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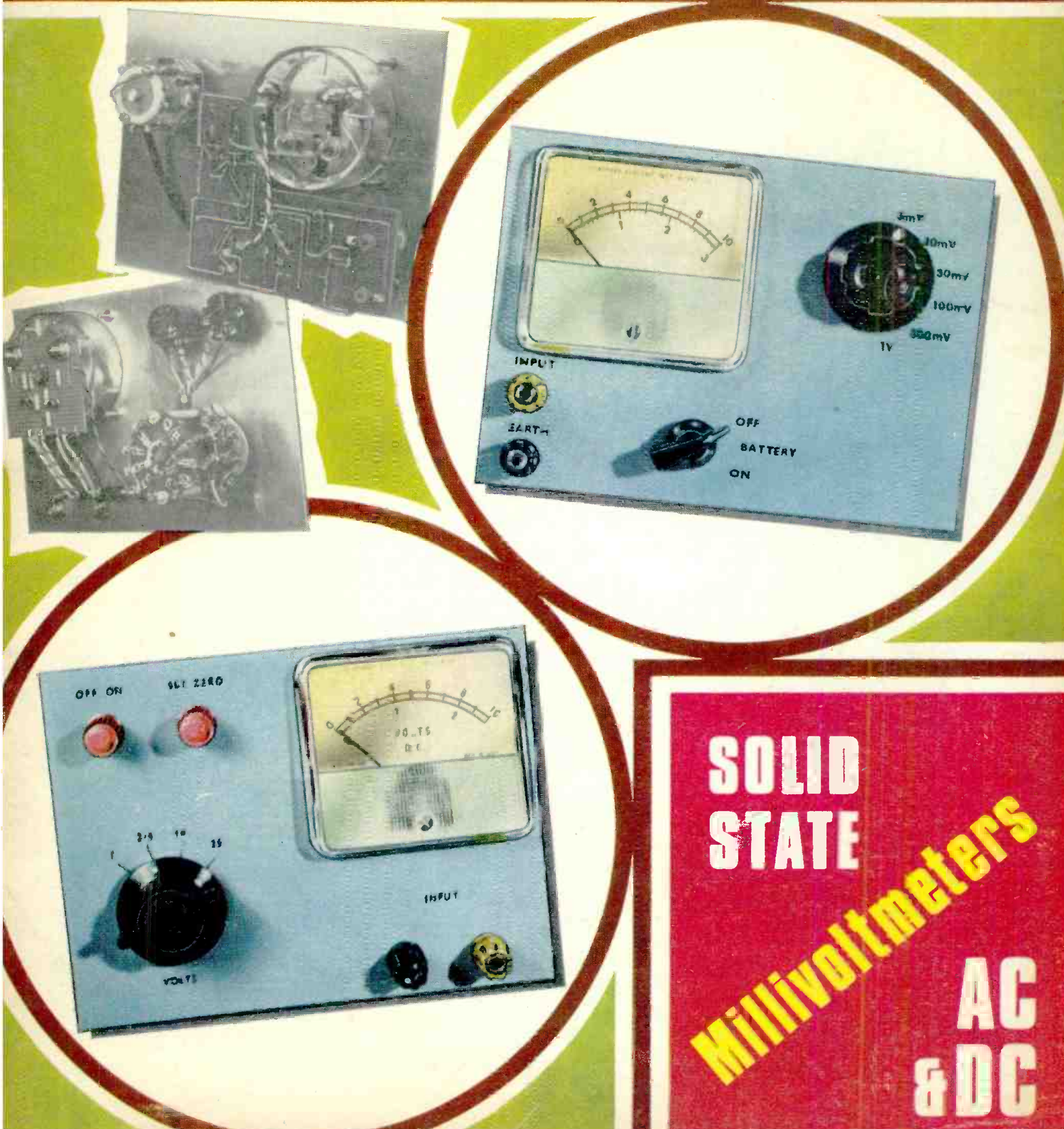

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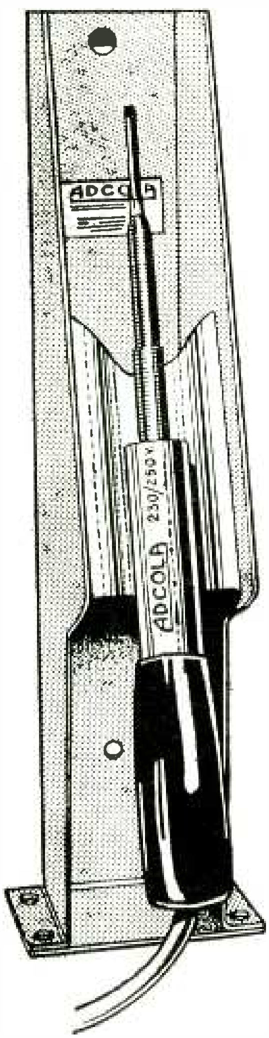

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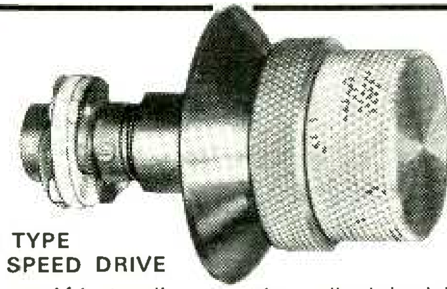

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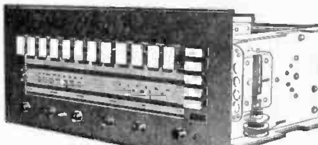

Model T10E—made for U.K. use by famous North American manufacturer and originally installed in De Luxe Hi-Fi consoles costing several hundred pounds. The chassis is of outstanding appearance and quality and offers many unique features plus an extremely comprehensive specification.

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Tech. spec.: Output 10 watts RMS per channel: output imp. 8Ω p.c.; sensitivity 50mV for 8W output at 1 Kc.; input imp. 100 KΩ p.c.; 12 unique tumbler type function controls, 8 push button wavechange and station selection controls, vol., bass, treble and balance controls, push button contour (loudness) control; illuminated tuning scale; AM ranges: MW 520-1640 Kc/s, LW 140-290 Kc/s, Continental TR 170-345 Kc/s; FM range 88-108 Mc/s with switched AFC. Operates on 200/250V A.C., 50 or 60 c/s. Size 17½ x 8 x 12in.

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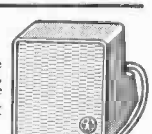

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4in. Triple play, 900ft. Mylar	17	6	7in. Standard play, 1200ft. Acet.	12	6
5in. Double play, 1200ft. Mylar	15	0	7in. Standard play, 1200ft. Mylar	12	6
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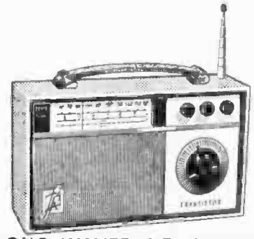

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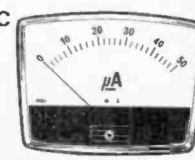

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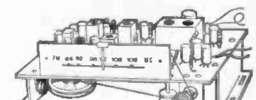
TRANSISTOR FM TUNER CHASSIS



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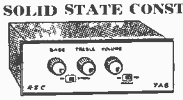
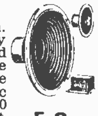
RSC TA6 6 WATT HIGH FIDELITY TRANSISTORISED AMPLIFIER
SOLID STATE CONSTRUCTION



200-250v. AC mains operated
Frequency Response 30-20,000 cps —2dB. Harmonic Distortion 0.3% at 1,000 cps. 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 5¼ins. Attractive brushed silver facia plate 10¼ x 3¼ins. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6 **6 Gns.**
Or factory built with 12 mths. guarantee £7.19.11.

AUDIOTRINE HIGH FIDELITY SPEAKER SYSTEMS



Consisting of matched 12in. 12,000 line, 15 ohm high quality speaker; cross-over unit and Tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating. Or Senior 20 watt inc. Fane 122/10 speaker 7 Gns. Carr. 8/9. **5 Gns.** Carr. 6/9

Tweeters R.A. 3 ohm or 15 ohm 25/9

HI-FI CATALOGUE AVAILABLE 4/6. Personal shoppers welcome. Open all day Sats. except High Holborn branch.

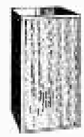
ALL LEADING MAKES of HI-FI EQUIPMENT STOCKED Cash or Terms
Full range Hi-Fi Furniture

HI-FI LOUDSPEAKER ENCLOSURES
All types of pleasing modern design acoustically lined and ported and beautifully finished in light Teak or Walnut veneer. Credit terms available
JE8. Size 20 x 11 x 8in. Gives pleasing results with any 8in. Hi-Fi speaker. **£4.19.9** Carr. 7/6

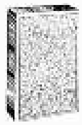
SE8. For optimum performance with any Hi-Fi 8in. speaker. Size 22 x 15 x 9in. Carr. 7/6 **£5.19.9**
SE10. For 10in. Hi-Fi Speaker with provision for tweeter. Size 24 x 15 x 10in. Carr. 10/- **£6.19.9**
SE12. For outstanding performance with any 12in. Hi-Fi speaker. Cut for tweeter. Size 25 x 16 x 10½in. **8 Gns.** Carr. 10/-

NEW RANGE OF LINEAR HI-FI AMPLIFIERS IN STOCK

HIGH FIDELITY LOUDSPEAKER UNITS
Cabinets of latest styling Satin Teak or Walnut, acoustically lined (and ported where appropriate). Credit Terms available on all units.
The FULTON Size 11 x 14 x 7ins. Fitted Volume Control. Ideal as sensitive ext. unit for Tape Recorder etc. Incorporates Audiotrine HF810 8in. speaker with cast chassis and treated cone surround. Response 45-13,000 cps. Rating 8 watts. Imp. 3-8-15 ohms. Carr. 7/6 **£5.15.0**



The DORSET Size 22 x 11 x 8in. Response 45-18,000 c.p.s. Rating 10 watts. Fitted Audiotrine HF811D speaker. Impedance 3 or 15 ohms. Carr. 9/6 **£8.19.9**
The DORCHESTER Size 24 x 15 x 10in. Fitted Audiotrine HF101D Speaker. Rating 12 watts. Impedance 3 or 15 ohms. Frequency Response 30-20,000 c.p.s. Carr. 15/- **12½ Gns.**
The 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. Carr. 15/-. **12½ Gns.**

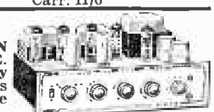


The BRONTE Size 22 x 15 x 9in. Fitted Wharfedale Super 8 RSDD or Audiotrine HF 815D Speaker, with Roll surround and dual cone. Rating 6/10 watts. Impedance 3 or 15 ohms. Carr. 16/6. **13 Gns.**

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER

A complete set of parts for the construction of a unit giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Provision is made for use as straight (monaural) 10 watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point to point wiring diagrams and instructions supplied. Send S.A.E. for leaflet.
Or supplied factory assembled with 12 months' guarantee for 11 gns. **£8.15.0**
Terms: Dep. 36/- and 9 monthly payments 25/5 (Total £13.4.9). Carr. 11/6

R.S.C. STEREO/20 HIGH FIDELITY AMPLIFIER



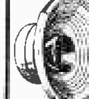
PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE" GRAM., RADIO OR TAPE. Employing valves ECC83, ECC83, ECL86, ECL86, ECL86, ECL86, EZ81. Frequency Response: ±2dB 30-20,000 c.p.s. Hum Level: 65dB down. Sensitivity: 5 millivolts maximum. Harmonic Distortion: (each channel): 0.2%. ★Four-position tone compensation and Input Selector Switch. ★Stereo/Mono switch. ★Will amplify direct from Tape Heads. ★Neon panel indicator. ★Handsome Perspex Frontplate. ★Separate Bass "Lift" and "Cut" and treble "Lift" and "Cut" controls. Output transformers are high-quality sectionally wound to required specification. Output matching for 3 and 15 ohm spkrs on each channel. Complete set of parts, point-to-point wiring diagrams and instructions. **14 Gns.**
Or factory assembled, tested and supplied with our usual 12 months guarantee. **19 Gns.**
Or Deposit £3 and 9 monthly payments 43/2 (Total £22.8.6). *Send S.A.E. for leaflet.* Carr 12/6

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

Total cost of parts with detailed wiring diagrams and instructions. Carr. 10/- **12½ Gns.**
Or factory built 15½ Gns. Or in Teak finished cabinet as illustrated 19½ Gns. Terms: Deposit £5 and 9 monthly payments 39/-. Total £22.11.0.

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

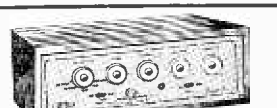
AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS
Heavy cast construction.
Latest high efficiency ceramic magnets Dual Cone for extended frequency range. Plastic treated surround giving low fundamental resonance. Response 40-18,000 c.p.s., Impedance 3 or 15 ohms. Post free.



HF810D	8in. 8 watt	£3.19.9
HF811D	8in. 10 watt	£4.19.9
HF101D	10in. 12 watt	£5.15.0
HF100D	10in. 15 watt	6 Gns.
HF120D	12in. 12 watt	£4.15.0
HF121D	12in. 20 watt	£6.15.0
HF127D	12in. 30 watt	9 Gns.

R.S.C. SUPER 15 HI-FI AMPLIFIER
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.
Maximum instantaneous Peak power output 28 watts.
SOLID STATE CONSTRUCTION
LATEST MULLARD TRANSISTORS. AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2.5mV. Radio/Aux or Ceramic P.U. 110mV.
FREQUENCY RESPONSE: ±2db 20-20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10 Kc/s.
BASS CONTROL: +12dB to —15dB at 50 c/s. HUM LEVEL: —75dB.
HARMONIC DISTORTION at 10 Watts R.M.S. 1 000 c.p.s. 0.25%.
NEGATIVE FEEDBACK: 52dB.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **11½ Gns.**
Supplied factory built 15½ Gns. Carr. 12/6. Terms: Deposit 49/- and 9 monthly payments 35/- (Total £18.4.0). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated, 4 Gns. extra.
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

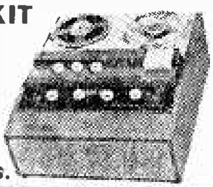
TECHNICAL SPECIFICATIONS COMPARE MORE THAN FAVOURABLY with SIMILAR AMPLIFIERS AT TWICE THE COST



R.S.C. SUPER 30 STEREO AMPLIFIER
A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Close tolerance Ganged Pots. Matched Components.
CROSS TALK: —52dB at 1,000 c.p.s.
CONTROLS: 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/- **19 Gns.**
Unit factory built 26½ Gns. or deposit 83/9 and 9 monthly payments 59/3. (Total £30.17.0). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £4.15.6 and 9 monthly paymts 67/- (Total £34.18.6). *Send S.A.E. for leaflet*

LONDON-NEWCASTLE-GLASGOW
New branches now open—see addresses

AUDIOTRINE HI-FI TAPE RECORDER KIT



REALISM AT INCREDIBLY LOW COST: CAN BE ASSEMBLED IN AN HOUR. ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS. S.A.E. for leaflet.
Incorporating the latest Magnavox Tapedeck. The Audiotrine High Quality Tape Amplifier with switched equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a handsome Portable Cabinet of latest styling finished dark grey leathercloth. Size 14½ x 17 x 8½in. and circuit. Purchased separately would total approx. £34. Performance equal to units in the £50-£60 class. Deposit 4 gns. and 9 mthly paymts 59/6 (Total 29½ gns.) **26½ Gns.**
4 Track Model 3 gns. extra. Carr. 19/6

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

R.S.C. 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 practically all "mikes". Separate Bass and Treble controls giving "lift" and "cut". Hum level 71dB down. Negative Feedback 15dB. Reserve power supply 300v 25 m.a., 6.3v. 1.5a. for Radio Tuner or Tape Pre-amp. For A.C. mains 200-250v. Speaker output 3 ohms. Complete in every detail with fully punched enamelled chassis, point-to-point wiring diagrams and instructions. Or assembled ready for use 8 gns. plus 5/9 carr. **£4.17.9**

TAPE AMPLIFIERS 4-5 Watts output
200-250v. Mains A.C. Suitable for use with Magnavox 363 Decks. Switched equalisation. Originally 13 Gns. **£6.19.11**

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 available. Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Specially designed sectionally wound ultra linear output transformer with 807 output valves. 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 fully punched chassis, point-to-point wiring diagrams and instructions. **12 Gns.** Carr. 12/6
Supplied factory built with EL34 output valves. 12 months guarantee for 15 gns. If required perforated cover with carrying handles can be supplied for 21/-. Send s.a.e. for leaflet.
TERMS: Deposit 48/- and 9 monthly payments of 33/7 (Total £17.10.3).

LOUDSPEAKER CORNER CONSOLE CABINETS
Attractive design. With polished walnut finish. Model M for 10" speaker Size 28 x 19 x 12in. **59/11** Model S for 12" speaker and tweeter. Size 31½ x 22½ x 14in. **5 Gns.**

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

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP Two input sockets with associated controls allow mixing of "mike" and gram. etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, EZ81. High quality sectionally wound output transformer and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. Frequency response ±3dB 30-20,000c/s. Six negative feedback loops. Hum level —60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s all types "mikes". Comparable with the very best designs. For Musical Instruments such as String Bass, Electronic Guitars, etc. Reserve Power 300v. 30mA. and 6.3v. 1.5a. for Radio Tuner or Tape Pre-Amp. Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohm speakers. Full instructions and point-to-point wiring diagrams (or factory built £11.15.0). Metal cover with 2 handles available for 21/-. TERMS ON ASSEMBLED UNITS: Deposit 36/6 and 9 monthly payments of 25/9 (Total £13.8.3). **£8.15.0** Carr. 11/6
Send S.A.E. for leaflet.

R.S.C. A11T TRANSISTORISED VERSION
of above Complete Kit **9 Gns.** Carr. 9/6

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

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape, and general public address.
★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 12in. 30 watt unit PLUS a FANE 12in. 20 watt unit with extended frequency response. ★ 4 Jack Inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes".
★ Cabinets covered in two-tone Rexine/Vynair with gold trimming. Fitted carrying handles. ★ Separate Bass and Treble Controls giving "lift" and "cut".
49½ Gns. Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass-Regent with units at three times the cost.
Carr. 30/- Or deposit £7.17.6 and 9 monthly payments of £5.10.10. (Total 55 gns.)

B20 MULTI-PURPOSE AMPLIFIER especially suitable for Bass Guitar
Incorporating massive 15in. high flux loudspeaker. Rating 25 watts. Individual bass and treble controls. Two jack inputs separately controlled. Substantial cabinet attractively finished in Rexine and Vynair. Size approx. 24 x 21 x 11in. Send S.A.E. for leaflet. Or Deposit £4.14.6 and 9 monthly payments of 66/-. (Total £34.8.6). Carr. 17/6. **29½ Gns.**

G15 15 WATT AMPLIFIER for Lead or Rhythm Guitar, Vocal Groups, etc.

High-fidelity output. Separate bass and treble controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Heavy Duty 12in. 20 watt Speaker. Cabinet covered in attractive Rexine/Vynair. Size 18 x 18 x 8in. Deposit 3 gns. **19½ Gns.** Carr. 15/- and 9 monthly payments of 43/7 (Total £22.15.3). S.A.E. for leaflet

G80 80 WATT AMPLIFIER
2 Channels, 6 inputs. Tremolo. 2 Columns and 1 Bass Speaker unit with two 15in. Heavy Duty Speakers. **99 Gns.** Carr. £3

R.S.C. BATTERY/MAINS CONVERSION UNITS

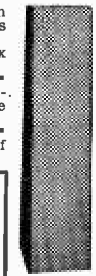
Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 47/9 or ready for use 59/11.

