid
High quality construction. Input 230 V. 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.**

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	22/6
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.

TAPE CASSETTES

C60—60 minutes	12/6
C90—90 minutes	17/6

Over £2 post paid.

LUCAS 20/0/20 AMMETERS. Brand new boxed. Suitable car/motorcycle. **12/6.** P. & P. 2/-.
EVERSHED VIGNOLES SERIES II 500 VOLT MEGGERS. Perfect condition **£21.** P. & P. 10/-.
DUBILIER NITROGEL CONDENSERS. Brand new. 8 mfd. 800V. **8/6.** P. & P. 2/-; 2 mfd. 5,000V., **42/6.** P. & P. 5/-.

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/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

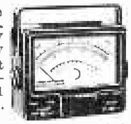
0–20 Kc/s. Output 5 K or 500 ohms. 200/250 V. A.C. offered in excellent condition. **£12.10.0.** Carriage 10/-.

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

G. W. SMITH & CO (RADIO) LTD.
3-34 Lisle St., W.C.2
Also see oppos. page

MULTIMETERS for EVERY purpose!

LAFAYETTE DE-LUXE 100KΩ/VOLT "LAB TESTER." Giant 6½in. scale. Built-in meter protection. 0/·5/2·5/10/50/250/500/1,000V D.C. 0/3/10/50/250/500/1,000V A.C. 0/10/100μA/10/100/500mA/2·5/10A. 0/1K/10K/100K/10M/10MΩ.—10 to 49·4dB. **£18.18.0.** P. & P. 5/-.



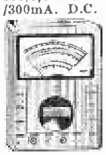
LAFAYETTE 57 Range Super 50kΩ/volt Multimeter. D.C. volts 125mV -1000V. A.C. volts 1·5V -1000V. D.C. current 25μA-10 amp. Ohms 0-10megΩ. dB —20 to +81 dB. Overload protection. **£12.10.0.** Carr. 3/6.

NEW MODEL 500 30,000 O.P.V. with overload protection, mirror scale 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000v. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg./60 Meg.Ω. **£8.17.6.** Post paid.

PROFESSIONAL 20,000opv LAB. TYPE Multitester. Automatic overload protection, mirror scale. Ranges: 1/10/50/250/500/1,000 volts. D.C. and A.C. 0-500μA, 10mA, 250mA. Current: 0/20K, 200K, 2 megohm. Decibels: —20 to +22dB. **£5.19.6.** P. & P. 2/6.

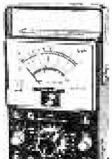
MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30μA/3/30/300mA. 0/16K/160 K/1·6M/16 Meg.Ω. **£5.10.0.** P. & P. 3/-.

TE-51. NEW 20,000Ω/VOLT MULTIMETER with overload protection and mirror scale. 0/6/60/120/1,200v. A.C. 0/3/30/60/300/600/3,000v. D.C. 0/60μA/12/300mA. D.C. 0/60K/6meg. ohm. **85/-.** P. & P. 2/6.

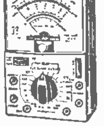


MODEL 250J. 2,000 O.P.V. 0/10/50/500/2,500v. D.C. 0/10/50/500/2,500v. A.C. 0/2 Meg. Ω.. 0/250 mA. —20 to +36dB. **49/6.** P. & P. 2/6.

TE-900 20,000Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000v. A.C. 0/25/12·5/10/50/250/1,000/5,000v. D.C. 0/50μA/110/100/500 mA/10 amp. D.C. 02K/200K/20 MEG. OHM. **£15.** P. & P. 5/-.

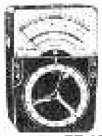


MODEL AS-100D. 100KΩ/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600v. A.C. 0/10μA/6/60/300mA/12 Amp. 0/2K/200K/2M/200MΩ. —20 to +17dB. **£12.10.0.** P. & P. 3/6.

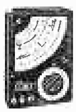


MODEL AF-105. 50kΩ/Volt. Mirror scale, built-in meter protection. 0/·3/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600/1,200v. A.C. 0/30μA/6/60/300mA/12 Amp. 0/10K/1M/10M/100 MΩ. —20 to +17dB. **£8.10.0.** P. & P. 3/6.

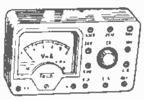
MODEL TE-12 20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6 Meg./60 Meg.Ω 50pF. 0·2 mFd. **£5.19.6.** P. & P. 3/6.



MODEL TE-80. 20,000 O.P.V. 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/600 K/6 meg. **£4.17.6.** P. & P. 3/-.

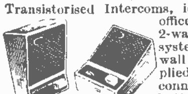


MODEL TE-10A. 200kΩ/Volt 5/25/50/250/500/2,500v. D.C. 10/50/100/500/1,000v. A.C. 0/50μA/2·5mA/250mA D.C. 0/6K/6 meg. ohm. —20 to +22dB. 10-0, 100mFd. 0·100-0·1mFd. **69/6.** P. & P. 2/6.



MODEL PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000v. A.C. and D.C. 0/1/100/500mA D.C. 0/100KΩ. **39/6.** P. & P. 1/6.

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/-.

AUTO TRANSFORMERS

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

150 W.	**£1.12.6.**	P. & P. 3/6.
300 W.	**£2.7.6.**	P. & P. 3/6.
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/-.

HOSIDEN DH04S 2-WAY STEREO HEADPHONES

Each headphone contains a 2½in. woofer and a ⅞in. tweeter. Built in individual level controls 25-18,000 c.p.s. 8Ω imp. with cable and stereo plug.
£5.19.6. P. & P. 2/6.

OMRON MK2 RELAYS

Brand New and Boxed. 24V. D.C. coils. 2 Pole changeover. 5 amp. contacts. **7/6** each. P. & P. 1/6

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.

MODEL ZQM TRANSISTOR CHECKER

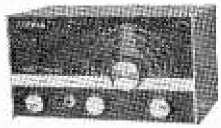
It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec: A: 0·7-0·9967. B: 5-200. Ico: 0-50 microamps 0-5mA. Resistance for diode 200Ω-1MΩ. Supplied complete with instructions, battery and leads. **£5.19.6.** P. & P. 2/6.

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

MAGNAVOX 363 3-SPEED TAPE DECKS

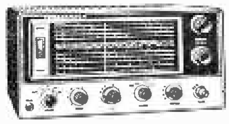
4-track, **£13.10.0.** Carriage extra.

UNR-30 4-BAND COMMUNICATION RECEIVER



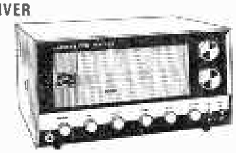
Covering 550 Kc/s-30 Mc/s. Incorporates variable BFO for CW/SSB reception. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. **13 Gns.** Carr. 7/6

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



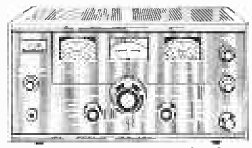
8 Valves, 5 bands incorporating 2 MECHANICAL FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150-400 Kc/s, 550/1,600 Kc/s, 1·6-4·0 Mc/s, 4·8-14·5 Mc/s, 10·5-30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter, B.F.O. product detector, electrical bandspread, S meter, slide rule dial. Output for phones, low to 2kΩ or speaker 4 or 8Ω. Operation 220/240V. A.C. Size 7¾ × 15 × 10in. Supplied brand new and guaranteed with handbook. **36 gns.** Carr. 10/-. S.A.E. for leaflet.

NEW LAFAYETTE SOLID STATE HA600 RECEIVER



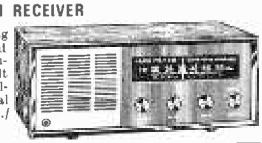
5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE. 150 Kc/s—400 Kc/s AND 550 Kc/s—30 Mc/s. F.E.T. front end ● 2 mechanical filters ● Huge dial ● Product detector ● Crystal calibrator ● Variable BFO ● Noise limiter ● S Meter ● 24½in. Bandspread ● 230V A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9½in. × 8½in. Wt. 18 lbs. EXCEPTIONAL VALUE £45. Carr. 10/-. S.A.E. for full details.

TRIO COMMUNICATION RECEIVER MODEL 9R-59DE



4 band receiver covering 550 Kc/s to 30 Mc/s. continuous and electrical bandspread 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. bandspread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250 V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. **£37.10.0.** Carriage 12/6.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

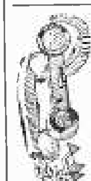


A completely new transistorised receiver covering 152–174 Mc/s. Fully tuneable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. **£37.10.0.** Carr. 10/-.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

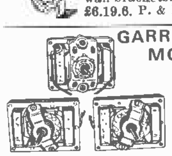
19 transistors, 8 diodes, IHF music power, 30W at 8Ω. Response 30-20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3-16Ω Separate L. and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10¼ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. **£28.** Carriage 7/6.

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. **£6.19.6.** P. & P. 3/6.

GARRARD TAPE MOTORS



Brand new stock as used by famous manufacturer. 200/250V. A.C. Capstan motor **15/-.** Fast Forward **10/6.** Fast Rewind **10/6.** P. & P. 3/-. Set of three motors **32/6.** P. & P. 5/-.

RECORDING HEADS

Reuter ¼-track. As fitted to Collaro Mk. IV and Studio Decks. High imp. record playback, low imp. erase. Brand new. **19/6** pair. **Miniflux ¼ track,** record **12/6.** **Cosmocord** with mounting plate:

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Post extra.

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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 88-108Mc/s. Ready built ready for use. Fantastic value for money. **£6.7.6.** P. & P. 2/6. Stereo multiplex adaptors **5 gns.**

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1025 mono	£7.10.0
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SP25 Mk. II less cart.	£12.10.0
A70 Mk. II less cart.	£12.12.0
AT60 Mk. II less cart.	£13.19.6
LAB80 Mk. II less cart. with WB2 base	£27.10.0

Carriage 7/6.

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An unsurpassed 20 watt high fidelity valve powered stereo amplifier to exact Mullard spec. With passive pre-amp network input sensitivity 210mV tapped o/p transformer, 3 and 15 Ω, all controls, H.T. and L.T. outlets, mono, stereo and speaker phase switching. Complete with escutcheon, knobs, plugs, etc. Ready built or in kit form.

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KIT complete with valves, knobs, control panel and instructions. *Carriage and packing on either* 12/6. **£17.10.0**

2+2 PRE-AMP/CONTROL UNIT FOR ABOVE

TRS-Mullard design, ready assembled and absolutely complete. Input sensitivity 5–70mV. 3 stage switched input control. Panel size 11 × 2¾in. *Carriage and packing* 7/6 **13 gns.**

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Owing to steep rise in timber prices, we cannot continue to offer our famous TRS 'Pack Flat' Speaker Cabinet kit at 75/- once stocks are exhausted. Size 21 × 15 × 7½in., teak finished to finest professional standards. State if for 8 or 10in. unit when ordering. 3in. tweeter cut-out is standard. (Carr. and Packing 7/6). **75/-**

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AN IMPORTANT NEW FM STEREO TUNER FROM TRS

Available shortly, this de-luxe transistor F.M. Stereo Tuner comes to you in prefabricated module form ready for instant and simple assembly. It embodies every worthwhile feature including excellent sensitivity, switchable AFC, automatic stereo function, rugged construction and modern appearance. S.A.E. brings details of this worthwhile tuner.

GARRARD UNITS AND PLINTHS

LM3000 Record Player with 9T.A. Stereo Cartridge. **£10.5.0.** **AT.60 Mk II De-luxe** Auto-changer, die-cast turntable. Less cartridge. **£13.5.0.** **SP.25 De-luxe** single record player, die-cast turntable. Less cartridge. **£11.19.6.** Brand new in makers' cartons. Packing and carriage on any one of above 7/6. **GARRARD LAB 80** Transcription Autochanger. **£25.** (Cartridge extra). C./P./Ins. 12/6.

GARRARD PLINTH WB.1. In fine Teak for any of above units. (Packing and carriage 5/-). **65/-.** Garrard clear-view rigid perspex cover (carriage 4/6), **62/6.** **CARTRIDGE OFFER TO PURCHASERS OF PLAYER UNITS—STEREO** Sonotone 9TA/HC Ceramic with diamond **49/6**; Decca Deram with diamond **92/6**; **MONO** Acos GP91-1 21/-; Goldring **MX2M 26/6.**

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RESISTORS—Modern ratings, full range 10 ohms to 10 megohms. 10% ¼–½W, 4d. each; 20% 1W, 6d, each; 2W, 9d. each; 5% Hi-stab, ½W, 5d. each; ¼W, 6d. each; 1·2–10 meg. 10% ½W, 4d. each; ½W, 5d. each. 1% Hi-stab. ½W, 1/6 each (below 100 Ω, 2/- each).
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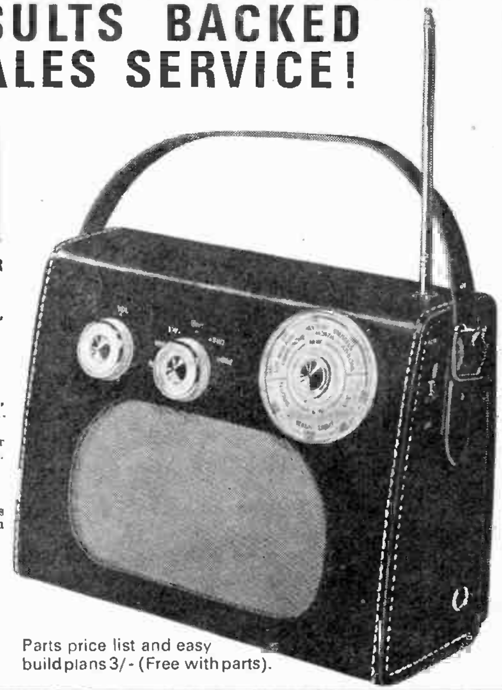

SEVEN WAVEBAND PORTABLE AND CAR RADIO WITH A SUPER SPECIFICATION GIVING OUTSTANDING PERFORMANCE!

- **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.
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- Socket for Car Aerial.
- Powerful push pull output.
- 7 transistors and two diodes including 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. 7/6

Personal Earpiece with switched socket for private listening 5/- extra.

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

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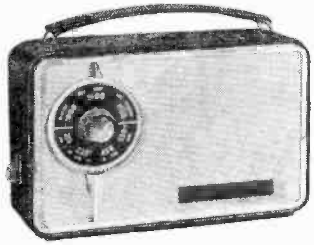


TWO WAVEBAND PORTABLE

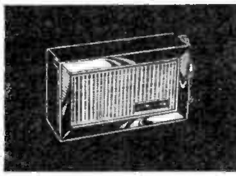
- **8 stages—6 transistors and 2 diodes**

Covers Medium and Long Waves. Top quality 3in. Loudspeaker for quality output and also with Personal Earpiece with switched socket for private listening. Two RF stages for extra boost. High "Q". Ferrite Rod Aerial. Push-pull output. Handsome pocket size case with gilt fittings. Size 6½ x 4 x 2in.

Total building costs **69/6** P. & P. 4/3

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

POCKET FIVE

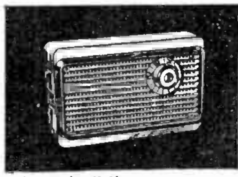


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

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 moving coil speaker, also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list. 1/6 (FREE with parts).

Total building costs **44/6** P. & P. 3/6

TRANSONA FIVE

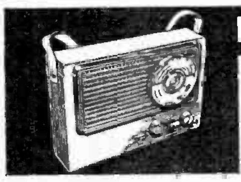


MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6½ x 4½ x 1½in. Fully tunable. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. All first grade components. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs **47/6** P. & P. 3/9

ROAMER SIX

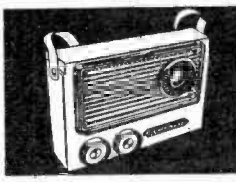


SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

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 Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra.) Easy build plans and parts price list 2/- (FREE with parts). (Personal Earpiece with switched socket for private listening 5/- extra.)

Total building costs **79/6** P. & P. 4/6

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). (Personal Earpiece with switched socket for private listening 5/- extra.)

Total building costs **69/6** P. & P. 4/6

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VIKING AMPLIFIER

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

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.

Price
27 gns
P & P 20/-

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.

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 ECL86 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.

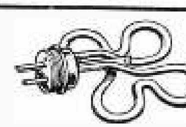
Price
13 gns
P & P 15/-

SPEEDEX the SPEED CONTROLLER for ELECTRIC POWER DRILL

infinitely variable electronic speed controller for your electric power drill. Varies the speed of all power tools (up to 600W) between 12 r.p.m. and maximum r.p.m.

Instantly adjustable with simple single control overriding switch for instant maximum speed. Simply connected into lead of power tool. Only 25/– plus 3/6 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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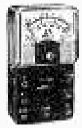
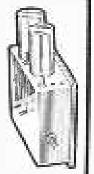
POCKET MULTI-METER



Size 3⅞ x 2½ x 1⅝in Meter size 2⅜ x 1⅝in 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 × 5½ × 1⅝in. 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 5/- P. & P.
Similar speaker to the above without tweeters in 3 and 15 ohm 39/6 plus 5/- 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.

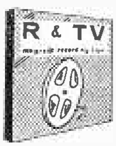
2½ watt ALL TRANSISTOR AMPLIFIER

AC mains 240V. Size 7" x 4½" x 1⅞". 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 5⅛ x 3¼ x 1⅝in. 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. **49/6** P. & P. 3/6.

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.

THE RELIANT 10W SOLID-STATE HIGH QUALITY AMPLIFIER

SPECIFICATIONS

Output—10 watts RMS Sine-wave
13 watts RMS Music-power
Output Impedance—3 to 4 ohms
Inputs—1. -xtal mic 10mV
2. -gram/radio 250mV
Tone Controls—Treble control range ± 12dB at 10KH2
Bass control range ± 13dB at 100H2

Frequency Response—(with tone controls central) Minus 3dB points are 20H2 and 40KH2. Signal to Noise Ratio—better than —60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input— —220 —250V. A.C. Size of chassis—10" × 3¾" × 2". A.C. Mains, 200-250V. For use with Std or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control for gram. and mike. Built and tested. 8" × 5" speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit 12/6 plus 1/6 P. & P.
PRICE £5.5.0 plus 5/- P. & P.

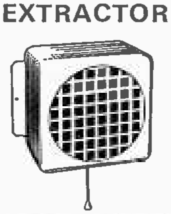
RECORD PLAYER SNIP

The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7" to 10" or 12". Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and insurance 7/6 extra

ANTI-THIEF CAR BURGLAR ALARM

The Melguard Safermatic consists of an electrical device housed in small metal box 4" × 2" × 1½", which has been designed and developed to provide protection required by the average motorist at an economic cost. Using this system, an alarm and the immobilised condition is set automatically as soon as you park the car. Should you leave the key in the ignition, no one but you can drive the car away. Upon entering the vehicle the method of starting the car is by switching on the ignition, depressing two hidden switches, and simultaneously operating the starter. Location of the switches is known only to you. Should the alarm be set off it can be stopped by following the normal starting procedure. For 12V operation. List price 79/6, our price **29/6** plus 2/6 P. & P. Full easy-to-follow instructions supplied.

EXTRACTOR FAN



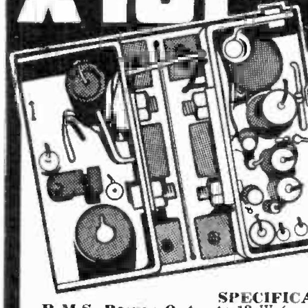
AC Mains 230/250 v. complete with pull switch. Size 6" x 6" x 4". Price 27/6 plus 5/- P. & P.

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: 2¼" 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.

79/6 plus 2/6 p. & p.

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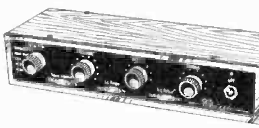
HIGH QUALITY SOLID-STATE AMPLIFIER (MONO)



SPECIFICATION

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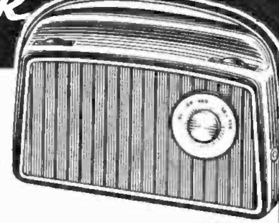

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plus 7/6 postage and packing.
Circuit and parts list 2/6 free with parts.

- 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.

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COMBINED PORTABLE and CAR RADIO

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★ I.F. neutralization on each separate stage.
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★ Room filling output 300mW.
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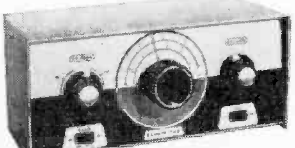
∗Ideal for SWLs ∗5 valves (inc. two twin triodes) giving 7 valve line-up ∗Excellent on amateur and shipping frequencies ∗Calibrated signal strength meter (illuminated) ∗Automatic volume control ∗Separate B.F. oscillator for morse and S.S.B. signals ∗Two speed vernier tuning



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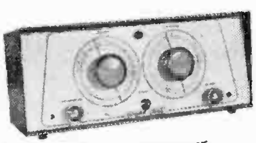

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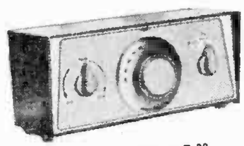
World wide reception. ∗Separate electrical bandspread. ∗3 slow motion drives. ∗Output 3 watts for 2/3 ohm speaker. ∗Valves ECC81, EL84, EZ80. Size 12" x 5½" x 7". CODAR-KIT CR.45K with 3 coils (10-28, 25-75, 60-176 metres). £9.10.0. Carr. 6/-, or ready built CR.45 £11.7.0. Carr. 6/-. Extra coils 5/-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



R.F. PRE-SELECTOR MODEL P.R.30 1.5-30Mc/s

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

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∗Can be built in one evening. ∗Complete with valve, one coil 25-75 metres and 4 page instruction manual. Price 39/6. Carr. 3/-. Extra coils 5/- each.

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PRACTICAL WIRELESS

VOL 44 No 6

issue 740

OCTOBER 1968

TOPIC OF THE MONTH

The Sound Scene

MANY "radio enthusiasts" are interested in subjects not strictly speaking *radio* at all, such as electronic devices, test equipment and the type of interest referred to collectively as "audio".

The last decade has seen a remarkable growth in audio interest. At one time, an amplifier was a relatively simple proposition involving perhaps two or three valves in one of several conventional configurations, and associated equipment was similarly fairly "standard". Since then, great strides have been made in the design of components and circuitry, helped along by several innovations in recording and playback techniques.

First came microgroove disc recordings, with attendant raising of standards in playback equipment, then came the rapid development of tape recording and now we have the introduction of stereo on disc and tape recordings and for f.m. radio broadcasting.

During the time that audio has been flourishing, a multitude of specialist shops have sprung up and even many ordinary radio and TV dealers have made an effort to establish departments capable of handling and exploiting today's sophisticated audio products.

Also, in that time, the spread of participation has grown accordingly and an audio enthusiast today may design his own equipment, build it from P.W. articles, make it up from kits, or buy build-up units and interconnect them into a system. He may, in fact, be anything from a keen technician to a complete layman.

A result of this audio explosion has been a bewildering proliferation of products—commendable in that the prospective buyer has a wide choice but an inbuilt disadvantage because of the confusing variety available.

Our new series of special supplements is aimed to help readers sort out the wheat from the chaff, to provide a concise but informative survey of what to look for in the constituent units in a modern audio complex. The supplements will be useful even to those who normally build their main equipment, for certain items—such as loudspeakers, deck mechanisms and microphones—must be purchased.

This month we cover the main units of an audio set-up, next month we deal with the end links, the transducers, and finally we will cover workshop practices. Plus, next month, a special wall chart of reference material.

W. N. STEVENS—*Editor.*

CONSTRUCTIONAL

GENERAL INTEREST

"With this month's issue the price of PRACTICAL WIRELESS has been increased to 3/-. This is the first increase since May 1966. Since that time all costs have increased and the position has now been reached when we must ask our readers to make some contribution if the standard and authority that has been associated with PRACTICAL WIRELESS from its foundation is to be maintained. With the next issue we change our production methods to web-offset and this will permit better reproduction of photographs which will be of great benefit in constructional articles. We are sure our readers will appreciate this improvement in production and will understand the reasons for the increase in price."

NOVEMBER ISSUE WILL BE PUBLISHED ON OCTOBER 4th

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: 42s. per year to any part of the world.

NEWS AND COMMENT...

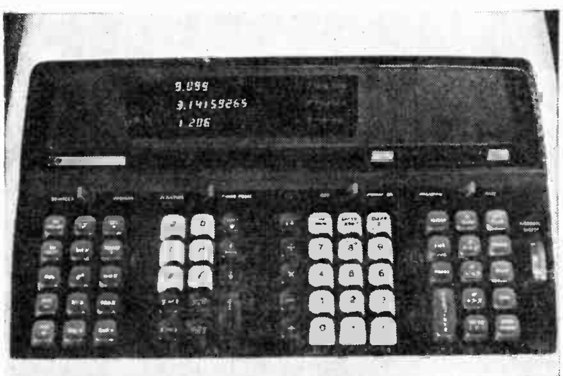
MICRO-MASSIVE

Microelectronics, small as the resultant units are, is spreading. Marconi-Elliott have recently opened what they claim is Britain's largest and most modern micro-electronics plant, at Witham in Essex. Personnel already approaches the 450 mark.

The standard of air cleanliness in production areas is controlled to very precise limits. Dust concentrations in the air are filtered out conforming to Class 1,000 conditions—no more than 1,000 particles greater than 0·5 of a micron in diameter in every cubic foot. Typical figures for air in the average office could be 500,000 particles up to 250 microns in diameter.

After primary filtration, the air passes through a refrigerator bank circulating 270 tons of refrigerant per hour which removes the water vapour. It is then split, part being raised in temperature by a heater supplying over $2\frac{1}{2}$ million B.Th.U's per hour. Any area is then controlled in temperature by blending the two supplies. Some areas have even cleaner air —Class 100! (100 particles less than 0·5 microns in diameter per cubic foot).

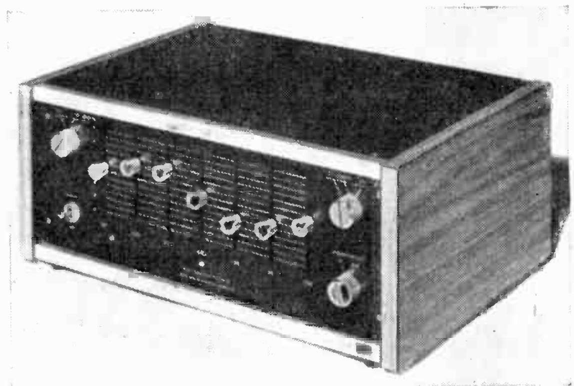
ELECTRONIC SLIDE RULE



The HP 9100A is a programmable, electronic calculator which performs operations commonly encountered in scientific and engineering problems. The easily-readable cathode ray tube instantly displays entries, answers and intermediate results. Not much larger than an office typewriter, this midget mathematical brain will perform a wide variety of intricate mathematical functions. It will read up to 10 significant digits with automatic decimal point placement.

Operations appear almost endless and include—addition, subtraction, multiplication, division and finding the square root. Other operations include—log x; ln x and e^x; sin x; cos x; tan x; $\sin^{-1}x$; $\cos^{-1}x$ and $\tan^{-1}x$ (x in radians or degrees). Also available are the hyperbolic functions—sinh x, cosh x, tanh x, $\sinh^{-1}x$, $\cosh^{-1}x$ and $\tanh^{-1}x$. In addition, the calculator will provide co-ordinate transformation from polar to rectangular, rectangular to polar, cumulative addition and subtraction of vectors. The unit can be programmed and this can be recorded on small magnetic cards, the capacity being 196 steps. Further details are available from the makers, Hewlett-Packard, 224 Bath Road, Slough.

AUDIO EQUALISER



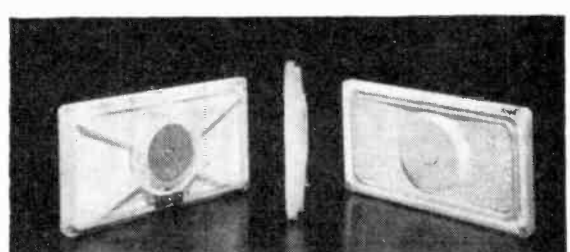
Leevers-Rich have introduced a new audio equaliser, model A501, which covers the audio spectrum in seven separately adjustable, overlapping, logarithmically spaced bands. Control knobs for the seven "constant B" type equalisers are arranged on the front panel to provide a graphic display of the correction applied.

Features of the A501 include negligible distortion, low noise, zero insertion loss, switchable HP and LP filters and a wide control range. The equipment is all solid state.

Specifications are: Input—600 ohms, bridging or terminating, balanced or unbalanced; Gain—unity, adjustable ±10dB; Output—isolated, to feed 600 ohm load at +20dBM max; Frequency range—30c/s to 20kc/s ±2dB; Noise level—below −60dBM; Centre frequencies —40, 100, 250, 630, 1,600, 4,000 and 10,000 cycles; Control range— +8dB to −8dB (each band); HP filter—Off/70c/s/100c/s; LP filter—7,000c/s/10,000c/s/off; Low level switch—reduces both maximum output and noise level by 20dB, other parameters not affected.

Further details may be obtained from Leevers-Rich Equipment Ltd., 319 Trinity Road, London, S.W.18.

WAFER SPEAKERS



Oakland Trading Company, announce the new Poly-Planar "Wafer-Type" wide-range electro-dynamic speakers in a 5 watt model. The unit is extremely thin, about one-fifth the depth of conventional cone speakers in the same power range. Weighing only 11 oz. the P5 shown measures only $8\frac{1}{2}$ x $4\frac{1}{2}$ x $\frac{13}{16}$in. and is made of expandable polystyrene plastic.

Further details are available from the Oakland Trading Company, 68 Lupus Street, London S.W.1.

NEWS AND COMMENT...

R.F. BOMB

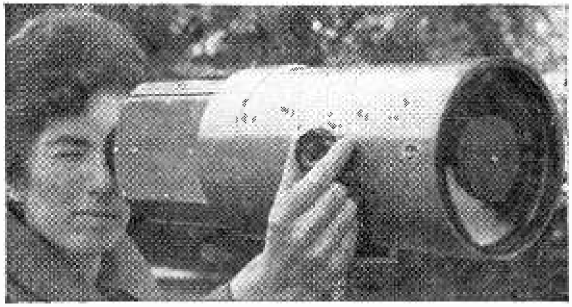
A safe-area power rating of 100 watts and an F_T of 30Mc/s are features of the latest discrete-emitter power transistor from SGS-Fairchild. They are designating this little r.f. bomb the BLY72.

The transistor has 262 discrete-emitter sites and a diffused channel stopper. In addition to its 100 watt safe area power rating it features high voltage (60V minimum LV_{CEO}), high current (V_{CE} sat. = 1·7 volts at 10 Amps. Encapsulation is in a TO-61 isolated collector stud package.

HOBBIES MANUAL

Electroniques have just published the second edition of their Hobbies Manual. This new, enlarged and entirely revised 1968 edition contains 960 Pages and costs 16s. 6d. although this cost is offset by vouchers valued at £25. It comprises a vast catalogue of goods from single components to complete kits, in fact just about everything the home constructor is likely to need for almost any project. The Manual is available from Electroniques dealers or from Electroniques, Edinburgh Way, Harlow, Essex.

OWL OPTICS



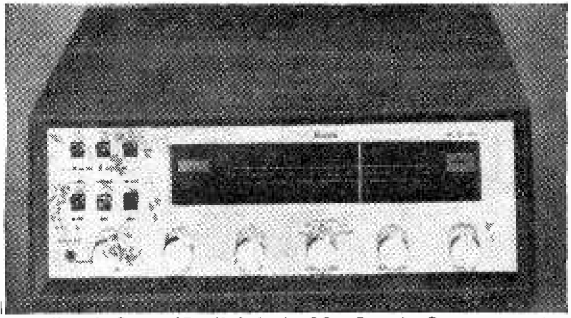
Seeing in the dark without the aid of a source of infra-red radiation to illuminate the object or scene being observed is now possible using an image intensifier tube say Mullard.

The tube operates by using a wide diameter objective lens to collect up as much light as possible reflected by the object or scene being observed. This light is then focussed on to a photoemissive surface (known as a photocathode) which converts it into electrons. These electrons are then directed and greatly accelerated by means of metal plates, connected to a high positive voltage on to a phosphor screen. Because of their very high velocity they cause more photons to be emitted from this screen than were first received by the first photocathode, hence the original "image" is "intensified".

To ensure that as much of the light as possible is transferred from the phosphor screen of the first tube to the input photocathode of the second tube (and so on) it is guided by means of special transparent fibres (fibre optics), finally ending up as a visible image on a miniature "television type" screen 25mm in diameter. The sensitivity of the tube makes it possible to see clearly and recognise individuals and objects under starlight conditions.

The present viewer uses three tubes coupled by fibre optics and requires a total e.h.t. of 45kV at a minute current.

HI-FI EAGLE



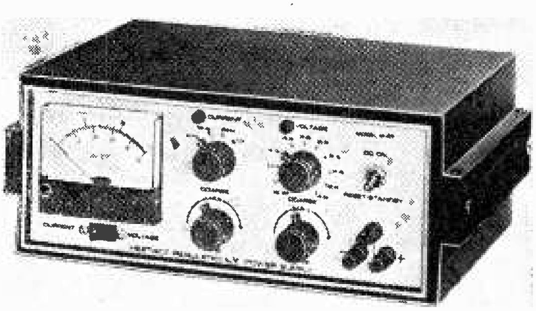
B. Adler & Sons (Radio) Ltd., 32a Coptic Street, London W.C.1. have sent the following specifications of the new Eagle RA.96 tuner amplifier.

Tuner section: 88–108Mc/s with a sensitivity of 2μV for 20dB s/n ratio and image rejection better than 55dB. F.M. stereo separation better than 28dB at 1kc/s. The a.m. range covers 535–1,605kc/s with a sensitivity of 700μV and image rejection of 35dB.

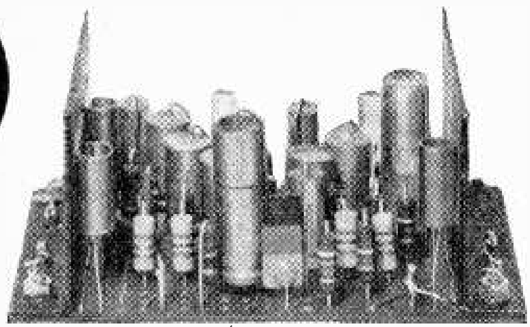
The amplifier section has an output of 20 watts r.m.s. (10 watts r.m.s. per channel) with less than 1% distortion measured at 8 watts and a response of 20 to 20,000c/s ±2dB. Five inputs are available: Magnetic, Ceramic, Aux, Tape monitor and Tape recorder output. Tone controls are bass— ±12dB at 50c/s and treble— ±12dB at 10kc/s. A low-cut filter provides −10dB at 50c/s, while the high-cut filter allows −13dB at 10kc/s. Channel separation is given as better than 45dB.

The circuit uses 2 integrated circuits (preamp), an f.e.t. front end (f.m.), 24 transistors and 16 diodes. Size is 14 x 11$\frac{5}{8}$ x 5in. and the price is £86 which includes purchase tax of £17 2s.

NEW P.S.U.



A new improved version of the Heathkit transistorised, regulated low voltage power supply, model IP-27, is offered by Heathkit at a price of £46 12s or assembled at £55 p & p 9s. With an input of 120/240V a.c. at 50/60c/s an output of 0·5–50 volts d.c. is available with better than ±1·5mV regulation from zero to full load. There are four current ranges—50mA, 150mA, 500mA and 1·5 Amps. The unit is entirely solid state with an adjustable current limiter for 30 to 100% on all ranges and is fully portable.



amplifier module

R. LEYLAND

THIS mains-powered a.f. amplifier is constructed on a small Veroboard panel measuring approximately $2\frac{1}{2} \times 3\frac{1}{4}$in. At each end, a heat sink gives protection to the components and also serves as a support during soldering. Components are mounted upright to occupy the minimum area, and hole spacing on the Veroboard accommodates capacitor lead spacing satisfactorily. Flat mounting of components would secure them more firmly, but a board of larger area would be required.

An output on speech and music approaching 3 watts is obtained in a high flux 15Ω loudspeaker. When a continuous sine wave test signal is applied, more current is drawn from the supply and there is an appreciable drop in voltage. This restricts the output available under test conditions to about 2 watts. A loudspeaker of less than 15Ω impedance should not be connected as the currents in the output transistors to provide the increased power output would be excessive and would cause overheating and damage to these transistors.

Circuit Description

Included on the circuit board, in addition to the power amplifier, is a two-stage preamplifier with provision for connecting a treble control. The coupling capacitor, C6, between the pre-amplifier and power amplifier allows separation of the d.c. conditions in the two circuits. It is arranged that the collector voltage of Tr2 is at a lower voltage than at the base of Tr3, so ensuring the necessary polarizing voltage for the electrolytic capacitor, C6.

The mid-point voltage at the output is closely maintained by Tr3, to a value set by the potential divider consisting of the resistors R9, R10, R11 and R4 in series across the 24-volt supply. Carbon film resistors of 5% tolerance are used throughout the amplifier, making pre-set adjustments unnecessary, except for the choosing of a suitable value for R17.

The d.c. feedback loop via R14 also stabilises the currents in Tr3 and Tr4. The current in Tr3 is determined by the base-emitter potential of Tr4 across

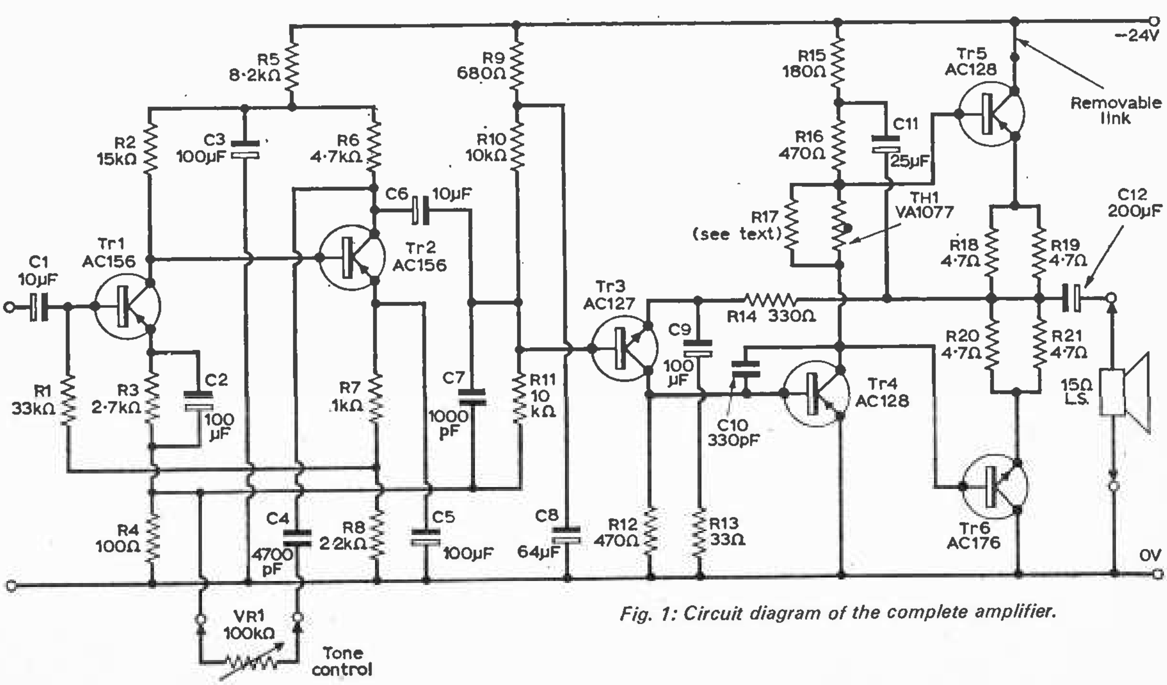


Fig. 1: Circuit diagram of the complete amplifier.

R12 and will be under 1mA. This current also flows in Tr5 and forms part of the quiescent current of this transistor. The current in the driver transistor, Tr4, is the amount required to drop half the supply voltage across the total resistance in the collector circuit. Because the driver transistor is a Class A stage, its quiescent current is much larger than the quiescent current in the Class B output stage.

Even with negative feedback, it is only possible to eradicate every trace of crossover distortion in the output stage by providing a small quiescent current of about 3mA. This is increased in Tr5 by an additional 1mA flowing from Tr3 to a total of about 4mA. The amount of this quiescent current is adjusted by changing the value of R17 as already described. Variation of the quiescent current with temperature is compensated by a Varite thermistor, type VA1077. This thermistor is rectangular in shape and measures 7·5 × 18 × 1·5 millimetres. It is colour-coded black, red, orange, and is the standard component for the circuit, which is on conventional lines in the driver and output stages.

The bootstrap capacitor, C11, applies the output voltage to the upper end of the driver load resistance R16, and providing the value is restricted to 25μF, permits a large drive voltage to be obtained with less inherent distortion.

Anything short of severe mismatching in the output stage will tend to be disguised by the action of the negative feedback. Nevertheless a matched complementary pair of transistors is necessary for optimum performance. These transistors, p-n-p type AC128 and n-p-n type AC176 must be put in their correct positions, otherwise the transistors will be damaged. Special care should be taken as the transistors look alike, and the markings can no longer be seen when the transistors are in the cooling clips.

Emitter resistors of 2·2Ω are required with the output transistors to improve thermal stability. Resistors of this value can be obtained, but the majority of suppliers only have values down to 4·7Ω. Two 4·7Ω resistors are therefore used in parallel at each emitter, giving a slightly higher effective value of 2·35Ω.

The driver transistor, Tr4, dissipates 240 milliwatts, and is mounted in a cooling clip on the same heat sink as Tr6. Preceding the driver transistor is an n-p-n transistor type AC127, and this should be enclosed in an insulating sleeve, since in this transistor, the collector is joined to the metal case.

The preamplifier, consisting of the transistors Tr1 and Tr2 increases sensitivity to about 8 millivolts r.m.s. for maximum output on a sine wave input signal. Decoupling of the two stages by R5 and C3 prevents undesirable feedback via the supply. Direct coupling between the preamplifier stages enables d.c. stabilising feedback to be applied over the two stages via R1. Negative signal feedback is applied through R11 to R4 in the emitter circuit of Tr1. The capacitor C3 reduces high-frequency distortion and noise. Additional frequency-dependent feedback can be applied by means of an external 100kΩ treble control. At maximum treble, the h.f. response extends to —3db at 15kc/s, and at minimum, it is about 14db down at 10kc/s.

The bass response extends to −30dB at 60c/s, some attention being provided by the low value of C12. If loudspeaker resonance occurs at about 60c/s, the bass response may be increased, but only slightly, because of the low output impedance. Capacitor C12 is kept outside the main feedback loop via R14, since low capacitance values in the feedback loop would tend to produce a peak in the low-frequency response. One advantage of the 200μF capacitor is that it takes up a minimum of space, and its working voltage need only be greater than half the supply voltage.

Construction

To improve heat transfer between the transistors and the cooling clips, silicone grease is applied before inserting the transistors. Burrs should be removed at holes when the cooling clips are to be fastened. As neither the heat sink nor the cooling clip are perfectly flat, it is best to smear some silicone grease on the cooling clips to fill any minute air gaps existing between them, air being a poor conductor of heat. The heat sinks are painted matt black except for the area occupied by the cooling clips, and a margin of 1/16in. around them. Electrical connection is made to the heat sinks on the flanges, and a small area around the securing bolts can be left unpainted for the purpose.

The leads of the output and driver transistors should be straightened to avoid contact with the heat sink or with each other. The mode in which

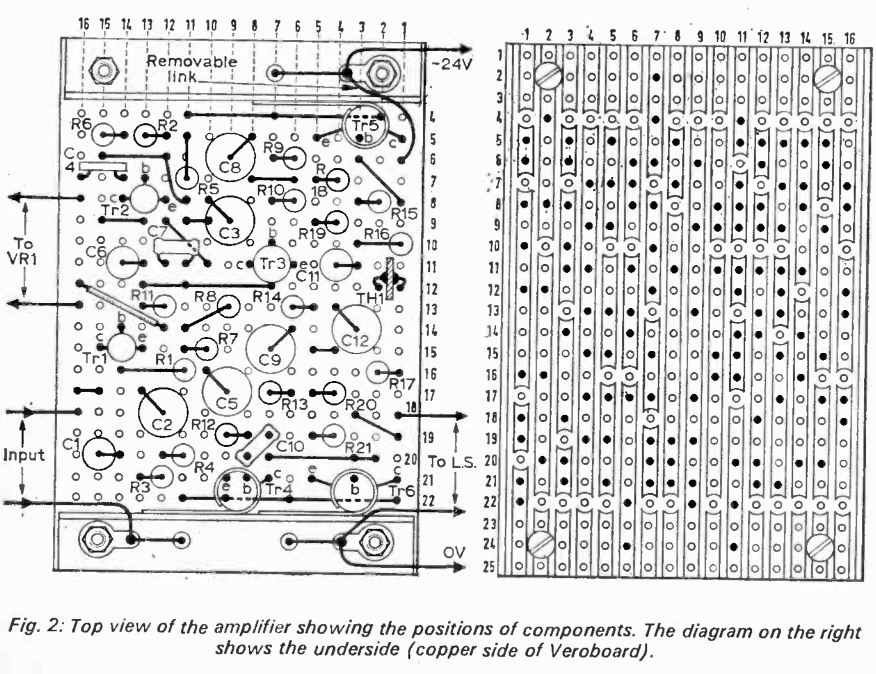


Fig. 2: Top view of the amplifier showing the positions of components. The diagram on the right shows the underside (copper side of Veroboard).

the transistors are inserted into the cooling clips is shown in the diagrams of Fig. 3.

At some positions on the Veroboard, two jumper links have to be inserted into the same hole. This is possible by using 24 s.w.g. tinned copper wire for the jumper links. When the hole has been located on the Veroboard, the wire is passed through from the copper side and back through the other hole where it is bent and held while the wire is drawn tight and pressed flat. The bent portions on the copper side are clipped with side cutters, leaving enough for soldering. If the bends are in opposite directions, the jumper link will stay in place until it is soldered. The jumper link adjacent to R11 should be insulated; similarly the lead of R12 adjacent to C10. All electrolytic capacitors should be fully insulated, either by a sleeve or if necessary by wrapping them with plastic tape before putting them into the circuit.

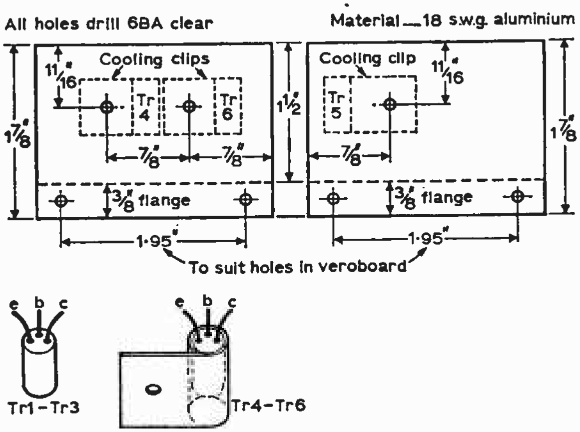


Fig. 3: Details of the heat sinks and transistor connections.

Efficient soldering depends upon the quick transference of heat, so that the temperature rise is localized. The tip of an instrument-type soldering iron is filed flat and tinned, and requires to be at the right temperature. With sufficient downward pressure on a flat joint, the 18 s.w.g. printed circuit solder melts immediately and can be fed in to produce a good soldered joint in less than a second. This can be recognised by the absence of gaps or irregularities. The solder should have flowed evenly all over the component lead (which must not be moved when the solder is setting) and spread on the metal to produce a bright smooth dome of solder. This method is ideal for transistor leads which, in common with the jumper links, are bent over and clipped to leave enough for soldering. The transistors are inserted after the soldering of the other components is completed, and heat sink tweezers are applied on the particular transistors lead being soldered. The length of the leads of the output transistors is determined by the position of the cooling clips on the heat sinks. The height of the other transistors can be made just enough to allow a cooling clip, held vertically, to slide underneath the transistor. In making connections to the amplifier, the soldering iron should not be allowed to come against any of the transistors.

The possibility of inserting components into the wrong positions, and later needing to remove them,

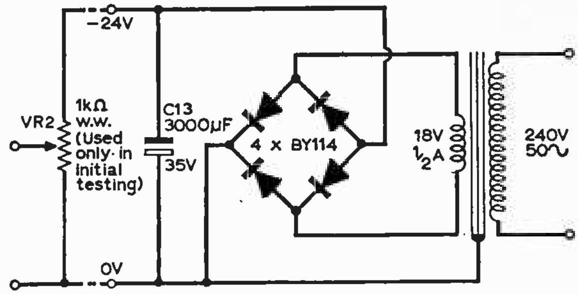


Fig. 4: Circuit of a suitable mains power supply.

encourages the use of another method for the resistors and capacitors, with their thicker leads. This is to keep the component leads straight, clip them to length, and hold the component in position until one lead is temporarily secured with solder. Solder is then run in around the leads. A clearance of about ¼in. between components and the circuit board is usually advisable and allows the use of heat sink tweezers. It is not so quick and easy a method as the other one, and the soldering iron is only applied for a moment at a time, allowing the joint to cool before any further attempt is made.

Resistors are prepared for upright mounting by bending one lead over some form of 1/16in. diameter mandrel. Capacitors similarly have the negative lead brought down their sides, preferably inside the insulating sleeves. Components should be inserted as shown in Fig. 2.

Test Procedure

By following a cautious procedure in trying out the amplifier for the first time, it is possible to discover any mistake before damage is caused. There is only a narrow margin of safety with germanium output transistors, and small types are particularly susceptible to failure from thermal runaway. It is inadvisable to switch on without making some preliminary adjustments and measurements. A short-circuit or open-circuit if present in the amplifier is liable to cause immediate damage.

Apart from errors such as the omission of a jumper link, or wrong placing of components, the closely-spaced copper strips could become bridged with solder at some point. For example, solder could fall from the tip of the soldering iron without being noticed. The careless use of test prods or similar methods of making temporary connection is not recommended and steps should be taken to see that the amplifier cannot come into accidental contact with metal objects.

A check is first made on the voltage of the power supply unit before connecting the amplifier. It should not exceed 26·5 volts and will be less when the amplifier is connected and drawing current. It is necessary to measure the current taken by the output transistors on no signal, while gradually increasing the voltage from zero up to its full value. This can be done by connecting the amplifier to the power unit via a suitable wire-wound potentiometer of 1,000Ω. A value has to be selected for resistor R17 to give a current of between 4 and 5mA in Tr5. This current is measured by omitting the link wire between the terminal pin at the collector of Tr5 and the tag

—continued on page 407

transistorised CALIBRATION OSCILLATOR

F. L. THURSTON

AN invaluable aid in any amateur or professional electronics workshop is an accurate frequency calibration standard, this device being essential for the accurate calibration of oscilloscopes, audio generators, radio receivers, etc. Such a device should have a frequency accuracy at least ten times greater than that of the instrument to be calibrated, and an absolute accuracy of better than 0·1% will generally prove to be more than adequate in most applications. Ideally, the unit should be portable, reasonably inexpensive, and easy to use.

The unit described meets all of these requirements, consisting of a crystal controlled oscillator, followed by two decade frequency dividers, the device giving switch-selected output frequencies of 100kc/s, 10kc/s, and 1kc/s. A seven transistor circuit is used. The amplitude of the output signal can be varied by means of a built-in attenuator.

How it Works

The full circuit diagram of the unit is shown in Fig. 1. The crystal oscillator section is made up by Tr1 and Tr2. Basically, Tr1 is wired as a grounded base amplifier, with its base-bias fixed by R1 and R2 and decoupled by C1; the input signal is applied to the emitter of such an amplifier, and the output taken from the collector. If a positive-going signal is applied to the emitter, the emitter-base potential of the circuit will be increased, and the collector current will rise, so increasing the potential drop across the collector load, R3, and causing the collector to move in a positive direction. Thus, the input and output signals can be seen to be in phase.

Transistor Tr2, on the other hand, is wired as an emitter follower, with its base wired to Tr1 collector. This transistor also gives an output, from its emitter, which is in phase with the input signal to its base, but this circuit gives an impedance transformation, with unity voltage gain. Hence, it can be seen that Tr1 gives voltage gain, and the output signal at Tr2 emitter is in phase with the input at Tr1 emitter; these are the essential requirements for oscillation, and the circuit can be made to oscillate by simply coupling the two emitters together via a blocking capacitor.

In the circuit diagram, this coupling is achieved via the crystal, and, since the crystal represents a very low impedance at its designed operating frequency, the circuit oscillates at the frequency of the crystal with which it is used. The output signal can be taken, at low impedance, from Tr2 emitter.

Since exceptionally high orders of accuracy are not

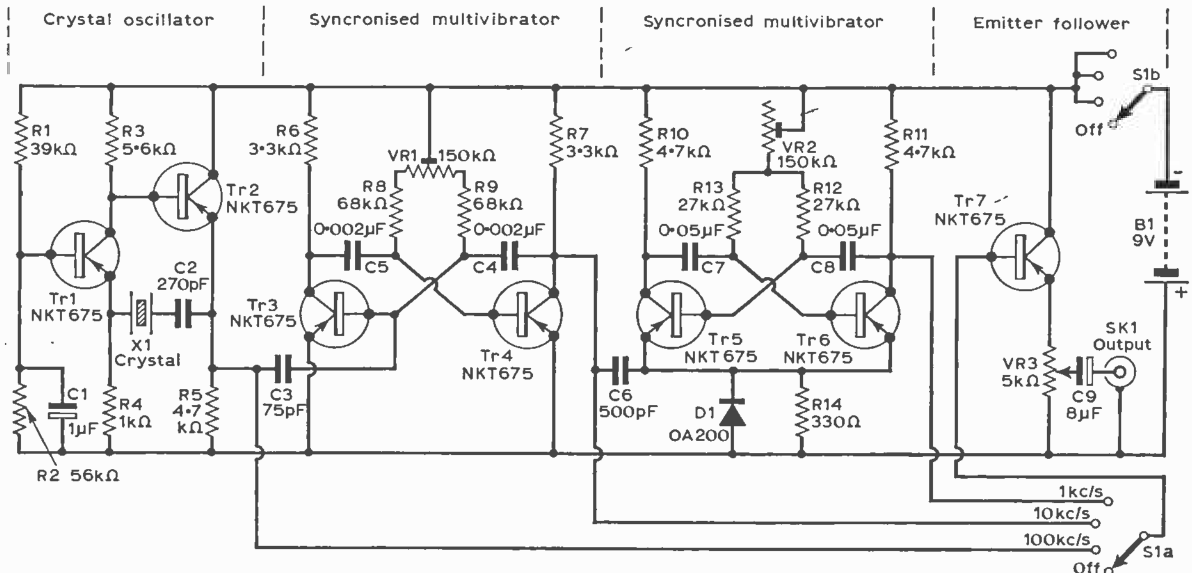


Fig. 1: Complete circuit of the calibration oscillator.

required from this circuit, there is no need to take measures to counteract the slight shift in phase characteristics that occurs in the transistors at the 100kc/s operating frequency, and, as it stands, the operating frequency will be accurate to considerably better than 0·1%.

The 10kc/s frequency standard is obtained from the Tr3-Tr4 astable multivibrator, which is synchronised to the crystal oscillator by means of sync pulses fed to Tr3 base via C3. This synchronising action is best understood with reference to Fig. 2a, which shows the waveforms involved in the circuit. This diagram shows that, in the conventional free-running version of the astable multivibrator, the base of Tr3 is biased in a positive direction, thus reverse biasing the emitter-base junction, when Tr3 is off. This positive bias decays exponentially, and as soon as the

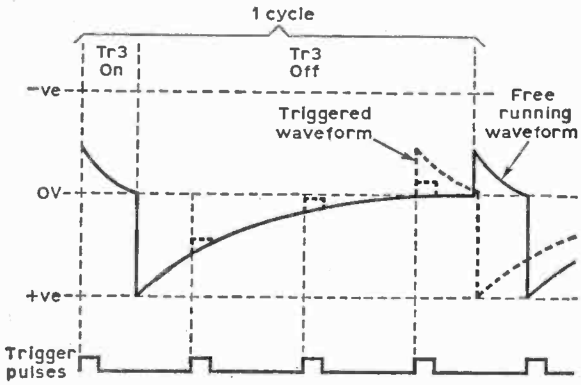
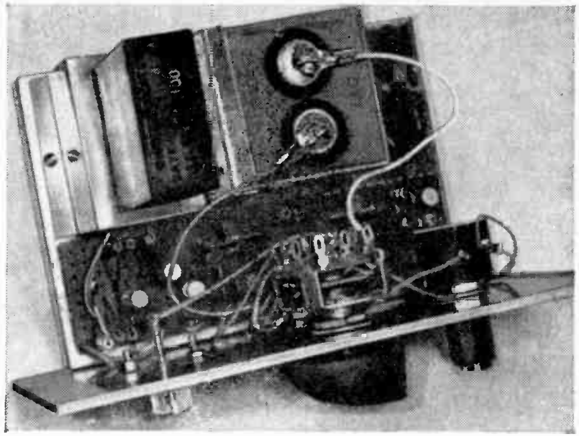


Fig. 2a: The effect of the synchronising pulses and "locking action" on the main waveform.

emitter-base junction again becomes forward biased the transistor begins to conduct and the circuit "flips" or changes state. In the triggered version of the circuit, on the other hand, brief negative-going synchronisation pulses are imposed on the base waveform, and, as indicated in the diagram, these bring Tr3 into conduction prematurely and trigger the circuit. Thus, the operating frequency of the multivibrator is "locked" to the frequency of the trigger signal, and accurate frequency division is achieved.

In this particular circuit, the synchronising signal is applied to one transistor (Tr3) only, and the output



General view of the completed instrument.

waveform has an uneven mark/space ratio: this is of little importance in most applications, however, and has the advantage of giving very stable operation.

The second frequency divider stage, Tr5-Tr6, on the other hand, has the synchronisation signal applied to both transistors. Here, the two transistors share a common emitter resistor, R14, across which the sync signal is applied. This sync signal is derived from the output of the 10kc/s multivibrator, and is differentiated by C6-R14 and discriminated by D1, to give a final series of unidirectional pulses of short duration, which synchronise the multivibrator in a manner similar to that already outlined.

The main disadvantage of this method of operation, which is essential if a 1:1 mark/space output waveform is required, is that the two time constants of the astable circuit must be fairly closely matched if stable operation is to be achieved. Satisfactory operation can be achieved, however, by using fairly close tolerance values of timing components and taking reasonable care in initial setting up of the division frequency. The prototype unit gives stable operation even when the supply potential is reduced from 9 to 3 volts.