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.

HEAVY DUTY SELENIUM RECTIFIERS
12v. 15 amps, F.W. (Bridged). Only **19/9**

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. COLUMN SPEAKERS

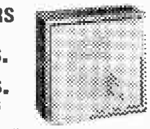


Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. 15 ohm matching.
Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. Or deposit 44/- and 9 mthly pmts 34/9 (Total £18.1.6) **15 Gns.** Carr. 10/-.
Type C412, 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/- **22 Gns.** Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0).

30 WATT HI-FI AMPLIFIER for Guitar, Vocal or Instrumental Group

A 4 Input, 2 volume control Hi-Fi unit with Separate Bass and Treble controls. Latest valves. Strong Rexine covered cabinet with carrying handles. Attractive black/gold perspex facia. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. **17 Gns.** Carr. 12/6 Deposit £3 and 9 monthly payments of 37/5 (Total £19.16.9).

12in. HIGH QUALITY L'SPEAKERS



In teak veneered cabinets.
10 Watt Model. Gauss 12,000 lines. 3 or 15 ohms. Carr. 7/6 **5 Gns.**
20 Watt Model. 15 ohm. Size 18x18x10in. Gauss 12,000 lines. **8 Gns.**
Rexine covered £1 extra. Carr. 10/6
Terms available on both.

FANE HEAVY DUTY HI-FI SPEAKERS
122/10A Dual Cone. 12in. 20 watt. 15 ohms. Frequency range 40 to 18,000 c.p.s. Carr. 5/9 **£5.11.9**

LOUDSPEAKERS
Limited number at fraction of list price 15 ohms impedance. Brand new, guaranteed. Terms available.
12in. HEAVY DUTY 30 watts £7.19.9 Carr. 10/- Normally £13 approx.
15in. EXTRA HEAVY DUTY 40 watts **12 GNS.** Carr. 15/-
Massive units. Gauss 17,000 lines. Usually app. £19.

HIGH FIDELITY 12in. 10 WATT SPEAKERS **59/11**
Flux Density 12,000 lines Impedance 3 or 15 ohms.

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

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

JASON VHF/FM TUNER
Complete kit with valves. **£6.19.11**

INTEREST CHARGES REFUNDED
on H.P. and Credit Sale Accounts settled in 3 months.

MOVING COIL AMMETERS **8/9**
Sangamo thermo-couple type 0-3.5a. Dia. 2½in. Each

R.S.C. MAINS TRANSFORMERS
FULLY GUARANTEED. Interleaved and Impregnated. Primaries 200-250v. 50c/s. Screened.

MIDGET CLAMPED TYPE 2½ × 2½ × 2½in.

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 fully shrouded	55/9

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

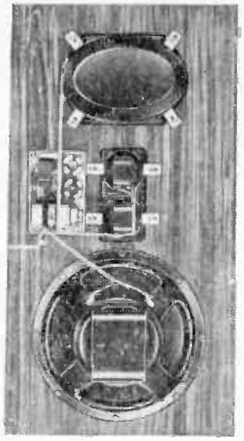
R·S·C HI-FI CENTRES LTD.

Peerless

HI-FI BAFFLE SPEAKER SYSTEMS FOR MONO OR STEREO

The new Peerless systems are engineered to the high quality standards that have made Peerless pre-eminent in high-fidelity design over the past years. Our experience, together with the most careful selection of materials and strictest manufacturing controls, assure performance of highest quality.

All the speaker systems are mounted and wired on a front board covered with plastic fabric grille and ready for cabinet mounting.
Available in 4Ω, 8Ω or 16Ω impedance.



4-30 PABS

4-30 PABS (also available as KIT, see below).
Is a 3-way speaker system consisting of 4 speakers and crossover network.
Max. Power Input: 30 Watts.
Frequency Range: 30-18000 c.p.s. in 50 litres (1.75 cu. ft.) cabinet.
Speakers: Woofer D 120 W special. Mid Range O 570 MRC.
Tweeters 2 × MT 25 HFC.
Crossover Frequencies: 500 and 3500 c.p.s.
Dimensions (inside) for 50 litres cabinet: Approximately $24\frac{13}{16} \times 13\frac{3}{8} \times 9\frac{1}{4}$in. (630 × 340 × 234 mm).
Brown coloured plastic fabric grille.

2-8 PABS (also available as KIT, see below).
is a 2-way speaker system consisting of 2 speakers and crossover network.
Max. Power Input: 8 Watts.
Frequency Range: 50-18000 c.p.s. in 16 litres (0.57 cu. ft.) cabinet.
Speakers: Woofer B 65 W. Tweeter MT 25 HFC.
Crossover Frequency: 4000 c.p.s.
Dimensions (inside) for 16 litres cabinet: Approximately $15\frac{9}{16} \times 9\frac{5}{8} \times 6\frac{1}{2}$In. (395 × 245 × 165 mm).
Specify grey or golden coloured plastic fabric grille.

2-10 PABS (not available as KIT).
is a 2-way speaker system consisting of 2 speakers and crossover network.
Max. Power Input: 10 Watts.
Frequency Range: 50-18000 c.p.s. in 6.5 litres (0.23 cu. ft.) cabinet.
Speakers: Woofer O 525 WL. Tweeter MT 20 HFC.
Crossover Frequency: 3500 c.p.s.
Dimensions (inside) for $6\frac{1}{2}$ litres cabinet: Approximately $9\frac{15}{16} \times 6\frac{1}{4} \times 6\frac{9}{16}$in. (252 × 158 × 167 mm).
Dark coloured plastic fabric grille.

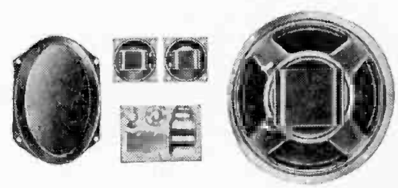
3-15 PABS (also available as KIT, see below).
is a 3-way speaker system consisting of 3 speakers and crossover network.
Max. Power Input: 15 Watts.
Frequency Range: 45-18000 c.p.s. in 30 litres (1.06 cu. ft.) cabinet.
Speakers: Woofer P 825 W. Mid Range GT 50 MRC. Tweeter MT 20 HFC.
Crossover Frequencies: 750 and 4000 c.p.s.
Dimensions (inside) for 30 litres cabinet: Approximately $20\frac{1}{4} \times 8\frac{5}{8} \times 10\frac{5}{8}$in. (515 × 218 × 270 mm).
Specify grey or golden coloured plastic fabric grille.

3-25 PABS (also available as KIT, see below).
is a 3-way speaker system consisting of 3 speakers and crossover network.
Max. Power Input: 25 Watts.
Frequency Range: 40-18000 c.p.s. in 100 litres (3.5 cu. ft.) cabinet.
Speakers: Woofer CM 120 W. Mid Range G 50 MRC. Tweeter MT 20 HFC.
Crossover Frequencies: 750 and 4000 c.p.s.
Dimensions (inside) for 100 litres cabinet: Approximately $25 \times 15 \times 16\frac{1}{4}$in. (635 × 380 × 412 mm).
Specify grey or golden coloured plastic fabric grille.

Peerless

LOUDSPEAKER SYSTEMS IN KITS FOR MONO AND STEREO

If you want to spend a little extra time to establish your high-fidelity sound system and at the same time save money, you can get four of our PABS systems in KITS. A KIT system consists of speakers, crossover network, drawing of cabinet as well as mounting instruction, but without baffle.
Available in 4Ω, 8Ω or 16Ω impedance.

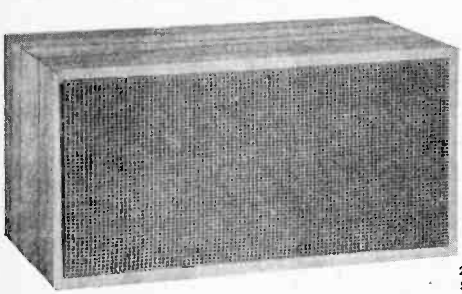


4-30 KIT

Peerless

HI-FI CABINET SPEAKERS FOR MONO AND STEREO

A trio of 2-way and 3-way compact speaker systems in oiled teak cabinets of bookshelf type, Danish design and technique at its very best.
Available in 4Ω, 8Ω or 16Ω impedance.



2-10A MEDIUM SIZE SYSTEM

2-10 COMPACT SYSTEM

is a 2-way speaker system in cabinet with dark coloured plastic fabric grille. Combines one special woofer ($5\frac{1}{4}$in.), one closed-back tweeter (2in.) and a crossover network. Crossover Frequency: 3500 c.p.s. Frequency Range: 50-18000 c.p.s. Power Capacity: 10 Watts. Cabinet Size: $10\frac{1}{4} \times 6\frac{3}{16} \times 8\frac{3}{8}$in. (260 × 156 × 213 mm).

2-10A MEDIUM SIZE SYSTEM

Is a 2-way speaker system in cabinet with brown coloured plastic fabric grille. Combines one special woofer ($6\frac{1}{2} \times 10\frac{1}{4}$in. elliptical), one closed-back tweeter ($2\frac{1}{2}$in.) and a crossover network. Crossover Frequency: 3500 c.p.s. Frequency Range: 40-18000 c.p.s. Power Capacity: 10 Watts. Cabinet Size: $19\frac{3}{4} \times 9\frac{7}{8} \times 10\frac{5}{8}$in. (500 × 250 × 270 mm).

4-30 MONITOR SYSTEM

is a 3-way speaker system in cabinet with brown coloured plastic fabric grille. Combines one special woofer (12in.). one special mid range (5 × 7in. elliptical), two closed-back tweeters ($2\frac{1}{2}$in.) and a crossover network. Crossover Frequencies: 500 and 3500 c.p.s. Frequency Range: 30-18000 c.p.s. Power Capacity: 30 Watts. Cabinet Size: $25\frac{9}{16} \times 14\frac{3}{16} \times 11\frac{7}{8}$in. (650 × 360 × 300 mm).

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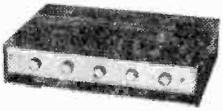
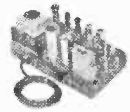
HI-FI AMPLIFIERS — TUNERS — RECORD PLAYERS

20+20 STEREO AMP. AA-22U



GARRARD PLAYER AT-60

10W POWER AMP. MA-12



9+9W STEREO AMP. S-99

TRANSISTOR MIXER. MODEL TM-1. Four channels. Battery operated. Kit **£11.16.6.** Assembled **£16.17.6**

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

GARRARD AUTO/RECORD PLAYER. Model AT-60, less cartridge **£14.12.10.** With Decca Deram pick-up **£19.7.4** incl. P.T.

LOW-COST MONO AMPLIFIER. Model MA-5. 5W. Built in pre-amp. Inputs for Gram, Radio. Separate bass, treble, volume controls. Easy printed circuit construction. Modern functional appearance. **Kit £11.9.6. Assembled £15.15.0**

HI-FI MONO AMPLIFIER. Model MA-12. 10W output, wide freq. range, low distortion. Use with control units. Models UMC-1 (Mono) or USC-1 (Stereo). Kit **£12.18.0** Assembled **£16.18.0**

CONTROL UNITS. Mono, UMC-1. Kit **£9.2.6.** Assembled **£14.2.6.** Stereo, USC-1. Kit **£19.19.0.** Assembled **£27.5.0.**

DE LUXE STEREO AMPLIFIER. Model S-33H. 3 + 3W output. Three stereo inputs . . . ceramic/crystal pickup, radio tuner and aux. Separate bass, treble, volume and balance controls. Easy printed circuit construction. Attractive styling. Kit **£15.17.6** Assembled **£21.7.6**

HI-FI STEREO AMPLIFIER. Model S-99. 9 + 9W output. Ganged controls. Stereo/Mono gram, radio and tape inputs. Push-button selection. Printed circuit construction. Matches FM-4U and AFM-1 tuners in styling. Kit **£28.9.6** Assembled **£38.9.6**

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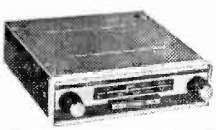
HIGH PERFORMANCE CAR RADIO CR-1



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

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

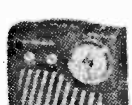
Kit (less spkr.) £12.17.0 incl. P.T. (6″ x 4″ LS £1.4.5 extra).

RADIOS

Oxford

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

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



UXR-1

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

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

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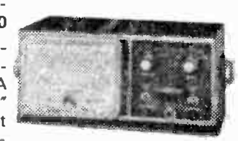
5″ GEN.-PURPOSE OSCILLOSCOPE. Model 10-12U. An outstanding model with professional specification and styling. "Y" band width 3c/s-4·5 Mc/s ± 3dB. T/B 10 c/s-500 kc/s. Kit **£35.17.6.** Assembled **£45.15.0**



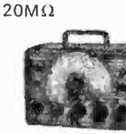
VVM, 1M-13U

DE LUXE LARGE-SCALE VALVE VOLTMETER. Model 1M-13U. Circuit and specification based on the well-known model V-7A but with many worth-while refinements, 6″ Ernest Turner meter. Unique gimbal bracket allows operation of instrument in many positions. Modern styling. Kit **£18.18.0** Assembled **£26.18.0**

V-7A

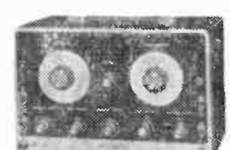
VALVE VOLTMETER. Model V-7A. 7 voltage ranges d.c. volts to 1,500 A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0·1Ω to 1,000MΩ with internal battery. D.C. input resistance 11MΩ. dB measurement, has centre-zero scale. Complete with test prods, leads and standardising battery. Kit **£13.18.6**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

MULTIMETER. Model MM-1U. Ranges 0–1·5V to 1,500V a.c. and d.c; 150μA to 15A d.c.; 0·2Ω to 20MΩ 4½″ 50μA meter. Kit **£12.18.0** Assembled **£18.11.6**



RF-1U

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



HFW-1

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

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

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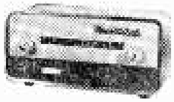
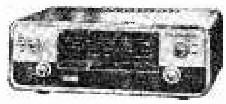
VALVE TUNERS



TUNERS
←FM
AM/FM→



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

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

★ Models available in two units for your convenience.

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

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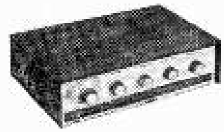
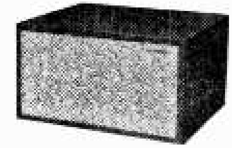


STEREO AMPLIFIER, TS-23



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

Good performance from a Mini speaker with the **'AVON' BOOKSHELF SPEAKER SYSTEM.** Occupies the minimum space consistent with first class reproduction. Only $7\frac{3}{4}$" x $13\frac{1}{4}$" x $8\frac{3}{8}$" deep. Two special speakers $6\frac{1}{2}$" BASS, $3\frac{3}{8}$" HF unit and crossover network. Kit **£4.18.0** incl. P.T. Walnut veneered, Fully finished cabinet, kit **£8.18.0.**
TOTAL PRICE KIT **£13.16.0** incl. P.T.

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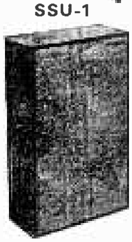
SPEAKER SYSTEMS

SSU-1



Berkeley

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

The **BERKELEY SLIM-LINE SPEAKER SYSTEM,** fully finished walnut veneered cabinet for faster construction. Special 12" bass unit and 4" mid/high frequency unit. Range 30-17,000 c/s. Size 26" x 17" only $7\frac{3}{8}$" deep. Modern attractive styling. Excellent value.
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MFS: Size 36" x $16\frac{1}{2}$" x 14" deep.
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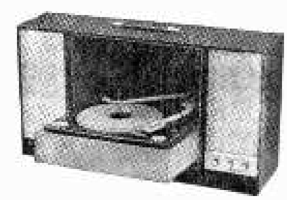
Automatic playing of 16, 33, 45 and 78 rpm records. All transistor—cool instant operation. Dual LP/78 stylus. Plays mono or stereo records. Suitcase portability. Detachable speaker enclosure for best stereo effect. Two 8in. x 5in. special loudspeakers. For 220-250v ac mains operation. Overall cabinet size $15\frac{9}{16}$ x $3\frac{7}{8}$ x $10\frac{1}{4}$in.



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

KIT £27.15.0 Assembled price on request.

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

AMATEUR BANDS RECEIVER Model RA-1. To cover all the Amateur Bands from 160-10 metres. Many special features, including: half-lattice crystal filter; 8 valves; signal strength "S" meter; tuned R.F. Amp. stage.
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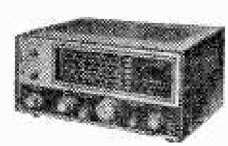
160-10M TRANSMITTER. Model DX-100U. Careful design has achieved high performance and stability. Completely self-contained.
Kit **£81.10.0** Assembled **£106.15.0**



RA-1

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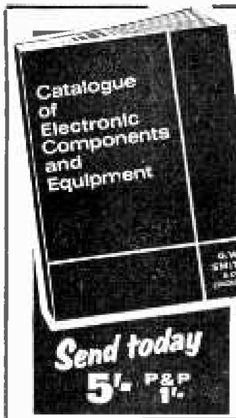

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	1mA 22/6	750mA 22/6	500V D.C. ... 22/6
	2mA 22/6	1A D.C. 22/6	750V D.C. ... 22/6
	5mA 22/6	2A D.C. 22/6	15V A.C...... 22/6
	10mA 22/6	5A D.C. 22/6	50VA.C. 22/6
50µA.........32/6	20mA 22/6	3V D.C. 22/6	150V A.C.....22/6
100µA 29/6	50mA 22/6	10V D.C.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

POST EXTRA. Larger sizes available—send for lists.

R.C.A. AR 88 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.

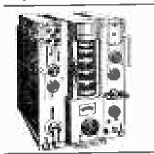
COSSOR 1035 Mk II DOUBLE BEAM OSCILLOSCOPES

Latest model using miniature valves Perfect condition. **£45.** Carr. 30/-.

GARRARD RECORD PLAYERS

SRP22 Player mono **£4.4.0**; 1000 changer mono or stereo **£5.15.6**; 2000 changer mono or stereo **£6.19.6**; 3000 Changer mono or stereo **£7.19.6**; SP25 Player mono or stereo **£9.19.6**; SP25 with cast turntable **£10.19.6**; AT60 Changer mono or stereo **£10.10.0**; AT60 **Mk II** less cartridge **£11.19.6**; A70 less cartridge **£19.19.0**; LAB80 **Mk II** Stereo **£25.0.0**; 401 Transcription **26 gns.** Brand new and guaranteed. All plus post and packing 5/-.

ADMIRALTY B.40 RECEIVERS

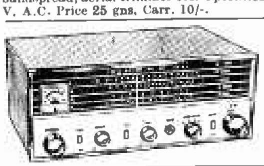


Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s.-30 Mc/s. I/F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O., calibrator I/F. output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 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/-

LAFAYETTE KT-340 COMMUNICATION RECEIVER SEMI-KIT

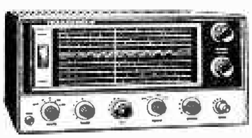
Build this wonderful receiver and save pounds. Supplied semi completed, main components ready mounted, R.F. section already wired and aligned. Full and precise instructions supplied. Specification:— 8 valves + rectifier, 4 bands covering 550 Kc/s.-30 Mc/s. Incorporates 1 R.F. and 2 I.F. stages, 'Q' multiplier, B.F.O., A.N.L., 'S' meter, bandspread, aerial trimmer etc. Operation 115/230 V. A.C. Price **25 gns.** Carr. 10/-.

HAM-1, 4 BAND COMMUNICATION RECEIVER



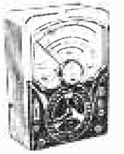
4 wavebands covering 535 kc/s. to 30 Mc/s. 5 valve superhet circuit Incorporates S meter B.F.O., BANDSPREAD TUNING, BUILT-IN 4in. SPEAKER, FERRITE AERIAL AND EXTERNAL TELESCOPIC AERIAL. Operation 220/240 v. A.C. Supplied brand new with handbook. NOW **£15.15.0.** Carr. 10/-.

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



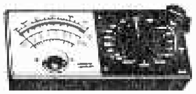
8 valves, 5 bands incorporating 2 MECHANICAL-FILTERS for exceptional selectivity and sensitivity. Frequency coverage on 5 bands 150-400 kc/s., 550-1,600 kc/s., 1·6-4·0 Mc/s., 4·8-14·5 Mc/s., 10·5-30 Mc/s. Circuit incorporates R.F. stage, aerial trimmer, noise limiter, B.F.O., product detector, electrical bandspread, S meter, slide rule dial. Output for phones, low to 2K Ω or speaker 4 or 8 ohms. Operation 220/240 volt A.C. Size 7⅛in. × 15in. × 10in. Supplied brand new and guaranteed with handbook **36 GNS.** Carr. 10/-. S.A.E. for leaflet.

CALLERS WELCOME!
Open 9 a.m. to 6 p.m. every day Monday to Saturday. Trade supplied. All items available as previously advertised.



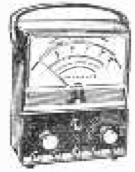
NEW MODEL 500. 30,000 o.p.v. With overload protection, mirror scale. 0/·5/1/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000v. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg./60 Meg. Ω. **£8/17/6.** Post Paid.

PROFESSIONAL 20,000 o.p.v. LAB. TYPE MULTITESTER



With automatic overload protection, mirror scale. Ranges: 1/10/50/250/500/1,000 volts, D.C. and A.C. 0–500 µA, 10 mA, 250 mA. Current: 0/20K, 200K, 2 megohm. Decibels: —20 to +22dB. **£5/10/0.** P. & P. 2/6.

TE-900 20,000 Ω VOLT GIANT MULTIMETER

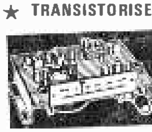


6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000v. A.C. 0/25/12·5/10/50/250/1,000/5,000v. D.C. 0/50µA/110/100/500 mA 10 amp. D.C. 02K/200K/20 Megohm. **£12/19/6.** P. & P. 5/-.

MODEL ZQM TRANSISTOR CHECKER

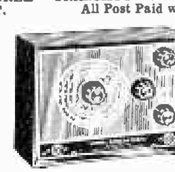
It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0·7–0·9967. B: 5–200, Ico: 0·50 microamps 0–5mA. Resistance for diode 200 Ω–1 Meg. Supplied complete with instructions, battery and leads. **£5.19.6.** P. & P. 2/6.

★ TRANSISTORISED FM TUNER ★



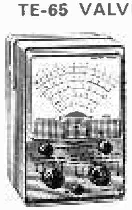
6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6in. × 4in. × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 volt battery. Coverage 88–108 Mc/s. Ready built ready for use. Fantastic value for money. **£6/17/6.** P. & P. 2/6.

NOMBREX TRANSISTORISED EQUIPMENT. All Post Paid with Battery



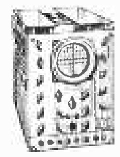
Model 22 P.S.U. 0–15v. D.C. **£14.** Model 30 Audio Generator 10 c/s–100 Kc/s **£19/10/0.** Model 31 R.F. Generator 150 Kc/s.–350 Mc/s. **£12/10/0.** Model 27 Signal Generator 150 Kc/s.–350 Mc/s. **£10/10/0.** Model 62 C.R. Bridge **£9.** Model 66 Inductance Bridge **£18.** Model 61 P.S.U. 0·5–15v. D.C. **£6/10/0.**

TE-65 VALVE VOLTMETER



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

TYPE 13A DOUBLE BEAM OSCILLOSCOPE BARGAIN!

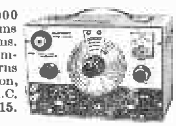


A high quality instrument, offered at a fraction of original cost. Timebase 2 c/s–750 kc/s. Separate Y1 and Y2 amplifiers up to 5·5 Mc/s. Built-in calibrators at 100 kc/s and 1 mc. Operation for 115/250v. A.C. Available in excellent condition, fully tested and checked. **£22/10/0.** Carr. 30/-.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s—260 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator. Operation 200/240v. A.C. Brand new with instructions **£12/10/0.** P. & P. 7/6. S.A.E. for details.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER



2 P.F. – 2,000 MFD. 2 ohms 200 megohms. Also checks impedance turns ratio, insulation, 200/250 v. A.C. **Brand New £15.** Carr. 7/6.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

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

ARF-100 COMBINED AF-RF SIGNAL GENERATOR

AF. SINE WAVE 20 – 200,000 cps. Square wave 20–30,000 cps. O/P. **HIGH IMP.** 21 v. P/P 600 Ω 3·8 v. P/P. TF. 100 kc/s–300 Mc/s. Variable R.F. attenuation Int/Ext. Modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240v. A.C. **£27/10/0.** Carr. 7/6.

F.M. WIRELESS MICROPHONE

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

SILICON RECTIFIERS

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

Discounts for quantities. Post extra.

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Cables: SMITHEX LESQUARE
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VIKING TRANSISTOR

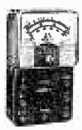
40-50 WATT AMPLIFIER

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

MAINS TRANSFORMER, primary 200/250 volt, secondary 425/425 volt. 250 mA, 6·3 volt 4 amp, 5 volt 3 amp; fully shrouded. chassis mounting. Price **£2.5.0** plus 7/6 postage and packing. Auto transformer step-up-step-down, 240/110 volt 400 watt. Price **£1.5.0** plus 7/6 postage and packing.

MAINS TRANSFORMER 200/250 volt, secondary 250/250 volt, 70 mA, 6·3 volt, 3 amp drop through. Price **12/6** plus 4/6 postage and packing. Elac 10 inch, 10,000 lines ceramic magnet, 3 or 15 ohms, 7 watt, **£1.9.6** plus 4/6 postage and packing.

POCKET MULTI-METER

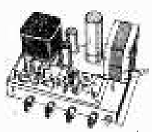


Size 3⅞ x 2¼ x 1⅞in. Meter size 2⅛ x 1⅜in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1000. D.C. current 0-150mA. Resistance 0-100kΩ. Complete with test prods, battery and full instructions, 42/6. P. & P. 3/6. FREE GIFT for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

600 mW SOLID STATE 4-TRANSISTOR AMPLIFIER

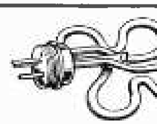
Features NPN and PNP Complementary Symmetrical Output Stage. The elimination of transformers ensures maximum efficiency and frequency response. Automatic heat compensation. Combined AC/DC feed back. Class B output stage, i.e. output power is proportional to total current consumption, this ensures long battery life. Under no signal condition(IQ) current drain is approx. 12mA at 9 volts (4mA in the output pair). Printed circuit construction, size 2¼" x ⅞" x ⅞". Speaker output impedance 12 ohms. Output power 600mW at 5% distortion, 400mW at 2·5% distortion, 750mW at 10% distortion. Supply 9 volts. Total current consumption at a reasonable listening level approx. 35–40mA at full power (speech and music), average 65mA. Sensitivity for 50mW output is 10mW. Frequency response —3dB points 90c/s and 12Kc/s. Price **15/-**, plus 1/- P. & P.

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



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

GEC KETTLE ELEMENT



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

RADIO & TV COMPONENTS (Acton) LTD

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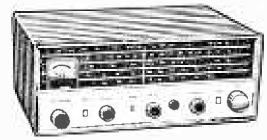
Shop Hours 9 a.m.—6 p.m. Early Closing Wednesday
Goods not despatched outside U.K. Terms C.W.O.
All enquiries Stamped Addressed Envelope

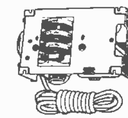
Also at **323 EDGWARE ROAD, LONDON, W.2.** Personal shoppers only. Early Closing Thursday. All orders by post to our Acton address.

STAR SR 150 COMMUNICATION RECEIVER



Frequency range: 535Kc/s–30Mc/s. 4 wavebands. 5-valve superhet. Incorporates BFO, bandspread tuning, "S" meter, external telescopic aerial and ferrite aerial. Built-in 4in. speaker. Easy-to-read dial. For 240V A.C. operation. Complete, brand new, with full instruction manual. **15 gns.**, P. & P. 10/-.

TRANSISTORISED 1½ WATT AMPLIFIER

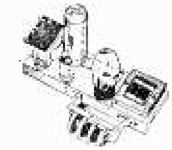


comprising Mullard 2AC 128, 20C 75 and 2 AA129 separate bass and treble volume controls. Complete with Power Supply AC mains 240 v. Size 7½" × 3¾" × 2" Price **50/-** plus 2/6 P. & P.

ANTI-THIEF CAR BURGLAR ALARM

The Melguard Safermatic consists of an electrical device housed in small metal box 4" x 2" x 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.

3 to 4 Watt AMPLIFIER



3-4 watt Amplifier built and tested. Chassis size 7 x 3¼ x 1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohms speaker. Valves ECC81 and 6V6.
£2.5.0 plus 5/6 p. & p.
The above in Kit Form, **£1.14.6** plus 5/6 p. & p.

"MUSETTE" 6-Transistor Superhet Portable Radio

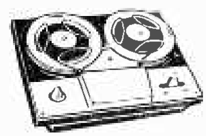
★ 2¼" Speaker. ★ 6 Transistor Superhet Output 200mW. ★ Plastic Cabinet in red, size 4¾" x 3" x 1⅜" and gold speaker louvre. ★ Horizontal Tuning Scale. ★ Ferrite Rod Internal Aerial. ★ IF 460 kc/s. ★ All components Ferrite Rod and Tuning Assembly mount on printed board. ★ Operated from PP3 Battery. ★ Fully comprehensive instructions and point-to-point wiring diagram ★ Printed Circuit Board. ★ Tunable over medium and long waveband. ★ Car aerial and earpiece socket.

Price 39/6. inc. carrying strap. Circuit Diagram 2/6 free with parts. P. & P. 3/6.

NEW TRANSISTORISED SIGNAL GENERATOR

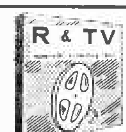
Size 5¼ x 3¼ x 1½in. For IF and RF alignment and AF output 700 c/s frequency coverage 460 kc/s to 2 mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. P. & P. 3/6. **39/6**

BSR TAPE DECKS
200/250V A.C. mains



Type TD2 Tape speed 3¾ twin track, **£5.19.6.**
Type TD10 2-track, 3 speed, plus rev. counter—**£7.19.6.**
Type TD10 4-track, 3 speed, plus rev. counter—**£9.5.0.** P. & P. on each 7/6.

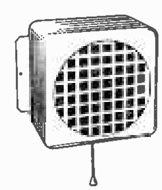
FIRST QUALITY P.V.C. TAPE



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

EXTRACTOR FAN

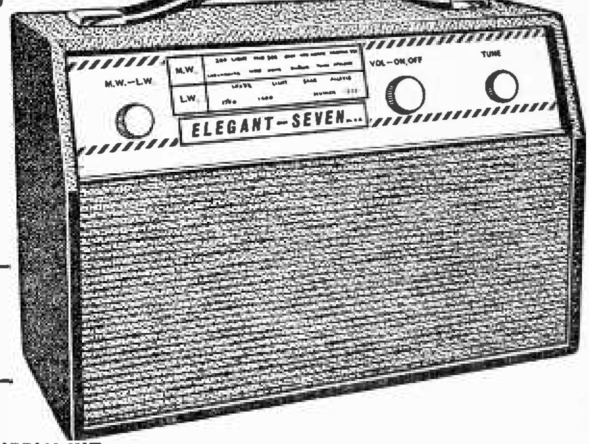


AC Mains 230/250 v. complete with pull switch. Size 6" x 6" x 4". Price **27/6** plus 5/- P & P.

GEC DOORBELL

Complete with mains transformer 240 v. AC & bell push Price 12/6 plus 5/6 P. & P.

Elegant Seven Mk II A COMBINED PORTABLE *and* CAR RADIO



SPECIAL OFFER

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

★ De luxe grey wooden cabinet size 12½" x 8½" x 3½".
★ Horizontal easy to read tuning scale printed grey with black letters, size 11½" x 2"
★ High 'Q' ferrite rod aerial.
★ I.F. neutralization on each separate stage.
★ D.C. coupled push pull output stage with separate A.C. negative feedback.
★ Room filling output 350mW.
★ Ready etched and drilled printed circuit board back printed for fool proof construction.
★ Fully comprehensive instructions and point-to-point wiring diagrams.
★ Car aerial socket.
★ Fully tunable over medium and long wave. 168-535 metres and 1250-2000 metres.
★ All components ferrite rod and tuning assembly mount on printed board.
★ 5" P.M. speaker.
★ Parts list and circuit diagram 2s. 6d. free with parts.

ONLY **£4.4.0**

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

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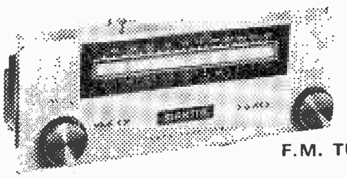

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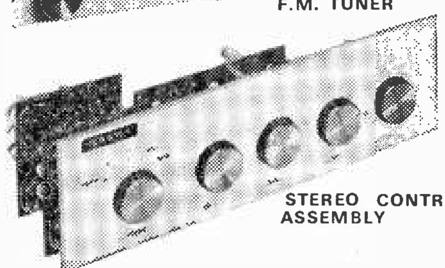

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PW107

CODAR CR.70A

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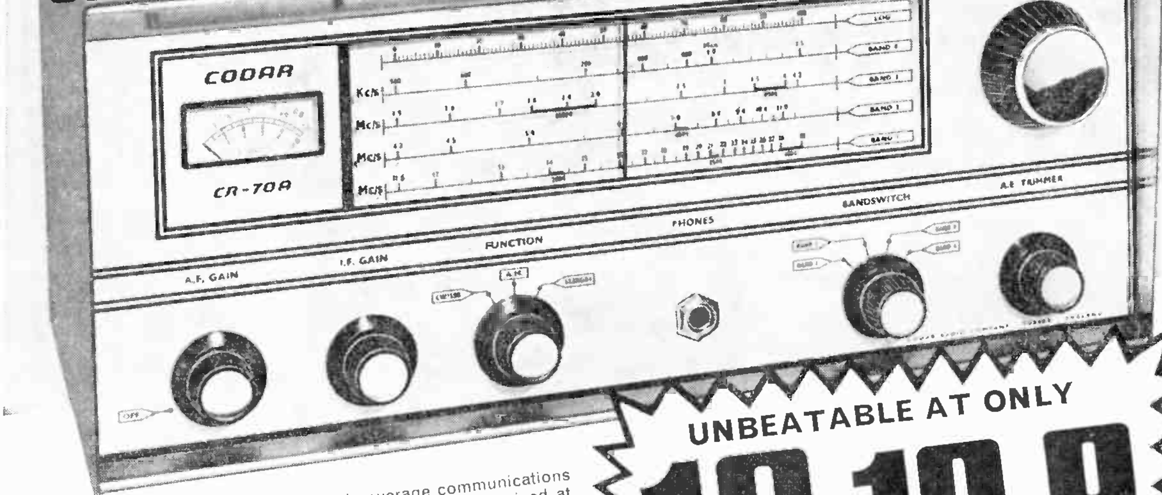

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The Codar CR.70A is an excellent general coverage communications receiver for the keen short wave listener. Very reasonably priced at just £19.10.0 the CR.70A is outstanding value for money. In four stable ranges, the receiver covers from 540 metres medium wave, right through the shipping and coastguard frequencies all the short wave and international amateur bands up to and including 10 metres, where the rapidly improving conditions that now prevail allow the regular reception of world-wide call-signs!

The CR.70A has a high 'Q' aerial input stage giving extremely high gain with low noise level. Double tuned, iron cored I.F. transformers produce high selectivity. Ready to plug into 200-250 volt AC mains, the CR.70A needs only your aerial and a 2-3 ohm loudspeaker. The cabinet measures only 13" x 5¾" x 7¾" and the control panel is finished in black and white with chrome trim knobs. Fully guaranteed for 12 months!

Buy your Codar equipment from your radio hobby store or direct from Codar. The order form will also bring fully descriptive leaflets (6d stamps appreciated).

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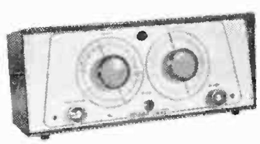
9 transistors, bandspread 1.8-2Mc/s and 3.5-4Mc/s 12 volts, only 8" x 4" x 3½". Ideal portable, mobile or home receiver. Efficient BFO, printed circuits. ONLY £15.10.0. Carr. 4/6.



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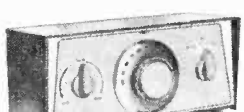

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PRACTICAL WIRELESS

VOL 43 No 6

issue 728

OCTOBER 1967

TOPIC OF THE MONTH

The great shake-up

IN three weeks' time, the revamped BBC sound broadcasting set-up gets under way. If you have not already been whipped into a fever of apathy by the subject, it all starts on September 30 and goes like this:

The m.w. Light programme outlet becomes Radio 1, serving up a diet of 14 hours of pop per day. The l.w. and v.h.f. Light remain as before but will be called Radio 2. The existing Third and Home outlets stay but will become Radio 3 and Radio 4 respectively.

Mr. Frank Gillard, director of BBC Radio, is on record as saying that a great deal of thought had gone into choosing the new names. Well, Radio 1, 2, 3, 4 does not seem much result for such effort. Nor does it seem a worth-while change, because apart from the new service on 247m. it is really the mixture as before. It would have been easier and more convenient to keep the old names and call the new outlet the Pop programme, or suchlike. As it is, listeners will have to work out if Radio 2 is the Light programme, the Home Service or a new detergent.

Broadly, we like the reshuffle, for it provides a pop channel without biting into existing services. And, of course, it is all part of the master plan to silence the pirate stations. On August 15, the Marine Broadcasting (Offences) Act became law and the pirates are now officially beyond the pale. Some have accepted the situation, others may continue to flaunt the Jolly Roger. International legislation is needed to back up national laws but in Europe only Holland now stands aloof.

We need not mourn the passing of the pirates because on Radio 1 the BBC will be churning out a massive volume of pop music, supported by hordes of DJ's, some of them recruited from the high seas. And if 14 hours a day are not enough, then it's about time listeners tried broadening their horizons!