The final stage of the circuit is the emitter follower output transistor, Tr7, which uses variable resistor VR3 as its emitter load. The input to Tr7 is selected by S1a, and may be either 100kc/s from Tr2 emitter, 10kc/s from Tr4 collector, or 1kc/s from Tr6 col-

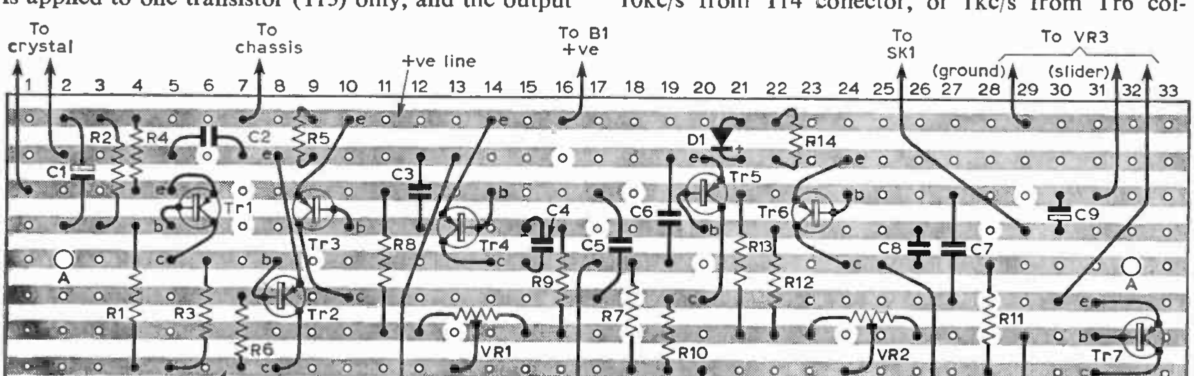
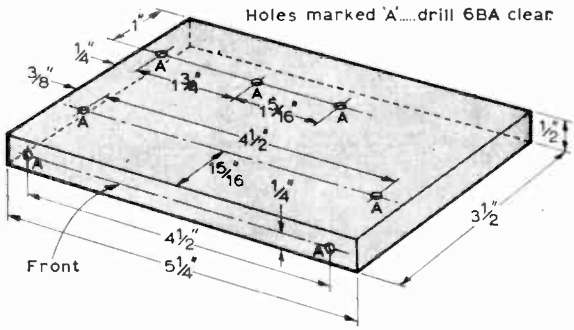


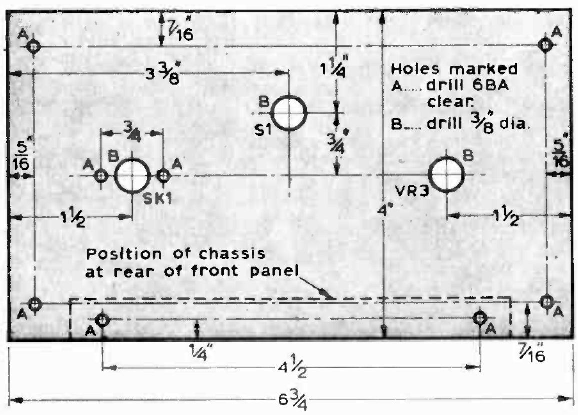
Fig. 2b: Veroboard connections and layout of components.

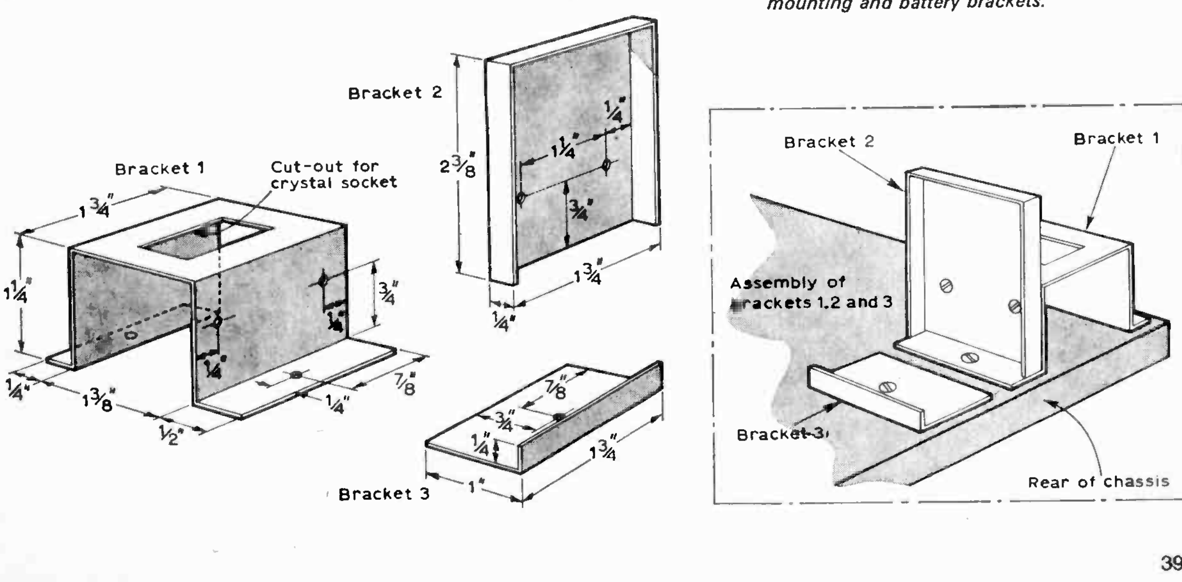
lector, and the final output signal is taken from VR3 slider and fed, via C9, to the output socket, SK1. The built-in 9 volt battery supply is connected to the circuit via S1b.

Construction

For ease of construction, the major part of the electronic circuitry is wired up on a small piece of Veroboard panel, thus retaining all of the advantages of printed circuit construction, while involving none of the complications of marking out, etching, etc., which are normally involved in printed circuit practice.







Start construction by cutting the Veroboard panel to size, as shown in Fig. 2b, and then break the copper strips, with the aid of a small drill or the special cutting tool that is available, as indicated. Now drill the two small mounting holes, to clear 6BA screws, where shown, and cut back the copper around them to eliminate any danger of short-circuits when the panel is finally secured in place on the main chassis.

Now assemble the components and leads on the plain side of the panel, as shown in Fig 2b, and solder them in place. Note that all components are mounted vertically on the panel, and the layout is fairly cramped; insulated sleeving should be used where there is any danger of short-circuits occurring.

Before attempting to secure VR1 and VR2 in place on the panel, the width of their mounting legs should be reduced, with the aid of a small file, so that they fit easily in the small holes in the Veroboard panel. Heat shunts should be used when soldering all semiconductors in place.

When assembly is complete, double check all wiring and ensure that no short-circuits are occurring between the copper strips on the underside of the panel. If satisfactory, the circuit should now be given a functional check and adjusted to give the correct output frequencies, as follows.

Temporarily wire VR3 and S1 to the unit, to conform to the circuit diagram, and connect the crystal and the battery in place. Switch on, and check on an oscilloscope that the 100kc/s signal is available at Tr2 emitter. Now monitor the waveform at Tr3 base; it should be possible to clearly see the sync pulses superimposed on the multivibrator waveform. Carefully adjust VR1 until ten sync pulses are obtained for each complete cycle of the multivibrator; the unit is now operating at 10kc/s.

Now monitor the voltage at Tr6 base, and adjust VR2 until ten sync pulses are again obtained for each complete cycle of the multivibrator; a 1:1 mark/space ratio should be obtained. Check that Tr3 is still operating correctly.

Fig. 3a (top left): Drilling and bending details of the "main" chassis.

Fig. 3b (centre left): Details for making the front panel.

Fig. 3c (below): Bending and drilling details for the crystal mounting and battery brackets.

Having completed the initial setting up, the rest of the unit can now be made up. Cut the main chassis, from light gauge aluminium, as shown in Fig. 3a. Next, make up the front panel, using a medium gauge aluminium, as shown in Fig. 3b. When ready the front panel should be covered with Fablon or a similar self-adhesive decorative plastic material; a material with a light wood-grained finish was used on the prototype.

Now make up the crystal holder bracket and the two battery holder brackets, as shown in Fig. 3c, and assemble them, as indicated in the inset, on the main chassis. Now secure the front panel to the chassis. Secure the Veroboard panel to the chassis using two 6BA screws passed through the mounting holes that are provided, and using two small rubber grommets interposed between the panel and the chassis to act as spacers/insulators. Fix S1, VR3, and Sk1 in place on the front panel, and complete the wiring up of the unit. When ready, the operating frequencies of the multivibrator sections of the unit should again be checked, as already outlined, and, if necessary, final adjustments should be made.

An attractive cabinet can be made up, with very little skill, as shown in Fig. 4. The two side pieces, the top, the base, and the rear panel should be cut from ⅛in. hardboard, using the dimensions shown, and the four corner pieces should be cut from ⅝ x ⅞in. timber, and the unit should then be assembled as indicated. The hardboard parts should be nailed or screwed to the timber corner pieces, and care should be taken to ensure that all nails and screws are sunk flush with the outer surfaces of the cabinet. When assembly is complete, remove any rough spots with sandpaper, and then cover the entire cabinet with Fablon or a similar material.

The unit is held in place in its cabinet by means of four self-tapping screws passed through the holes at the corners of the front panel and screwed into the timber corner pieces of the cabinet. The unit can be given a final attractive finish by marking the front panel with pressure sensitive lettering, as indicated in the photographs.

The unit is now complete and ready for use; it should be noted, however, that fairly frequent checks should be made on the accuracy of frequency division of the multivibrator circuits throughout the life of the instrument. ■

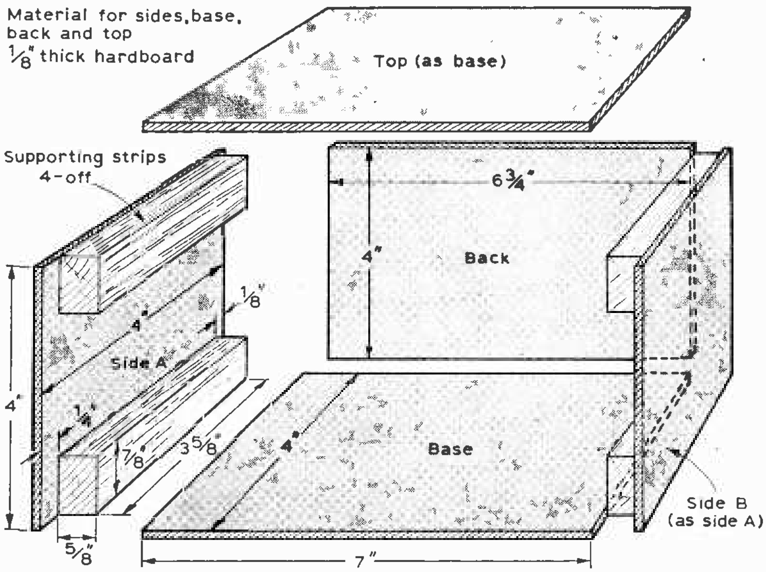
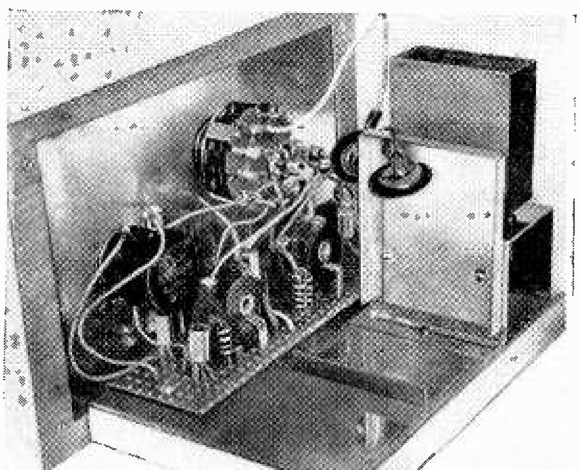


Fig. 4: Dimensions and details for making a suitable case.



The prototype with case removed.

★ components list

Resistors: all ½W carbon 10% except where marked

R1	39kΩ
R2	56kΩ
R3	5·6kΩ
R4	1kΩ
R5	4·7kΩ
R6	3·3kΩ
R7	3·3kΩ
R8	68kΩ 5% hi-stab
R9	68kΩ 5% hi-stab
R10	4·7kΩ
R11	4·7kΩ
R12	27kΩ 5% hi-stab
R13	27kΩ 5% hi-stab
R14	330Ω
VR1	150kΩ sub-min skeleton preset
VR2	150kΩ sub-min skeleton preset
VR3	5kΩ panel mounting variable

Capacitors: all sub-min.

C1	1μF 15V electrolytic
C2	270pF
C3	75pF 5%
C4	0·002μF
C5	0·002μF
C6	500pF
C7	0·05μF 5%
C8	0·05μF 5%
C9	8μF 15V electrolytic

Semiconductors: (or similar)

Tr1	NKT675
Tr2	NKT675
Tr3	NKT675
Tr4	NKT675
Tr5	NKT675
Tr6	NKT675
Tr7	NKT675
D1	OA200

Miscellaneous:
100kc/s crystal; socket to suit; switch—2 pole 4 way break-before-make; co-ax socket; 9 volt battery—PP7, DT7 etc.; wire; sleeving; Veroboard, rubber grommets; nuts and bolts; aluminium, etc.

practically wireless commentary by HENRY

No. 49

Here be Monsters

LONG as Henry may be in the tooth, decrepit as he may appear on one of those mornings after the gentlemen of the Press have been regaled by some self-seeking manufacturer, bloodshot as those orbs may seem, he can nevertheless hit a barn door with a well-aimed clod when called upon to do so.

Which makes it all the more annoying when a circuit has to be scanned with the sort of scrutiny your wife affords a post-party handkerchief, to find, not smudges of red, or any other colour, but conventional shapes, lines and symbols that custom has taught us ought to be in a particular place.

Custom may stale, and perhaps it is the same incentive our *avant-garde* artists have to present us with the unexpected which makes circuit drafters perform their convolutions. Whatever the reason, their efforts have an infinite variety. Searching for a particular component in some drawings is worse than digging for an errant sixpence under the eagle eye of a traffic warden.

Readers who become accustomed to the circuits that bespangle these pages may consider themselves well served. From jottings that would not disgrace the back of one of Alan Blumlein's envelopes, the careful lads of Newnes turn out an understandable print. The joints dot in where they should, the cross-overs follow a set pattern, there is a satisfying constancy about the illustration of components. This is, in short, what is known as the "house style".

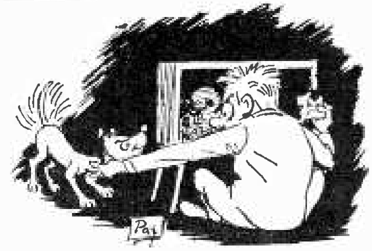
... the eagle eye of a traffic warden.

In the radio trade, a very different situation obtains. No two manufacturers think alike. In fact, one would be tempted to conjecture that many of them are as violently opposed to their rivals as they can be—even to the extent of wilfully making their service manuals just that little bit different.

Life would be dull if we were all the same. But life would be a lot easier if, in the technical manual field, at least, there was some measure of conformity. Some circuit diagrams defy analysis until one has taken a course in identification; where resistors and capacitors both appear as little boxes, where strange dots and triangles tell us what sort of component the ambiguous block is meant to be, provided we can find the key tucked away in the corner that always gets tea-stained first.

Provided, also, that we happen to have the visual acuity of a half-starved hawk. Why do some illustrators specialise in the sort of lettering more used to scribing texts on the head of a pin than underlining vital items on a circuit diagram? And why are some of the circuits that have more parallel lines than the approach to Clapham Junction printed in a scale so minute that magnifying glass and miniature pointer must be used to trace an inter-connection? Is it the work of those devils, conspiring in their chapels, chuckling in their Gutenberg ale?

Some sadistic draughtsmen lay out their originals on one of those drawing boards the size of a hoarding that one sees in fascinating glimpses as one flashes past in the train. But, in an effort to eliminate the masses of close-woven lines, some circuit designers bend over the other way. Here we find an output from stage B with an angled arrow marked 22. Somewhere on another part of the circuit there will be an answering arrow. By the time you have found it in the tangled mass of transistors, the set will have gone up in smoke.

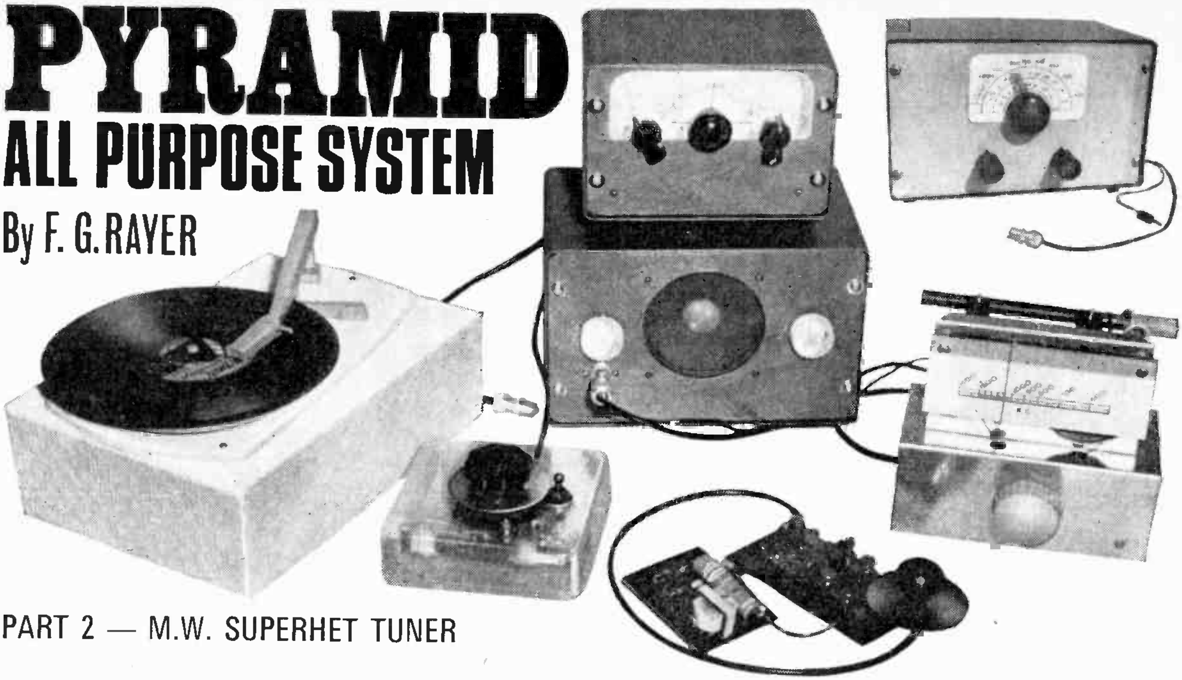


... just recovered from the dog.

On other types of circuit, there is no common earth or chassis return line. Each return is a dinky little black bar, easily overlooked and often unexpectedly "high" in the circuit layout—a dead trap for we oldies who still think that the voltage rises the higher up the drawing we go. The catch with these circuits is the odd audio circumstance when a true earth and a chassis return are not the same thing, or where some returns go to a common point to avoid the bugbear of hum loops.

Crossovers are a very dodgy business. There are four main systems: the hump-backed bridge where two wires cross but do not connect; the broken line that is almost the same thing, but which can be ambiguous; the plain line, except where dotted to show a joint, and the plain line which crosses except where it terminates against another line—no dots needed. There is a good case to be made out for all, but I fear those who conjure with the arguments do not have to crouch behind a radiogram in a dark corner of the lounge, with a crumpled wad of circuit just recovered from the dog.

PYRAMID
ALL PURPOSE SYSTEM
By F. G. RAYER



PART 2 — M.W. SUPERHET TUNER

THIS tuner is primarily designed for plugging into the "Pyramid" amplifier, for immediate reception over the medium wave band. Long wave coverage can be added later, if wanted. The tuner could be used with other amplifiers, or for excellent phone reception, for personal listening.

Figure 1 is the circuit, and current is drawn from the amplifier. L1 is a ferrite rod winding, dispensing with any need for an external aerial. L1 and the oscillator coil L2 are tuned by the ganged capacitor VC1/VC2, which has trimmers TC1 and TC2, and an oscillator padder C3.

There are two stages of intermediate frequency amplification, followed by the diode D1, which provides audio signals and automatic volume control bias through R12 to Tr2. The amplifier volume control supplies the diode load. If the tuner is used with other equipment, a 5·6kΩ resistor may need wiring across C11, for this purpose. Medium or high impedance phones may be connected across C11. A straightforward circuit of this type is generally easy to build and align. When used in conjunction with the "Pyramid" amplifier, a large number of stations can be received at excellent volume.

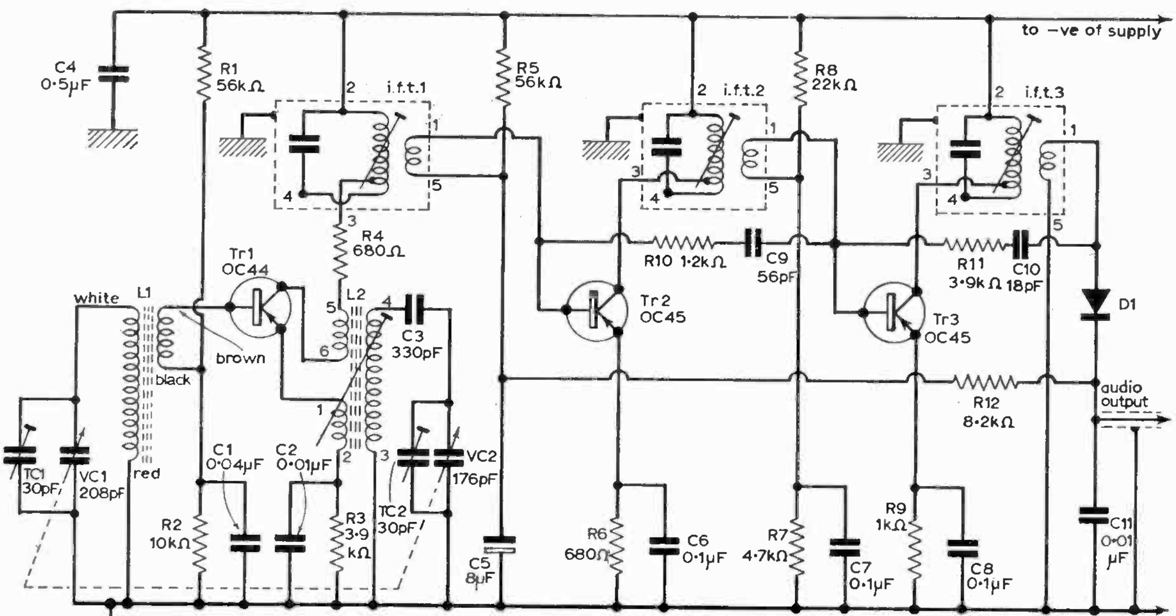


Fig. 1: Circuit of the medium wave superhet tuner.

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1N5GT 7/9
1P1 7/6
1P10 4/9
1P11 5/6
1R5 4/9
1S4 4/9
1S5 3/9
1T2 34/11
1T4 2/9
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3S4 4/9
3V4 5/6
4D1 3/9
5R4GY 8/9
5U4G 4/9
5V4G 8/-
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6AL5 2/3
6AM4 16/6
6AM5 2/6
6AM6 3/3
6AQ5 4/9
6AR6 20/-
6AT6 4/-
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6AV6 5/-
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6BA6 4/6
6BE6 4/3
6BG6G 20/5
6BH6 7/-
6BJ6 6/9
6BQ5 4/6
6BQ7A 7/-
6BR7 9/-
6BR8 8/-
6BS7 16/6
6BW7 5/6
6BX6 4/6
6C5GT 6/-
6C6 3/9
6C9 12/6
6CD6G 19/6
6CD7 9/6
6CH6 6/-
6CW4 12/-

6D3 7/6
6D6 3/-
6E5 9/6
6F1 8/9
6F6G 4/-
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6F12 3/8
6F13 3/6
6F14 15/-
6F15 10/9
6F17 12/6
6F18 8/6
6F23 12/3
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 2/-
6K7GT 4/6
6K8G 3/-
6K8GT 7/6
6L6GT 7/9
6L1 19/6
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/-
6SC7GT 6/6
6SG7 7/9
6SH7 3/-
6SJ7 5/-
6SK7 4/6
6SL7GT 4/9
6SN7GT 4/6
6SQ7GT 6/-
6SS7 2/-
6U4GT 9/6
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6U7G 7/-
6V6G 3/6
6V6GT 6/6
6X4 3/6
6X5GT 5/-
6Y7G 12/6
7A7 12/6
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7B6 10/9
7B7 7/-
7C5 40/-
7C6 6/-
7H7 5/6
7R7 12/6
7V7 5/-
7Y4 6/6
9BW6 9/6
9D7 7/6
10C1 12/6
10C2 12/-
10D1 7/-
10D2 14/7
10F1 15/-
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10F18 8/6
10LD3 7/6
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10P13 15/6
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12A6 5/-
12AC6 9/-
12AD6 10/3
12AE6 8/6
12AT6 4/6
12AT7 4/-

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12AU7 4/6
12AV6 5/9
12AX7 4/9
12AY7 9/9
12BA6 5/-
12BE6 5/3
12BH7 6/-
12E1 17/6
12J5GT 2/6
12J7GT 6/6
12K5 11/6
12K7GT 3/6
12K8GT 7/9
12Q7GT 3/6
12SA7GT 6/9
12SC7 4/-
12SH7 3/-
12SJ7 5/-
12SK7 8/-
12SQ7GT 8/-
12SR7 5/-
12Y4 2/-
13D1 5/-
13D3 9/-
14H7 9/6
14S7 19/6
18 12/6
19 10/6
19AQ5 4/9
19H1 40/-
20D1 13/-
20D4 20/5
20F2 14/-
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 6/6
30C15 13/6
30C17 13/-
30C18 8/9
30F5 11/9
30FL1 15/-
30FL12 15/-
30FL14 12/6
30L1 6/-
30L15 13/9
30L17 13/-
30P4 12/-
30P4MR 17/6
30P12 13/-
30P19 11/-
30PL1 15/-
30PL13 15/-
30PL14 15/-
30PL15 15/-
35A5 15/-
35D5 11/9
35L6GT 6/3
35W4 4/6
35Z3 10/-
35Z4GT 4/9
35Z5GT 5/6
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43 10/-
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50B5 6/3
50C5 5/9
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53KU 14/6
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77 5/-
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EB91 2/3
EBC3 20/6
EBC41 9/6
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EBC90 4/-
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EBF83 7/-
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EC53 12/6
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ECC33 29/1
ECC34 29/6
ECC35 4/9
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ECC81 4/-
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ECC83 4/6
ECC84 6/-
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ECC807 27/-
ECF80 7/-
ECF82 6/9
ECF86 9/-
ECF804 42/-
ECF805 12/6
ECH21 9/-
ECH33 22/8
ECH35 5/9
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ECH81 5/6
ECH83 7/9
ECH84 7/-
ECL80 6/-
ECL82 6/6
ECL83 9/-
ECL84 12/-
ECL85 11/-
ECL86 7/9
ECLL800 30/-
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 4/9
EF86 6/3
EF89 4/9
EF91 3/3
EF92 2/6
EF97 8/-
EF98 10/6
EF183 6/3

EF184 6/3
EH90 6/6
EL32 3/-
EL33 12/-
EL34 9/6
EL35 10/-
EL36 8/9
EL37 16/6
EL41 9/3
EL42 9/-
EL81 8/-
EL83 6/9
EL84 4/6
EL85 7/6
EL86 8/-
EL91 2/6
EL95 5/-
EM71 14/-
EM80 5/9
EM81 7/6
EM84 6/-
EM85 11/-
EM87 7/3
EY51 6/6
EY81 7/-
EY83 8/3
EY84 9/6
EY86 6/-
EY87 6/-
EY88 7/6
EY91 3/-
EZ35 5/-
EZ40 7/3
EZ41 7/3
EZ80 3/9
EZ81 4/6
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 27/4
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
KT41 19/6
KT44 5/9
KT61 12/-
KT63 4/-
KT66 16/6
KT74 12/6
KT76 7/6
KT88 29/6
KTW61 5/9
KTW62 12/6
KTW63 5/-
KTZ41 6/-
LN309 8/9
LP2 9/6
LZ319 6/6
LZ329 6/6
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 10/-
PC88 9/9
PC95 8/3
PC97 7/9
PC900 9/-
PCC84 6/-
PCC85 6/9
PCC88 11/-
PCC89 10/3
PCC189 9/3
PCF80 6/6
PCF82 6/3
PCF84 8/-
PCF86 8/9
PCF801 7/-
PCF802 9/6
PCF805 8/9
PCF806 11/6
PCF808 12/6
PCL81 9/-
PCL82 6/6
PCL83 8/9
PCL84 7/3
PCL85 8/3
PCL86 8/3
PCL88 15/-
PEN45 7/-
PEN45DD 19/6
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PEN384 11/6
PEN453DD 19/6
PENA4 19/6
PEN/DD 4020 17/6
PFL200 12/6
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PL36 9/9
PL38 19/9
PL81 7/6
PL81A 7/6
PL82 5/9
PL83 6/-
PL84 6/3
PL302 11/-
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PL504 13/-
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PM84 9/3
PX4 14/-
PY31 6/6
PY32 9/6
PY33 9/6
PY80 5/-
PY81 5/-
PY82 5/-
PY83 5/6
PY88 6/3
PY800 6/6
PY801 6/6
PZ30 9/6
QP21 5/-
QQVO3/10 30/-
Q875/20 10/6
Q8150/15 9/6
R10 15/-
R11 19/6
R12 6/6
R16 34/11
R17 17/6
R18 9/6
R19 6/6
RK34 7/6
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TH4B 10/-
TH233 8/-
TP22 5/-
TP25 5/-
TP2620 8/9
TY86F 12/2
UABC80 5/9
UAF42 9/6
UB41 10/6
UBC41 7/6
UBC81 6/6
UBF80 5/9
UBF89 6/3
UBL21 9/-
UC92 5/6
UCC84 8/-
UCC85 6/6
UCF80 8/3
UCH21 9/-
UCH42 10/-
UCH81 6/-
UCL82 7/-
UCL83 9/6
UF41 9/3
UF42 9/-
UF80 6/9
UF85 7/3
UF86 9/-
UF89 5/9
UL41 9/-
UL46 9/6
UL84 6/-
UM80 5/-
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UU5 7/-
UU8 16/6
UU12 4/6
UY1N 10/3
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UY85 5/6
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U52 4/9
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U78 3/6
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W61M 24/6
W63 10/6
W76 3/6
W77 2/6

W81M 6/-
W101 26/2
W107 10/6
W729 11/6
X24 16/6
X41 10/-
X61 5/9
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 11/9
Z729 6/3
Z759 23/-

Transistors and diodes

2G225 10/6
2N404 6/-
2N2297 4/6
2N2369A 4/3
2N3121 50/-
2N3866 20/-
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/-
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AC169 6/6
AC176 11/-
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ACY19 6/3
ACY20 4/9
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AF181 14/-
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ASY29 10/-
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BA116 9/-
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BA130 2/-
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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/-
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BF159 5/-
BF163 4/-
BF167 2/6
BF173 2/6
BF180 12/-
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BY114 6/6
BY126 6/6
BY234 4/-
BY236 4/-
BY238 4/-
BYY23 30/-
BYZ10 5/-
BYZ11 5/-
BYZ12 5/-
BYZ13 5/-
BYZ15 35/-
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GD4 6/6
GD5 5/6
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GD8 4/-
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GET119 4/6
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GET882 10/-
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GEX35 4/6
GEX36 10/-
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M3 2/10
OA5 5/6
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
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 16/6
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
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/-
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OC202 5/6
OC203 5/6
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TS3 15/-
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XA103 15/-
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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.