Of more significance is the recent appointment of Lord Hill as chairman of the Governors of the BBC. At the time of going to press there is much speculation as to the ultimate reason for this move—including a possible merger between BBC and ITV—and we will be having more to say about this at a later date.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

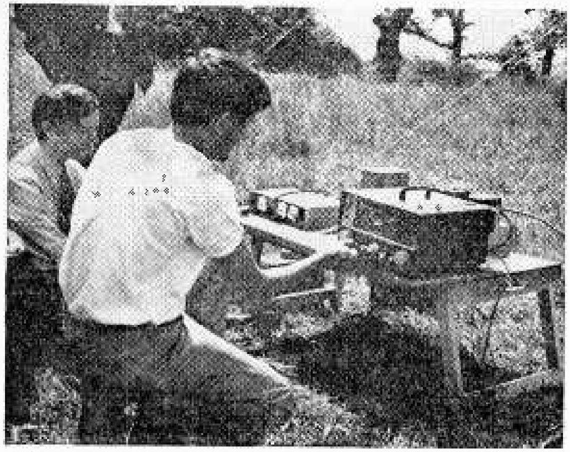
CONSTRUCTIONAL

OTHER FEATURES

NOVEMBER ISSUE WILL BE PUBLISHED ON OCTOBER 6th

NEWS AND COMMENT...

RSGB NATIONAL MOBILE RALLY



Within minutes of arriving, there was a beam up, and this G8 station was on the air on 70 cms and in QSO too!

You are 12 miles N.N.E. of Charing Cross on the Greenwich meridian, and approximately 200 feet above sea level—or you would have been had you attended the R.S.G.B. National Mobile Rally at Gilwell Park in Essex. This training ground of the Boy Scouts Association positively bristled with cars, mostly sporting mobile whip antennas for one band or another. Once past one of the four talk-in stations operating on 160, 80, 4 and 2 metres you would have been able to see the Trade Exhibition or watch the model aircraft display. For the thirsty the bar opened at noon and for the people who like a little flutter there was a Grand Raffle, a children's lucky dip, competitions for the ladies and numerous sports events for all age groups. If you couldn't make it don't worry, the next National Mobile Rally is at Woburn Abbey, Bedfordshire on Sunday, Sept. 10th.

MORE Q-MAX METAL PUNCHES

Q-Max (Electronics) Ltd., Napier House, High Holborn, London, W.C.1, have added three new sizes to their range of sheet metal punches. They are 2⅝in., 2¾in. and 3in. models, costing 73s. 6d., 94s. 6d. and 147s. The key costs an extra 3s. 6d. This increases the Q-Max range to 30 sizes ranging from ⅜in. to 3in.

A fully descriptive leaflet giving full details of Q-Max punches may be obtained free from them at the address above.

MARCONI SECURE "MARKET" ORDER

Another Common Market order for Marconi's aircraft radio compass has been placed for a fleet of twenty-one Boeing and Fokker aircraft. Air France, one of the world's leading airlines, is to use the equipment on Continental routes and a night postal service which delivers the mail in almost all weather conditions throughout metropolitan France. Late last year, similar equipment was ordered by the German airline, Deutsche Lufthansa.

For Air France, dual automatic direction finders, Type AD 370 will be fitted to twelve Fokker 27-500 series aircraft, which are to be used for the night postal service, and nine Boeing jets, type 727.

MAINTENANCE KIT FOR TAPE RECORDERS

Multicore Solders Ltd. have produced the Bib Size E Tape Head Maintenance Kit, suitable for both reel and cassette tape recorders.

Packed in a blue plastic wallet contained in a transparent bag with a three-colour header card for pegboard display, the kit comprises 2 Blue Tape Head Applicator Tools; 2 White Tape Head Polisher Tools; 10 Applicator and Polisher Sticks; 1 Double-ended Brush; 1 Bottle of Bib Instrument Cleaner; 1 Packet of Cleaning Tissues and a comprehensive 5-page instruction booklet.

The recommended retail price of the kit, reference Size E, complete in plastic wallet, is 12s. 6d. Replacements for the tape head polisher tools and tape head applicator tools are available at 2s. 6d. per packet of two. (Size F and Size G respectively.) A packet of 20 tape head applicator and polisher sticks costs 1s. (Size H.)

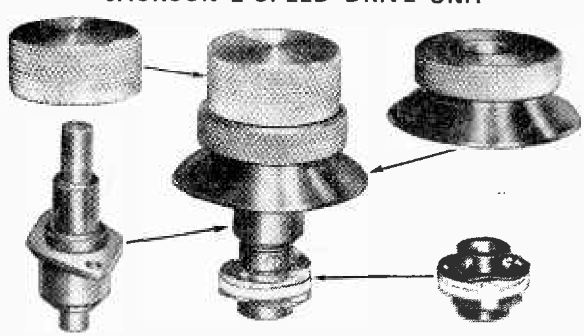
IEE PUBLISHING DEPARTMENT MOVE

The former Editorial, Science Abstracts and Advertisement Departments of the Institution of Electrical Engineers are being combined and integrated to form a new Publishing Department located at Stevenage, Herts., which will embrace most of the IEE's publishing activities.

The Editorial Sections of the Proceedings *and* Electronics Letters *and the Advertisement Section moved to the new offices at Stevenage some time ago and the remaining Editorial Sections, including* Electronics and Power, IEE News, Science Abstracts *and the* Current Papers *series follow in September.*

The new address is Institution of Electrical Engineers, Southgate House, Stevenage, Herts.

JACKSON 2-SPEED DRIVE UNIT



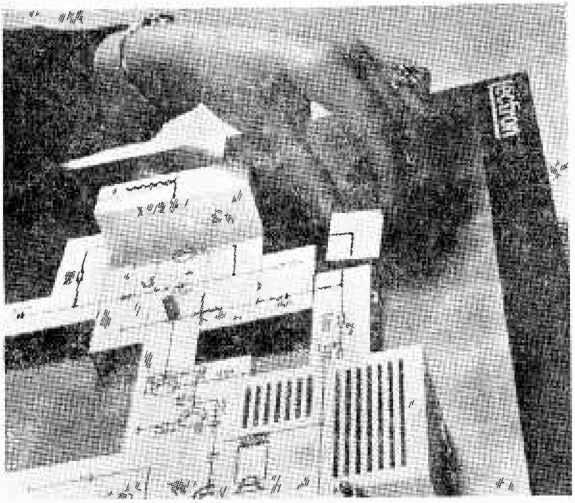
Jackson Brothers (London) Ltd., Kingsway, Waddon, Croydon, Surrey announce their D Type Two-Speed Drive Unit. The slow motion drive is controlled from a 1in. diameter satin anodised aluminium knob. The direct drive is operated by the 1½in. diameter dial.

The drive unit itself gives a reduction of 4½:1. It mounts on the outside of the panel (which may be of any thickness) so that the dial and knob are instantly located at the optimum height above the face panel. A flexible coupling completes the unit and allows an angular misalignment of 15° and/or linear misalignment of 0·005in. between the drive shaft of the component to be driven.

Further details may be obtained from Jackson Brothers at the above address.

NEWS AND COMMENT...

DOMINO RADIO HELPS THE BEGINNERS



Electronic dominoes that make child's play out of electronics have been introduced by Raytheon Company.

The new learning aid is expected to streamline the teaching of electronic theory in schools. More than 90 different experiments in electronics are possible with a single set of electronic dominoes.

The individual units are held together by built-in magnets, which also assure proper electrical contact and the units are as quickly disassembled as a game of traditional dominoes.

Each domino contains a circuit element, such as a transistor, inside a container made of clear plastic for easy viewing. The symbol for the element is imprinted on the top of the domino. The magnetically-joined circuit elements eliminate the maze of wires, the solder, and the despair which usually accompany experiments in beginning electronics. No wire whatever is used. For each experiment there is a diagram of the circuit provided in an instruction book, in domino format. To complete the experiment the student is required to assemble the dominoes into an identical configuration.

The dominoes were developed in Germany. Raytheon has been named the exclusive distributor for the United States and various other parts of the world.

NEW RADIO SOCIETY

A Flint and District Radio Society was inaugurated at a well-attended meeting held at the Central Library, Flint, on Friday, June 30th.

The Society intends to promote all aspects of amateur radio, including construction of equipment, operation of a Flint transmitter and preparation of members for the Radio Amateurs' Examination and the Post Office morse tests.

Lectures are to be held at the Central Library, Church Street, Flint, and the Society also has accommodation available for its varied programme of practical activities.

The Society is affiliated to the Flint Association for the Arts and joins the highly-successful Flint Photographic Society and the Flint and District Art Society which were also formed in association with Flint Public Libraries.

RAE COURSES OF INSTRUCTION

At the Evening Education Centre, 28 Beckenham Road, Beckenham, Kent. Thursdays from 7–9 p.m. Fees are graded according to age, the maximum being 40s. Enrolment is at the first class on September 28. Further details if required from: M. D. Bass, B.Sc. (G3OJE), 42 Clevedon Road, London, S.E.20.

At the Western Road Evening School, Sheffield 10. Wednesdays at 7.00 p.m. commencing September 20. Further details from: J. Bell, G3JON, 25 Edale Road, Sheffield 11.

At Westfield School, F.E. Centre, Bedford. From September 1967 to May 1968. Inquiries in first instance to: J. R. Clarke, G3OWQ, 12 Robin Hill, Brickhill, Bedford.

At March Street Youth Centre, High Street, Walthamstow, E.17. Further details from the warden at the Centre or from K. L. Smith, G3JIX, 82 Granville Road, Walthamstow, E.17.

LONDON BROADCASTING CONVENTION

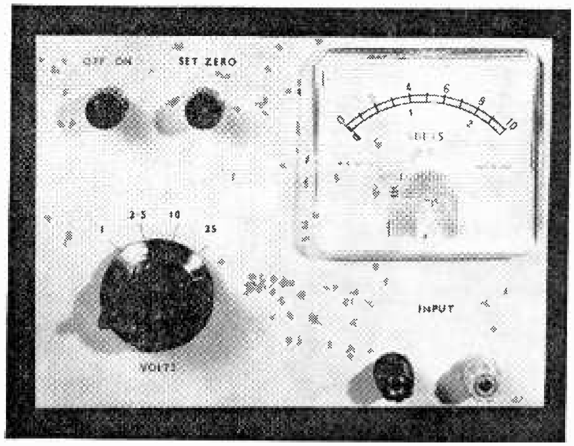
London's International Broadcasting Convention, which takes place from September 20—September 22, 1967, at the Royal Lancaster Hotel, London, is attracting convention papers and delegates from all over the world. The Convention, which includes an exhibition, is organised by the Electronic Engineering Association and the Royal Television Society.

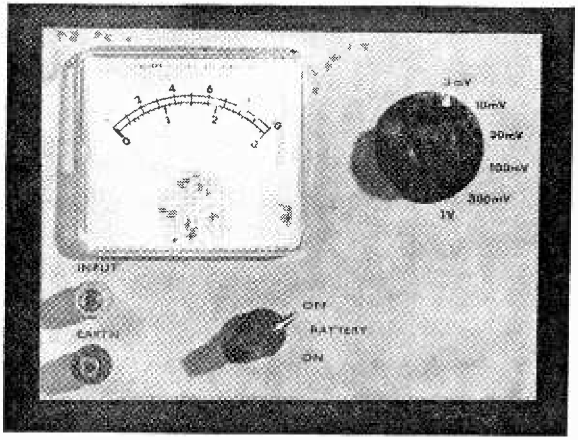
Papers to be read during the Convention cover the whole field of television and sound broadcasting techniques, transmitting, studio and outside broadcast equipment.

ELECTRONIC ORGAN FROM HENRY'S RADIO

Amongst home constructors the electronic organ enjoys wide popularity. Messrs. Henry's Radio Ltd., 303 Edgware Road, London, W.2 (PADdington 1008/9) were the first to offer to the home constructor an all transistor portable electronic organ, suitable for use by schools, clubs, church etc. The "Mayfair" is available either as a kit, sub assemblies or completely assembled. Its many features include full polyphonic design—switched vibrato—ten selected tone colours, six octaves of generators, printed circuits for easy assembly. Optional extras include a reverberation unit—13-note pedal board and various types of amplifiers are available. Further details on the Mayfair are obtainable from Henry's Radio Ltd. The complete kit retails for 99 gns. (plus carriage). A complete range of organ parts for other models are also available.

two voltmeters





FOR THE WORKSHOP

COVER SUBJECT

GRAEME LYNN

PART 1: A.C. MILLIVOLTMETER

A SIMPLE BUT ACCURATE MILLIVOLTMETER USING SILICON TRANSISTORS

LABORATORY test equipment is often regarded as the prerogative of the professional research and development organisations. This has, in the main, been due to the relatively high cost of such equipment, placing it outside the pocket of the majority of private users. This expense has not, however, necessarily been because of the complexity of the test apparatus, for in fact most of the prime pieces of test equipment are in themselves simple, but because there is first not a vast market for products such as these and secondly and more importantly test equipment has to be made so that after many years the instrument still performs accurately. Laboratory equipment has also to work in a considerable variation of temperature and humidity, has to be robust and able to withstand a great deal of manhandling.

A lot of the original trouble in overcoming these kinds of problems was due to the inclusion of thermionic valves which, as we all know, take a grave dislike to being roughly treated and what is more relevant tend to vary during warm-up periods and lose their emission over a relatively short period of time. Since the introduction of semiconductor devices, however, the instrument maker's life has eased considerably with regard to the problems of long term stability and mechanical strength.

Circuit description

The circuit of Fig. 1 is intended to take advantage of the long term stability of semiconductor devices, presenting a very simple yet accurate a.c. millivoltmeter which is completely self-contained, being powered by its own internal battery. The supply has been stabilised to ensure that the working points of the transistors do not vary and any deterioration in the battery condition that may impair the accuracy of the instrument can be readily ascertained by reference to the meter. A considerable amount of negative feedback has been applied over the circuitry and this, coupled with the epitaxial planar transistors used throughout, ensures that a wide range of frequencies can be measured accurately. Due to the fact that the transistors are of the silicon variety it has been possible to operate in the temperature range from 0°C to 60°C without any measurable change in the output readings on the meter.

Preamplifier stage

An input impedance in the order of 0·5MΩ has been achieved by the use of the bootstrap technique between the emitter and the base of the first stage, Tr1. The emitter load of Tr1 consists of a very accurate attenuator (R14—R22) giving a coverage from 3mV to 1V in six ranges. The reasons for using two resistors where it would appear that one would have sufficed are first that some values are difficult to obtain and secondly that should 5% resistors be used it is probable that the movement in tolerance in one direction may be partially cancelled out by a similar movement in the opposite direction by the introduction of a second resistor. The final tolerance under these circumstances can not be worse than the original 5% and by the laws of averages could be about 2%. Should this be the

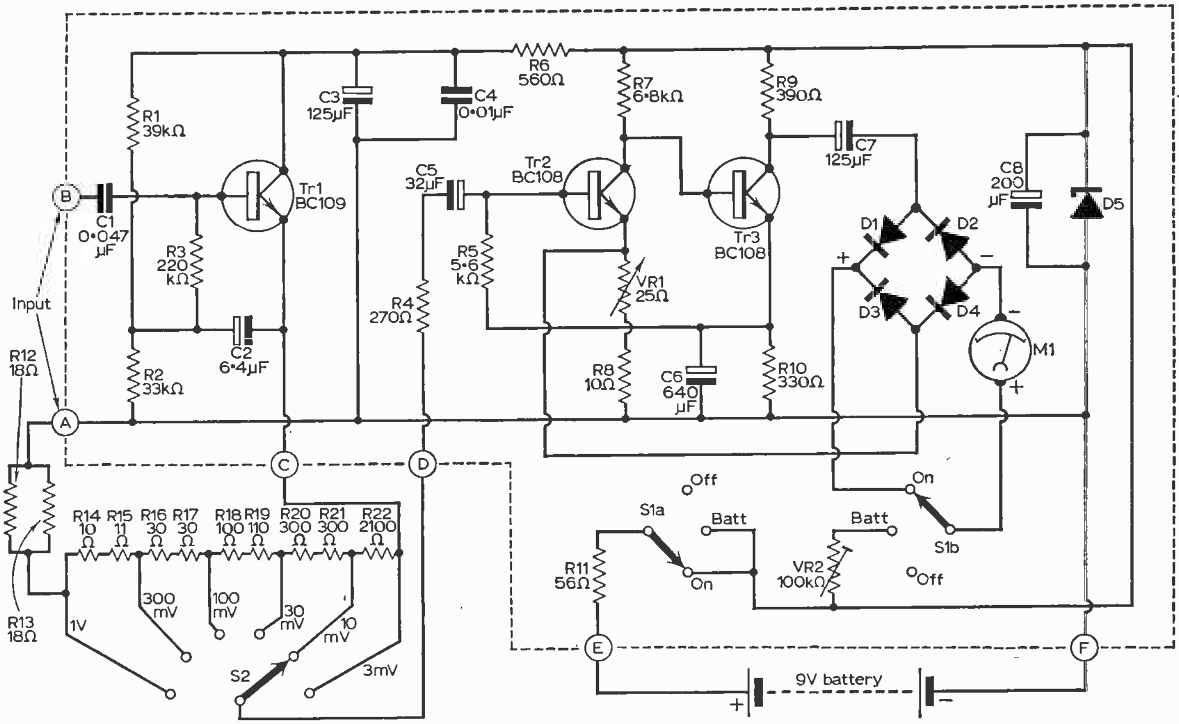


Fig. 1: Circuit diagram of the a.c. millivoltmeter.

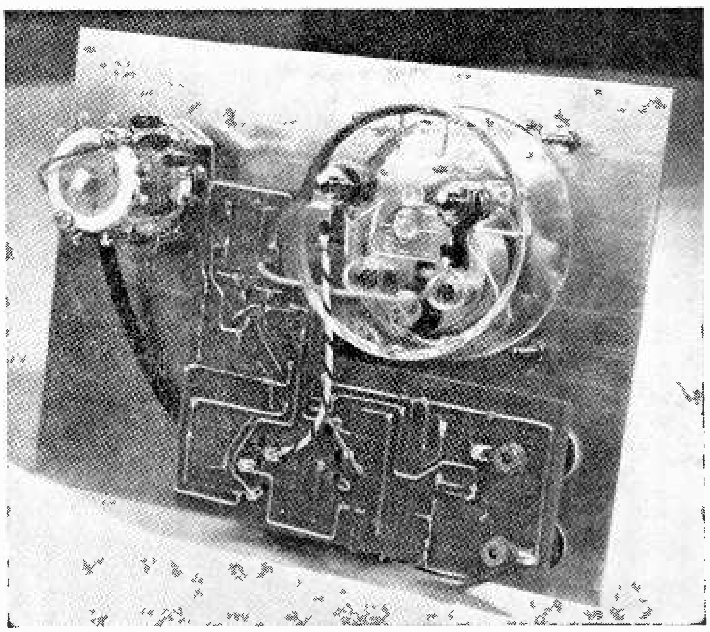
case then the attenuator will approach the accuracy that one can expect from a high quality meter.

Main amplifier

In order to avoid shunting the output from the attenuator network, the input impedance of the first stage of the main amplifier, that is Tr2, is increased to something in the order of 20kΩ by the introduction of series negative feedback in the emitter circuit. This feedback is provided by VR1 plus the negative feedback via the meter circuit. The inclusion of R4 in the base circuit of Tr2 does not assist in this increase but tends to ensure that Tr2 base does not look back into a widely varying source impedance thus altering the noise characteristics of the main amplifier.

The emitter of Tr3 has been well decoupled so that any shunt feedback that may have been applied to the base of Tr2 via R5 is reduced to virtually zero. Shunt feedback would have the undesirable effect of lowering the input impedance of the main amplifier and would have required a further stage of amplification to achieve the required input sensitivity. Without any feedback the input sensitivity of the main amplifier is somewhere in the region of 200μV; therefore to realise the 3mV required, a great deal of negative feedback can be applied over the circuit, ensuring stability of the overall gain figure of the amplifier over a wide range of frequencies.