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★ components list

Resistors:
R1 56kΩ
R2 10kΩ
R3 3·9kΩ
R4 680Ω
R5 56kΩ
R6 680Ω
R7 4·7kΩ
R8 22kΩ
R9 1kΩ
R10 1·2kΩ
R11 3·9kΩ
R12 8·2kΩ
All 10% ¼ watt

Capacitors:
VC1/VC2 208/176pF
TC1 30pF
TC2 30pF
C1 0·04μF
C2 0·01μF
C3 330pF 2%
C4 0·5μF
C5 8μF 6v
C6 0·1μF
C7 0·1μF
C8 0·1μF
C9 56pF 2%
C10 18pF 2%
C11 0·01μF

Semiconductors:
Tr1 NKT152 or OC44
Tr2 NKT153 or OC45
Tr3 NKT154 or OC45
D1 OA70, OA81, etc.

Inductors:
L1 Medium wave ferrite rod aerial for OC44 or similar, Osmor QFR2B etc. for 208pF tuning.
L2 Oscillator coil for OC44 or similar, Osmor Red Spot etc., for 176pF.
IFT1 and IFT2, 1st and 2nd IFT's for OC45 or similar, Osmor White Spot, etc.
IFT3 3rd IFT, Osmor Blue Spot, etc.

Miscellaneous:
Knob; paxolin; tag strip; chassis about 6 x 3 x 2in. deep; 5 x 3in. Universal chassis single side; DL32 drive spindle; 2⅜in. diameter drum; cord; spring; wheels (Home Radio).

Transistors and most other parts are assembled on a paxolin panel 5½ × 1½in. This oscillator/i.f./detector strip is later placed in a chassis 6 × 3 × 2in. or 2½in. deep. The chassis supports a drive panel carrying VC1/VC2, so that a cord drive and horizontal tuning scale can be provided.

Drive Panel

To avoid metalworking, this is a "Universal Chassis" single side, 5 × 3in. This item has a ½in. flange all round, and can be bolted to the chassis. VC1/VC2 occupies the position shown in Fig. 3, with its spindle through a clearance hole. Three 4BA bolts secure the capacitor, and these must be short, or have extra washers or other spacers, or screwing them home will damage the capacitor.

Trimmers TC1 and TC2 were soldered to tags bolted to the capacitor. A capacior already fitted with trimmers may be used instead. VC1 is the larger section, having most plates; VC2 has fewer plates and is to the rear.

Two supports are cut from wood or other insulating material, Fig. 3, and screwed to the drive panel. For easy identification, coloured leads were soldered to the winding tags, as in Fig. 3. The winding is then put on the rod, which is held with string or elastic. Three leads pass through the chassis, to be connected to the oscillator transistor circuits later. Earth returns are completed by the drive panel and chassis.

Two 4BA bolts, with extra nuts, support the scale plate (cut from hardboard 5 × 2in.) and small wheels, Fig. 4. Clearance holes are punched in the chassis, for the cord. The spindle drive is situated in

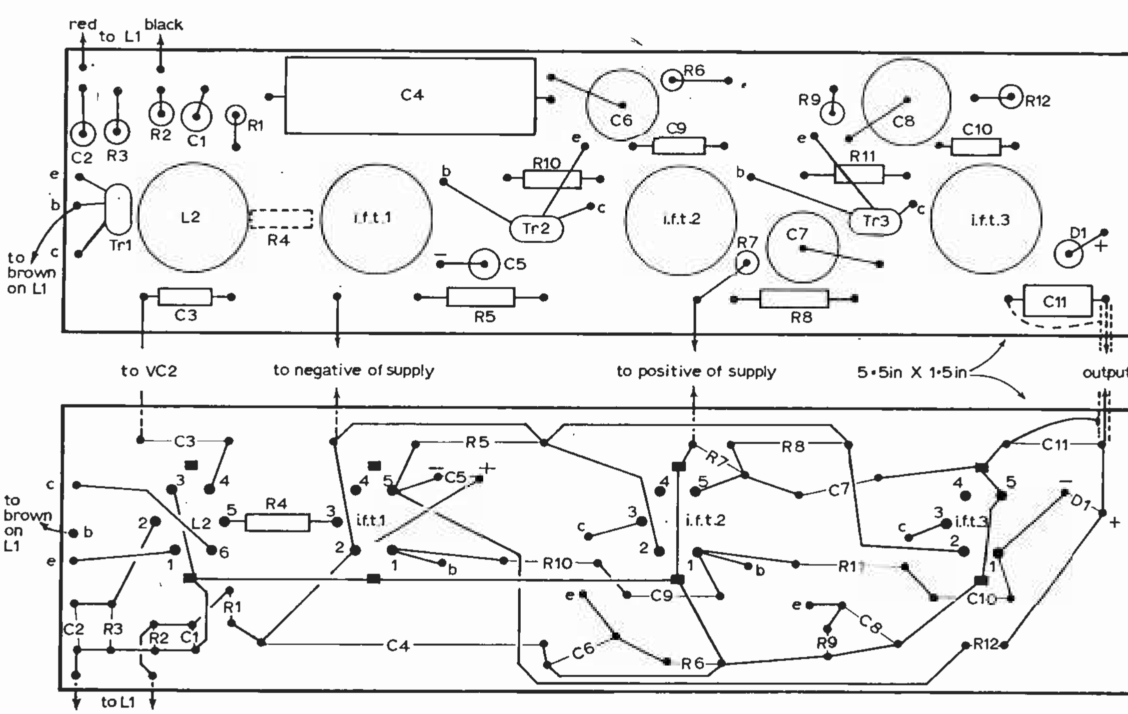

Fig. 2: Wiring and component layout of the receiver.

the middle of the chassis front runner. Arrange the drive, small wheels, and drum so that all are in line. This can be done by moving the drum on the capacitor spindle, adjusting the small wheel spacing nuts, and putting washers or extra nuts on the driving spindle bush, if necessary.

Drive Assembly

The cord is taken out through the drum slot, given half a turn round the drum in a clockwise direction, and passed down through the hole. It is given a complete turn round the driving spindle, goes up through the second hole and over the left-hand pulley, across to the right pulley, down to the drum and round this to the drum slot. The ends are tied with the spring, which goes on the drum projection, under tension.

If necessary, adjust the drum to allow proper 180 degree rotation of VC1/VC2. A small piece of tinplate is clipped on the cord with pliers, and a wire pointer soldered to it. The end goes under and behind the scale plate, Fig. 4, with enough clearance for free horizontal movement. With this diameter drum the actual scale is 3·4in. long.

Component Panel

Figure 2 shows the insulated panel, with all components except R4 one side, and wiring the other side. Coil L2, i.f.t.1, i.f.t.2 and i.f.t.3 have can tags which are bent over to hold them in position, and all are joined to the earth or positive line. With

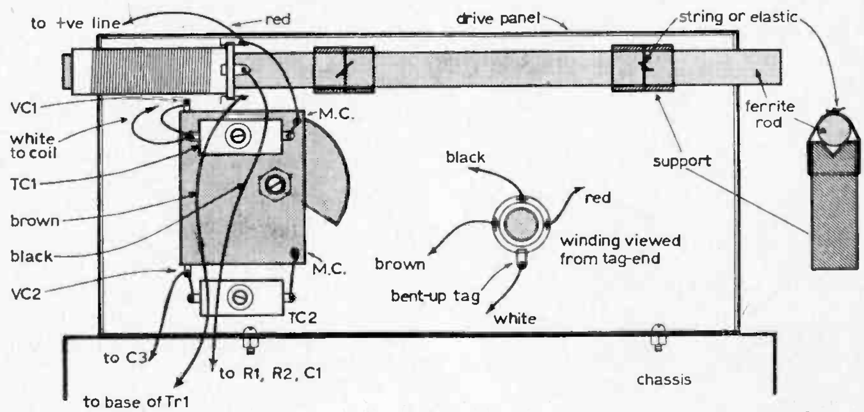

Fig. 3 (right): Method of mounting ferrite rod assembly and tuning capacitor.

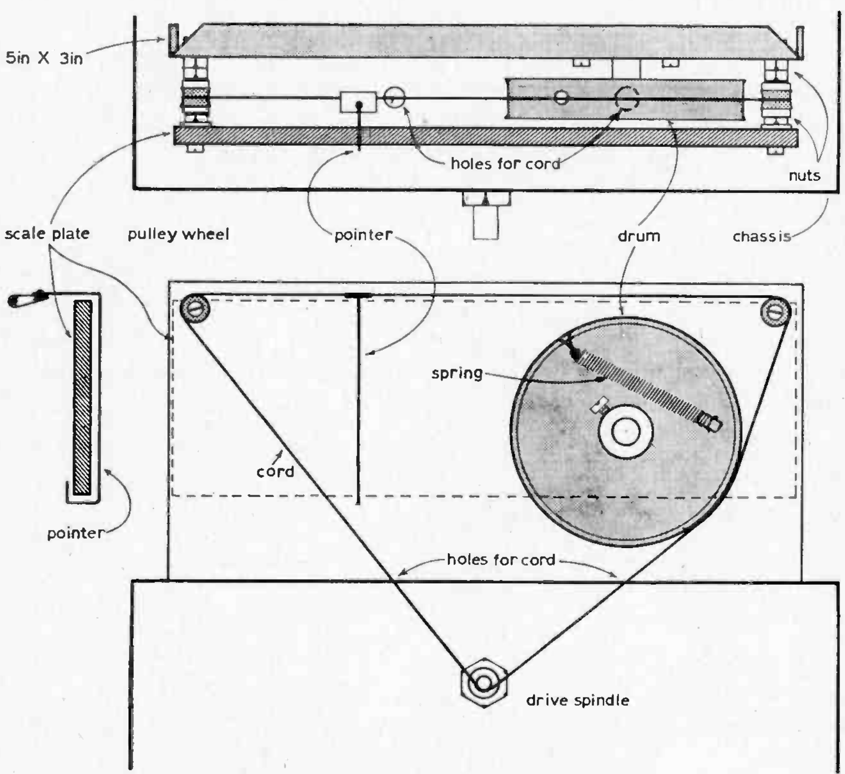

Fig. 4 (below): Arrangement of the tuning drive assembly. Note that the drive cord goes through holes in the chassis to the drive spindle—ensure that they have sufficient clearance.

L2, a coloured dot comes between pins 1 and 6. I.F. transformers i.f.t.1, i.f.t.2 and i.f.t.3 each have pin 4 unused. Other wires must not touch these pins.

The simplest way to avoid errors is to mark each component and lead with coloured pencil, as it is fitted and connected. This shows at once if anything is omitted. The diode and electrolytic capacitor C5 polarity must be as shown. Leads should be quite short and direct, and covered with 1mm. insulated sleeving where necessary. Connections can be 26 s.w.g. or similar tinned copper wire. Leave a short flexible lead for the negative connection, and another from the diode. Also leave short wire ends projecting from C3, R2 and Tr1 base.

The finished strip is held in place by two ½in. bolts, with extra nuts to leave enough clearance for wiring and R4. One bolt has a tag, connected to the strip positive circuit, so that this is common to the chassis when

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EF50	1/-	PL81	4/-	6K25	5/-	30P12	5/-
EF80	1/6	PY33	5/-	6U4	5/-	30F5	2/6
EF91	9d.	PY81	1/6	6V6	1/9	30FL1	5/-
EL36	5/-	PY82	1/6	6P28	5/-	6/30L2	5/-
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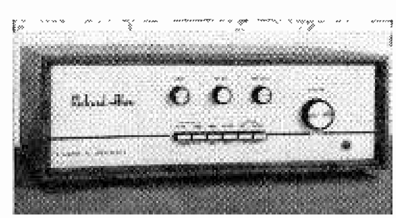

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the strip is in position. The brown and black leads are cut and soldered to the correct points, and also the lead from VC2 to C3.

Connections

A tag strip having one earthed and two insulated tags is bolted to the rear of the chassis inside. The strip negative lead is soldered to one insulated tag, which anchors a black flexible lead passing out of the chassis, and fitted with a plug.

The end of a co-axial lead is prepared, and the outer brading taken to the earthed tag. This forms the battery positive return with the "Pyramid" amplifier. The remaining tag is a junction point for the co-axial cable inner conductor, and lead from diode positive.

Current is obtained from the amplifier by inserting the co-axial and negative plugs. For use alone or with other equipment, the tuner requires a 6V supply.

Alignment

For alignment without a signal generator, tune in any station and adjust the cores of i.f.t.1, i.f.t.2 and i.f.t.3 for best volume. A meter in the negative supply lead should also show a drop in current as this is done. Then tune in a transmission with VC1/VC2 nearly fully open, and adjust TC1 and TC2 for best results. Afterwards, find a station with VC1/VC2 nearly fully closed, and adjust L2 core, and the position of L1 on the ferrite rod, for best reception. Repeat all the adjustments mentioned, using transmissions of low signal strength, if possible.

If band coverage is unsuitable, this is due to the settings of TC1, TC2, L1 on the rod, and core L2. Should it be found that transmissions around 200 metres cannot be reached with VC1/VC2 fully open, unscrew TC1 and TC2, and re-trim. At the low frequency or high wavelength end of the band (VC1/VC2 fully closed) coverage can be modified by adjusting the core of L2 slightly, and also moving the winding L1, as required to maintain best reception. The scale can now be calibrated in frequencies or wavelengths by means of a signal generator, or by tuning in transmissions whose frequency is known.

The optimum value for R4 depends somewhat on individual transistors, and is best as low as possible, provided oscillation is not audible when tuning. With some transistors R4 can be omitted. If the tuner is not used with the amplifier mentioned, remember a resistor of about 5·6kΩ *must* be provided in parallel with C11, or at the equivalent position in the amplifier.

TO BE CONTINUED

DIARY DATE 2 - 5 OCTOBER 1968

Don't forget to visit the PRACTICAL WIRELESS stand at the RSGB EXHIBITION, Royal Horticultural New Hall, Greycoat Street, Westminster, London, S.W.1.

YOUR ? QUESTIONS ANSWERED

Record Player Interference

I have a Garrard 1000 record player but find that the reproduction is spoilt by interference from the pickup lead. This interference consists of the distorted reproduction of the record and is still present when the cartridge is disconnected and the turntable unit only is switched on. I have ensured that there are no loose connections.—B. Bishop (Falmouth).

It seems obvious that your amplifier is picking up radiated interference from the motor circuit of the Garrard 1000. First, we would want to know whether the trouble derives from the motor circuit or from the "open" circuit of the pickup. Short-circuit the pickup input at the amplifier. If this cures the fault, look for common earth connections at the head shell, connector bracket or tagstrip. There should be no common return for the signal via the deck chassis. The deck should be separately earthed and the motor circuit adequately suppressed. If no switching suppressors are fitted try a $0{\cdot}01\mu F$ in series with a 100Ω. The capacitor should be at least 500V working and the resistor 1W. A suppressor per switch pole is the normal requirement. The separate earth should not return, in this case, via the amplifier. All signal return leads **should** return to the amplifier, and not to the deck.

Always watch for hum loops caused by signal earth lines.

Bandspread ?

I am puzzled by the term bandspread which I have seen used. This appears to apply both to transmitters and receivers. Can you explain please? —A. Davies (Wales).

The term bandspread refers to a system of tuning used in receivers (and transmitters) whereby a small variable capacitor is connected in parallel with the larger main tuning capacitor. This means that for any setting of the main tuning capacitor the small extra capacitor can be used to tune a small band in the region of the main setting. In effect, the extra capacitor permits small increments and decrements in the main tuning.

Another method is to connect a variable voltage capacitor to the tuned circuit controlling the tuning of the transmitter or receiver. This is a capacitor whose extra value depends on the voltage applied to it. Thus by varying a d.c. voltage applied to the capacitor, it is possible to vary its capacitance and therefore the tuning of the circuit. In this instance, a d.c. bias voltage (normally quite low) can be made to alter frequency.

Radio Club

I wish to join a radio club, how do I find out where the nearest one is?—F. Mallory (Derby).

Your best bet is to join the Radio Society of Great Britain (R.S.G.B.). Their address is 28 Little Russell Street, London, W.C.1. They will give you the address of the secretary of your nearest radio club.

MAKING A GROUND PLANE AERIAL

R. F. GRAHAM

THE ground plane aerial provides low angle radiation and omnidirectional coverage. It was decided to try such an aerial, as a change from the dipoles, long wires and doublets previously favoured, and after comparing the signal strength of a number of stations who themselves were using ground planes.

For those not familiar with the ground plane, Fig. 1 gives the essential details. The vertical element (usually self-supporting, though it can be wire) is a $\frac{1}{4}$-wave long for the chosen band. Each radial is usually a little longer. At least four radials are recommended, more or less evenly spaced round the pole. They also act as guys. The whole is as high as convenient above surrounding objects, and can be fed with 50Ω co-axial cable. The cable inner conductor goes to the bottom of the vertical element, and the outer conductor to all the radials.

Constructional Work

It was apparent that the whole could be prepared and put up in two or three hours. Clamps were made from $1\frac{1}{2}$in. wide strips of stout sheet metal, Fig. 2. These were fashioned by taking two round pieces of wood, one the size of the pole and the other equivalent to the vertical element, shaping the strips to suit in a vice, and drilling them for 2in. long 5/16in. bolts. Stout gauge tubing was used for the vertical, and seemed in no danger of collapsing.

The radials were 14s.w.g. aerial wire, looped through two turns of similar wire round the pole. This was drawn tight, twisted, and all joints were soldered. (A large iron is needed.) The co-axial outer conductor is soldered to the ring (radials). The inner conductor is bolted to the vertical element. Joints, and the exposed end of the co-axial insulation, are painted to keep out moisture. The co-ax was stapled a little way down the pole, to take stress off the end.

It was found that the whole could be easily raised into a vertical position, using the method for lifting a long ladder. The bottom end of the pole is pivoted on a post, tied to a strong peg, or placed against something which will not allow movement outwards. The top end of the pole is then raised above the head with both hands. Walking towards the pole base and simultaneously moving hand over hand along the pole raises it. The pole was tied temporarily to its post, and the radials loosely attached to surrounding objects (a tree, post, and house). The pole was then raised to its higher position (Fig. 1) and the radials drawn tight at 45 degrees to keep it vertical.

Dimensions

The aerial erected was designed for near 14·2Mc/s. The vertical was 16ft. 6in. and each of the four radials was 17ft. long. The standing wave ratio was better than 1·5:1 throughout the 14—14·35 Mc/s band. The pole was 18ft. long, fixed with its bottom

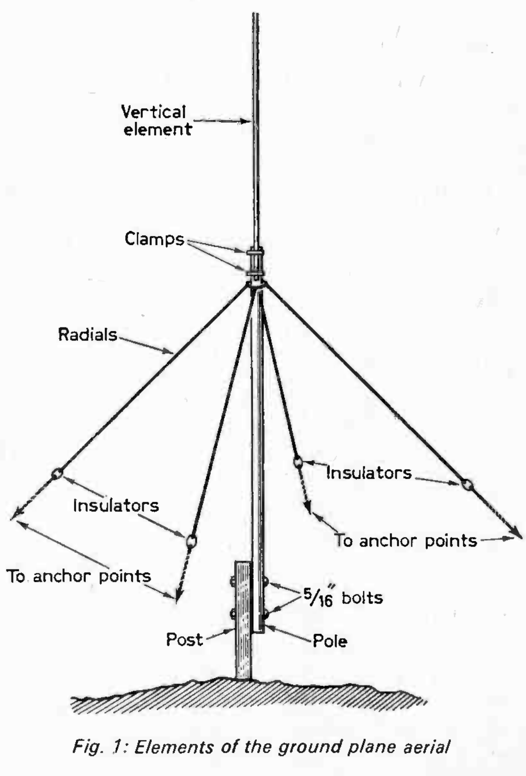


Fig. 1: Elements of the ground plane aerial

end 5ft. above the ground. For the 10m or 15m bands, the length of the vertical, in feet, can be found from 234M/cs. The radials are a trifle longer, equal to 240Mc/s.

Feed impedance is low with the radials at 90 degrees to the vertical element (e.g., horizontal) but rises as the radials are sloped downwards. An angle of about 45 degrees is suitable for 50Ω co-ax feed, this cable being any length. If circumstances permit, the ends of the radials can be raised or lowered, and the effect on the SWR noted.

Results

When first used with a receiver, the ground plane furnished results of about 5/5 from Australia, South Africa, Philippines, Guiana, and other prominent distant signals. Nearer ranges, such as USA, were around 5/7 to 5/9. Closer stations, and Europeans, were generally well up in strength, and one SP (Poland) station also using a ground plane gave a reading of 20db over S9.

When transmitting, the ground plane allowed the P.A. to be easily loaded by adjusting the pi tank capacitors. When used with a transceiver in which the method of tuning and particular i.f. caused bad 80m breakthrough on 20m with a long wire, the breakthrough disappeared. This was a great benefit when listening.

The best long distance contact reports were 5/5 with VK and ZL (Australia, New Zealand). This was with 150 watts input. The relative polarisation of aerials, depending in this case on the polarisation used by the other station, seemed to have no bearing on signal strength. On the basis of the reciprocal relation between receiving and transmitting with a given aerial, the ground plane seemed sometimes better and sometimes worse than a dipole and long wire, as would be expected. In any case this relationship does not hold for long distance short wave transmission. Equipment used was free from TVI with horizontal aerials. As the home and other local TV aerials were vertical, it was thought that TVI might commence with the ground plane. But in this particular instance TVI was also absent with the ground plane.

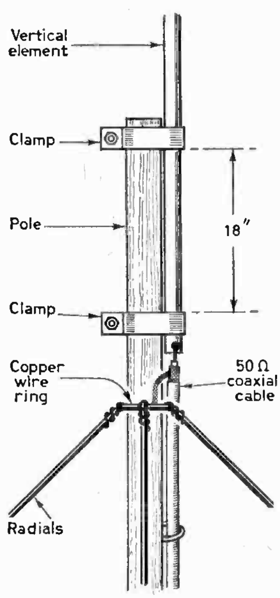


Fig. 2: Details of fitting etc.

The final opinion was that the ground plane was quite a useful aerial to have, and that its actual construction was not a matter of much difficulty. With radials at 45 degrees, such an aerial as that described requires a minimum diagonal space of about 25—26ft., or a square of about 18 × 18ft. ■

A.F. AMPLIFIER MODULE

—continued from page 392

on the heat sink (Fig. 2) and connecting a millammeter in its place.

Beginning with a low value for R17, higher values are substituted ranging from 10 to 39Ω, until a current of between 4 and 5mA is obtained in Tr5 at full voltage, care being taken not to warm up the thermistor when soldering. To facilitate the selection of a resistor for R17, temporary lead wires

★ components list

Resistors:

R1	33kΩ	R12	470Ω
R2	15kΩ	R13	33Ω
R3	2·7kΩ	R14	330Ω
R4	100Ω	R15	180Ω
R5	8·2kΩ	R16	470Ω
R6	4·7kΩ	R17	See text
R7	1kΩ	R18	4·7Ω
R8	2·2kΩ	R19	4·7Ω
R9	680Ω	R20	4·7Ω
R10	10kΩ	R21	4·7Ω
R10	10kΩ		

All ½ watt 5% miniature

Capacitors:

C1	10μF 25V electrolytic
C2	100μF 16V electrolytic
C3	100μF 16V electrolytic
C4	4,700pF ceramic
C5	100μF 16V electrolytic
C6	10μF 25V electrolytic
C7	1000pF ceramic
C8	64μF 40V electrolytic
C9	100μF 16V electrolytic
C10	330pF ceramic
C11	25μF 25V electrolytic
C12	200μF 16V electrolytic

Transistors:

Tr1	AC156	Tr4	AC128
Tr2	AC156	Tr5	AC128
Tr3	AC127	Tr6	AC176

Miscellaneous:

Th1 Varite Thermistor type VA1077; Veroboard 2½ x 3¾in, 0·15in. pitch; 3 transistor cooling clips; 18 s.w.g. aluminium (see Fig. 4); VR1 100kΩ potentiometer

can be soldered in place to which trial resistors can be attached by soldering, the voltage being reduced to zero to enable a new value of resistor to be substituted for R17 and then increased while measuring the collector current of Tr5, taking care that it does not reach an excessive amount.

The chief risk to guard against is an open circuit at R17, and the soldered joints at R17 must remain completely reliable, otherwise electrical failure will occur and replacement of the output transistors will become necessary. In each instance the joints should be tested mechanically before gradually turning up the supply voltage. The total current taken by the amplifier under quiescent conditions is about 27mA. ■

A LOOK AT INFRA-RED

A DAY by the seaside, that's what the Signals Research Development Establishment offered the press on Thursday, July 11th. When material becomes unclassified, the Establishment makes the information available to industry, and one or two firms were there showing some of their products resulting from this.

To describe the whole tour would be impossible, so let's look at some of the more interesting items. Infra-red was the main attraction and to illustrate advancements in this field, S.R.D.E. promptly set about proving that night or day, you can still be watched.

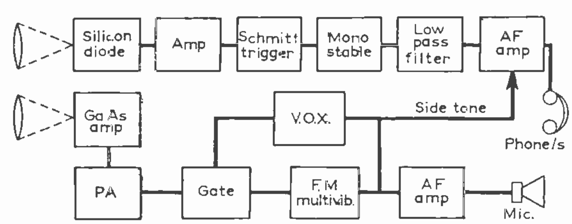
Two types of system were shown—active, and passive. The active system requires a source of infra-red light but the passive type will "see" a scene in almost total darkness. A moonless night gives adequate illumination for the image intensifier devices.

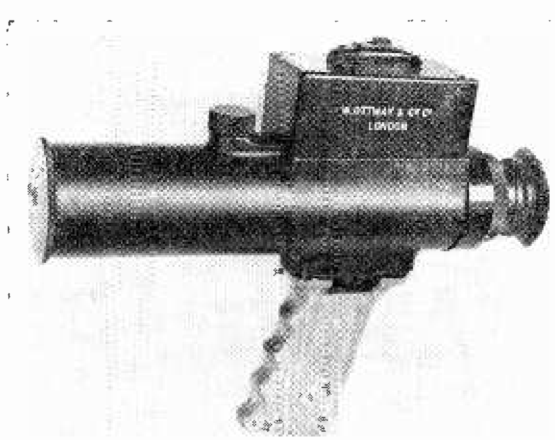
A pair of binoculars had been converted for use as a communications system, as the photograph and block diagram shows. The image is selected by drilling small holes opposite the prisms. One lens system acts as a transmitter and the other as a receiver, thus one can not only see the other "station" but can talk to them once the binoculars are lined up. A range of around 1 kilometre should be possible with modern Gallium Arsenide devices.

Another fascinating unit appeared to be two blackened cocoa tins mounted on a tripod. These contained a small lens system and a sensitive infra-red detector. Its special trick was that it could detect a man walking in front of it some thirty feet away. "It can tell that the man is not the same temperature as the background," explained our guide. It consumes less than 1 watt too and has a range of 100 metres—no false alarms. The resolution accuracy is 1 degree and the sensitive element which does all the magic is called a thermistor bolometer.

In some situations it might be useful to transmit messages from a fixed transmitter to a receiver situated anywhere in a room, with the provision that the messages must not be intercepted outside. This was demonstrated by illuminating a room with invisible infra-red rays which were modulated with the required signal. Anyone in the room with a suitable receiver could pick the signal up. This might offer useful possibilities in place of the inductive loop principle of radiating a signal around the house. The power used in the demonstration was only 3 milliwatts from a Gallium Arsenide device. Note—the human eye has a maximum tolerance of 60 milliwatts in this area of the spectrum, any increase would be dangerous. ■

The photograph above shows a pair of infra-red binoculars in use. Below, is a photograph and block schematic of the converted binoculars which form an optical transceiver. The bottom photograph is of a commercial infra-red viewer for use with an infra-red light source.