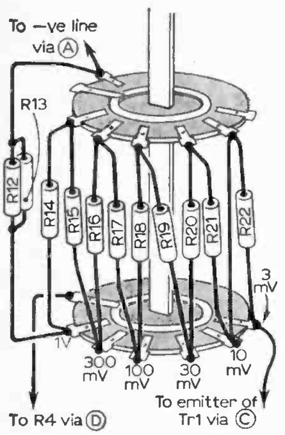
The main amplifier Tr2 and Tr3 is directly coupled in a very temperature stable configuration whereby any increase in the base current of Tr2 occasioned by an increase in temperature causes the collector voltage of Tr2 to become more negative. The result of this is that the same negative change at the base of Tr3 is present at the emitter of Tr3, due to emitter follower action, and is then fed back

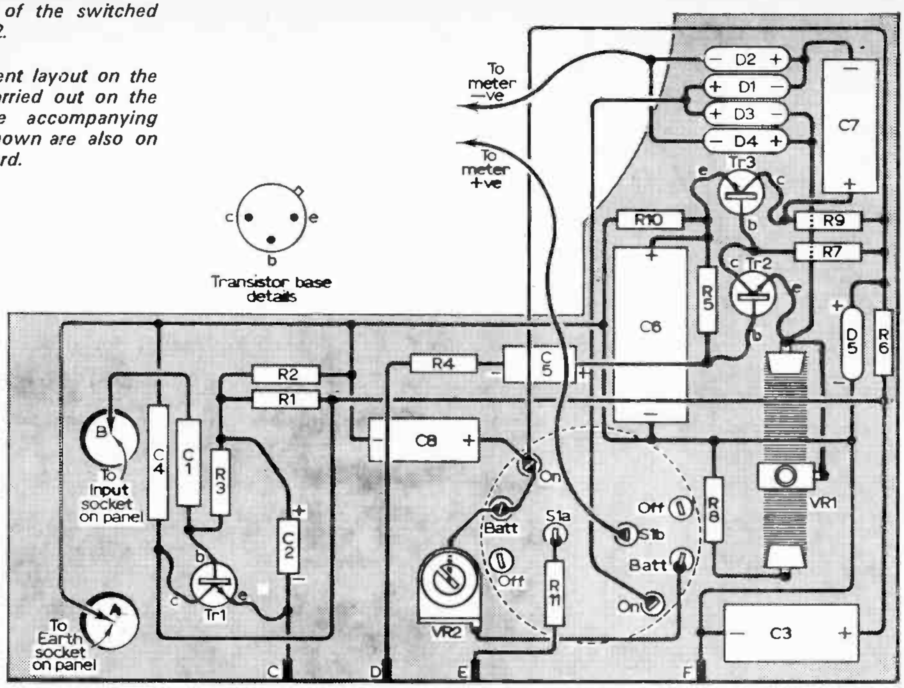


Rear view of the completed a.c. millivoltmeter.

Fig. 2 (below left): Wiring of the switched attenuator S2.

Fig. 3 (below right): Component layout on the perforated board. Wiring is carried out on the underside as shown in the accompanying photographs. SI connections shown are also on underside of board.



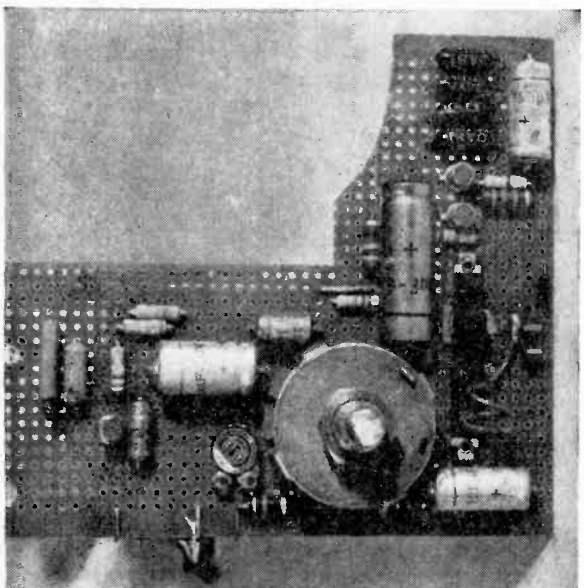


to the base of Tr2 reducing its base to emitter voltage and in turn increasing its collector voltage, positively, to restore the circuit to its original condition.

Meter circuit

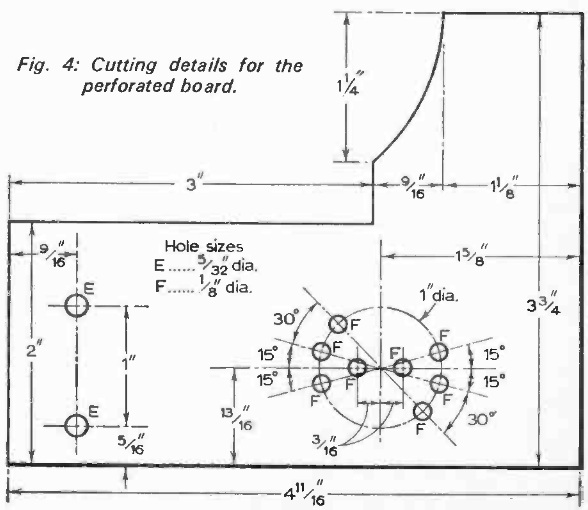
The main amplifier feeds, via a bridge rectifier, a $100\mu A$ meter giving full scale deflection for an input signal of 3mV r.m.s., the output reading obtained being consistent to within $\pm$ 2dB from 10c/s to 1·0Mc/s. By using the low noise resistors indicated in the component list the noise voltage indicated upon the meter when the input is open circuit and switched to the 3mV range does not deflect the meter zero reading by more than one half of one division, that is to say that the noise voltage is less than $50\mu V$. The a.c. millivoltmeter draws 25mA from the battery when the battery is in a new condition but when the battery has reduced to its normal working voltage this current drain drops to something in the order of 8mA giving approximately 150 hours of working life without having to renew the battery. Once the battery reading indicated by the meter has dropped to 8 then it is necessary to replace the battery to preserve the accuracy of the instrument. The figure 8 does not indicate the voltage of the battery at that particular time but only the state of the cells with regard to the requirement of the millivoltmeter.

The amplifier was constructed on a piece of pre-punched board having an 0·1in. grid, the



Component side of the perforated board.

Fig. 4: Cutting details for the perforated board.



underside wiring being as shown in Fig. 3. Where the component wires are insufficiently long, the wiring was continued in 20 s.w.g. tinned copper wire. The layout indicated is not over critical but to ensure stability it would be wise to adhere to this particular arrangement. The board was drilled in the first instance as shown in Fig. 4 to take the input terminals and the rotary switch, after being cut to the correct size. In order to avoid fixing screw holes appearing on the front of the metal panel, the switch and the input terminals form the fixing points of the amplifier board, therefore it is essential that the relationship between the terminal holes and the switch fixing centre is maintained between the front panel and the amplifier board.

The metal front panel shown in Fig. 5 was finally finished by spraying with a cellulose aerosol spray that may be obtained in the majority of hardware shops. The finished instrument is shown less any external casing but in order to ensure that extraneous signals picked up do not give false readings when measuring low signal levels it is advisable to make up a metal case. For constructors who do not have the facilities for relatively comprehensive metal work the design has been arranged so that the instrument will fit into a commercially available case manufactured by Imhof, Type no. VM4080, which costs £1 8s 9d. The front panel of this case is somewhat larger than that shown in Fig. 5 but if the junction of the two centre lines is placed directly in the centre of the case front panel and marked accordingly the whole instrument will fit together correctly.

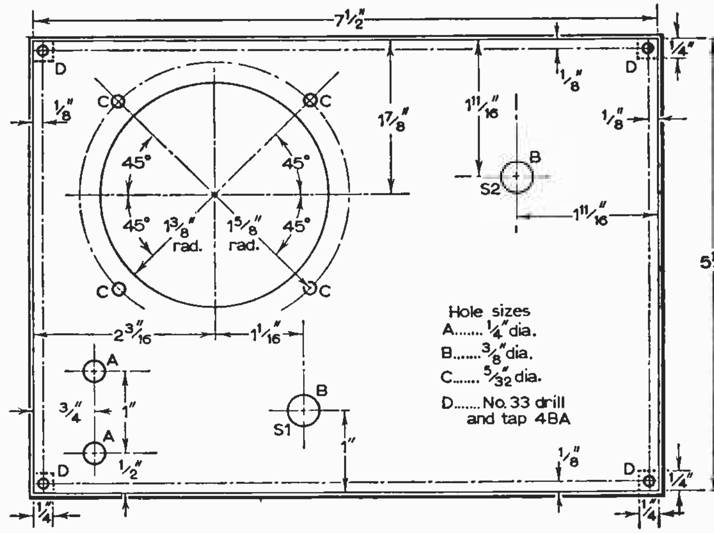


Fig. 5: Details of the front panel.

★ components list

Resistors:

R1	39kΩ	R12	18Ω
R2	33kΩ	R13	18Ω
R3	220kΩ	R14	10Ω
R4	270Ω	R15	11Ω
R5	5·6kΩ	R16	30Ω
R6	560Ω	R17	30Ω
R7	6·8kΩ	R18	100Ω
R8	10Ω	R19	110Ω
R9	390Ω	R20	300Ω
R10	330Ω	R21	300Ω
R11	56Ω	R22	2100Ω

All 5% high stability low-noise carbon

Potentiometers:
VR1 25Ω w.w.
VR2 100kΩ carbon

Capacitors:
C1 0·047μF 25V Hunt's Metalmite
C2 6·4μF 25V electrolytic
C3 125μF 10V electrolytic
C4 0·01μF 250V Hunt's Metalmite
C5 32μF 10V electrolytic
C6 640μF 6·4V electrolytic
C7 125μF 10V electrolytic
C8 200μF 10V electrolytic

Semiconductors:
D1–4 All type OA81
Tr1 BC109
Tr2 BC108
Tr3 BC108
Z1 7·5V zener diode

Miscellaneous:
M1 100μA moving-coil meter
S1 2-pole 3-way rotary switch
S2 1-pole 6-way rotary switch.
4$\frac{11}{16}$ x 3¾in. perforated board on 0·1in. grid. 7½ x 5½in. 18s.w.g. aluminium sheet. Red and black input terminals. PP7 battery connector.

Setting up

After making sure that the unit has been correctly wired up, switch to the "on" position and connect a d.c. voltmeter with a sensitivity of 20kΩ per volt between the collector of Tr3 and the negative rail. If the main amplifier is functioning correctly, the voltage should be in the order of 6·5V. The next step is to obtain an accurate source of 1V a.c. between 20c/s and 1Mc/s. With this applied to the input switch the instrument to the 1V range and adjust VR1 so that the meter reads full scale deflection. There is no need to make any further sensitivity adjustments as all the other ranges should now be calibrated accurately if the attenuator is functioning correctly.

As a final step in the setting up procedure switch the function switch to the "battery" position and, with a new battery fitted, adjust VR2 so that the meter reads full scale deflection. Should the meter reading in this position at some later stage fall to 8 the battery must be replaced in order to maintain accurate measurement of the input signals.

Next month: the d.c. voltmeter

EXPERIMENTERS CORNER

SOLID STATE VOX UNIT

L. McNAMARA B.Sc.

IN some amateur transmitting stations it is not necessary to operate a switch to power the aerial relay; with the first syllable spoken into the microphone, the system goes into operation of its own accord. This is known as a voice-operated switch, or "vox", and the unit to be described is a reliable and economical addition to provide this facility to stations without one. It is necessary to ensure that the relay closes immediately the operator begins to speak, yet incorporates a delay to prevent its opening between words otherwise enough would be lost in such gaps as to leave the transmission garbled.

The first two stages are orthodox a.f. amplifiers, with their familiar germanium p-n-p circuitry. (It is worth mentioning, however, that if a crystal microphone is to be employed, an emitter-follower input stage is advisable. The "ham" for whom this article is designed will be able to incorporate this in his printed circuit without further instructions.) A d.c. supply is required for the relay, which will rise quickly with the onset of the first syllable spoken, yet remain for ½ to 1 sec. following the cessation of the audio input. Such a supply is obtained from the output transistor which is transformer-coupled to the driver transistor, but biased into class B. When there is no input from the microphone, the only current flowing in the relay is the leakage current from the transistor. On the negative-going half-cycles only the transistor conducts—a considerable current flows in its collector circuit, through the relay which closes rapidly.

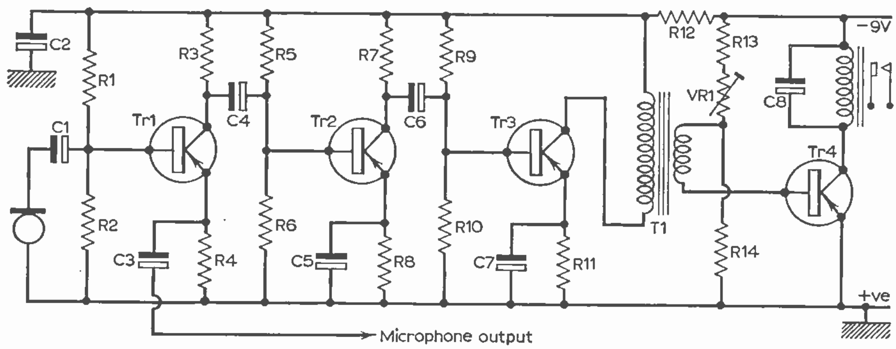


Fig. 1: Circuit diagram of the complete VOX unit.

The microphone which operates the "switch" must also supply the audio signal to the transmitter, and it is the function of Tr1 to provide for this. It is the familiar split-load phase splitter circuit which is employed.

A medium impedance dynamic microphone was used in the prototype, but since, from the point of view of the transmitter input Tr1 functions as an emitter-follower the output impedance of the circuit is high, and can therefore match efficiently into a valve amplifier.

The lower input impedance of a transistor amplifier merely reduces the level of negative feedback which the emitter circuit presents.

It will be noted that the negative line is decoupled by a resistor and a large capacitor between the driver and relay power stages. This is essential since otherwise the output stage, drawing as it does a fairly high current in pulses during negative-going half cycles, would induce noise and distortion in the earlier stages, including Tr1, and thus into the transmitter audio circuits.

The unit was assembled on a circuit board as shown in Fig. 2. This board may be prepared by the standard method of painting the pattern on a copper laminate, and etching off the unwanted copper, or simply by applying the more recent "Cir-kit" technique, with self-adhesive copper tape being applied to a sheet of plain paxolin. In either case, the "printed" wiring follows the figure. When all the components are in place, the board itself may be mounted on the relay using tapped holes made available by the removal of a stack of contacts surplus to requirements. The board must be cut and mounted so that it does not interfere with free movement of the arm of the relay. No details of finishing are provided as each constructor will find his own method depending on the application. In most cases it will be found possible to incorporate the unit into the transmitter cabinet; otherwise one of the small plastic lunch-boxes from a department store will serve.

Finally, the testing of the completed unit. The power supply and the microphone are connected, and as the value of the preset sensitivity control VR1 is reduced the relay should close. If the control is now backed off a little to open the contacts of the relay, speaking softly into the microphone should close them, and they will remain closed while speech at the ordinary pace is maintained. There will then be a delay of a second or so before they reopen. The relay in the prototype was an ex-government type LP 14901/TEG, with a coil resistance of 150 ohms, and closing at a current of 12mA. If one of this sensitivity is not available to the constructor it is suggested that a standing current be set up in the relay by means of a resistor in parallel to Tr4, so that an increase of about 10mA, supplied through Tr4 on application of an audio signal, will cause it to close. It would be convenient to use another variable preset, this time a wire-wound one, due to the higher current required. As an objective assessment of the sensitivity and performance of the circuit, an audio signal was injected into the prototype from an "Advance" calibrated signal generator. With an output impedance of 600 ohms, and using a sine wave at 1kc/s, the switch operated when the signal amplitude reached 8mV. The experienced constructor will recognise that a dynamic microphone will give this output for normal spoken words at a distance of two or three feet, and will agree that this unit can provide a reliable and definitive switching operation. The wiring of the switches on the relay cannot, of course, be treated in detail since requirements vary so widely with the equipment an amateur may possess. Suffice it to say that relays are available to provide switching which either makes or breaks its circuit when the relay is energised, and this in any desired combination of "makes" and "breaks". If necessary in a high-powered transmitter a coaxial or other aerial changeover relay can be energised through low powered contacts on the vox unit. ■

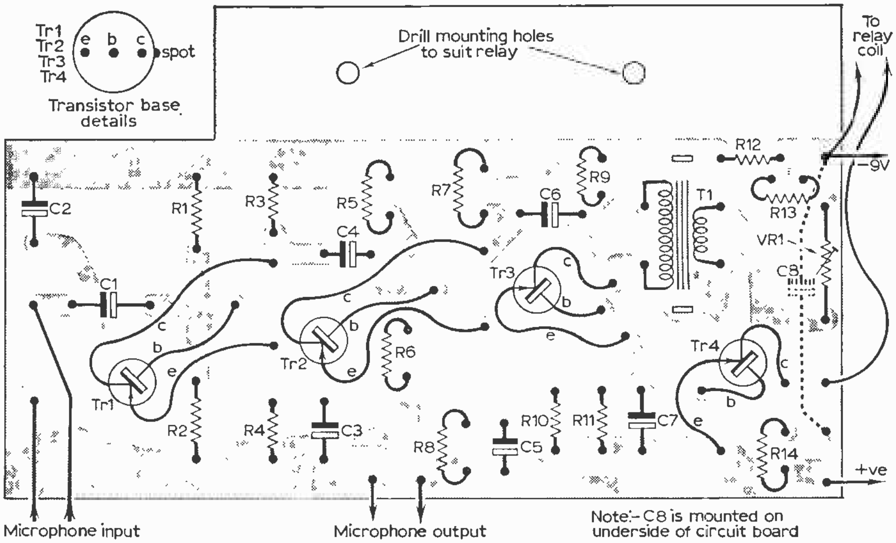


Fig. 2: Printed circuit board layout and wiring diagram.

★ components list

Resistors:

R1, 5, 9	47kΩ	R7	3·9kΩ
R2, 6, 10	10kΩ	R12	100Ω
R3	5·6kΩ	R13	1·5kΩ
R4, 8, 11	1kΩ	R14	27Ω

Capacitors:

C1, 3, 4, 5, 6, 7 10–50μF 3V
C2 100μF 9V
C8 1000μF 9V

Transistors:

Tr1, Tr2 OC71 Tr3 OC81D Tr4 OC81

Miscellaneous:

T1 transformer type T9A or similar interstage (4·5:1)
Relay 150Ω coil (see text). VR1 1·5kΩ pre-set pot.

practically wireless commentary by HENRY

No. 37

Beyond Economical Repair

IF you are one of those 2·4 "family units" used to illustrate statistical findings, you will sympathise with the Editor of one of our contemporaries who was surprised to find that his readers who answered a questionnaire owned 1·624 tape recorders each.

Any professional service engineer will swear that he has had that odd 0·624 of a tape recorder on his bench. Along with that 0·995 of a television that lacks an unobtainable coil and the 0·756 of a transistor radio that Junior gave to the dog. Some of these fractional failures still lurk in the darker corners of the workshop, reminding us at each stocktaking that we have potential income "in bond".

Now and again we feel a twinge of guilt, haul the carcass from its dark corner, dust it off, and have a go at bringing it to life. We begin like the charge curve of a good electrolytic, steeply uphill with gusto; sorting out a wrong connection here, a broken tag there, identifying a missing part and finding some replacement. But gradually the curve tails off. Was that blackened resistor a 4·7k or a 47k? Will a standard transformer go in that space without resorting to blacksmithery? Surely that switch-blade is not meant to bend quite so far back?

Transistor radio that junior gave the dog

Then, just as we have the hulk dissected and the vital bits spread around in what one service manager friend used to call "a logical confusion" some unsympathetic superior foists a job of greater priority on us. We shovel the bits and pieces into a handy box and stuff the derelict back in its cranny.

For every half-dozen jobs that succumb to the normal process of fault-finding there will be one that costs more to repair than it is worth. Most of the cost being labour charges. Hence the occasional grumble: "Whew! Two quid for fitting a ninepenny condenser."

The catch is that these uneconomical jobs often look deceptively simple when they first arrive. Here is a radiogram, for example, with a "weak and distorted" label. As we suspected, the cathode resistor of the single-ended output stage is burned out. The by-pass electrolytic is trying to do its job—and failing. We replace both and up comes the volume. But—ah, but!

With the increase in gain comes harshness—loudspeaker trouble, by the sound of it. We rig up an alternative to prove the fault and find we have bags of output but a ringing i.f. valve.

Someone rings up and asks how long shall we be, and how much it will cost. We make a wildly cheerful guess—then, too late, discover that the tuning, which we had been operating blindly from behind, runs the pointer the wrong way along the dial. Some blighter has been there before.

And so it goes on. Get the radio section right and the gram will be faulty. The cartridge is cracked, or that gremlin has been soldering the pick-up wires directly to its tags. Then the autochange mechanism fails to trip, or the pick-up sets down wrongly. After righting this, a wow is noticed, and when we

That gremlin has been soldering

cure that problem and box the whole job up, a rumble, previously inaudible, resounds around the workshop. (There is no trouble hearing it—by then everybody else has gone home.)

Small wonder that we have to condemn some jobs as "Beyond economical repair". The owners are incredulous. "It has been going well for years", they point out, forgetful that its long service is one reason why the antique should be retired. We stress that word *economical*. Of course, the job could be done, but at a formidable price, and with little guarantee that something else might not crop up quite soon.

It is mainly for this reason that we try to discourage the owner. Any professional engineer hates the call back, repeat job or second complaint. Useless to explain that it is not your fault when something quite unconnected with the repair you did gives up the ghost. Your fingerprints are on the job, mate. You're guilty—fix it!

Sometimes we will take a defunct monster in part exchange. It may come in handy for spares, but more often it sits in the attic "graveyard", slowly mouldering, until it becomes one of those 0·624 units.

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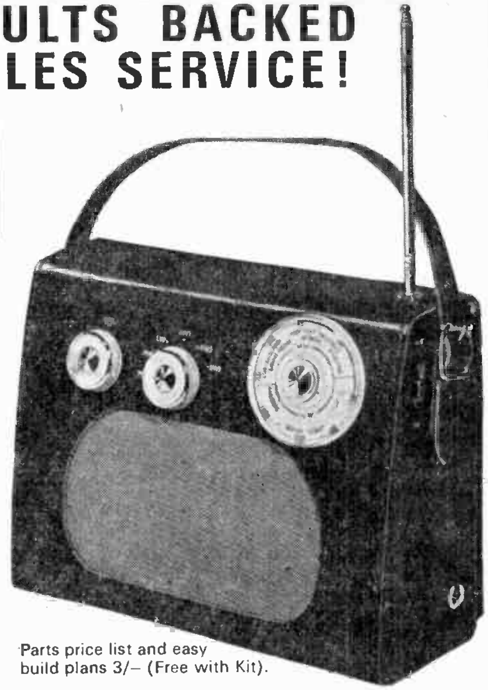
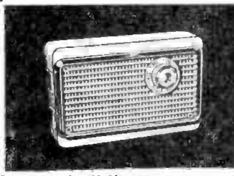


Parts price list and easy build plans 3/– (Free with Kit).

TRANSONA FIVE



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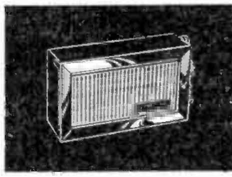
POCKET FIVE



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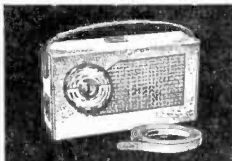

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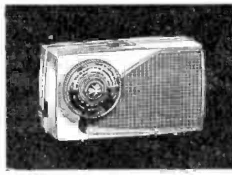

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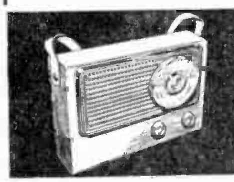

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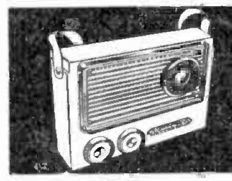

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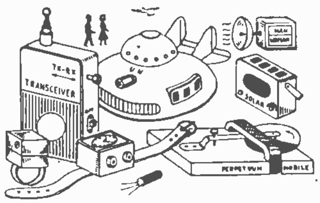

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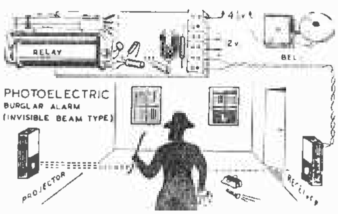

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1μF	15V.	4μF	100V.	20μF	6V.	100μF	9V.
1μF	40V.	5μF	6V.	20μF	9V.	150μF	12V.
1μF	50V.	5μF	25V.	20μF	15V.	150μF	25V.
1·25μF	16V.	5μF	50V.	25μF	6V.	200μF	3V.
2μF	3V.	5μF	70V.	25μF	12V.	200μF	4V.
2μF	9V.	6μF	12V.	25μF	15V.	200μF	12V.
2μF	15V.	6μF	15V.	25μF	25V.	200μF	16V.
2μF	50V.	6·4μF	40V.	25μF	30V.	200μF	18V.
2μF	70V.	8μF	3V.	30μF	6V.	250μF	2·5V.
2μF	150V.	8μF	6V.	30μF	10V.	250μF	9V.
2·5μF	16V.	8μF	50V.	30μF	15V.	320μF	2·5V.
2·5μF	25V.	8μF	275V.	32μF	1·5V.	350μF	9V.
3μF	3V.	10μF	6V.	40μF	3V.	350μF	12V.
3μF	12V.	10μF	10V.	40μF	6·4V.	500μF	4V.
3μF	25V.	10μF	12V.	50μF	6V.	500μF	6V.
3·2μF	6V.	10μF	25V.	50μF	9V.	640μF	2·5V.
3·2μF	6·4V.	12μF	20V.	50μF	12V.	750μF	18V.
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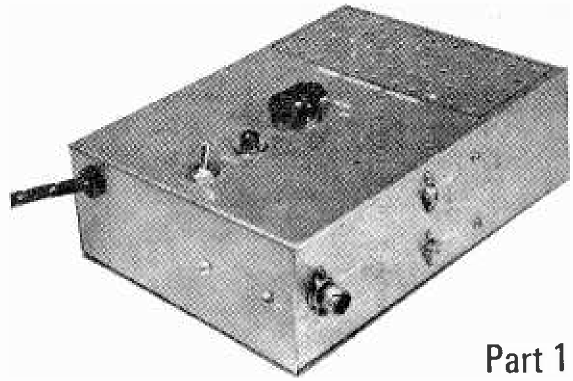
CRYSTAL CALIBRATION OSCILLATOR

R. C. KITCHING



Part 1

NEXT to the multimeter, a good crystal calibration oscillator is probably one of the most useful pieces of test gear to the radio enthusiast. Apart from its obvious use in calibrating receivers, it can also be used to calibrate or check the calibration of v.f.o.s, signal generators, g.d.o.s, absorption wavemeters, etc. Furthermore, since the frequency of the signals it generates is to all intents and purposes constant, it can be used to detect and estimate any frequency drift in such instruments.

For example, to determine the frequency drift of a v.f.o. tunable over the range 1·8 to 2·0Mc/s, the station receiver is tuned to say 1·9Mc/s, the calibration oscillator switched to 100kc/s and the output lead placed near to the aerial socket of the receiver, when a "swish" should be heard in the speaker, and the v.f.o. then tuned to 1·9Mc/s and adjusted to "zero beat" with the signal from the crystal oscillator. Any subsequent drift in the v.f.o. will be indicated by the production of a low growl in the speaker, the pitch gradually rising with further drift. The amount of drift can be estimated from the pitch of this beat note. Alternatively, for a more accurate measure, a variable frequency audio oscillator may be tuned so that the pitch of the note it produces is the same as that emanating from the speaker; the drift in c/s can then be read from the dial of the audio oscillator.

BASIC REQUIREMENTS

In order that full advantage may be taken of the facilities that a crystal calibration oscillator offers, certain basic requirements are necessary in the design.

(1) In addition to the usual 100kc/s crystal, another crystal with a frequency of 1Mc/s should be available so that the extent of a particular tuning range in an uncalibrated receiver may be quickly determined. The amateur bands enthusiast may prefer a 3·5Mc/s crystal here for rapid location of the l.f. end of the amateur bands below 80 metres.

Furthermore, facilities are desirable for filling in the gaps between the 100kc/s bars, this being necessary on the long waveband of broadcast receivers, the l.f. ranges of communications receivers and, in the case of high grade communications receivers, the h.f. ranges also. The fundamental frequency chosen was 10kc/s, though this may be modified as described later.

(2) The harmonics on all three fundamentals should be audible right up to the highest usable frequency on the receiver, which may be taken as about 15Mc/s on broadcast receivers, or up to 30Mc/s on communications receivers, the limit being set here.

Thus in addition to the class C crystal oscillator, a harmonic producing (distorter) stage is desirable though not essential.

(3) The unit should be completely reliable; it should have its own built-in, cool-running power supply unit, should not overheat after a few hours continuous use and should be unaffected by mechanical vibration and warm up.

In addition it should have a professional appearance, convenient yet attractive layout of controls, and should be self-contained without protruding crystals, valves etc.

CIRCUIT DESCRIPTION

The complete circuit diagram of the unit is shown in Figs. 1 and 2.

Valve V1, an EF80, and the associated circuitry form the crystal oscillator, with feedback obtained by tapping the cathode into the earth-grid capacitance. R1 and R3 are the usual grid bias resistors. R3, shunted at r.f. by C3, provides grid bias under all conditions, R1 providing grid bias only when grid current is flowing, i.e. when the valve is oscillating. The safety bias produced by R3 is necessary when neither of the crystals is switched in circuit. The value of these resistors is such that the amount of bias pushes the valve into class C operation, and the output of this stage is thus rich in harmonics.

The anode current through the valve varies in sympathy with the frequency of the oscillations in the grid circuit, and a corresponding r.f. voltage is produced across R4. This r.f. voltage is fed back into the grid circuit at the capacitance tap between C2 and either C1 or TC2, depending on which crystal is in use. The addition of C4 was found necessary to remedy a tendency towards parasitic oscillation.

In the prototype, the dual crystal unit type Z.A. 13327 was used. This unit contains two crystals, for 1Mc/s and 100kc/s, and the three-pin base fits a UX5 valveholder. Viewed from underneath, pin 2 is connected to one end of the 100kc/s crystal, pin 4 to one end of the 1Mc/s crystal, pin 3 being the common connection.

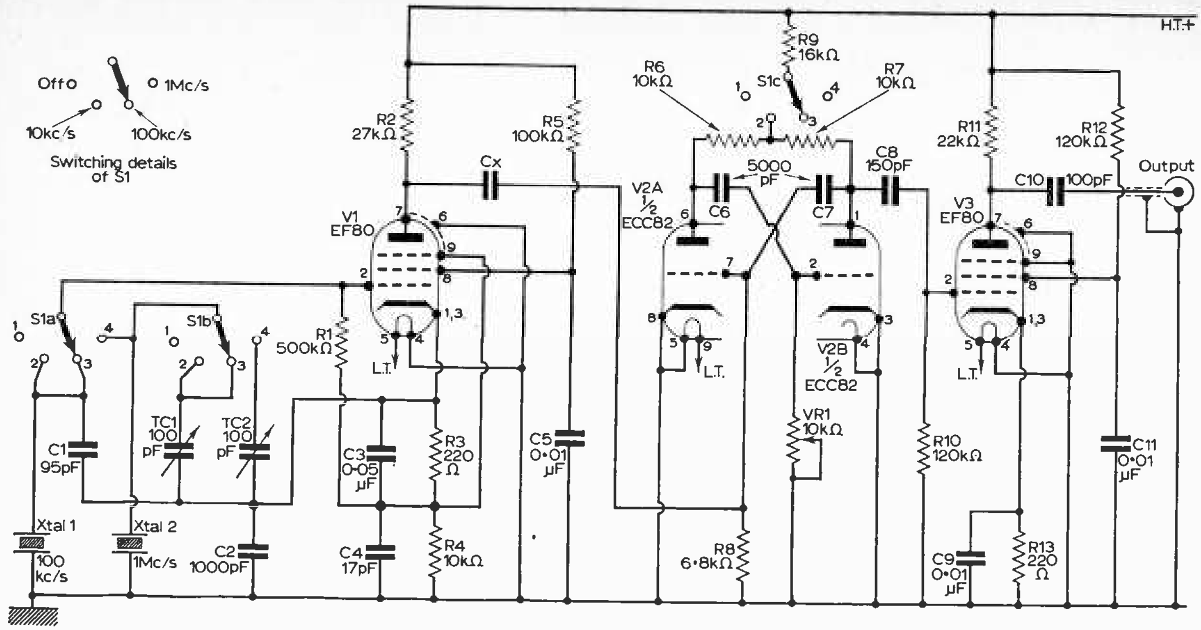


Fig. 1: Circuit of the complete unit minus the power supply arrangements.

The author considered it desirable to employ two trimmers so that both crystals could be made to zero beat with the MSF transmissions on 5·0Mc/s, instead of just providing this facility for the 100kc/s crystal as is more usual. This enables the constructor to accurately mark in the 1Mc/s divisions first of all and then to fill in the gaps with 100kc/s bars and finally (where applicable) the 100kc/s divisions with 10kc/s bars.

CRYSTAL OSCILLATOR STAGE

The original "lash-up" circuit for the oscillator is shown in Fig. 3, where it can be seen that the grid is switched between the 100kc/s crystal and TC1 (for the 100kc/s bars) and the 1Mc/s crystal and TC2 (for the 1Mc/s bars). It was found, however, that with this arrangement TC1 had virtually no effect on the frequency of oscillation of the 100kc/s crystal which was removed from that of the MSF transmission, but that TC2 could not only be adjusted to make the 1Mc/s crystal zero beat with MSF, but, with re-adjustment, would also make the 100kc/s crystal zero beat with the MSF transmissions (with the switch in the position so that the 100kc/s crystal is in circuit of course).

It was thus found necessary to modify the arrangement shown in Fig. 3 to that shown in the final design (Fig. 1). Here, TC1 is replaced by a capacitor with a nominal value of 95pF, and a switch S1b is introduced which switches either TC2 across the 1Mc/s crystal, this crystal being simultaneously connected to the grid by S1a, for 1Mc/s bars, or TC1 across the 1Mc/s crystal, the 100kc/s crystal being simultaneously connected to the grid by S1a, for 100kc/s bars. In this way, the 100kc/s crystal and the 1Mc/s crystal may be made to zero beat by adjustment of TC1 and TC2 respectively.

Should constructors find this dual crystal unobtainable, or have in their possession two separate crystals, then these can be used with confidence in the circuit shown in Fig. 3, though due consideration must be made regarding their size and the type

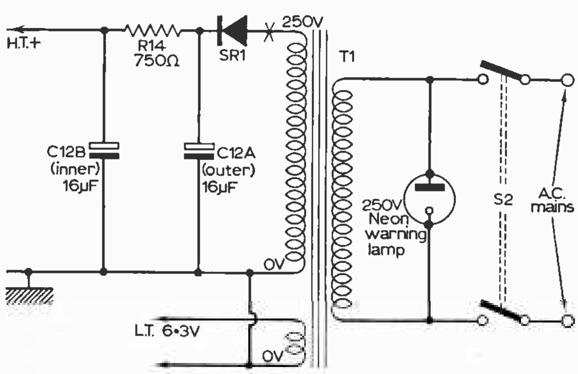


Fig. 2: Circuit of the power supply system.

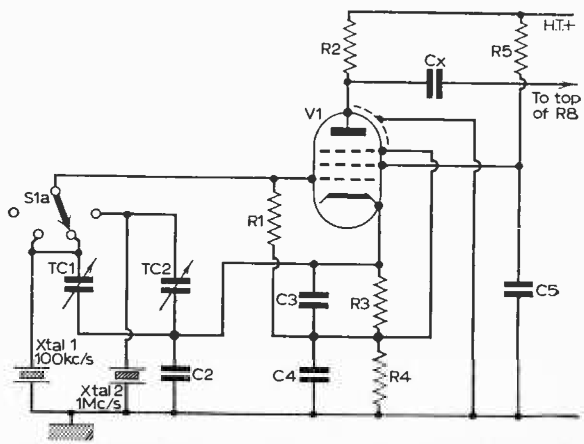


Fig. 3: Original "lash-up" of the crystal oscillator stage.

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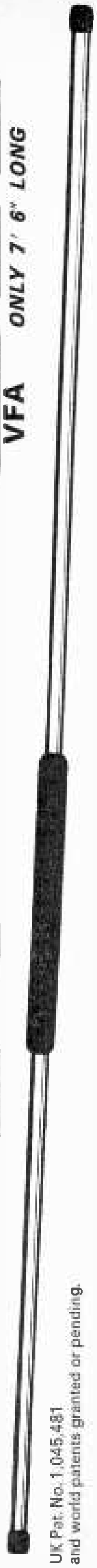

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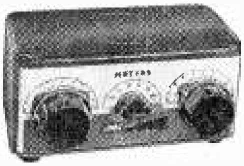

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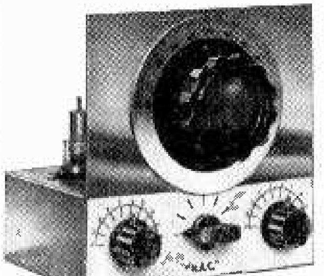

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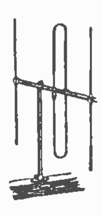

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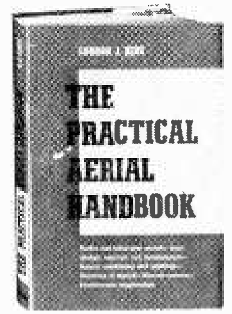

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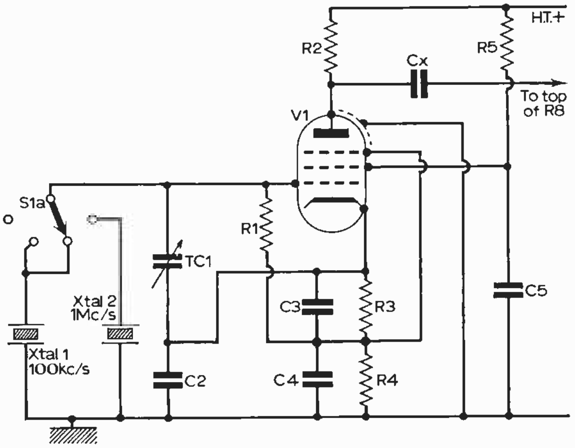

Fig. 4: Oscillator circuit with only one crystal tuned.

of holder they require. Those contemplating the use of separate crystals may prefer to use a different value, for example 3·5Mc/s, for the second crystal.