AUDIO SUPPLEMENT

No. 1 — AMPLIFIERS, TUNERS, TAPE RECORDERS

WHAT do we mean by Hi-Fi? The term can be taken literally—faithfulness to the original sound—but if we consider just what we are demanding by this over-simplified approach, we may realise that no equipment, however cleverly designed, would satisfy our requirements. It is necessary to consider the conditions under which we are listening to the reproduced sound. A ninety-piece symphony orchestra in the living room would be a trifle overwhelming!

The first thing we must get clear is the matter of acoustics, the characteristics of the human ear, the range of sounds we can expect to hear (and feel!) their intensity, pitch and effect in combination, together with a consideration of the listening room.

Useful guiding principles have been dealt with by Iain Smith (Five Steps to Hi-Fi. PRACTICAL WIRELESS, May-September) and our present brief is to discuss some of the equipment parameters that limit the highness of the fi we are able to get.

What we mean by hi-fi is the attainment of a *subjective* replica of the original sound: the equipment must convey the original sound in its true tonal proportions and not add any coloration of its own. It must be capable of delivering sufficient acoustic power to give us a true impression of the original.

The first thing is to take a look at the sound source from the dynamic point of view. What is the frequency range we wish to reproduce, and what sort of sound power has to be handed? Figure 1 and the frequency scale on the *chart* give some answers to these questions, but in doing so, raise others, connected with the dynamic range of musical sounds, sound effects (note the "natural" sound scales of Fig. 1) and speech.

Although the ear responds to sounds from below

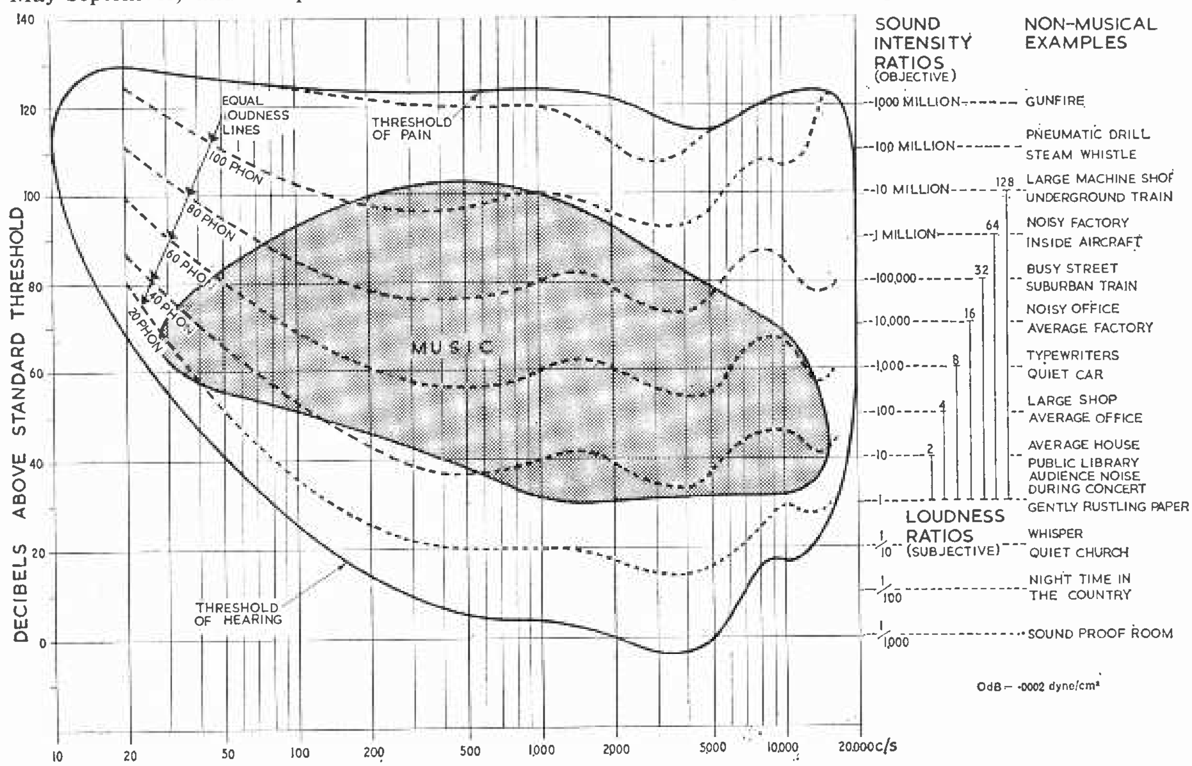


Fig. 1: Equal loudness curves based on measurements by Robinson and Dadson (reproduced by courtesy of Blandford Press from their forthcoming book Hi-Fi in the Home, *by John Crabbe).*

30c/s to above 15kc/s (extended to some 20kc/s in healthy youngsters and limited to about 10kc/s when we get a little grey), our ability to interpret the sounds we hear is modified by the loudness of these sounds.

The vast range in loudness and in frequency demands the utmost care in design if our hi-fi equipment is to handle it successfully. For example, a normal orchestra during a loud passage may produce some 70 watts (acoustic) whereas the solo violin in its quiet passage produces perhaps 0·0000038 watts. This is an intensity ratio of 18 million to one. Taking the square root of this, we find we still have a sound-pressure ratio of 4250:1.

We hear logarithmically. That is, our ears respond to proportional changes in sound level, not absolute levels. Every time the sound intensity doubles we hear an equal change in loudness; this applies whether we are listening to a whisper and then one twice as loud or comparing the whumps of a double-barrelled gun. (In a similar way. our sense of pitch follows a logarithmic law, each frequency doubling representing an octave change, very approximately. *See chart.)*

Decibels

Because of this trick of our hearing, it is more convenient, when talking of sound levels, to express ourselves in decibels. These are ratios, not concrete amounts. It is important to grasp this concept before going any further. It is quite wrong to say that a sound of 60 decibels (dB) was heard. The statement only acquires meaning when we relate the sound to some known standard. Thus, in Fig. 1 the decibel range is related to a definite sound pressure, i.e. 0dB=0·002 dynes per centimetre squared. Then, all increases in sound intensity can be compared with this level, and decreases can also be expressed, as minus quantities. This reference level relates to the threshold of human hearing, which, as the contours of Figs. 1 and 2 show us, change with frequency, being most sensitive at about 3,000 c/s.

Because of this convenient doubling property of decibels, we can now make the 18 million to one ratio easier to handle, this ratio being 72dB. Although a front-stall concert-goer may expect even a hundred decibel change when listening to, say, Prokofiev's Fifth Symphony, the average dynamic range our hi-fi equipment is expected to handle is around 60dB. This 72dB is the ratio of the softest to the loudest sound, and as we see from Fig. 1, may be between 30 and 102dB, the 30dB above threshold referring to the ambient and irreducible noise level in the concert hall.

The unit of loudness, which is the same as the decibel above zero at a frequency of 1,000c/s, is known as the Phon, and this can be used as a definite unit—but, just to be awkward, the exact relationship between phons and decibels only applies at this frequency, which is often taken as a reference level.

The decibel has a more useful function than simply expressing ratios of sound pressure. It can be used to compare powers, voltages or current. The difference in level between two powers (P1 and P2) is given by $NdB=10 \log_{10} (P2/P1)$. Voltage and current ratios are expressed as $NdB=20 \log_{10} (V1/V2)$ or $20 \log_{10} (I1/I2)$, because $P=I^2R$ or V^2/R, and logarithmically, when we square, we multiply the logarithm by 2. The 10 and the 20 simply indicate that the decibel, used for convenience, is actually a tenth of the unit, the Bel.

No advanced mathematics are needed to remember the decibel relationship. For practical purposes, it is enough to remember a few key ratios, as, for example:

Voltage: 2:1=6dB. 10:1=20dB.
100:1=40dB. 1,000:1=60dB.

For combinations, we simply add decibel amounts, thus,

20:1=20+6=26dB (i.e., 10 x 2:1)
200:1=40+6=46dB (100 x 2:1).

Having considered the convenience of decibels, we can begin to use them directly in talking about the dynamics of hi-fi. One of these points is directly related to the loudness phenomenon we have already touched upon. At middle and high frequencies we can judge level differences over a wide dynamic range fairly comfortably, but at lower frequencies, especially below about 100c/s, our ears are not so sensitive.

At the lower frequencies, the curves are closer together than at mid and high frequencies and quite large loudness changes produce small stimuli. Which is one reason why the bass end of the audible spectrum is lost first when we turn a gain control down. To overcome this, compensated gain controls are sometimes found, which alter the levels of bass and treble ends of the spectrum in some relationship to the characteristic of the human ear. These loudness controls should be approached with care, as should any form of filtering that attempts to reduce system noise electronically, where, in so doing, some of the basic information may be lost. Nevertheless, listening is a compromise between the ideal and what we can afford, and rumble filters, top-cut controls and loudness compensators may be a necessary evil if we cannot afford to engineer them out!

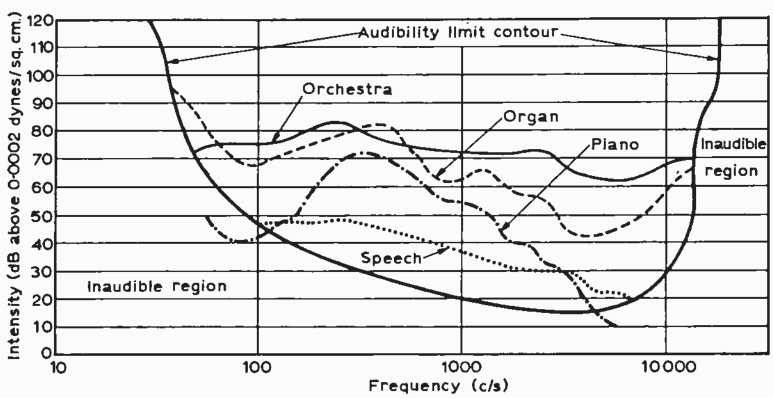


Fig. 2: Comparison of relative intensities of familiar sounds, showing the audibility limit contours. Compare with Fig. 1.

Stereo

For various reasons that have to do with the ambience in the concert hall or studio and the relative deadness (or spirited liveliness) of the domestic surroundings, minus the audience and the original reverberation, much better effect is gained if we listen binaurally. Stereo systems are to be desired, not only on the grounds of realism, but also for unwanted interference reduction and the proper assessment of complicated waveforms.

Complex waveforms should be studied briefly before we can regard the amplifier practically. Our brains identify sounds by the waveform structure and also by a complicated time-conscious business that can be best described as "hearing the attack".

As an example, let us take the readily identifiable thwack on a bass drum, a sound common both to "serious" and "pop" music. The aural effect that enables us to identify it is the time integral of the pressure levels, a function of the product of level and duration, and is contained in the first fraction of a second. After this, we have a reverberant sound that continues to reassure us, as it were, that it was really a bass drum we heard, not a clap of thunder.

The clash of cymbals is another example, the plucked harp and guitar, the percussive sound of the piano are others. These sounds require equipment responsive to the sudden increase in sound level and the decay that follows it. If you tape record a piano *arpeggio* and then replay it an immediate sense of loss occurs, because the notes come to us without the *attack*, or as G. A. Briggs describes it, "like a home-made harmonium suffering from anaemia and groaning in agony". He is not far wrong!

All this means that our equipment must have not only adequate power levels and wide and faithful frequency response, but also a capability of reproducing those sudden attacking sounds—the transients. Of the chain of equipment from source to speaker, the amplifier is the link which can be engineered to the closest tolerances. Having got the heart of the matter right, we can then consider the other parts of the chain—what specifications we require our equipment to have, and why.

Amplifier specifications

(1) Frequency response. Accuracy of reproduction depends on the range of frequencies which the system can handle, without distortion. We can detect sound level changes of about 1dB under good conditions—and this needs very careful engineering.

Even a ±2dB specification over the normal frequency range from 30c/s to 20kc/s is asking rather a lot. It is possible to keep the variation to within less than ±1dB over a range 40 to 15kc/s, at all levels of output power, but to improve upon this specification costs progressively more as the limits extend and the response gets more "flat".

Although we cannot hear the frequencies above, say 15kc/s, there are one or two design considerations that apply. First, for an amplifier with a fair amount of negative feedback (see Fig. 3), the bandwidth should extend at least an octave beyond the audio range to maintain stability. Second, to avoid "ringing" caused by a sharp cut-off at the upper end, the curve must slope away at not more than 6dB per octave attenuation, and this means an extended overall range. And, thirdly, to reproduce square-wave effectively needs a pass-band of *ten times* the frequency.

(2) Distortion. Even though the response of an amplifier may be reasonably flat, its handling of the signal can still produce a vague feeling of discomfort. Nothing very tangible, until a comparison is made with a better piece of equipment. This effect is often due to a distortion figure higher than the recommended maximum of 1%.

Non-linear distortion happens when spurious harmonics are added to the original sound because of faults in the reproducing chain. In the amplifier, this may be caused by biasing inconsistencies, especially in transistorised push-pull output circuits, where these are supplied from a badly regulated power source. In fact, this is so important that the latest DIN recommendations are for distortion factors not to exceed 1% at full output from 40—4,000c/s for preamplifiers and from full power down to —20dB over a power bandwidth of 40c/s to 12·5kc/s. This latter recommendation is to test transistorised amplifiers at low signal levels, where distortion can arise.

In practice, distortion figures of well below the 1% level are attainable, and the magic figure of "Point One" has for years been a valuable (and justifiable) advertising slogan of a well-known British manufacturer. One per cent overall distortion is just detectable by a discerning listener, and the trained ear can

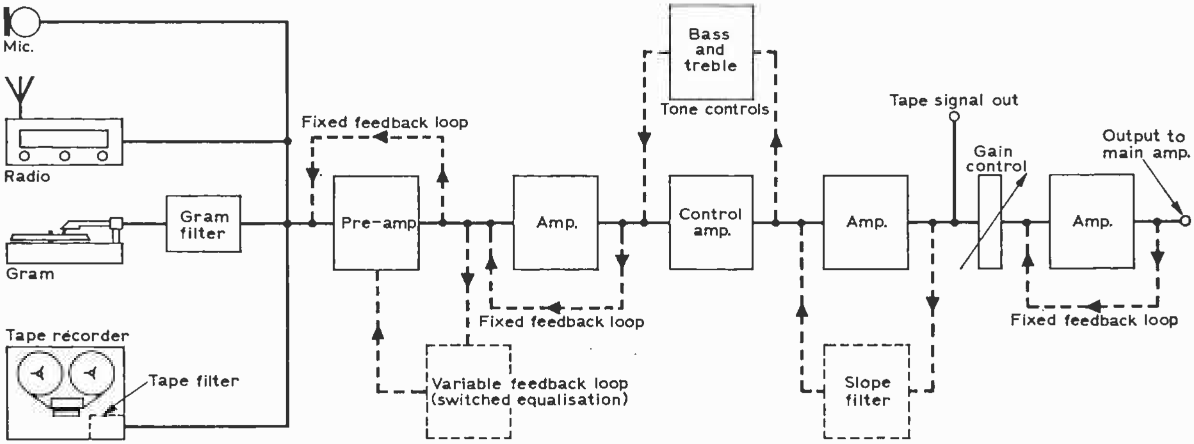


Fig. 3: Block diagram of typical preamplifier showing the extensive use of feedback in filters and to achieve stable amplification. Gram and tape filtering and equalisation is often in the source equipment but may be incorporated in the preamplifier.

detect half this amount. 2% is plainly audible to the music-lover, and 4% becomes intolerable to all but the cloth-eared few. By comparison, the cheap transistor radio may produce as much as 50% distortion and this will be tolerated!

There are several quite different sorts of distortion. Second harmonic distortion has been virtually eliminated by the use of push-pull output circuits. Figure 4 shows a basic push-pull circuit, each valve (or half-section of a single valve) handling an opposite phase of the signal.

When one grid is going positive and the anode current is rising, the other is going negative, with anode current falling. Even-order harmonics tend to cancel out. With correctly applied negative feedback, third-order harmonics will also be greatly reduced, and the push-pull stage, with its greater power handling capacity, is extensively employed as a result.

A refinement for hi-fi applications is the distributed-load technique. A tapped output transformer from which the screen grids of a tetrode pair are fed gives a characteristic between the triode and tetrode, getting the best of both worlds. This "ultra-linear" design requires less negative feedback, reduces total d.c. variations at high output levels and has a relatively smaller capacitative shunting effect at high frequencies as well as less phase shift. Against this, a special transformer is needed, and the position of the tapping point is critical. See Fig. 4 (b).

Most of the non-linearity and phase-shift leading to distortion originates in the output transformer. Experiments to eliminate this led to several interesting circuits, but it was the advent of transistors that made a high power, high fidelity, push-pull output circuit without transformers a tenable proposition.

Figure 5 (a) shows one channel of a stereo amplifier, where we see a complementary pair of transistors in the driver stage perform the function of phase-changing, eliminating the input transformer, and where the sharing of the signal by a directly coupled Class B push-pull pair of output transistors drives the loudspeaker directly. Figure 5 (b) shows the signal path through this network, with the phase of the signal at any given moment drawn in as a sinewave.

Intermodulation distortion has a very disturbing effect. It arises from sum and difference frequencies of the original tones being produced because of non-linearity of amplifier response. When a complicated piece of music is being played, with a large number of required fundamentals and harmonics, the extra beat notes of intermodulation distortion can be quite intolerable. DIN specifications require that intermodulation distortion be assessed separately and must be less than 3% maximum when two test signals of 250c/s and 8kc/s are simultaneously applied at an amplitude ratio of 4:1.

From the practical standpoint, there are two identifying features of IMD (Inter-Modulation Distortion) which can be spotted when, for example, a choir accompanied by an organ, has been recorded. The long-term IMD produces a blurring effect as the harmonies become more complex, and the beat-note distortion due to mingling of two fundamentals close together gives a low frequency "blasting" effect, most noticeable with organ music.

The foregoing spec. is quite generous, and most manufacturers of high-fidelity equipment would aim at a figure of 1% IMD.

(3) Transient response. Transients are short-term peaks of sound. We have already seen that the attack is important in identifying a sound and aiding stero location. Unless an amplifier has good transient response, the initial 10—50dB increase in a period as short as 100μS will be flattened out, or, worse, will give rise to a "ringing" of circuits and spurious distortion effects.

Fig. 5 (right): Transistor Class B push-pull transformerless output stage (a); signal paths of push-pull amplifier showing phase reversal effect of complementary push-pull driver pair.

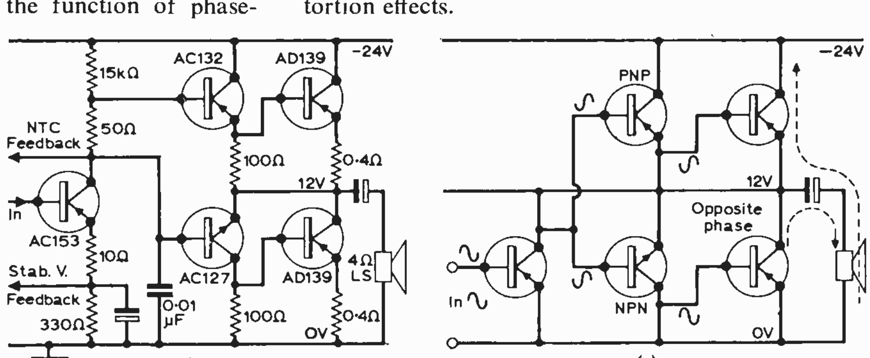


Fig. 4 (below): Basic push-pull circuit (a), basic ultra linear circuit (b).

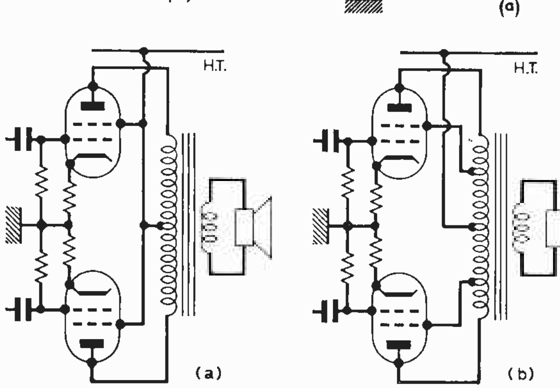


Figure 6 shows the simplified response curves taken from four amplifiers with similar overall specifications but different transient response characteristics. A square wave applied to each amplifier produces an output as shown in A, B, C, and D, and the curves resulting from this distorting effect are shown on the graph.

Amplifier A has a slight overshoot due to a small peak at about 60kc/s (well above the audio range), and B has a larger peak.

Amplifier A might be acceptable, but would possibly be triggered off by switching transients into some instability, especially if loudspeaker loading was poor. Amplifier B would certainly sound harsh, and transients would cause instability. The frequency

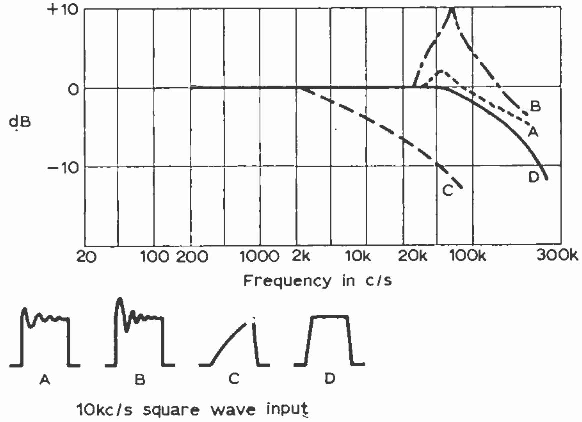


Fig. 6: Four different frequency response curves and the effect on a 10 kc/s based square wave of each of the four amplifiers. (Transient response is affected by the overall response curve of the amplifier).

response of C tails off too rapidly at the higher end, although still only about 3dB down at 10kc/s, which some mid-fi makers consider acceptable. An applied square wave would come out something like the peculiar shape below, and the sound from it would be dull and lacking in attack. In a piano *arpeggio*, the notes would tend to run together instead of being individual and distinct as they should be with D.

Transient response is affected by some tone (and even gain) control circuits, and for this reason testing is done at different levels and frequencies. The effect on the response curve of different tone control circuits can be seen in Fig. 7. The passive type of tone control has the effect of "hingeing" the response about a 1kc/s centre, but with the Baxandall type the boost and cut is initially confined to the ends of the scale.

This is most useful when the lower bass frequencies need boosting without affecting the 300-500c/s region. Where slope filters are fitted—providing top-cut fairly steeply to reduce distortion from the source, an ordinary passive tone control may be enough, but a combination of both is better. See Fig. 8.

(4) Signal-to-noise ratio. Noise can consist of hum, rumble (from turntables, etc.), hiss (from tape or preamplifiers) and random crackles, etc. While the power amplifier can be engineered to a very good specification, noise from preamplifiers, where the switching, tone controls and filters will be situated, is still difficult to eliminate.

AUDIO SUPPLEMENT

DIN specifications for noise level stipulate better than −50dB for preamplifiers at the nominal input signal amplitude and similarly for power amplifiers up to 20 watt rating, with a 50dB figure also for a 100mW output, which is a test for transistorised amplifiers.

The *minus* 50dB indicates that the level is measured in decibels below the maximum output of the equipment, this maximum determined by the specified distortion figure. A 50dB signal-to-noise ratio (which is the same thing stated positively) is generous. Most amplifiers would be better than 60dB, and a good hi-fi amplifier would have a S/N ratio of 70 to 100dB, much better than the figures of the source material, whether from tape, disc or radio.

As an example of the expected figures, we quote the requirements of one notable reviewer for hum and noise content of a hi-fi amplifier: these are minimum figures from various sources, each terminated by the appropriate load resistor.

Source Input	Sensitivity	Hum and Noise (rel. 10W)
Tape Head	2·5mV	−48dB
Magnetic pickup	3mV	−55dB
Crystal or ceramic pickup	50mV	−60dB
Radio	200mV	−65dB

Noise figures may be weighted or unweighted. This means that in testing some account has been taken of the peculiarities of our hearing apparatus. The ear is less tolerant of some kinds of noise than others, and will put up with a lot of mid-frequency components (where the ear is most sensitive). The main noise spectrum of transistor amplifiers lies in the mid-region and a weighted figure gives a better idea of transistor amplifier performance, subjectively.

(5) Power Output. Here we have what may be a stumbling block to many readers, because of the different methods of measurement—and the habit of some manufacturers to give a bald "*X-watts Output*" statement, without saying whether this is r.m.s., continuous sinewave, music power or what-have-you. Be wary of such specifications !

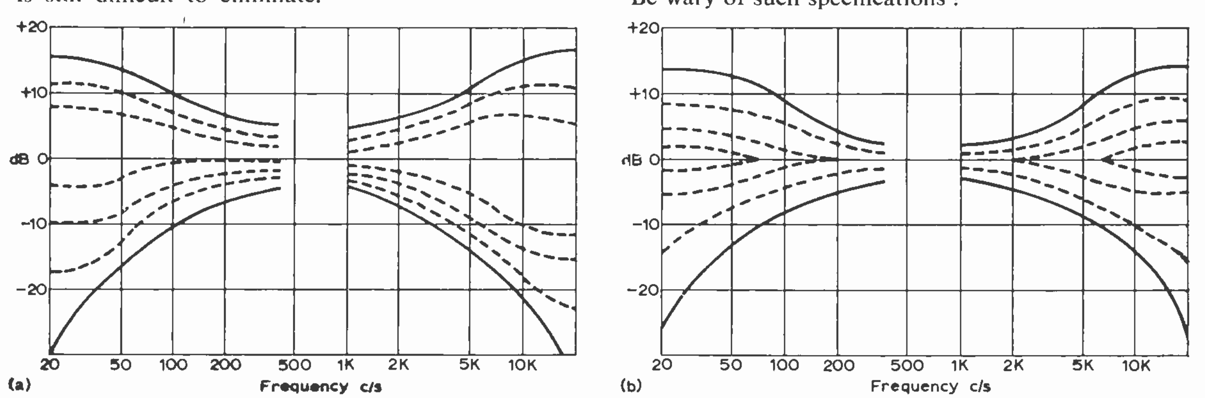


Fig. 7: Typical curves showing the effect of (a) passive and (b) active—in this case Baxandall—tone control circuits.

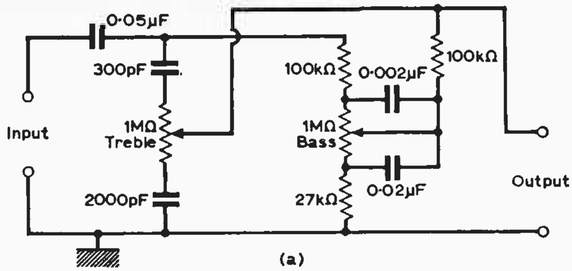
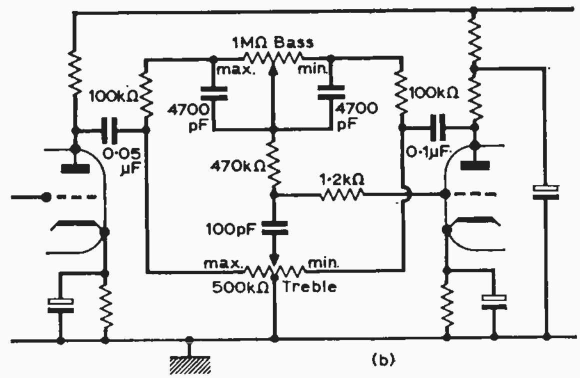


Fig. 8: Passive (a) and Baxandall (b) tone control circuits as used in practice.



DIN specifications recommend at least 10 watts mono and 6 watts each channel stereo, with a capability of producing sinewave signals of 1kc/s for a period of 10 minutes. Power output figures are related to a given level of distortion.

In this country, an r.m.s. figure is generally stated, referring to a maximum continuous output power at the specified distortion figure.

Peak power ratings are more generally quoted by American and Japanese manufacturers. We find the term "music power" in use. The IHFM definition states that: "*Music power shall mean the greatest single frequency power that can be obtained without exceeding the total rated harmonic distortion when the amplifier is operated under standard test conditions, except that the measurement shall be taken immediately after the sudden application of a signal and during a time interval so short that supply voltages have not changed from their no-signal values.*"

To begin with, this argues a well-regulated power supply, or an external stabilised power supply. The peak power is obtained by doubling the power rating. Figure 9 shows a half-cycle of a sinewave, with the comparison between peak and r.m.s. values. The effective continuous voltage is 0·707 times peak voltage and continuous power is half ($0{\cdot}707^2$), the peak power. Music power figures may give a false impression, often being some 30% above sinewave ratings. Care must be taken when studying these specifications.

Power bandwidth is also important when considering specifications. This relates to the frequency range lying between the extremes where power output falls by 3dB—or a half. Figure 10 compares the response related to power output of two quite dissimilar amplifiers. Both have a peak power handling capacity of 10 watts, and were both, in fact, sold as such. But whereas A gives a half-power figure at 15c/s and 30kc/s, B is restricted to 60c/s at the lower end and only 10kc/s at the upper end. Definitely midfi!

Power output at the upper end is important for good transient response and the half-power point should be 30kc/s or above for a good amplifier. At the lower end, half-power at 40c/s is desirable, and at 20c/s even better, although the fundamentals of few instruments go down so far. The piano and contra-bassoon and the lower strings of the harp go below 40c/s, but as the second and third harmonics are greater than the fundamental, losses are not too obvious.

But the organ can only be reproduced in the region where its music is "felt" rather than heard, with an amplifier (and accompanying system) whose half-power rating is 20c/s or below. This is where transformerless amplifiers have a decided advantage.