Constructors who consider the complexities involved in tuning both crystals not worth while are referred to Fig. 4 where the 100kc/s crystal only is tuned. This circuit may, of course, be used with separate crystals also.

Though 100kc/s crystals, especially surplus ones, tend to be sluggish in oscillating, no difficulty was experienced in this respect in the circuits shown, though the author had found it very difficult to make this crystal oscillate in preliminary experiments using different types of oscillator stage.

MULTIVIBRATOR STAGE

V2 is a twin triode type ECC82, the two halves with the associated circuitry forming a multivibrator oscillating at a frequency of about 10kc/s, though this may be increased to 20kc/s or so.

The stability of a multivibrator on its own is, of course, far from adequate for use in a calibration oscillator. However, by borrowing a technique from the television technicians, and synchronizing the multivibrator with the output from the crystal oscillator, operating on 100kc/s, in much the same way as the free-running timebase in a TV receiver (which is in fact generally a multivibrator) is synchronised by the sync pulses in the signal, the stability of the multivibrator is made dependent on the stability of the crystal oscillator and is thus very high.

The sync is applied to the grid of V2A by soldering a piece of insulated wire to V1 anode and wrapping the free end round the lead from R8 to V2A grid. The coupling is thus capacitive and is shown on the circuit (Fig. 1) as Cx.

With S1 in the 1Mc/s or 100kc/s position, the multivibrator is rendered inoperative by removing its h.t., the output from V1 then passing through Cx, C7 and C8 in series to the grid of the harmonic generator V3.

With S1 in the 10kc/s position, however, the multivibrator is operative and the crystal oscillator operating at 100kc/s. The crystal oscillator synchronises the multivibrator and the waveform at the

★ components list

Resistors:

R1	500kΩ	R8	6·8kΩ
R2	27kΩ	R9	16kΩ 3W
R3	220Ω	R10	120kΩ
R4	10kΩ	R11	22kΩ
R5	100kΩ	R12	120kΩ
R6	10kΩ ½W	R13	220Ω
R7	10kΩ ½W	R14	750Ω 3W
VR1	10kΩ carbon or w.w.		

(All ¼W 20% carbon unless otherwise stated)

Capacitors:

C1	95pF silver mica
C2	1,000pF silver mica
C3	0·05μF ceramic
C4	17pF silver mica
C5	0·01μF ceramic or paper
C6	5,000pF silver mica
C7	5,000pF silver mica
C8	150pF ceramic or mica
C9	0·01μF ceramic or paper
C10	100pF ceramic or mica
C11	0·01μF ceramic or paper
C12	16+16μF electrolytic 450V
TC1	100pF
TC2	100pF

TC1, TC2: air spaced with insulated mounting bushes. (If unavailable, normal type may be used, but moving vanes must be insulated from chassis by mounting in a grommet.)

(All 350V min. d.c. wkg. unless otherwise stated)

Transformer:

T1 Mains transformer with suitable primary. Secondaries: 0–250V 40mA; 6·3V 1·5A

Valves:

V1 EF80 V2 ECC82 V3 EF80

Rectifier:

SR1 Miniature silicon rectifier 350V 50mA

Switches:

S1 3-pole, 4-way rotary
S2 2-pole, 2-way mains toggle

Crystals:

Dual crystal unit 100kc/s and 1Mc/s type Z.A. 13327 (obtainable, price 22s.6d., from Henry's Radio Ltd., 303 Edgware Road, London W.2). Alternatively separate crystals may be used—see text.

Miscellaneous:

Metalwork, see text. 3 B9A valveholders; 1 UX5 valveholder (see text); 3 tag strips; 1 stand-off insulator; 2 earthing tags. Mount for electrolytic capacitor. 1 coaxial plug and socket; 2 yards coax; 2 crocodile clips. 2 yards mains cable; mains plug; grommet. Suitable nuts and bolts; self-tapping screws. Pointer knob for S1; 250V mains neon warning lamp. Hammer finish paint; transfers, etc. Rubber feet.

control grid of V3 will consist of the 10kc/s fundamental together with a large number of harmonics. (As a result of the sharp transient at the change-over point in a multivibrator output waveform, the output from a multivibrator is extremely rich in harmonics.) Superimposed on these will be the 100kc/s bars, and as a result every tenth 10kc/s bar will sound louder than the previous nine.

Should the 10kc/s bars not be required, then the multivibrator stage is omitted and the free end of the wire from pin 7 of V1 wrapped round the lead from R10 to pin 2, V3.

HARMONIC GENERATOR

V3, another EF80 high slope pentode, functions as a harmonic generator. The essence of any harmonic generator is that it cuts off during part of the cycle and as a result produces steep transients in its output waveform which is thus rich in harmonics; the steeper the transients, the more the output will approach a square wave which theoretically contains harmonics up to infinity.

This switching action is obtained here by biasing the valve into class C, see Fig. 5. The valve is cut-off for most of the cycle, though the positive peaks of the input waveform reduce the (negative) grid bias sufficiently to allow the valve to draw anode current. Thus the output from the valve consists of a series of pulses of short duration. By using a valve with a high mutual conductance and applying a fairly high anode voltage (i.e. increasing the gradient of the Ia/Va characteristic), the height of the output pulses for the same fraction of the grid cycle during

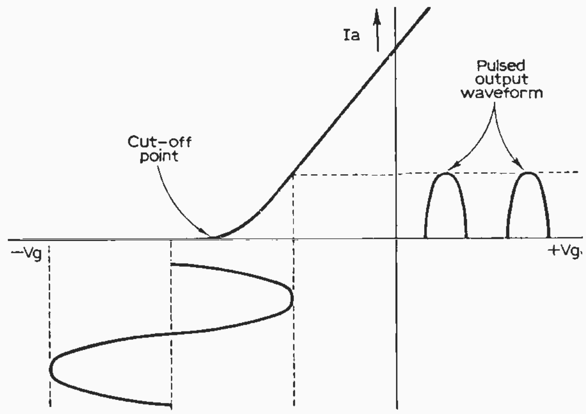

Fig. 5: Class C valve operation.

which the valve conducts can be increased and the sides made more vertical so that the waveform approaches the ideal square wave.

The output from this valve is taken via C10 and a length of coax to the output (coaxial) socket.

The power requirements for the unit are easily met and a circuit diagram of the built-in power supply unit is shown in Fig. 2. The constructor may wish to include a 40mA fuse at "x" to protect the transformer and silicon rectifier against possible overload.

to be continued

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

ISSUES WANTED

. . . September 1966 issue of *Practical Electronics* and/or December 1966 issue of P.W.—R Howard, 176 Wanstead Park Road, Ilford, Essex.

. . . May, June and July issues of P.W. featuring the Double Conversion Communications Receiver.—M. C. Mulchay, Castlelyons, Fermoy, Co. Cork.

. . . issues of P.W. that dealt with the construction of the Spectreuphon.—S. G. Murray, 30 Bonnyrigg Road, Eskbank, Dalkeith, Midlothian.

. . . issue regarding the 10 metre conversion for an 1155 receiver or alternatively details of 150 metre converter.—P. Cliffe, 13 St. Christopher Close, Upton, Chester.

. . . P.W. issues for Jan., Feb. and Mar. 1966 and Jan., Feb., Mar. and Apl. 1967.—M. I. Nicholls, 15a Iverson Road, Basement Flat, Kilburn, N.W.6.

. . . Jan. 1964, July 1964 and June 1964 issues of P.W.—M. P. Chandler, 58 Pentre Poeth Road, Bassaleg, Monmouthshire.

. . . issue of P.W. containing details of 15+5 Amplifier.—R. Conway, 113 Park Road, New Barnet, Hertfordshire.

. . . December 1965 issue of P.W. containing part 1 of the L.C.R. Bridge.—P. Vollans, 94 Marlborough Gardens, Upminster, Essex.

. . . May 1964 issue of P.W. concerning the mains distribution panel.—G. D. Sloan, Tudor Lodge, Leigh Place, Cobham, Surrey.

. . . July 1960 issue of P.W.—G. Lines, 14 Church Hill West, Brixham, S. Devon.

. . . August 1960 issue of P.W.—J. R. W. Brown, 38 Muirfield, Perth.

. . . the issue of P.W. containing the blueprint and text for the 35 Watt Guitar Amplifier.—A. Saxton, 31 Westhill Road, Grimsby, Lincolnshire.

. . . all the issues of P.W. in 1965 except the March issue. Also required, the 1966 issues January to April inclusive complete with blueprints etc.—G. W. Jackson, Flat C401, Henry Price Building, Clarendon Road, Leeds 2.

. . . March to June 1964 issues inclusive containing Junior Crystal Set articles.—K. G. Farran, 26 Belgrave Road, Cadishead, Nr. Manchester.

. . . the January and February 1967 issues of P.W.—A. Keith, 68 Corse Bar Road, Paisley, Scotland.

. . . January 1966 issue of P.W. Willing to swop October 1965 and February 1964 issues of P.W. for this.—T. Tappenden, 13a Stratford Road, Wolverton, Buckinghamshire.

. . . the blueprint featured in the December 1963 issue of P.W. describing the Beginners' 10W Transmitter.—D. Westwood, 48 Waitwith Road, Catterick Camp, Yorkshire.

. . . March, April, and May 1966 issues of P.W.—W. Rogers, 27 Merebrook Road, Macclesfield, Cheshire.

. . . June 1965 issue of P.W. and the December 1966 issue of P.W.—B. Rooney, Glencor P.O., Sligo, Eire.

. . . the issue containing the text for the P.W. Progressive Short Wave Superhet.—G. W. West, 26 Southdown Caravan Park, Drayton. Nr. Abingdon, Berkshire.

. . . the January 1967 issue of P.W. containing details for the Explorer v.h.f. Receiver.—W. H. Kemp, 19 Kirkwood Crescent, Leeds 16.

. . . the issue of P.W. containing an article on Chromasonics.—E. Chatfield, 31 Dunston Hill, Tring, Hertfordshire.

. . . the August 1964 and May 1965 issues of P.W.—M. Hewitt, 3 St. David's Drive, Quinton, Birmingham 32.

TAPESPONDENTS WANTED

. . . anyone using a tape recorder having speeds $1\frac{7}{8}$ and $3\frac{3}{4}$ i.p.s. and with 5in. spools. My interests are amateur radio, philately, and most types of music.—R. Garvey, 12 Coberley Road, Benhall, Cheltenham, Gloucestershire.

. . . anyone anywhere in the world who is interested in SWL, and radio and electronics in general. I have a Philips 4-track recorder with speeds $1\frac{7}{8}$ and $3\frac{3}{4}$ i.p.s. and 7in. spools. I am 15 years old.—J. Thomas, 24 Bethania Road, Upper Tumble, Nr. Llanelli, Carms., South Wales.

CORRESPONDENTS WANTED

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

ISSUES FOR DISPOSAL

. . . December 1964, March 1966, May 1966 to April 1967 inclusive issues of P.W. and the October 1966 issue of *Practical Electronics*.—R. H. J. Bowen, "Oakley Dene", 62 Roundmead Avenue, Loughton, Essex.

. . . January 1958 onwards with all the blueprints. I also have a number of issues dating back to 1949.—A. R. McEwan, 80 Comiston Road, Edinburgh 10.

. . . more than 100 issues dating between 1958—66. Please enclose a 1s. airmail for reply.—B. C. Goyal, 123 Sanghi Street, Mhow (M.P.), India.

. . . 1958 November, 1959 September, November, 1960 January, February, June, July, September, December. 1961 twelve issues. 1962 twelve issues. 1963 twelve issues. 1964 twelve issues. 1965 twelve issues. 1966 twelve issues. 1967 January and February. Blueprints are included with the relevant issues and I have some self binders.—M. East, 41 Avenue Close, Avenue Road, London, N.W.8.

. . . November 1966 issue of P.W.—D. S. Panesar, 24 Maryhill Road, Glasgow N.W.

INFORMATION WANTED

. . . any information on the 1475 surplus receiver.—Fl/Lt. W. C. Brown, Plas Amherst, Harlech, Merionethshire.

. . . any information on the type of battery and the voltage and the proper crystal to use in a Talbe transceiver, cat. BE226 type 9092, ref. 10D/19831 (Burndept, Erith, Kent).—R. Gauci, 21 South Street, Valletta.

. . . a plan of a tube checker with accompanying chart. I will return promptly after copying them.—Amir Wassef, 42 Rue Abou Helf, Saba Pacha, Alexandria, U.A.R.

. . . circuit for a V. R. Electrometer with indicator type 1079C, cat. No. 3–7/6651, serial No. 203 and Electrometer type 3–7/6652.—R. Tuffin, 49 Hill Drive, Hove 4.

. . . circuit for an amplifier using 6N7's only. Preferably parallel push-pull, about 40–50W using them as triodes.—J. Merlin, 14 Fanny Moor Crescent, Lowerhouses, Huddersfield, Yorkshire.

. . . any information regarding ex-U.S. Government v.h.f. receiver type 1585 ref. 10/D 2654. It also has a small plate marked R-H/AR22. It uses 11 valves and measures $4\frac{1}{2} \times 5\frac{1}{2} \times 8$in.—J. Leman, 15 Preston Road, Lytham, Lytham St. Annes, Lancashire.

. . . manual circuit and any other information on ex-W.D. Oscillograph No. 1, Mk.2 WYO212.—H. Lakin, P.O. Box 52, Limbe, Malawi.

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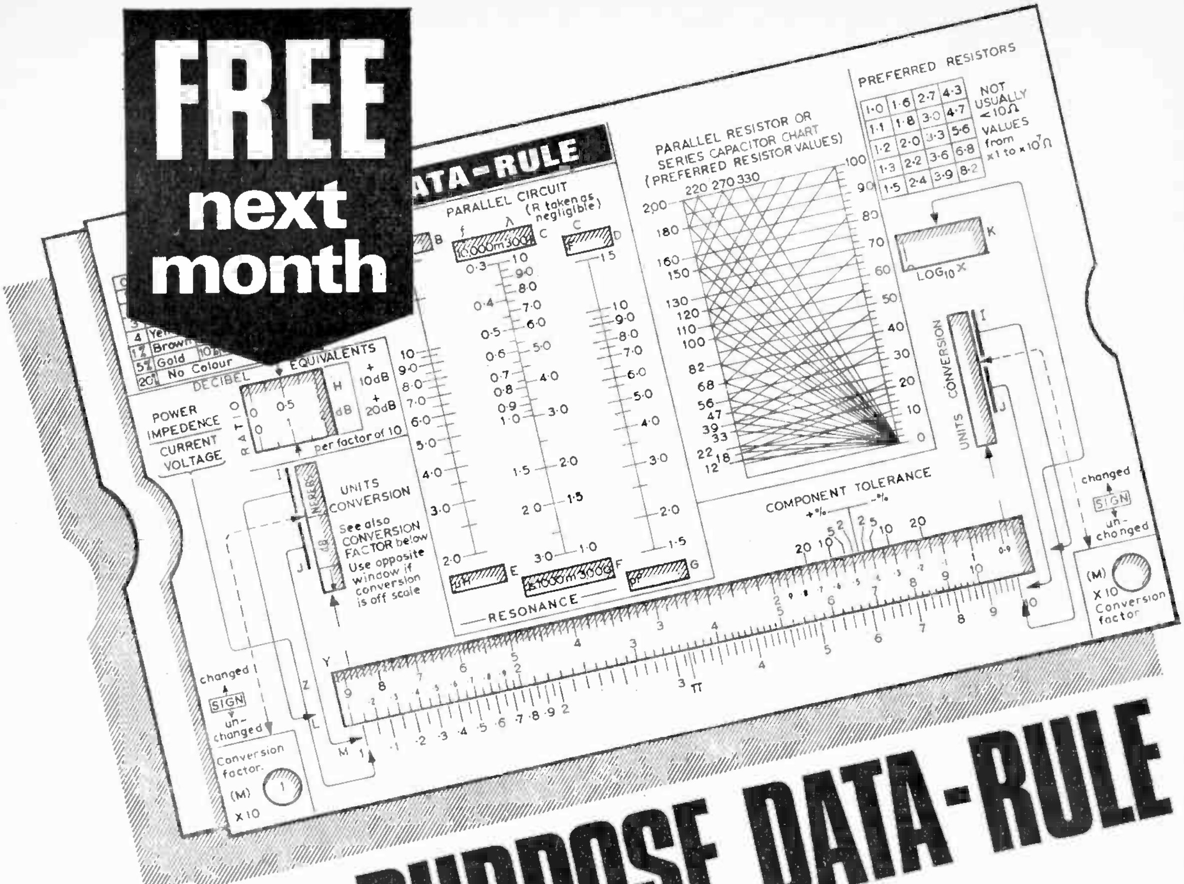

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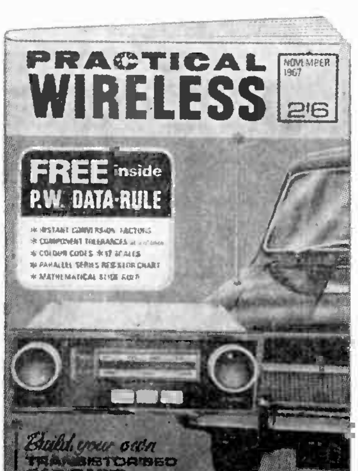

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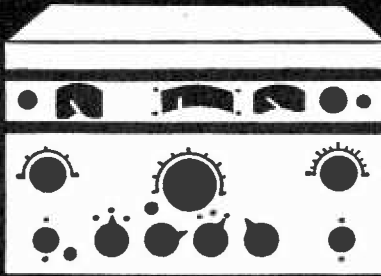


Guide to Surplus Communications Receivers

K. ADKINS

PART 3

The CR100 and CR150 Series

CR100

The CR100 was made by Marconi for the British Navy during the last war. Large numbers of them have been released over a long period of time, and they are quite popular.

The frequency range is from 60kc/s to 30Mc/s in six bands. The circuitry includes a crystal filter, a b.f.o., two r.f. and three i.f. stages and a.g.c. A 230V a.c. power supply is built in, but an external loudspeaker is required. Some models have a noise limiter.

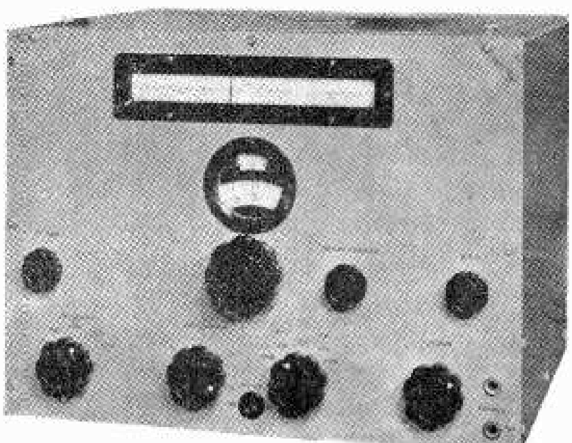
There are several variations of the CR100, all differing in minor respects. These include the CR100/2; /7; /8MOD; and /B28.

Modifications The CR100 does not require modification for normal operation. Certain models do not contain a noise limiter. The CR100 does not have an "S" meter, and it is a very common modification to add one. The performance of the CR100 may fall off a little towards the high frequency end of the range, in common with most receivers of this type. Realignment may help matters, but the usual procedure is to add an external r.f. preamplifier, or to replace the front end with miniature valves. The receiver performs quite satisfactorily on the l.f. bands, however, without any modification.