(6) Stereo separation. Although some authorities maintain that this specification is not so important, because a separation as poor as 10dB will still give a good stereo impression if the frequency range is wide enough and the transient response is good, the higher the separation the better.

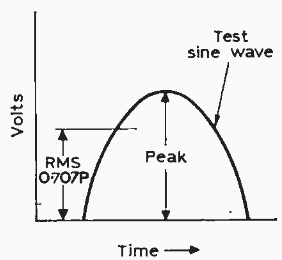
DIN recommendations require crosstalk between stereo channels to be better than −50dB at 1kc/s and −30dB between 250c/s and 10kc/s. Breakthrough between inputs should be −50dB or better at 1kc/s and −40dB or better between 250c/s and 10kc/s. Limiting factors are often sources, such as pickup cartridges and the discs themselves.

Tapes can achieve a better preparation, provided the tape recorder is properly adjusted and the preamplifier correctly designed. V.H.F. tuners should achieve a −30dB figure. For an amplifier of any pretensions to quality, −60dB should be aimed at.

(7) Sensitivities. Nominal sensitivities should relate to the specified output. When an input goes through a volume control, non-linear distortion should be less than 1dB when inputs are 12dB above nominal levels. Magnetic pickup: loading, 47kΩ, input sensitivity 5mV.

Crystal and ceramic cartridges: sensitivity is less, often 50mV or so, and impedances much higher. But it is possible to attenuate externally, or to apply a ceramic cartridge as a pressure-gradient source.

Radio tuner: many Continental tuners are designed to match a high sensitivity, 47kΩ—100kΩ



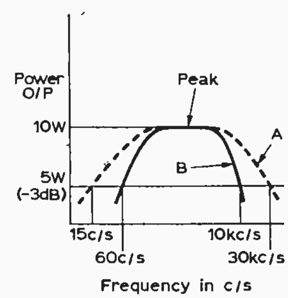


Fig. 9 (left): Peak power and r.m.s. values with output volts related to time and one half of the sinewave test signal shown.

Fig. 10 (right): Half-power figures are useful to indicate the power capability of an amplifier, where a peak figure is practically meaningless. Power bandwidth relates response to output power.

input whereas British tuners generally deliver a higher output into 500kΩ or so. But matching presents few problems. Outputs are specified as 1 volt across 47kΩ for matching or a preamplifier to a power amplifier, and for connection to a tape recorder should be 0·1mV to 2mV for every 1kΩ of resistance from 1kΩ to 50kΩ. There are many practical variations of this and selection should be made with care.

Power output matching is recommended at 4 and 16Ω, (our normal 3 and 15Ω loudspeakers suit these requirements). It should be remembered that transistor amplifiers tend to deliver greater power into a lower impedance, but are easily damaged by shunting with too small a matching impedance—the opposite to a valved amplifier, which dislikes an open-circuit.

Common practice with good quality equipment is to protect against overloads, short-circuits and power failures, but discussion of this is beyond the scope of these notes.

RADIO TUNERS

The radio tuner is nowadays an integral part of any hi-fi set-up. Many good programmes are available, and broadcasting quality on v.h.f. is capable of as fine results, provided reception conditions are sufficiently good. The tuner is, basically, a radio set without a power amplifier (and in some cases, without a power supply unit also), but, because it is specially designed for the purpose of matching other hi-fi equipment, the standards to which it may be designed and constructed will be much more rigorous.

A.M. and f.m. tuners, and some with combination of a.m./f.m. facilities, are available, but for the purposes of high fidelity reception we should consider f.m. The only reason for having broadcast bands on our tuner would be the need to reproduce stations not available on the v.h.f. band—and as the quality of programme from such stations is often dubious (from a technical point of view !) serious consideration should be given whether it is cheaper to buy a good v.h.f. tuner and a separate cheap radio for the odd a.m. broadcast, or pay a lot more for a combination a.m./f.m. tuner.

With a.m. the bandwidth is limited by factors beyond the broadcaster's control. Broadcast bands are very crowded; interference is rife. Transmissions can fade due to weather conditions and with time of day. Locally generated noise due to electrical apparatus presents the same pattern to the receiver as the modulating signal, and cannot thus be reduced without some curtailing of vital programme information. Highly selective and highly sensitive receivers can be designed, and are on the market at high prices, but these are more attractive to DX listeners than to the hi-fi enthusiast whose prime aim is high quality of sound. Restricted frequency response and high noise level are the two main drawbacks to a.m.

V.H.F. Band

There is more room in the v.h.f. band. The frequency range transmitted can be higher and, in fact, 15kc/s is reckoned to be available on many broadcasts, although land-lines between studio and transmitter and between stations limit the upper frequencies somewhat. Because the service range of the higher frequency transmissions extends mainly over a "line-of-sight" pattern, about 50 miles or so radius, a network of stations has been (and is still being) built up by the BBC to give full population coverage.

But it is necessary to employ a good aerial to get the best from v.h.f., not only because of signal strength, but to eliminate multipath effects (ghosts) which cause a buzzing background noise or distortion and tuning in some cheaper equipment.

It is also false economy to make do with an inefficient aerial on the grounds of noise suppression. Electrical interference is impulsive in nature, varying the amplitude of the signal. The f.m. signal is transmitted at a constant amplitude and thus we can eliminate impulsive noise by limiting the amplitude of the signal within the tuner, "chopping the peaks off", so to speak. But to get the best limiting effect, it is necessary to drive the tuner as hard as possible. Overloading is protected by automatic gain control circuits, which are a common feature.

Multi-element aerials give greater gain and better directivity and provide the correct match to the aerial input terminals of the tuner, which may be 300 or 75Ω, the latter favoured by most British manufacturers. Even a simple H aerial, erected out-of-doors and at an adequate height, is sufficient for most purposes. But although an indoor aerial may appear to give enough signal to drive the tuner, spurious signals can occur as it is "shadowed" by people moving about, or by reflections from internal plumbing, etc.

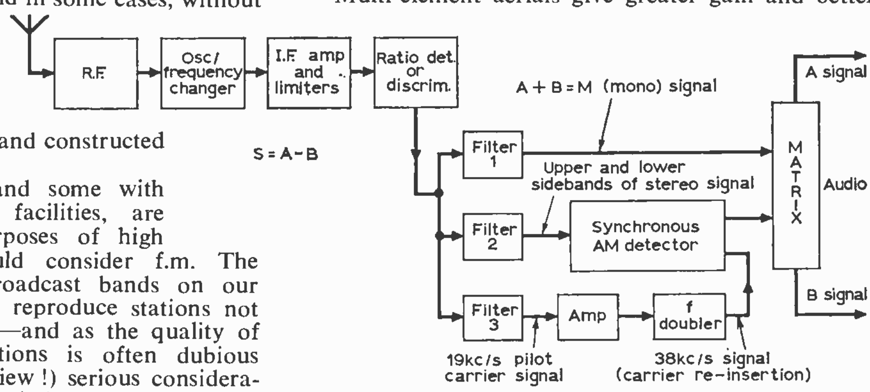


Fig. 11: Block diagram of f.m. tuner with decoder expanded to show operation (see text).

A loft aerial is a partial solution but housewiring, water-tanks and even the difference in field-strength of the signal shaded by a wet or a dry roof can give rise to reception changes. Height of aerial is a vital factor. Doubling the receiving aerial height is equivalent to multiplying the transmitter power four times !

Preamplifiers can be used to boost the f.m. signal, but there are drawbacks. The preamplifier must be of equal bandwith to the aerial, it must not of itself contribute noise to the system, and it should, for best effect, be mounted as near the aerial as possible, i.e. at the masthead—which raises powering problems.

It cannot contribute to directivity and, if the aerial is picking up noise, will amplify both noise and signal together. The solution, in all cases, is to capture as good a signal as you can with as good an aerial as you can erect, taking care over its siting.

Matching to the tuner is no difficulty. Normal coaxial cable is self-screening and has a nominal 75Ω impedance. Where a tuner only has a 300Ω input, a match can be made by connecting the outer braid of coaxial to the tuner chassis and the inner to one of the terminals, leaving the other unconnected. This gives an impedance match of 1:4 and uses the tuner input circuit as a 1:2 transformer.

Three hundred ohm cable (actually 240-300Ω ribbon-type) is not screened and its installation presents difficulties. It must be kept parallel at all times, should not run alongside guttering, pipes, etc., and should be spaced evenly away from all securing points. Aerial polarisation is horizontal for f.m. transmissions.

Stereo

Stereo broadcasts thoroughly justify the use of f.m. tuners with hi-fi gear, although these are at present limited to part-time broadcasts from only six stations. The BBC is extremely keen on high quality broadcasting, and the stereo network will grow. But although the same frequencies are used, the extra information needed for stereo reception is conveyed by a suppressed sub-carrier. This, with the pilot tone necessary to operate the decoder, means that a stereo signal has to be some 20dB stronger than a mono signal to obtain a comparable signal-to-noise ratio. Another point in favour of a good aerial installation.

The important factor in drawing up the specifications for stereo broadcasting was the need for compatibility. As with colour TV transmissions, the new service had to coincide with, rather than supplant the old. Receivers of mono transmissions must be able to pick up the stereo broadcasts in *mono* and stereo receivers had to accept the mono transmissions still being broadcast. The stereo signals contain all the mono information plus stereo information for the individual channels and a pilot tone to enable the decoder to work.

Typical Tuner

Figure 11 shows the block diagram of a stereo tuner, with the decoder section expanded to illustrate its operation. Up to the detector output, it is a normal mono f.m. tuner. From the detector the M and S signals plus the 19kc/s pilot tone are passed to the decoder. The M signal is the sum of the individual channel signals at the transmitter, and the S signal is the difference between them, with the 38kc/s suppressed so that only the sideband signals are transmitted. All three signals, M, S and pilot tone, modulate the carrier simultaneously.

In the decoder, Filter 1 selects the mono signal and passes it to the matrix. The S signal is passed via Filter 2 and is passed to the synchronous detector where the 38kc/s carrier, picked up via Filter 3 (as a 19kc/s pilot tone) and amplified, doubled and fed to the synchronous detector is also applied to the matrix. This translates back into the original A and B signals of the stereo broadcast for application to the main amplifier.

The important thing to note is that both the 19kc/s pilot tone and the 38kc/s carrier are available at the output from the tuner. This is no problem as far as radio reception via the hi-fi amplifier is required, but becomes a difficulty when tape recorders are part of the link-up. Either or both of these can beat with the tape recorder oscillators, giving rise to spurious notes within the audio spectrum.

Suppressors need to be fitted, usually in the form of notch filters, to eradicate these continuous tones. Many tape recorders in the high quality bracket already have these. Regrettably, not all are as effective as they might be, and as stereo broadcasting increases, we shall find ourselves carrying out suppression experiments on all classes of equipment. Specifications for tuners and tuner-amplifiers take this into account.

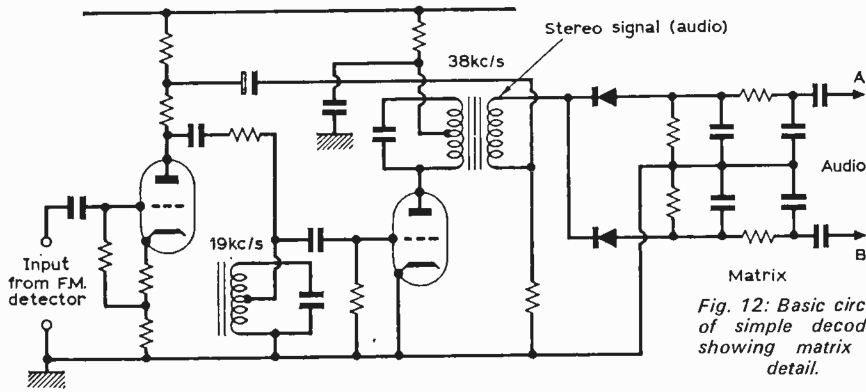


Fig. 12: Basic circuit of simple decoder, showing matrix in detail.

It should be remembered that not all f.m. tuners can be converted to stereo simply by the addition of a decoder. Although most foreign-made tuners already have decoders, because they were originally designed for use in countries where f.m. stereo broadcasting has been an accepted thing for many years, in the UK we find that manufacturers have geared production to demand and are only lately speeding up decoder production.

Cost of an additional decoder, including fitting, may put twenty pounds or so on the price of a tuner, and this factor should be considered when choosing. Again, some tuners will only accept the decoder designed by the same makers—unless one happens to be a handy constructor.

DIN recommendations relating to tuner-amplifiers are as follows: The standard is based on an aerial input of 1mV across 240Ω and an a.f. output 6dB below full volume except for distortion factor measurements.

Frequency range must be at least 40c/s to 12·5kc/s with permissible deviations (relative to 1kc/s) of ±4·5dB from 40 to 50c/s, ±3dB from 50c/s to 6·3kc/s and ±4·5dB from 6·3 to 12·5kc/s.

Channel balance must be not worse than 6dB from 250 to 6·3kc/s and not worse than 9dB when balance control is fitted giving an adjustment of at least 8dB.

PLEASE TURN TO PAGE 418

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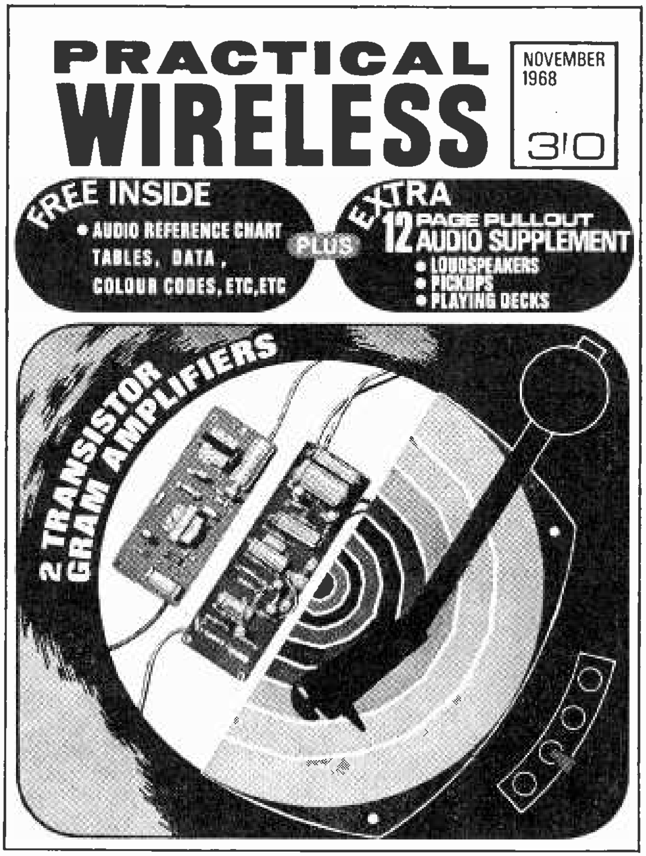

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—continued from page 416

Distortion should be less than 2·5% at 1kc/s with 40kc/s deviation—when the same signal is applied to each channel—with a power bandwidth of 40c/s to 12·5kc/s, the output correctly terminated.

Crosstalk: permissible figure is given as 24dB at 1kc/s, 18dB from 250c/s to 6·3kc/s and 14dB from 6·3 to 10kc/s.

Signal-to-noise ratio (unweighted) relative to 100mW (mono) and 2 × 50mW (stereo) from systems up to 20W output should be better than 40dB from 40c/s to 15kc/s with input of 1kc/s at 40kc/s deviation initially. Overall noise is given as better than 50dB for both mono and stereo systems between 40c/s and 15kc/s.

Pilot tone S/N ratio, when measured selectively at 19kc/s and 38kc/s should be equal to, or better than 19dB and 29dB respectively. This is with the input signal of 1kc/s deviated by 67·5kc/s and a level of 1mV into 240Ω.

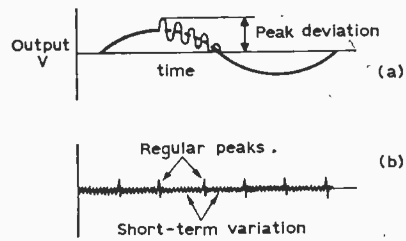

Fig. 13: (a) short-term flutter on a longer term wow may not be easily measureable by simply reading peak values: (b) pen recording showing the recurrent "pips" in waveform coinciding with mechanical vibrations in the tape transport.

TAPE RECORDERS

Here we introduce another factor into the hi-fi specifications—mechanical variations. Most readers will be familiar with the terms "Wow" and "Flutter", but a few words on the exact meaning of the terms may help to explain the specifications.

Speed variations take three forms: long-term stability, slow variations of the one to ten cycles per second periodicity and rapid variations that may extend well into the audio range. The effect of long-term speed variation may not be very noticeable, except on exchange of tapes or other methods of direct comparison, as pitch is the only thing affected to any extent, unless the variation is so severe as to be immediately audible.

Slow variations in the form of wow can be very obvious indeed, especially on piano and flute notes, where the speed variation causes pitch wobble of a quite distinctive nature. Our hearing mechanism is sensitive to this kind of change. As little as 0·15% is quite evident on piano notes around the mid-frequency region. In fact, the ear is a very good judge of wow, and instruments capable of making a comparable assessment are quite expensive pieces of laboratory equipment. The DIN recommendation for a combined wow and flutter content of less than 0·2% peak-to-peak would be too generous for most hi-fi enthusiasts.

But much depends on the basic speed of the tape transport. Wow is much worse at slower speeds. High quality recording is generally done nowadays at 7½in./sec., even though much pre-recorded material is available at 3¾in./sec. A wow and flutter figure of 0·15% should be regarded as the maximum at 3¾in./sec. for any sort of quality to be gained.

Flutter is the short-term variation, which can be caused by a number of small discrepancies in the tape transport system and pressure pad arrangement, and shows itself as a harshness much like the sound of intermodulation distortion in the amplifier. The two effects, though measurable separately are more often lumped together as overall speed variations, and, indeed, more than one authority is now doing this and using the blanket term "wobble".

Wobble may be measured as an r.m.s. value—sinewave signals being used for the test—or as a peak-to-peak value, which may be easier to understand, but can be misleading unless stated as such. Peak-to-peak values will be twice the peak value, and r.m.s. values are 0·707 or roughly two-thirds of peak value. It is therefore necessary to know, before buying, whether the wow and flutter figure was made under peak, peak-to-peak or r.m.s. conditions, and at what speed.

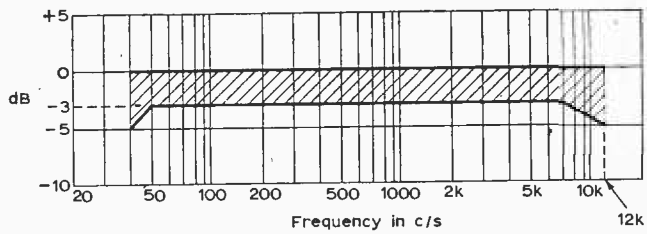

Fig. 14: Frequency response curve of amplified tape recorders are specified to fall within the tolerance limits shown

In the DIN specifications, variations between medium and average speeds over 30 seconds are not to exceed ±1%. Reproduction range of tape equipment should cover the 40 to 12·5kc/s range, with the response lying within the shaded area of Fig. 14. Full amplitude, measured at 333c/s is reached by a cubed distortion factor of 5%, at peak recording level, and the signal-to-noise ratio, referred to peak recording level should be better than 45dB.

For stereo machines, track separation should be 60dB and channel separation 25dB. Erasure should be 60dB below peak recording level.

Amplified tape recorders, i.e. decks with preamps, are given additional specifications. These may be summed up as the foregoing, plus:

Stereo crosstalk to be at least 24dB at 1kc/s and at least 21dB between 250 and 10,000 c/s. Signal/noise ratio better than 41dB (which is remarkably modest).

Output power is as for amplifiers, 10W mono and 2 × 6W stereo, the power to support a sinewave signal for at least 10 minutes (1kc/s).

Normal input and output sensitivities and impedances on tape recorders are much as amplifiers, except that a "line" output of 775mV at 100kΩ is becoming widely used and many variations of diode input between manufacturers—to match units of their own make—have rendered any standardisation impossible.

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OPTICAL COMMUNICATION

STUART GILLIES

OVER the years a large amount of material has been published in this magazine concerning optical communication systems. All of these systems have been concerned only with short range work, i.e. up to 30 yards or so using small lenses, and the writer decided to see what could be done about transmitting over longer distances. Two types of transmitter were tried: neon bulb and torch bulb. A third type will be tried some time in the near future using infra-red, obtained from a Gallium Arsenide electroluminescent diode, type CAY12. At present this is available from Mullard Ltd., but only through the trade.

Neon Transmitter

The circuit chosen for this unit was that published in the April 1967 edition of PRACTICAL WIRELESS and designed by H. L. Mason. This comprised a one valve two stage amplifier using an ECC82 valve. The anode load was a neon bulb plus current limiting resistor. The transmitter was built into a small aluminium case 4 × 4 × 3in. high which also housed the power unit. A co-axial socket was mounted on the top with the on-off switch and two wander plug sockets were mounted on the side for the neons. **WARNING:** High voltage is present at these sockets.

When the unit was being set up a small transistor multivibrator was used to provide a tone, but when speech was required a crystal microphone was used with a pre-amp. If the quality of the speech is of no concern then a carbon microphone plus battery and transformer could be used in which case the pre-amp would not be needed. The neon is capable of providing high quality sound and has a very good high frequency response. The current taken by the neon is about 2·5mA with no input, falling to about 750μA when fully modulated. The unit can provide power for up to four neons plus resistors in parallel, but it is difficult to use them all due to the small focal point of any reflector.

The reflectors used in the prototype were approx. 15in. in diameter and parabolic in shape. In theory a parabolic reflector will produce a parallel beam of light if a point source is placed at the focus. This was far from true in the reflectors used, but even so there was little to be gained from having more than one neon.

The neons were mounted in old discarded ball-pen tubes of the 'Biro' type. The ink tubes and end stops were removed, and the constriction at the end removed with a hack-saw. The neons used, made by MK, had a 270kΩ resistor soldered on to one lead, which was replaced by a 100kΩ ½W type. There is not much space available in the tube so this could profitably be replaced by two 47kΩ ¼W types in series. During this operation small pieces of sleeving were slipped on to the wires to insulate them. Two leads are then soldered on and the assembly mounted in the tube. If the unit is operated with no input then the resistor will run a little warm but this is nothing to worry about. The neon(s) were mounted at the focus of the reflector with standard laboratory type clamps and bosses.

Torch Bulb Transmitter

This unit used the amplifier from the neon transmitter with the neon replaced by an output transformer. A series resistor was also included to reduce the no signal current to below the limit for the valve. It was not considered worthwhile to change the bias on the valve because the author did not, at first, anticipate using the system for more than test purposes, and it worked well like this anyway. The output transformer was a small low power pentode type which was to hand. Most types should work in this circuit. Here again watch out for high voltages on the primary tags.

The bulb unit was the main beam part of a battery lantern. The connection between the centre pip on the bulb and the contact spring on the torch was broken by inserting a piece of p.v.c. tape, and two wires were soldered, one to each of the connections.

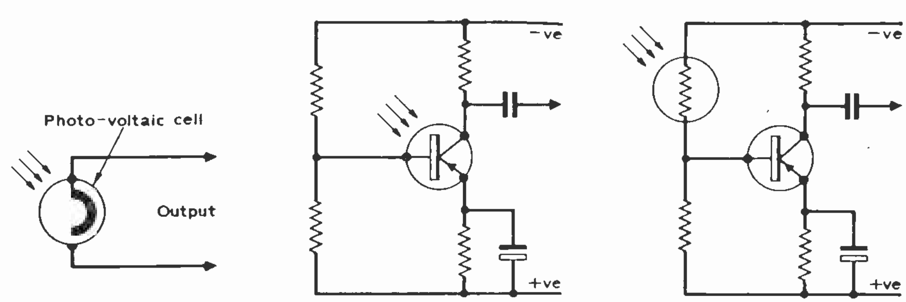

Fig. 1: Three of the receiver circuits tried by the author; (left) photo-voltaic cell, (centre) emitter follower transistor circuit and (right) phototransistor connected to a simple amplifier.

These wires were connected at the other end to the secondary of the transformer. As the lantern was powered by a six volt battery, the input did not fully modulate it. Even so the modulation could be seen, and the extra brightness helped to carry the signal.

The torch system is totally unsuitable for carrying music due to the very bad frequency response of the bulb (caused by the fact that it takes a finite time to heat up and cool down each cycle), but this does not matter where speech is concerned as intelligibility is the main requirement. The lantern gave a good beam which was only about 15 degrees across.

Reflectors

The most important link in the chain is the pair of reflectors or lenses used. Reflectors are to be preferred to lenses of the same diameter at the transmitter, as a larger solid angle is covered and thus a larger proportion of the light is collected and aimed at the receiver. There is no reason why a lens should not be used at the receiver, as it is only the area covered that is of importance, and a lens will probably have a better focal point than a reflector. The problem with lenses is that large ones are hard to come by, the best are probably those from old signal lamps. If reflectors are to be used then the best easily obtainable types are WD surplus searchlight reflectors, or those removed from a car headlamp.

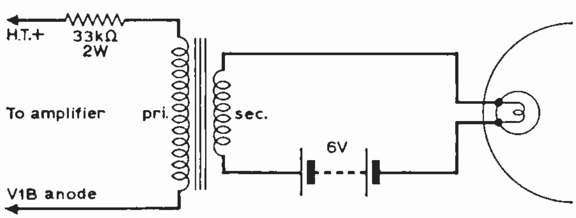

Fig. 2: Circuit of the torch bulb transmitter.

The Receiver

Several types of receiver were tried: photovoltaic cell connected across the input of an amplifier. This was not very sensitive and was discarded. Emitter follower circuit using a photo-resistive cell as part of the biasing network. This was fairly sensitive but was changed for experiment's sake to a phototransistor itself connected in a simple amplifier circuit. This was not found to be as sensitive as the final circuit chosen which was a battery, resistor, and photoconductive cell in series. When light falls on the cell its resistance decreases causing the current through it, and thus the resistor to increase. Thus the voltage drop across the resistor increases and the input signal is formed. The cell used was an OC71 transistor with the opaque paint removed, connected by the emitter and collector leads with the base left unconnected. A 3·3kΩ resistor was used with a 4·5 volt battery which passed a few milliamps through the cell, not enough to exceed the rating.

The input signal was fed to a pre-amplifier (Eagle type EM-3) and then to a Heathkit 10 watt amplifier. The battery used in the prototype to power the photo cell was separate from that used for the preamp, but no doubt the same one could be used.

When the system was assembled in the lab. the receiver was completely overloaded, producing distortion. In the case of the neon transmitter acoustic feedback occurred whenever the microphone was connected, even though it was thirty feet away from the loudspeaker. To prevent feedback the gain of the amplifier had to be turned right down. When the torch bulb transmitter was used feedback of the normal sort was avoided. Instead, a low pitched gurgle was produced.

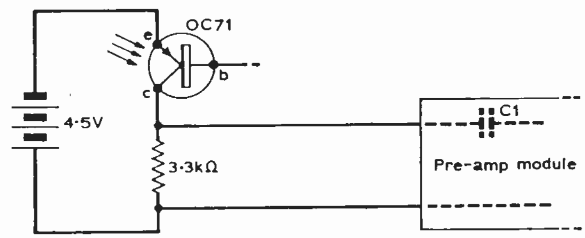

Fig. 3: Final receiver design used by the author.

The system was put into operation across a playground—a distance of about 75-80 yards, between a lab. and a workshop. The beam had to pass through two windows en route. When the neon was used it took some time to align the reflectors for optimum performance. This was due to the beam being red, and also spread over a large area of reflector. With the reflectors used it was possible to utilise about 2/3rds. of the area at any one time. The only efficient way to increase the power from this transmitter is to use more than one neon, each neon having its own reflector. As it was, plenty of power was available to operate a telephone handset. It was felt that this was the useful limit of the neon as regards distance.

With the bulb connected greater power was available at the receiver and the distance could be increased to 300 feet or more. It was found much easier to line up the receiver due to the beam being concentrated from a point source. To achieve the greatest distances the per cent modulation of the beam should be increased. ■

LETTERS...

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

Radio Eireann

In the June 1968 issue of PRACTICAL WIRELESS in "Your Questions Answered", a Mr. Browne of London, N.W.1, requested information *re* better reception of Radio Eireann on 530 metres.

As I am a regular listener of this station I feel that I can help Mr. Browne with his problem. Briefly, the effective improvement I use is to resonate a short indoor aerial to the desired frequency by means of a series inserted coil wound on a ferrite rod and placed beside the receiver, effecting coupling to the receive aerial.—**D. Walsh** (13 *Sixth Avenue, Chelmsford, Essex*).

P.O.P.

Reader's letter in issue No. 738, Postal Order Problem, J. Martin, Halifax. I had a postal order returned to me, so here is the procedure I carried out. I took the P.O. and the counterfoil to the office of issue. Postal order signed in the usual manner in the presence of the postmaster, money refunded. If unable to contact Post Office of issue, contact the Head Postmaster for instructions.—**J. Wright** (*Co. Durham*).

Things that go Bump

Re Mr. S. Pinder's letter "Your Questions Answered" headed Audio Thump.

I feel that his trouble does not lie in the power supply, as he suggested, but (assuming his amplifier has a transformerless output stage) in the loudspeaker decoupling capacitor.

The remedy in this case is to connect two large capacitors of similar value across the power supply, and to connect the speaker to the centre tap. This simple modification provides an artificial a.c. centre-tap across the supply lines, and has completely cured a similar problem in my own amplifiers.—**G. Fecitt** (*Lancs.*).

★ ★ ★

I have read this month's "Questions Answered" and I wish to offer a few words on the Audio Thump from S. Pinder.

This thump, has, I suppose, nothing whatever to do with the power supply in any way. Almost without exception transistor power amplifiers have this thump which occurs only when switched on after being off for some time. Most amplifiers are designed for class B and as such require a large capacitor to supply current of an opposite direction to the transistor that is on and discharges through the speaker. This capacitor has to fill up—this is done via the speaker hence the displacement, thump, when the supply is switched on. It does, however, fill up to half the supply voltage in a fraction of a second and should cause no concern.

For peace of mind this thump can be avoided by placing a similar value capacitor in position from the mid-point to the opposite supply side.—**R. King** (*Beds.*).

Solid State. That letter

I would like to take the opportunity to answer the query of Mr. W. J. Tomlinson, in the July edition of PRACTICAL WIRELESS, concerning the "solid state".

This term is of a somewhat nebulous nature to define. Strictly speaking, it applies to the group of substances known as solids, i.e., those substances which possess both definite volume and definite shape; in contrast to these are the substances known as fluids, which depend on their surroundings for their shape.

The study of substances in the solid state, a branch of physics, deals with the structure and properties of solids, and may be divided into three approximate groups. Firstly, the structure of solids, i.e., crystallography, the structure of metals, etc.; secondly, the natural phenomena exhibited by solids, i.e., specific heats, thermal and electrical conductivity, intrinsic semiconductivity, magnetic and dielectric properties, etc., and finally, the defects of solids, such as impurity semiconductivity, lattice defects, etc.

From this rather broad division, it will be seen that included are the substances known as semiconductors. It is to this small group of substances that the term "solid state" has been widely, though incorrectly, applied.

Thus, when Mr. Tomlinson notices the words "solid state" on a piece of electronic equipment, he will now realise this. I hope that these few remarks may prove useful in some way to the people concerned, if not to others.—**C. J. Gibbins, B.Sc.** (*Liverpool*).

S.W.L. Cards

I have just received a most disappointing B.C. verification card from the other side of the world, the result of many nights of patient listening

On the front, there is a photograph of a landscape which could just as well have been in Scotland, New Zealand or the USSR. The station name, along with the usual verification details is given on the back. This is only one of many I have received. Most S.W.L.s like to display their "catches" on the wall next to the receiver, and therefore prefer the station name, along with a simple design and/or station information to be shown on the front.

B.C. stations should bear in mind that the S.W.L. is primarily interested in the station and not in views of their country, which can be found in most school geography books anyway.—**R. Mitchell** (*Glasgow*).

Son of Instant Silence

Beginning to tire of large super sets and such like, I decided to return to something very simple, as the weather was hot. So I disinterred an old Tungstalite detector and made a crystal set. Result: utter and complete silence. So I then made a one diode and one transistor set. Result: the same only more so. This made me somewhat wild (reasonable—Ed.), so I set to and made up a two diode and two transistor set from a reliable "expert" design. I tried this out on a long garden aerial. Result: an intensified silence, far more so than the other silences had been.

So it's now to hell with transistors with me. I'm going to carry on with a sturdy little two valve set right away. You can always rely on a jolly good little stout two valver. — **A. Trowbridge** (*Middlesex*).

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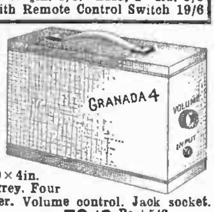

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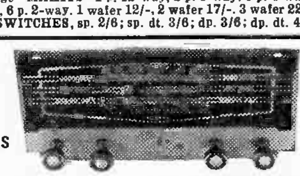

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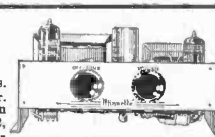

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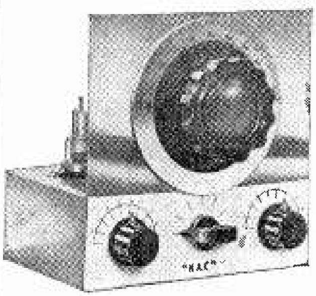

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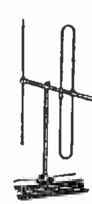

BBC (Band 1). Telescopic loft, 25/-. External S/D, 30/-. "H" £2.15.0. **ITV (Band 3).** 3 element loft array, 30/-. 5 element, 40/-. 7 element, 50/-. Wall mounting. 3 element, 47/6. 5 element, 52/6. **Combined BBC/ITV.** Loft 1+3, 40/-; 1+5, 50/-; 1+7, 60/-; Wall mounting 1+3, 57/6; 1+5, 67/6; Chimney 1+3, 67/6; 1+5, 75/-. **VHF** transistor pre-amps, 75/-.

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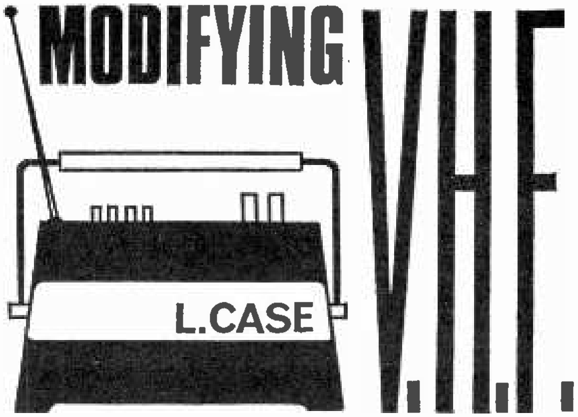


The author discusses a practical approach to a means of making a "standard" v.h.f. radio cover other segments of v.h.f. such as the aircraft and amateur bands.

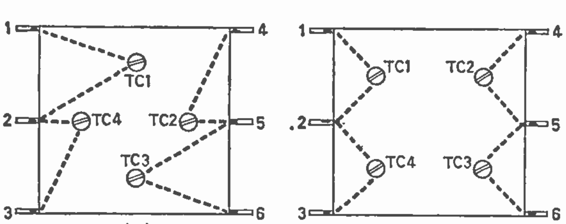
FOR quite a number of years now, requests, from PRACTICAL WIRELESS readers have appeared in these columns asking for various types of v.h.f. receivers covering frequencies outside the standard Band II allocation (88—108Mc/s). Many asked for a fully tuneable superhet type of receiver with a band coverage of say 60—170Mc/s, and although this is possible produces many design headaches as far as the switching of the signal frequency circuits is concerned. An admirable solution would be to utilise some form of turret tuner to switch the aerial, mixer and oscillator tuned circuits and feed the output into a standard 10·7Mc/s i.f./a.f. amplifier. Attempts were made to obtain v.h.f. coverage with a standard television receiver by altering the inductances of the biscuit tuning coils, employed in the turret tuner, and results obtained have been quite resonable only to be spoilt by the extremely wide sound channel i.f. bandwidth which can be up to 200kc/s wide. Consequently when tuning over a particular band of frequencies it was possible to receive two, or sometimes even three, stations at the same time at one particular frequency setting. For the reason stated above this approach was abandoned and other ideas were looked for.

FRESH APPROACH

Since the introduction, by the BBC, of v.h.f. local radio stations the v.h.f. Band II has been introduced to many more transistor portables and there has been quite a drop in the price of such items. On acquiring one of these sets, having medium wave, long wave and v.h.f./f.m. coverage, ideas on how to

Fig. 1 (above): Method of obtaining a small capacitive effect by twisting two insulated wires together.

Fig. 2 (below): Alternative trimmer layouts discussed in the text.



modify the set for other v.h.f. frequencies were sought after. The standard v.h.f. coverage was 88—108Mc/s and it was soon realised that by the addition of suitable values of capacity, wired in parallel with the aerial and oscillator tuning capacitors, the tuning could be brought down to cover the 80Mc/s commercial band. The first thought was to utilise small trimmers, having a maximum capacity of about 20—30pF, but the set was so compact and neatly built that there was not enough space for their inclusion.

WIRE CAPACITOR

A well known method of obtaining small values of capacity is by twisting together two lengths of insulated wire, the basic idea being shown in Fig. 1. The wire used can be standard insulated solid core tinned copper wire, adjustment of the capacity value being achieved by altering the length of the twisted wires. Two of these capacitors were prepared, each having a length of about 8 inches, and wired across the appropriate aerial and oscillator tuning capacitors. In order to discover which terminals on the tuning capacitor to use, the following procedure should be carried out. Tune to the local Radio 2 station (about 90Mc/s on the tuning dial) and, in turn, adjust each small trimmer screw on the back of the tuning capacitor. Two of these trimmers will control the v.h.f. coverage and the remaining two the m.w./l.w. coverage. If no difference is noted in the Radio 2 signal, on adjustment of a particular trimmer, then the trimmer should be returned to its original position. If, however, the signal decreases slowly in strength then this will be the v.h.f. aerial trimmer, and should be noted as such. If, on the other hand, the signal disappears completely on turning a particular trimmer only fractionally, then this will be the v.h.f. oscillator trimmer.

TRIMMER LAYOUTS

Figure 2a shows the four trimmers as mounted on the tuning capacitor and the appropriate terminals to use. Figure 2b shows another type of tuner layout very often used. If Tc1 is found to be the aerial trimmer then the capacitor should be wired across terminals 1 and 2. Similarly, if Tc4 was found to be the v.h.f. oscillator trimmer, then the remaining capacitor should be wired between terminals 2 and 3. The oscillator capacitor was next cut down to

—continued on page 433

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

WELL here we are in the autumn/spring transmission period which started on Sept. 1 and finishes on Nov. 3. During this period the conditions on 25 and 21Mc/s provide excellent DX during daylight and early evening hours, with again good signals from the Americas all hours of the day. So now here are the propagation conditions for the main circuits in the United Kingdom.

South Africa: 0800-1400 25, 21 and 17Mc/s; 1400-1600 25, 21, 17 and 15Mc/s; 1600-1800 25, 21, 17, 15, 11 and 9Mc/s; 1800-2000 21, 17, 15, 11, 9, 7 and 6Mc/s; 2000-2400 17, 15, 11, 9, 7, 6 and 5Mc/s; 2400-0200 15, 11, 9, 7, 6 and 5Mc/s; 0200-0400 11, 9, 7 and 6Mc/s; 0400-0600 15, 11, 9 and 7Mc/s; 0600-0800 21, 17 and 15Mc/s.

East Africa: 0800-1400 25, 21, 17 and 15Mc/s; 1400-1600 25, 21, 17, 15 and 11Mc/s; 1600-1800 25, 21, 17, 15, 11 and 9Mc/s; 1800-2000 21, 17, 15, 11, 9, 7 and 6Mc/s; 2000-2200 17, 15, 11, 9, 7, 6 and 5Mc/s; 2200-2400 15, 11, 9, 7, 6 and 5Mc/s; 2400-0200 11, 9, 7, 6 and 5Mc/s; 0200-0400 11, 9 and 7Mc/s; 0400-0600 15, 11 and 9Mc/s; 0600-0800 25, 21, 17, 15 and 11Mc/s.

South Asia: 0800-1200 25, 21, 17 and 15Mc/s; 1200-1400 25, 21, 17, 15 and 11Mc/s; 1400-1600 21, 17, 15, 11, 9 and 7Mc/s; 1600-1800 17, 15, 11, 9, 7, 6, 5 and 4Mc/s; 1800-2000 15, 11, 9, 7, 6, 5 and 4Mc/s; 2000-2400 11, 9, 7, 6, 5 and 4Mc/s; 2400-0200 9, 7, 6, 5 and 4Mc/s; 0200-0400 11, 9, 7 and 6Mc/s; 0400-0600 15, 11 and 9Mc/s, 0600-0800 21, 17, 15 and 11Mc/s.

North East Asia: 0800-1200 21, 17 and 15Mc/s; 1200-1400 17, 15 and 11Mc/s; 1400-1600 15 and 11Mc/s; 1600-2200 11 and 9Mc/s; 2200-2400 11Mc/s only; 2400-0400 circuit closed; 0400-0600 15 and 11Mc/s; 0600-0800 17 and 15Mc/s.

Australia via Asia: 0800-1000 25 and 21Mc/s; 1000-1200 21 and 17Mc/s; 1200-1400 17 and 15Mc/s; 1400-1600 17, 15 and 11Mc/s; 1600-1800 15, 11, 9 and 7Mc/s; 1800-2000 11, 9, 7 and 6Mc/s; 2000-2200 11, 9 and 7Mc/s; 2200-2400 11Mc/s only; 2400-0600 circuit closed; 0600-0800 21Mc/s only.

West Coast South America (North of Chile): 1200-1800 25 and 21Mc/s; 1800-2000 25, 21 and 17Mc/s; 2000-2200 21, 17 and 15Mc/s; 2200-2400 17, 15 and 11Mc/s; 2400-0200 15, 11 and 9Mc/s; 0200-0800 11 and 9Mc/s; 0800-1000 17, 15 and 11Mc/s; 1000-1200 17 and 15Mc/s.

During the last few weeks I have had letters from beginners to DX-ing asking me to list all the DX programmes that they can listen to, so here goes, The programmes listed here are only the ones beamed to Europe, I have put in the frequencies if they are given for the period Sept-Nov., otherwise I have not listed the frequencies.

Sundays: DX-ers calling, *R. Australia* 0730-0740 on 11,710, 9,560; World Radio Club, *BBC*, London 0930-0945 try 21Mc/s and 15,070; DX Window, *R. Denmark*, Copenhagen 1015-1035 on 9,520; DX-ing Worldwide, *R. New York Worldwide* 1930-1935 on 17 and 15; Finland's DX-Club Programme, Helsinki over *Finnish Broadcasting Co.* 1615-1630 on 15,185.

Mondays: World Radio Club, *BBC*, London 0245-0300 on 6,110; Swiss S.W. Merry Go Round, Berne 0730-0800 on 9,535, 6,165 and 3,985; Deutsche Welle DX-Programme 0915-0930 every 2nd Monday on 6,075; Swiss SW Merry Go Round, Berne 1200-1230 on 11,865 and 9,665; *R. Berlin* International DX-Club during 1730-1800, 2015-2045, 2200-2230 and 2300-2330; Deutsche Welle DX-Programme 1830-1845 every 2nd Monday on 6,075; Swiss S.W. Merry Go Round, Berne 2000-2030 on 9,665 and 11,865 or 6,015; Emissora Nacional, DX Club, Lisbon during 2045-2130 on 7,130 and 6,025; *R. Stn. HCJB*, Quito, DX-party line 2100-2130 on 17,880 and 15,325.

Tuesdays: Sweden Calling DX-ers, Stockholm 1120-1130 on 9,625; *Polish Radio* DX-programme every 1st Tuesday during 1830-1857 on 11,815 and 7,125; *R. Budapest* DX-programme during 2130-2230 on 11,910, 9,833, 7,220, 7100 and 3,995; *Polish Radio* DX-programme every 1st Tuesday during 2130-2155 on 11,815 and 7,125; Sweden calling DX-ers, Stockholm 2105-2115 on 6,065.

Wednesdays: *R. Stn HCJB*, Quito DX-party line 0930-1000 on 15,325; *R. Prague* DX-programme during 1200-1230 on 15,285, 11,960 and 9,560; 1630-1700 on 7,345 and 5,930, 1900-1930 on 7,345 and 5,930; *R. South Africa* DX-corner 1925-1935 on 17,790 and 15,245; *R. Bucharest* DX-programme during 1930-2030 and 2200-2300.

Thursdays: *R. Nederland* DX-jukebox 1442-1512 on 6,020; *BBC* World Radio Club 1245-1300 on 21Mc/s and 15,070; *R. Kiev* DX-club during 1900-1930 on 11 and 9Mc/s; *R. Nederland* DX-jukebox 1912-1942 on 6,020, 2012-2042 on 11,730 and 6,020.

Fridays: *R. Prague* DX-programme every 2nd and 4th during 0700-0755 on 9,575 and 6,055; Finland's Dx-Club programme over *R. Finland* 1815-1830 on 15,185; *R. Bucharest* DX-programme during 1930-2030 and 2200-2300; *Trans-World Radio* "DX-special" via Bonaire 2100-2115 on 15,245Mc/s; *R. Sofia* DX-programme during 1930-2000 and 2130-2200 on 9,660 and 6,070.

Saturdays: DX-special. *Trans-World Radio*, Monte Carlo 0610-0625 on 41,18; *Radio Canada* S.W. club, Montreal 0730-0740 on 9,625 and 5,990; *Radio Japan* DX-corner, Tokio 0825-0830 every 1st and 3rd on 21,535 and 17,825; *Radio Canada* S.W. club, Montreal 1235-1245 on 17,820; DXing Worldwide, *R New York Worldwide* 1730-1800 on 21,525 and 17,845; *R Budapest* DX-programme, during 2130-2230 on 11,910, 9,833, 7,220, 7,100 and 3,995; *Radio Canada* S.W. Club, Montreal 2123-2133 on 17,820, 15,320 and 11,720.

Deadline is the 15th September, so until next month 73's and good DX-ing.

WHATEVER happened to poor old 10 metres? I've listened, you've listened, but no one seemed to hear very much at all. The band seems to be getting worse and the openings are rarer and shorter. Anyone offer any theories as to why this should be so just at the time when 10 should be giving us some FB DX? It certainly can't be the gear or the individual since there is such a variety of receivers in use and a vast number of s.w.l's.

Most logs were the result of "easy" DX heard on 20 and 15 metres. Few ventured lower than 20, and only two logs arrived for 7 megs. How about only listening on 160-80-40 metres this month—go on, I dare you.

J. Baker (Lancs.) says that the 4A callsigns have been given to Mexican stations (normally XE) to commemorate the Olympic Games and may only be used for the period March 31st-December 31st 1968. The SK callsigns are issued only to Swedish club stations and SK6AB was heard to say that there are about 15 SK calls at present. Another callsign confusion comes from Indonesia, where there are now three sets—YB (500 watts), YC (75 watts) and YD (10 watts). Only the YB stations are permitted to work foreign stations. PK8's are legal but have to apply for new licences within the next year.

W. Mantovani (Yorks.) writes in with his solutions to queries raised in past pages. First, QQ7A claiming to be on Ganzo Island is definitely flying the Jolly Roger. IØARI is apparently a goodie. The correct call should read IØART and was heard April/May when it was the call of a special station in Florence at some obscure festival. Also reported was the arrival on topband of AC4AN (Tibet) on s.s.b. on July 2nd. The last AC4 I can recall which was heard on topband was found to be located in the Bermondsey area of London! Never mind, there's no cause for Alahma.

I hear that some of the gang from Leyton intend to set up a station at Harringay dog track! I've heard of DX hounds but this is ridiculous. Apparently they discovered that there is a nice fat pipe (or something conductive) which goes right round the entire track. With this as an earth, plus a good vertical, they hope to work some real DX. They also have their sights set on Fred (G3SVK) when he does his Channel Islands DX pedition.

LOW LOGS

One interesting suggestion this month is that local nets should take place on 40 metres with a 10-second pause between overs for any stations from further afield who would like to call in. This would keep the band inhabited and dissuade those nasty commercials from invading too. On the other hand, 40 metres is only 100kc/s wide for G stations. Anyone any views?

M. Pasek (Notts), QP166 into an HRO, 2-element fixed wire beam (inverted V's), hooked some FB DX on 40 metres s.s.b., including—HP1JC, PY2ENR, VK2ABZ, VK2AVA, VK2SA, VK3AHT, VK3HW (at 5 and 9 plus 10dB), VK3OZ, VK3ZL, YV1BI, YV1EL.

W. Mantovani (Yorks.), Ham-1, 600ft. long wire (cor, that's what I call a long wire), a.t.u. reports PAØBRM and EI2BG using s.s.b. on 160. On 80 s.s.b. the log reads—EI8BT/P, G3WMZ/5A, IZ6KDB (Ponza Island), W1DRS, W1EBC. Forty metres s.s.b. produced sigs from—CN8BV, DU2BU, EA4JV, EA6BG, LA2PH/MM (near Capetown), PY6NG, PY6WA, PY7ASM, PY7GAY, TA2BK, TJ1AL, TU2AK, UW3FA, VK3HW, YV1PW, YV2VO, 5A2MJC, and a 6O1AT who was suspected of being a pirate.

HIGH LOGS

Now we pass on to the lush DX pastures of 20 and 15 metres. Certainly no shortage of activity here.

M. Collins (Leeds), HE5O plus a 90ft end fed snuffed these out on 15 s.s.b.—CE1HU, CE2VX, CN8BV, CN8FV, CO2FM, CP6HI, CR6GM, EL3C, EP3AM, HC5BZ, HK4BFF, HK4BIW, KØFBL, K6EVR, KC4AM, KC4CA, KP4FA, KZ5BU, LU2OF, LX1RB, OA4OA, OA4ZI, OD5BZ, OX3DM, PJ5BE, PZ1BX, SVØWL, VEØAE, W7HRH, YV3KW, YV5CR, ZC4RB, ZD7KH, ZD8CC, ZD8NK, ZD8HAL, ZP3TW, ZS4AA, ZS6AD, 4U1ITU, 4Z4HE, 5H3KJ, 6W8CZ, 7Q7BN, 9G1GD, 9H1K, 9Q5DG, 9U5IV, 9X5AA.

G. Coomber (Essex), HRO-MX, dipole, 15 s.s.b. —CR6BF, EL2AK, ET3REL, HK5MO, JA1QWT, JA3APL, KP4AST, MP4MBB, LU9DM, PY2ARS, SV1BK, YV4QG, ZD8AB, ZP5JB, ZS2GF, 4Z4HF, 9G1FL, 9M2DQ, 9U5CR, 9V1OC.

G. Maitland (Isle of Wight), R107T, PCR30, 50ft end fed, logged these on 20 metres s.s.b.—CN8AW, CR6FC, CR7IC, EA8AV, EL2Z, EP2JP, FR7ZC, HS1HI, JA1CEU, K6JN/P, K6TXQ/MM, KA3TZN, KR6BD, LU2BU, MP4BEU, MP4TCE, TA2EL, TN8BRW, VK3AHF, VQ8AS, G5PP/P/W2, W6BMG, XW8AX, ZD8CC, ZL2EM, ZL3UY, 5V2TS, 9A1U/M, 9G1GD, 9K2BJ, 9M2BD.

A. Robnett (Herts.), CR7OA, PR30, 66ft. end fed, 14Mc/s s.s.b. — CR6DU, HS1MAG, HV3SJ, JAØADY, JX1BH, OA6MI, PY3BXW, SV1CB, TA2BK, VE1ASY, ZE5JU, 5H3JL, 9M2YC.

P. Leybourne (Glos.), HRO-M and Racal RA245, dipole, 20 s.s.b.—HB1AB, HC2CB, KØTXF/MM, KP4DAC, KZ5AA, LU6MJ, LU8KAE, MP4TCE, OA6RP, PY6NX, SVØWMM, TA2BK, UO6GR, VE2YA, VE3FIE, VK3MO, VK7RX, VP7DL, W5ZPD, XE1EW, YN1GBH, ZL4BO, 4A1MZ, 6Y5DW, 8R1F.

R. Dinning (Ayrshire), HA-350, dipole, logged these on 14Mc/s s.s.b.—AP6GGB, CP5DB, CR6GQ, FO8BY, FR7ZL, GC2LU, HV3SJ, KL7FBO, KV4FA, OH2AM/P/OHØ, PK1TH, TA2BK, UF6CR, UJ8AC, VK2SB, ZC4RB, 4A3AF, 4U1ITU, 5A1TK, 5H3JW, 5H4TH, 9Q5CR, 9Q5HS, plus countless W's.

CONTESTS

Unfortunately, the contests list for this month (September) was given last month, so you'll have to dig out your previous copy of P.W.—Sorry.

Please note that all logs should reach me by the 20th of each month. Those arriving later, no matter how good, are, unfortunately, just too late for publication in the current issue, and will be too out of date for the following one.

AN AUTOMATIC PARKING LIGHT SWITCH

D. LEWIS

THIS unit was designed and built to be used on a motorcycle having a small six volt battery, but it can also be used with a little modification on cars.

It would be convenient if the parking lights would switch on automatically, instead of somebody having to go out to turn the lights on when they are needed. If the parking lights are switched on when the vehicle is originally parked, there will be an unnecessary drain from the battery which may lead to difficulty in starting the engine or even ruining the battery due to excessive discharge. This unit was needed in particular for the author's motorcycle because the accumulator is rather small (14 A.H.) and there is no room for a larger battery.

As soon as it gets dark enough to need the parking lights, the automatic parking light switch will turn them on, and will not turn them off until daylight. The device is not affected by the headlamps of moving vehicles if a little sense is used when positioning the photoelectric cell.

CIRCUITRY

The light sensitive element is an ORP12 photoconductive cell—an ORP12 was used because the author had one conveniently at hand, and other cells might be cheaper and more effective, but the author has not tried any other types specifically intended for the purpose. However, an OC70 was tried for reasons of economy. The OC70 (or OC71 or any other transistor with a glass encapsulation) is prepared by scraping off the black paint and carefully filing a hole in the glass. The opaque jelly is then dissolved out using carbon tetrachloride (which incidentally is very useful for cleaning and degreasing variable condensers, resistors, switches etc) and the hole in the glass covered up to prevent contamination (covered by Sellotape). Like all semiconductors, these modified transistors are sensitive to light, but unfortunately the resistance in the dark (of the one OC70 tried) was too low, causing the lights to be permanently off, and also the sensitivity to light was inadequate for this particular application.

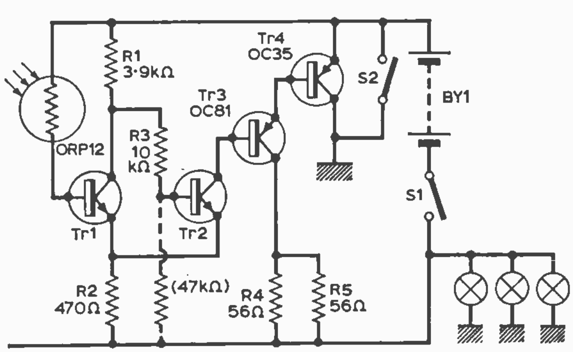


Fig. 1: Circuit diagram of the unit as built and tested by the author.

CONSIDERATIONS

A simple d.c. amplifier was first tried, but as expected, it was rather inelegant because the lights turned on slowly, causing rather excessive dissipation in the final stages of the amplifier and hence being perhaps rather apt to failure unless large transistors were used. Therefore it was decided to use a Schmitt trigger, which is in effect a d.c. amplifier with infinite gain, and therefore permanently overloaded in either of two states, viz Tr2 conducting (i.e. "on") or Tr1 conducting (i.e. "off").

This circuit solved the problem very neatly, the lights now being turned on suddenly when the ORP12 is dark enough. The consumption when the circuit is "off" is of the order to 5mA (depending on the amount of light), so that the drain on the battery is negligible, when the lights are off. The switch alone takes about 200mA (i.e. slightly more than the base current of the OC35) when "on" but this current is small compared with the current taken by the parking lights ($2\frac{1}{2}$A in the author's case).

OPERATION

The operation of the circuit is quite simple. Assume first that there is enough light on the ORP12 to keep the lights switched off. The ORP12 has a low resistance, causing increased base current in Tr1 and hence Tr1 is conducting heavily with a low voltage between its collector and emitter. This voltage is in fact too low to allow Tr2 to conduct, and therefore Tr3 and Tr4 cannot conduct either, since they have no base currents. (The effect of leakage is negligible). If the light on the ORP12 now gradually decreases, its resistance will rise until eventually the current through it is insufficient to maintain the collector current in Tr1. The collector current of Tr1 then starts to fall, causing the base-emitter voltage of Tr2 to rise and eventually Tr2 starts to conduct, making the common emitter voltage rise and hence reducing further the current in Tr1. Tr2 is now driven rapidly into full conduction and the current through it is multiplied by Tr3 and Tr4 to supply current to the lights. The 47kΩ

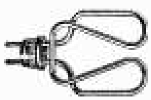
THERMOSTAT WITH PROBE

This has a sensor attached to a 15A switch by a 14in. length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at 12/6 each.

CAPSTAN DRIVEN TAPE RECORDER. Only £5/19/6.

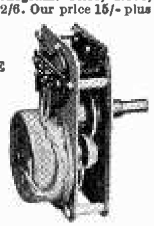
(Batteries extra) Portable with built-in microphone and loudspeaker using a 5 transistor amplifier with P.P. output. Operation by chargeable batteries. Tape capacity 25 mins. Tape position indicator. Recording level automatically preset. Inter-lock prevents unintentional erasures. Tape speed controlled by a flywheel driven capstan. Neat case with carrying handle, size approx. 6¼ x 7¼ x 2in. Postage and insurance 7/6.

KETTLE ELEMENT



230/240V 1500 watt. Made by Best for kettles with 1⁹/₁₆ in. dia. hole including: Best, Besco, Chalfont, Davidson, Dimplex, Grafton, Hawkins, Jurymaid, Mirroware, Monogram, Pifco, Revo, Towen, Swan. Normally 32/6. Our price 15/- plus 2/6 post.

GEARED MOTOR



HALF REV. PER MINUTE
Made by famous Smith Electric, mains operated and quite powerful. Size 3½ x 2½ x 1¼in. deep. Secondary use as process timer. Internal switch can be made to break circuit within a period up to 2 mins. 17/6. P. & P. 2/6 unless ordered with other goods.

Just arrived a similar geared motor but this has final speed of 16 r.p.m., 14/6 each.

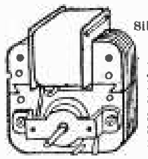
HI-FI BARGAIN

FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the 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 30-10,000c.p.s.—Input Impedance 15 ohms—Main resonance 60 c.p.s.—Input Impedance 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—¼in. diam. on pitch circle 11⅝in. diam.—Overall height 5¼in. A £6 speaker offered for only £3.9.6 plus 7/6 p. & p. Don't miss this offer.

DOOR INTERCOM

Know who is calling and speak to them without leaving bed, or chair. Outfit comprises microphone with call push button, connectors and master inter-com. Simply plugs together. Originally sold at £10. Special snip price 69/6, plus 3/6 postage.

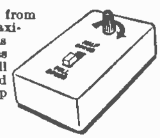
MOTOR BARGAIN



Silent running mains motor by very famous maker. Ideal for gramophone, tape recorder, fan, etc., etc. 200/250 volts AC., shaded pull start. Size approx. 2¾ x 2½ x 1⅝ins. 1,400 r.p.m. Spindle diameter ⁵/₃₂in. Spindle length ⅝in. Brand new, guaranteed. Price 9/6, Plus 3/- post.

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

DRILL CONTROLLER



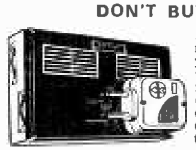
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. 19/6 plus 2/6 post and insurance. Or available made up 32/6, plus 2/6 post.

BARGAIN OF THE YEAR

MICRO-SONIC

7 transistor Key chain Radio in very pretty case, size 2⅜ x 2⅛ x 1⅛in.—complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5mv/m. Intermediate frequency: 465 Kc/s, or 455 Kc/s. Power output: 40mW, 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.

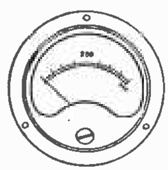
DON'T BUY ANOTHER BATTERY



Nickel Cadmium cells are rechargeable from the mains so if these replace the normal batteries in your radio and if you fit a battery charger to it—the radio will still remain portable but will in fact be mains operated. Our outfit comprises (1) full wave battery charger with high low switch (2) 9 volt (approx.) 120mA hour Battery stack, (3) full instructions for fitting. Price is 29/6 (less than regular price of battery stack) plus 2/6 post and insurance.

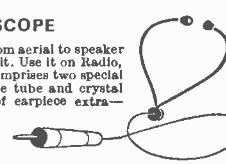
THIS MONTH'S SNIP

2½" MOVING COIL METER



Meters are always being needed and they are jolly costly when you have to buy them in a hurry. So it's sensible to take advantage of this offer: 2½in. (3" o.d.) flush mounting moving coil meters only 8/6 each. These are scaled 0-300mA but once the internal shunt is removed the f.s.d. is usually about 10mA so you can make it into almost anything by adding shunts or series resistors. These are ex. W.D. of course but are all new and unused. Price only 8/6 each plus 2/6 post. 12 or more post free.

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 stetoset instead of earpiece extra—post and ins., 2/9.

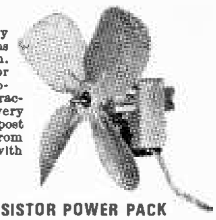
PROTECT VALUABLE DEVICES

Transistors, rectifiers, thyristors can be saved from thermal runaway by fitting this contact thermostat on the heatsink. As its name implies this will give control without being inserted, i.e. just strap it to the water tank (or hold it with magnets). Has dozens of applications, e.g. let the wife's smoothing iron or your soldering iron rest on it, will stop it from overheating whilst keeping it always at the ready. Fitted with calibrated dial for setting between 90°–190°F. or with dial removed range setting is between 80°–800°F. Price 10/-.

TANGENTIAL HEATER UNIT

Winter is coming but act today and you won't dismay. This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Units complete, wired ready to fit into cases, i.e. motor, impeller, 3 Kw. heater switching 1, 2 and 3 Kw, and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need on/off switch, 59/6. Postage and Insurance 6/6. Don't miss this.

AC FAN

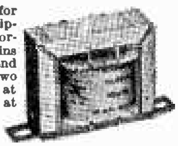


Small but very powerful mains motor with 6½in. blades. Ideal for cooling equipment or as extractor. Silent but very efficient. 17/6, post 4/6. Mounts from back or front with 4BA screws.

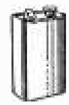
MAINS TRANSISTOR POWER PACK

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

MAINS TRANSFORMER SNIP

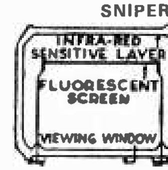


Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/40V) and isolated secondaries. Two types: (1) 12V 500mA at 9/6. (2) 15V 500mA at 10/5.



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

SNIPERSCOPE



Famous war-time "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. A golden opportunity for some interesting experiments. 7/6 each, post 2/6. Data will be supplied with cells, if requested.

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.

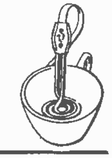
BLANKET SWITCH

Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element—new plastic case. 7/6 each.

FLUORESCENT CONTROL KITS

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

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. 12v. car model also available.

ELECTRONICS (CROYDON) LIMITED

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resistor shown dotted was not needed in the original, but it may be necessary with some transistor types (particularly if Tr1 and Tr2 are germanium). However, Tr1 and Tr2 were bought as unmarked, untested silicon transistors and were not selected, but they worked well. Two 2N2926's were at hand and these planar transistors were also tried with no apparent change in performance, as was expected because the Schmitt trigger circuit is very tolerant of transistor parameters. An OC35 was used only because it was the cheapest power transistor that the author could find. Its ratings are quite ample for this circuit (maximum collector voltage 32V, at Ic =6A, max. collector current 8A, max. dissipation 30W) and since it only dissipates about 1W it does not need a heat sink. In fact, in the prototype it was soldered directly to the Veroboard on which the circuit was built, the whole lot being wrapped up in ¼in. thick foam rubber and insulating tape (of the thick black variety) to protect the unit from vibration.

COMPONENTS

The component values are not critical. The two 56Ω resistors connected in parallel are to act as a 28Ω 1W resistor, as no 1W resistors were available in the junk box when this unit was built. The value of the resistor used in this position should be about 30Ω, but definitely not less than 25Ω or the ratings of the OC81 may be exceeded. Since the base current of the OC35 when turned on is about 200mA this unit will only switch a current of up to 4A using a typical OC35, though OC35s with a larger β than normal will naturally handle a greater current.

If the unit is used on a car (with a 12V battery), then the resistor R2 should be increased to 1·2KΩ with possibly some increase in the values of the other resistors. A relay will have to be used instead of the OC35. The relay is connected instead of the two 56Ω resistors and the OC35 is also omitted. This is because there must be a very good connection from the battery positive pole to "earth" because of the very large current taken by the starter motor.

PROTECTION

It is essential that the OC81 is protected when the power is switched off. As the current in the relay winding falls, a large voltage is developed across it and this would almost certainly damage the OC81 if this high-voltage pulse were not suppressed. This if done by means of a diode capable of carrying at least five times the relay current. This diode is connected across the relay windings so that it is reverse biased when the relay is energised.

As mentioned above the unit was built on a piece of Veroboard. This measured 2½ by 1½in. with holes 0·15in. apart. In the prototype the ORP12 was fitted on the board, but it was later decided to have it separate from the board to make it easier to put it in the best place. The ORP12 was also wrapped up in foam rubber and insulating tape, leaving the "element" exposed and about a foot of thin twin flex was used to connect the cell to the rest of the circuit.

CONCLUSION

It may be necessary to connect a resistor in parallel with the ORP12 in order that the lights go on at the right time. A few hundred kΩ would be a suitable value to try first.

The author's unit has easily repaid for the cost and time involved in building it and it has performed reliably since it was fitted to the motorcycle, in spite of the vibration and temperature.

MODIFYING V.H.F. PORTABLES

—continued from page 425

6½ inches in length, when it was possible to adjust the associated trimmer so that the Radio 2 transmission was just off the scale at the high frequency end of the band. Tuning back over the dial should now produce several of the higher powered or local commercial signals and one selected at the centre of the scale.

FINAL ADJUSTMENTS

The aerial capacitor was then cut to a length of 7½ inches and by adjustment of the aerial trimmer it was possible to peak the selected station for maximum volume. Once these adjustments have been carried out the two twisted wire capacitors should be placed parallel with the ferrite rod aerial along the receivers length and bent if necessary to facilitate the fitting of the receiver's back cover. Final adjustments to the trimmers can now be carried out for correct band coverage and maximum volume and the back cover replaced.

The coverage of the receiver will now be from about 70Mc/s to just below 90Mc/s, the 80Mc/s band taking up about ⅔rds. of the scale length. The number of stations heard will vary from area to area but if you live near a reasonably large town or city there will be no shortage of signals for you to monitor. If coverage is required below 70Mc/s or so then the addition of extra capacity across the tuning capacitor should make this possible. Initial adjustments could be carried out by temporarily fitting 3—30pF beehive trimmers, and then replacing them with miniature fixed capacitors of the appropriate estimated values.

COVERAGE

For coverage of frequencies above 110Mc/s or so, it will normally be necessary to remove a turn or two from the aerial and oscillator coils, depending upon the actual coverage required. This is not advisable unless the necessary test equipment is available. One particular receiver modified for reception over these higher frequencies luckily had a 20pF fixed capacitor wired across the v.h.f. tuning capacitors for normal Band II reception. Removal of these capacitors brought in the 144Mc/s Amateur Band at about mid-scale, the signals received being peaked for maximum strength by means of the v.h.f. aerial trimmer. Unfortunately, the sensitivity over the 2 metre band was rather poor, and allowed reception of only very local amateur transmissions. Matters could be improved, no doubt, by preceeding the receiver with a suitable transistorised 2 metre preamp or the set could be used, without the pre-amp as a 144Mc/s monitor for your own signals. ■

CQ de GB2LO

SUCCESS OF RSGB FESTIVAL AMATEUR STATION

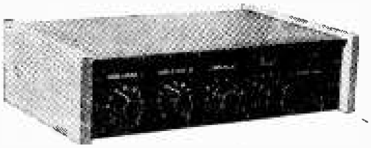
EVER seen an amateur station operating from the pavement of a city street? You would have, if you happened to have been passing the *Daily Mirror* building between July 8 and 20. As part of the City of London Festival, the Radio Society of Great Britain manned a special studio erected outside 33 Holborn by courtesy of the *Daily Mirror* who provided the facilities and bore the cost of the portable building.

The callsign of GB2LO was selected in honour of the famous 2LO which broadcast from Savoy Hill in the early 1920s. And another link with the past was the fact that the site of GB2LO was only about 200 yards from Hatton Garden where the pioneer London Wireless Club—the direct forerunner of the RSGB—held its meetings as far back as 1913.

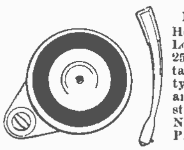
Through the glass panels of the station building, the general public were able to see amateur radio in operation and a P.A. system relayed both sides of QSO's to loudspeakers in the street. A team of about a dozen radio amateurs gave up their time to operate the station in relays and these included G2MI, G2OS, G3IUZ, G3UML, G5AAM and G6RC. During the run of the activity some 1,500 contacts were made with 108 countries, mostly on 'phone for obvious reasons. Schedules were maintained with the ARRL headquarters station W1AW and with the British Exhibition station VE3LON at London, Ontario. Most contacts were on 15 and 20m bands.

The station attracted considerable attention and also welcomed amateur radio enthusiast visitors from 30 countries. As a public relations operation the scheme was an outstanding success although it may be questioned whether the array of KW Electronics equipment conveyed the conventional "amateur" radio image! Also, by virtue of the rotatable 2-element cubical quad aerial 200ft. up aloft on top of the *Daily Mirror* building, coupled with the "exotic" callsign, it was not so much operating an amateur radio station as conducting a non-stop performance! We hope that Mr. General Public did not go home with the impression that amateur radio was as easy as (or simpler than) calling up Auntie on the GPO telephone! ■

TRANSISTOR STEREO 8 + 8 MK II



Now using Silicon Transistors in first five stages on each channel resulting in even lower noise level with improved sensitivity. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W. mono). Integrated pre-amp. with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work. Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Freq. response ±3dB. 20–20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 25V at ·6 amp.
PRICES: AMPLIFIER KIT £10.10.0; POWER PACK KIT £3.0.0; CABINET £3.0.0. All Post Free.
Circuit diagram, construction details and parts list (free with kit) 1/6. (S.A.E.).



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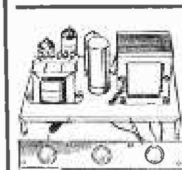
Set of Mullard 6 transistors OC44, 2—OC45, AC128D, matched pair AC128 **25/-**; Mullard LFH3 Audio Transistor Pack AC128D and matched pair AC128 **12/6**; ORP12 Cadmium Sulphide Cell **10/6**. All post free.



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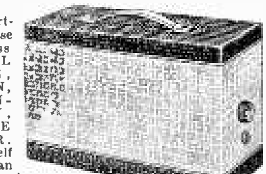

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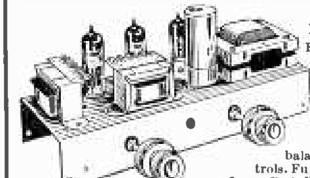

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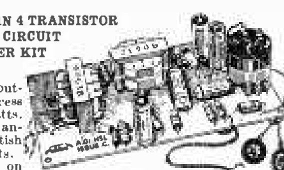

- Peak output in excess of 1½ watts.
- All standard British components.
- Built on printed circuit panel size 6 × 3in.
- Generous size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors (GET114 or 81 Mullard OC81D and matched pair of OC81 o/p).
- 9 volt operation.
- Everything supplied, wire, battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram **2/6** (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/-. P. & P. 3/-. Also ready built and tested, **52/6**. P. & P. 3/-.

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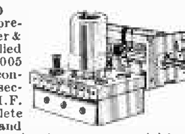

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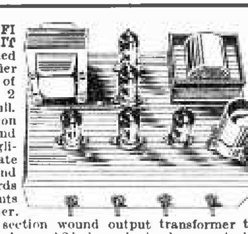
GORLER F.M. TUNER HEAD. 88–100 Mc/s. 10·7 Mc/s. I.F. **15/-** plus 2/6 P. & P. (ECC85 valves, **8/6** extra).

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **2/6** (Free with parts). **All parts sold separately. ONLY £7.9.6. P. & P. 8/6.** Also available ready built and tested complete with std. input sockets, **£9.5.0.** P. & P. 8/6.

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Re-activating MERCURY CELLS

BY L.B.STOTT

THE primary cell, by definition, is one which generates electricity, usually by chemical action, within itself. The secondary cell accepts electricity from an outside source, stores it, and gives it up as required.

It is usually assumed that there is a rigid line between the two, and that the primary cell cannot accept and store electrical energy from an outside source. Most dry cells in use are of the Leclanche type, and because of their reasonable price little attention has been paid to the possibility of prolonging their life by the supply of current from an outside source.

Such prolongation is, however, quite feasible and an article on the subject was published in the April 1961 issue of PRACTICAL WIRELESS. That article is still quite sound, but only refers to Leclanche cells.

COSTS

Lively interest in the subject has recently been aroused by the spectacular increase in the price of some mercury cells. These tiny cells, used in behind-the-ear and other miniature deaf aids were at the beginning of the year suddenly increased in price from 1s. 10d. to 2s. 9d. each, and this increase bears hardly on the users, many of whom are pensioners and persons living on fixed incomes.

The cells, in good condition, give a useful life of two or three days, and thus cost 1s. to 1s. 6d. a day to run. Many are not sold in good condition, and their useful life is accordingly shorter. Any re-activation which is possible is therefore well worth while. Re-activation is in one way a misleading term; the cells must not be allowed to run down very far before they receive attention, and the process is therefore one of keeping them in good condition over a longer period.

There is on the market at least one "charger", but the price is £1 18s. 6d., and to do the job effectively and conveniently at least two, and preferably more, "chargers" are required. This rules the commercial article out of the question for most people on grounds of cost.

D.I.Y.

Fortunately it is possible to make up simple "chargers" at very small cost, thus making the operation well worth while, as the effective life of the mercury cell can be at least doubled, and with care three or four times the ordinary life can be achieved. Two such "chargers" are described in this article.

It will be observed that the term "charger" has been used with inverted commas. It is, of course, quite incorrect. The correct term would probably be "re-activators" but for simplicity we will call them boosters.

The mercury cell should have a voltage when new of 1·4V, and has a reputed life of 35—40 milliamp-hours. The usual discharge rate is one to two milliamps an hour. The Leclanche cell has a voltage of 1·5V and quite a small cell can stand up to a continuous drain of 5 milliamps. At a discharge rate of one to two milliamps it will maintain its voltage of at least 1·5 for a considerable time, and this gives us the key to the design of our boosters.

CHARGING

The commercial "charger" uses two Ever Ready D14 cells (or equivalent) in series and thus has a voltage of 3; a 2,000 ohm resistor in series gives a charging rate of about 1·5 milliamps. The makers advise that the cells be used for 5 hours and then re-charged for 7 hours. It will be seen from this that more than one "charger" is required to maintain three cells (a day's supply at 5 hours each) in good condition.

The voltage used is rather high and if the time is substantially exceeded the cell may be damaged.

If a single Leclanche cell is used the time may be exceeded with impunity. Under these conditions a current of approximately 1mA flows from the Leclanche to the mercury cell. Typical conditions are as follows:

	At the outset	After 7 hours
Voltage of Leclanche cell	1·5	1·48
Voltage of partly discharged mercury cell	1·2	1·4

After 7 hours the voltage of the two in parallel remains steady at about 1·45 volts and the current ceases to flow. On separating the two the voltage of the Leclanche cell quickly returns to 1·5 and the other drops to 1·4.

CELL CONDITION

One important condition must be observed: it is no use trying to re-activate a nearly exhausted cell; the newer the cell the more efficient the result. The best plan is to bring three cells into use and to have two in boosters and one in the deaf aid. Four cells with three boosters is even better. The writer has five boosters in use and cannot remember when last he bought a packet of six mercury cells; it is certainly more than three months ago. The Leclanche cells have been replaced twice; it is important to have them in good condition, and showing as high a voltage as possible.

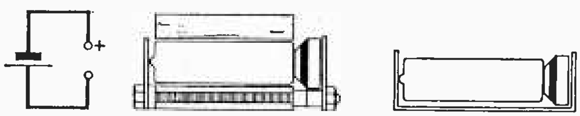
The nominal voltage of the mercury cell is 1·4, but it can drop to 1·25 and still give an effective output. It is better not to let it go any lower. These voltages should be measured on a 1,000 o.p.v. meter if possible. The indication will then be the voltage on load.

CONSTRUCTION

The author has two "boosters" and they are essentially identical. The circuit of one is shown in Fig. 1 and is the simplest ever published.

The larger of the two boosters is more suitable for use by an inexperienced person and it will be described first.

The body is a wooden bobbin approximately 2in. long with a central hole $\frac{9}{16}$in. in diameter. The bobbin used in the prototype was originally the core of a roll of paper tape, but another source of material could be the core from a reel of copper wire with the cheeks removed. The central hole must be opened out to a diameter of $\frac{9}{16}$in. so that the D14 cell slides easily into it.



Figs. 1, 2 and 3 indicate graphically the simple ideas outlined in the main text.

An additional smaller hole about $\frac{3}{32}$in. in diameter is drilled parallel with the larger one, and into this is inserted a length of 6BA studding or a long bolt if available; this should be a tight fit in the hole. On the ends of the 6BA studding are bolted two strips of springy brass, one close to the bobbin and the other fitted with spacers at a distance to ensure that the mercury cell is kept in firm contact with the Leclanche cell. The construction is shown in Fig. 2.

The only critical measurements are those specified.

ALTERNATIVE

The other booster, although it could not possibly be simpler, is equally efficient, but it requires greater care in use; if the mercury cell is inserted the wrong way round it would be ruined.

It consists of nothing more than a strip of hard brass with the two ends bent at right angles. The original was made from brass strip $\frac{1}{4}$in. wide and $\frac{1}{16}$in. thick, but these measurements may be varied according to what is available. It is essential, however, that the inside measurement should be exact, and to take a D14 cell with a 657 mercury cell the measurement should be $2\frac{1}{8}$in. If the distance is slightly exceeded matters can be adjusted by soldering a washer on one, or if need be on both, ends. The cells must be inserted in the booster as shown in Fig. 3.

It will be observed that a positive "earth" has been adopted. The outside of the Leclanche cell, being shrouded by the zinc negative pole, a negative "earth" is more usual. The mercury cell is, however, shrouded by the positive pole, and if the frame of the booster were negative, the positive pole of the mercury cell could easily come into contact with it and this would run down the cell.

The Leclanche cell is fixed to the frame by means of Sellotape, care being taken to ensure firm contact between the positive pole and the frame. The mercury cell is inserted between the negative pole of the Leclanche cell and the frame, care being taken to observe the correct polarity.

The voltage of the Leclanche cell should be checked frequently under load conditions, to ensure that the voltage appreciably exceeds 1·4 volts.

CONCLUSIONS

Both types of booster have been given an extensive field trial by elderly people who are probably below average in mechanical aptitude. Although it cannot by any means be claimed that the devices are foolproof no serious difficulties were encountered. Perhaps the consciousness that a mistake would cost 2s. 9d. was salutory.

These users were all anxious to know how they could be sure that the devices were operating correctly. Provided reasonably fresh "pen cells" were used they could be assured they were not at fault. It was found useful to show them how to test with a 3V bulb and to note the condition of the cell by the intensity of the glow. If the pen cells were in good condition the users could easily judge the condition of the mercury cells which, if faulty, would be found to be satisfactory for a few minutes and thereafter rapidly fade away. After a further period on charge, to ensure that a mistake had not been made, the mercury cells would be rejected if they became ineffective within a short period.

The pen cells lasted for about a month, and six mercury cells, using each cell in turn for four hours and leaving all the others in boosters, lasted two months, and some cases longer. ■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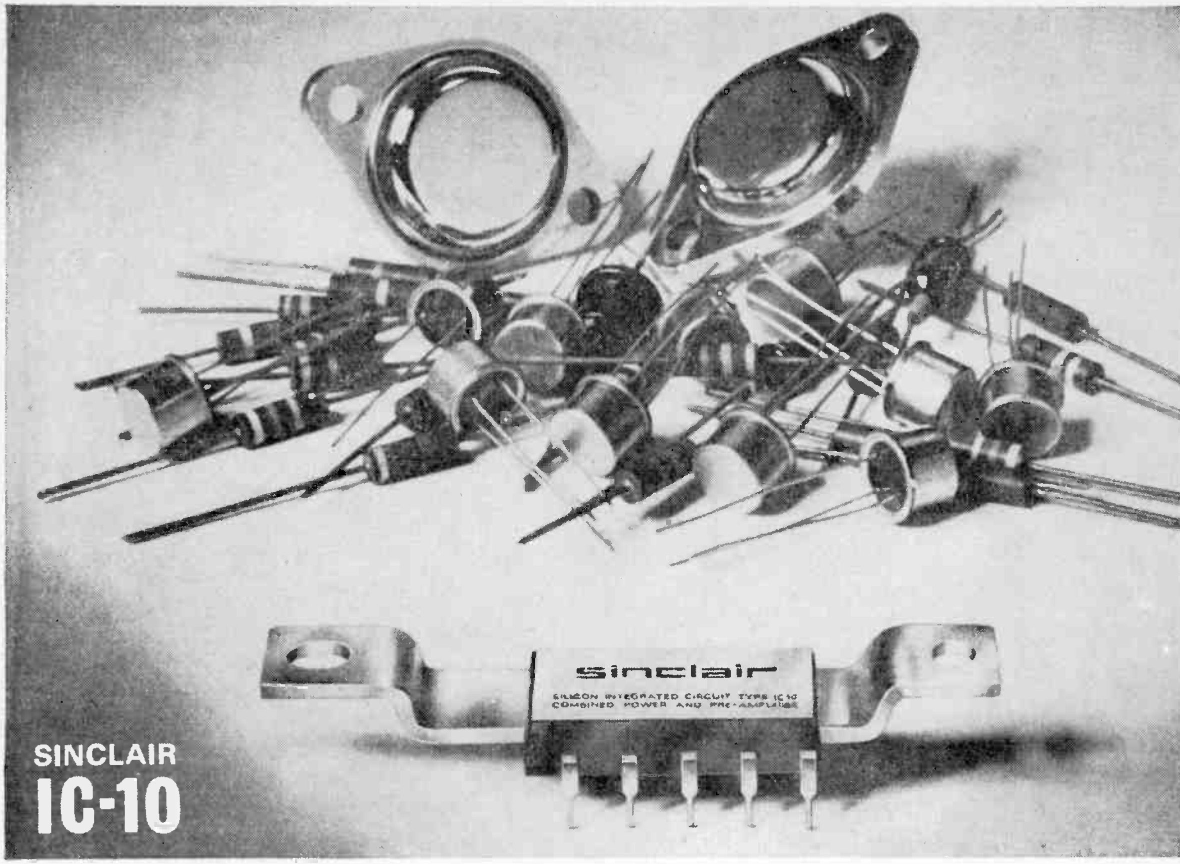
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10 WATT MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER

Specifications

Power Output	10 Watts peak, 5 Watts R.M.S. continuous.
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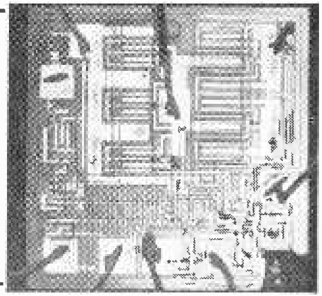
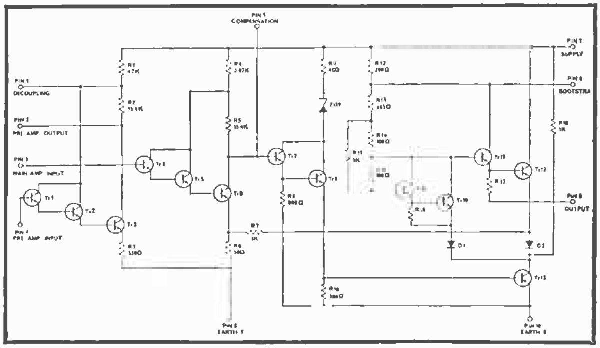
Total harmonic distortion	Less than 1% at full output.
Load impedance	3 to 15 ohms.
Power gain	110dB (100,000,000,000 times) total.
Supply voltage	8 to 18 volts.
Size	1 x 0.4 x 0.2 inches.
Sensitivity	5 mV.
Input impedance	Adjustable externally up to 2.5 M ohms for above sensitivity.

■

ABOVE SHOWS ACTUAL SIZE OF IC-10.
TO RIGHT, VIEW OF AMPLIFIER MAGNIFIED 625 TIMES.





Circuit Description

The circuit diagram of the IC-10 is shown on the right. The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. The output stage operates in class AB with closely controlled quiescent current which is independent of temperature. A high level of overall negative feedback is used round both sections and the amplifier is completely free from cross-over distortion at all supply voltages. Thus battery operation is eminently satisfactory.

Construction

The monolithic I.C. chip is bonded onto a gold plated area on the heat sink bar which runs through the package. Wires are then welded between the I.C. and the tops of the pins which are also gold plated in this region. Finally the complete assembly is encapsulated in solid plastic which completely protects the circuit. The final device is so rugged that it can be dropped thirty feet on to concrete without any effect on performance. The circuit will also work perfectly at all temperatures from well below zero to above the boiling point of water.

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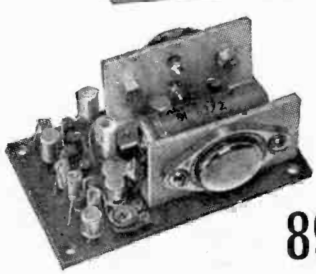

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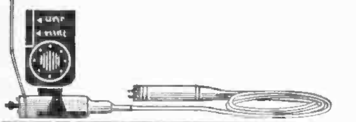

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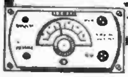

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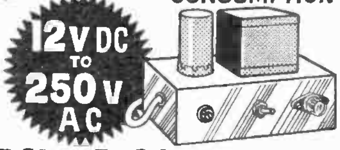

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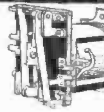

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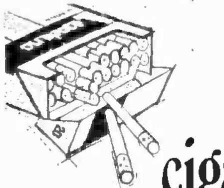

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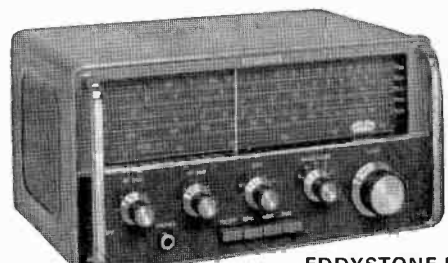

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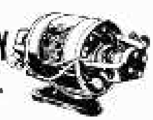

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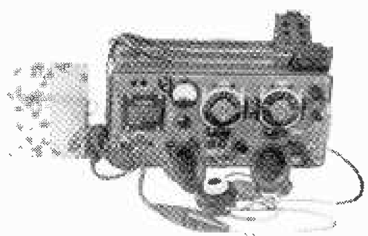

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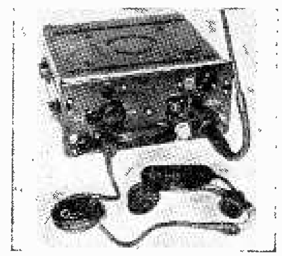

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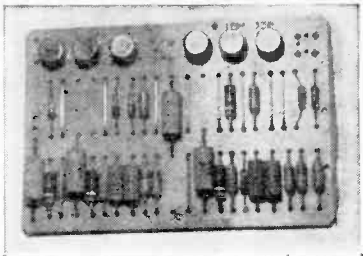

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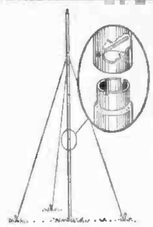

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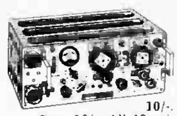

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PRACTICAL WIRELESS, OCTOBER 1968

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