Availability Although relatively few CR100's have been released in the last few years, there are a surprisingly large number of them in amateur hands. It is believed that many of these were released in the period before 1960. These can be obtained on the second-hand market for as little as £10 in grade 2/3, good working condition.

Since 1960, there has been a constant, if small, supply of the later models to the surplus market, and these have been priced at approximately £20 in grade 2 condition. Additionally, during the latter half of 1963, a small quantity of CR100/8MOD receivers were released in grade 1 condition. These were brand new in their original transit cases, with manuals, and they were sold for a standard price of £35 each. More recently, some CR100's have been available in excellent condition for about £30.

A good, late model CR100 can be obtained on the second-hand market for £15 to £20. CR100 spares have been available in the past. CR100 manuals, however, are difficult to obtain, and second-hand prices can go as high as 50/-. As mentioned above, manuals were supplied with all receivers of the 1963 CR100/8MOD release.



The CR100

CR150

The Marconi CR150 is little known, and relatively few of them exist. It has a superb specification and performance, however. The frequency coverage is from 2Mc/s to 60Mc/s in five bands, and dual conversion is employed. The first i.f. is 1,600kc/s, and the second is 465kc/s. The image signal is 40dB down up to 30Mc/s, and 20-40dB down from 30-60Mc/s. The bandwidth is switched from 100c/s to 10kc/s in five steps. An acoustic filter for c.w. reception is switched into circuit in the 100c/s bandwidth position.

The receiver has an "S" meter, and both mechanical and electrical bandspread. The supply is stabilised, and a crystal calibrator is included. Temperature compensation is another feature of the circuit. Output is 1mW at 600Ω and 200mW at 3Ω. Sensitivity is from 1 microvolt at 2Mc/s to 14 microvolts at 60Mc/s. The CR150 can be used for diversity reception. An external power unit is required.

There are two known developments of the basic CR150, differing in various respects. They are the CR150/2 and the CR150/3, and the differences will be mentioned in the relevant sections.

Modifications It is doubtful if the performance of a receiver of this calibre can be easily improved.

Availability A few CR150's were available as early as 1961. These had been overhauled to the original specification and were priced at £75, inclusive of power unit.

A small number of CR150's were released during 1963. They were in almost grade 1 condition and were priced at £60 with the mains power unit at £10 extra. Alternatively, a suitable power unit could have been supplied for £4 10s. They did not sell very well, because anyone with £60 or £70 to spend on a receiver would not normally contemplate buying a surplus one. Consequently, about a year later in 1964, the price was reduced to £49, without power unit. The price was further reduced to £39 in 1965, and nearly all CR150's had been sold by the end of last year.

CR150/2

This receiver has a similar specification to the CR150, but with a smaller frequency range of 1·5 Mc/s to 22Mc/s in four bands.

Availability A quantity of CR150/2's in grade 1/2 condition were released with the CR150's in 1963. They were priced at £35, power units extra as for the CR150. The price was reduced to £31 in 1965, and a further reduction was made to £26 in the summer of 1966. They are no longer available at this price, but some CR150/2's were made available at the beginning of this year, priced at £45 inclusive of power unit.

CR150/3

The CR150/3 has a similar specification to the CR150, with several important differences. It has a crystal controlled first oscillator, for fixed frequency reception. A separate aerial trimmer is provided on the front panel. A muting switch is provided. The widest bandwidth of 10kc/s in the CR150 was extended to 13kc/s in the CR150/3.

Availability A few CR150/3's in grade 1/2 condition were issued with the 1963 CR/150 release, and were disposed of within a few months. They were priced at £65, with power units available for £10 or £4 10s.

CR150/6

This receiver has a similar specification to the other models in this series, but is of more recent design. The frequency coverage is 2Mc/s to 32 Mc/s in four bands, and double conversion is employed. The bandwidth can be varied between 100 c/s and 13kc/s. A crystal calibrator, noise limiter and "S" meter are incorporated.

Availability This receiver first became available only in recent months and was priced at £40, mains power unit extra.

The HRO Series

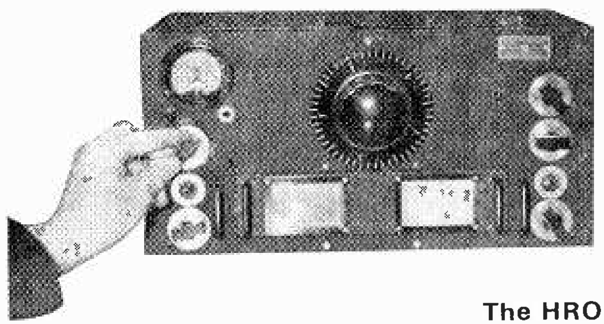
HRO Senior

This receiver, made by National of the U.S.A., is one of the most popular of ex-service receivers and is currently in use by many amateur stations. It was introduced in 1935, when it ranked among the more expensive receivers available for commercial use. It soon established a reputation for reliability. Its superior performance was due mainly to the sound design and construction to precision standards.

During the last war, large numbers of these receivers were built for the services both in the U.S.A. and in this country and these are the ones that are currently available on the surplus market. The models usually encountered are the HRO, HROM, HROMX, HRO5T, and HRO5R, all of which, apart from slight differences, are fundamentally alike. The HRO contains 9 valves as follows:—

HRO, HROM, HROMX (UX Types)	**HRO5T, HRO5R** (Octal types)
1st R.F. Amplifier 6D6	6K7M
2nd R.F. Amplifier 6D6	6K7M
Mixer 6C6	6J7M
O cillator 6C6	6J7M
1st I.F. Amplifier 6D6	6K7M
2nd I.F. Amplifier 6D6	6K7M
Detector 6B7	6SQ7M
B.F.O. 6C6	6J7M
Output 42	6V6GT/G

The HRO5T and 5R models, fitted with metal octal valves, were modified versions developed specially for the services. They are similar to the original models, but are not quite so sturdy in construction, and they have a tendency to drift. The HRO5T and 5R versions are fitted with a 0-1mA milliameter, whereas the original HRO has a calibrated "S" meter. The HRO5T is the table model, the HRO5R is for rack mounting. The HRO Junior is similar to the HRO Senior, but does not have a crystal filter or an "S" meter.



The HRO

The receiver covers from 50kc/s to 30Mc/s by means of a set of nine plug-in standard coil units. In addition, bandspread coil units were available for the 3·5, 7, 14, and 28Mc/s amateur bands. The standard coil ranges are:—

50—100kc/s	480—960kc/s	3·5—7·3Mc/s
100—200kc/s	900—2050kc/s	7·0—14·0Mc/s
180—430kc/s	1·7—4·0Mc/s	14·0—30·0Mc/s

The HRO has a unique dial, which is rotatable through 500 divisions, representing about ten feet of scale length.

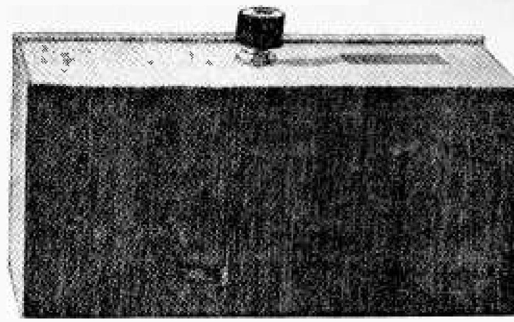
The front panel controls are: R.F. gain, audio gain, selectivity control, crystal phasing control, B.F.O. control, H.T. switch, A.V.C. switch and "S" meter switch.

By adjustment of phasing control and selectivity control, receiver bandwidth can be varied from 2·5 kc/s to 200kc/s. The i.f. is 456kc/s.

Headphones can be plugged into the socket provided on the panel. Output for a loudspeaker is obtained from two sockets at the rear of the cabinet, but an output transformer is not included in the receiver, and this must be provided. A loudspeaker must *not* be connected directly to the output sockets.

The HRO does not have a built-in power supply, but requires 230 volts d.c. at about 75mA and 6·3 volts at 3·1amps. (centre tap). Aerial and earth terminals are provided at the left side of the cabinet.

—continued on page 442



THE receiver described here will fulfil any need for a simple self-contained portable capable of tuning in stations with the absolute minimum of trouble. Its compact layout, small size and low cost make it an ideal receiver for the amateur constructor. It also makes a very acceptable "present" for the lady of the house, and will give a good account of itself wherever it is used. The case is simple yet presentable, and the circuitry involved is absolutely straightforward and devoid of frills.

Although the set is essentially an eight transistor m.w. receiver, it is only necessary to actually wire up three simple transistor stages. To this end use is made of a cheap but very efficient amplifier which is purchased ready-wired and requiring only one very slight modification to make it suitable for the purpose required. To eliminate hunting for stations the tuning is pre-set and all that is required to tune in to a station is to turn the selector switch. The on/off switch is also incorporated in this control thus eliminating the need for an extra knob. There are, in fact, only two controls. An on/off and station selector switch, and a volume control. Modifications of a very simple nature indeed are suggested at the end of the article to enable continuous tuning to be used as well as pre-set if desired.

Referring to Fig. 1, the three stages to wire up are the mixer, i.f. and detector, the a.f. panel being already wired. As shown the normal variable ganged tuning capacitor is omitted and is replaced by a switch and four trimmers. In the author's case the three switch positions are—Off, London Home Service and London Light Programme. It is possible of course to adjust the trimmers to tune-in any station in the medium waveband, thus a selection might be—Off, Luxembourg and West of England Home Service etc. It is possible to increase the choice of stations available by simply increasing the number of positions on the selector switch, and adding another pair of trimmers for each additional station required. Also, some constructors might prefer to use the selector switch purely for the purpose of station selection and in this case a simple on/off switch could easily be added at any convenient position in the case, its function being solely to break the negative line from the set to the battery.

By utilising different coils and capacitor values it should be possible to get the receiver working on the trawler bands which could also include the 160 metre amateur band. However, the coils must be suitable for use with a 455kc/s i.f. and these modifications have not actually been tried, thus no concrete advice can be offered.

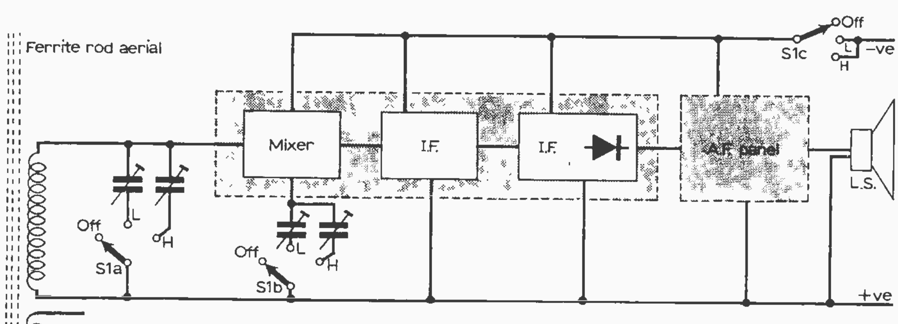


Fig. 1: Block schematic showing the arrangement used in the receiver.

I.F. STRIP

In the prototype the mixer, i.f. stages and detector are wired up on a standard 18 way tag-strip which was pruned down to 14 tags by cutting the excess strip off with a hacksaw. On reflection it would be advisable to leave the extra tags on since these would afford very useful anchoring points for the transistors and other floating leads. However, to avoid confusion it is assumed that the constructor will ignore the hint regarding the extra tags and will in fact use a modified 14 tag board or strip.

The numbering of the tags is from left to right i.e., mixer, i.f., detector, the detector stage being on the extreme right-hand end of the strip. First, the oscillator transformer and the three i.f. transistors are orientated in each instance so that the side with three pins is on the left and the side with two pins is on the right.

The four transformers are soldered directly to the appropriate tags via their cans. The inside tag end on the strip is, in each case, pushed down so that it just touches the walls of the screening can on both sides. Holes should be cut in the back of the tag strip in register with the holes at the tops of the cans which will allow adjustment of the cores later when lining up the i.f.t.'s should this prove necessary. The remaining resistors and capacitors may now be wired up on the tag strip leaving only the four trimmers, the switch and the speaker to wire up.

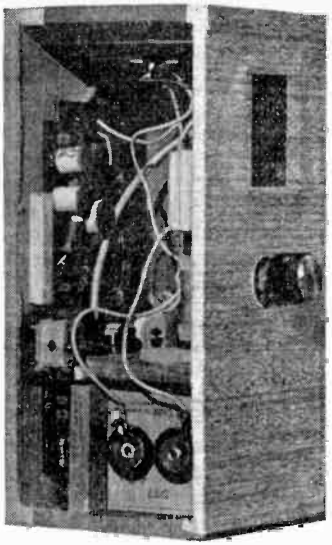
The pins on the i.f.t.'s are small and the composition in which they are set is susceptible to heat. Thus connections to these pins should be done as quickly as possible. Use a hot iron, and tin the wires of the relevant components prior to soldering. With a hot iron and tinned leads, connections to the i.f.t. pins should need only a touch of the iron.

The connections between the remaining components and units are all made while the units are out of the case, the wire for these leads being

IE

USIC

BOX



W.E.DODD

approximated. Note that both the input and output leads to and from the audio amplifier must be screened. After a check of all wiring the lining-up procedure can be followed after which the units may be lowered gently into the case and fixed in position as described later. Be careful of the leads to the ferrite rod aerial since the wire is very fine and easily broken. The prototype was produced in rather a hurry and constructors will doubtless improve upon the crude (but simple and cheap) method of securing the various units inside the case.

When checking, ensure that all the + leads are earthed—it's very easy to forget one. This especially applies to the cans of the i.f.t's since if these are not taken to earth instability seems practically guaranteed. Note that the emitter bias resistor and capacitor in each stage are twisted together and wired in as one component between the relevant tags on the strip.

The transistors Tr1, Tr2 and Tr3 are wired in last of all thus obviating the danger of touching them unwittingly with a hot soldering iron. Although the heat may not destroy them it can quite easily alter their characteristics. In the photograph of the strip, the transistors are omitted for clarity.

It is helpful to mark the collector side of the transistors with a spot of paint or a pencil for quick and easy indentification when wiring them in. Also advisable is the use of thin sleeving on the transistor leads to avoid them shorting although this precaution was not taken with the prototype.

A.F. BOARD

The audio unit is sold complete with a suitable loudspeaker. It is an amplifier which was originally intended for use with a small tape recorder, however it functions very well in the application used here.

There are two possible inputs, one across the volume control, and the other at the microphone input. The mike input was chosen because this gave extra sensitivity, and the volume control seemed to work rather more smoothly. On the amplifier board there is a small pre-set potentiometer and this is adjusted when the set is working for greatest volume consistent with acceptable distortion etc. In the author's case the best position was with the wiper almost extreme anti-clockwise although the setting is not critical.

The jack socket at one end is removed and any switch or spare wires at the other end are also removed. The connections to the a.f. board are shown in the diagrams and are quite straightforward. The only modification to the board is to short RV2, the volume control, to C4. Normally these two components are wired up to a switch for the record/playback facilities on a tape recorder.

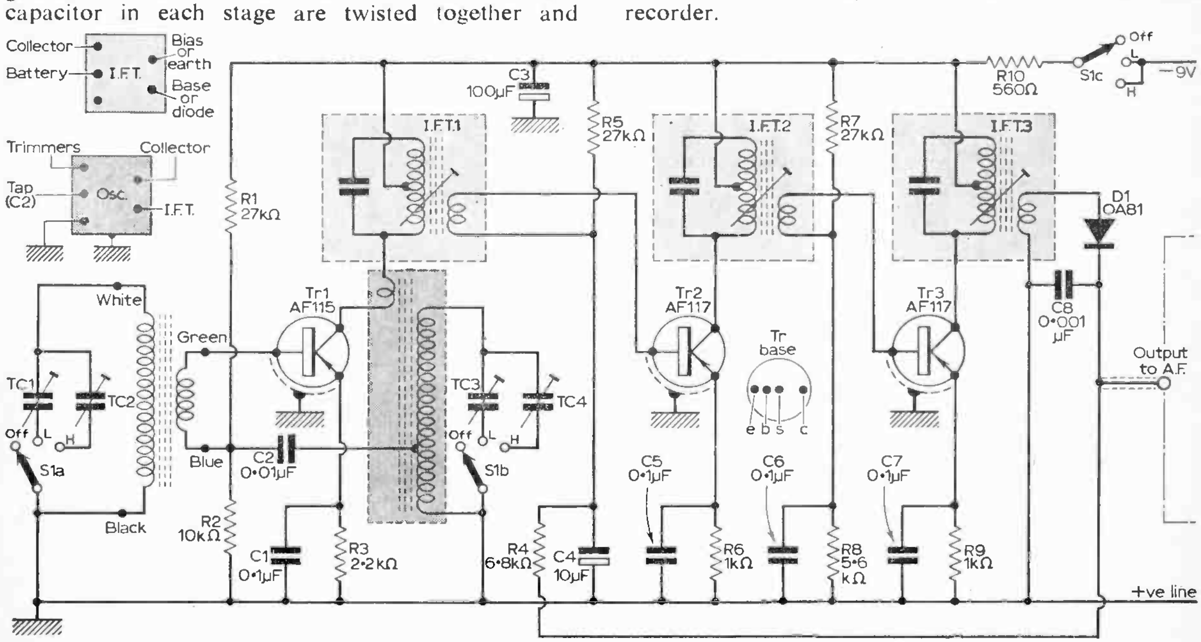


Fig. 2: Circuit diagram of the mixer, two i.f. amplifiers and the detector.

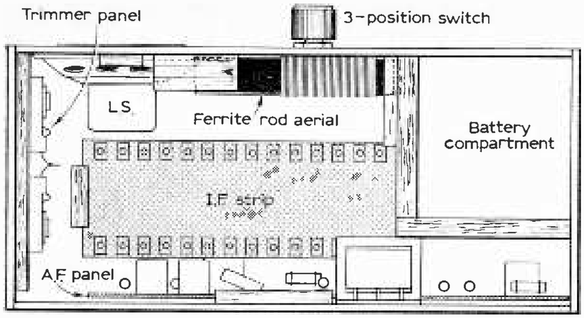


Fig. 3: General layout of the units in the case.

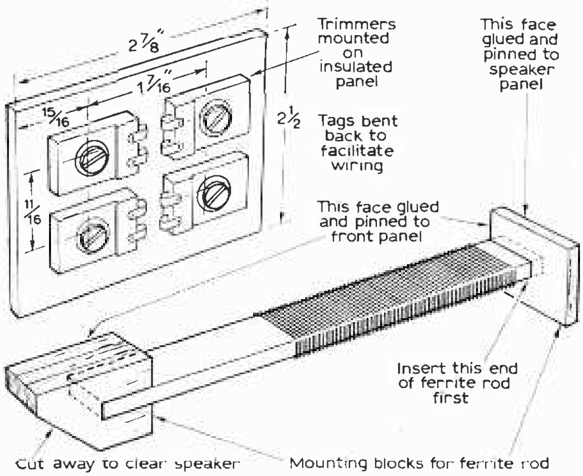


Fig. 4: Details of the ferrite rod and trimmers.

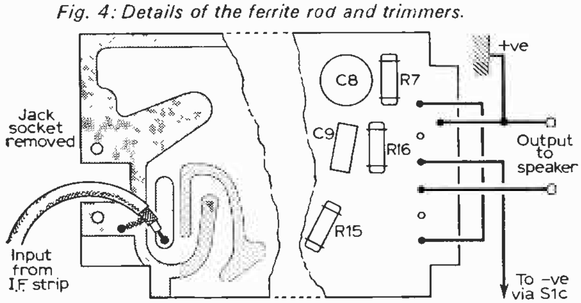
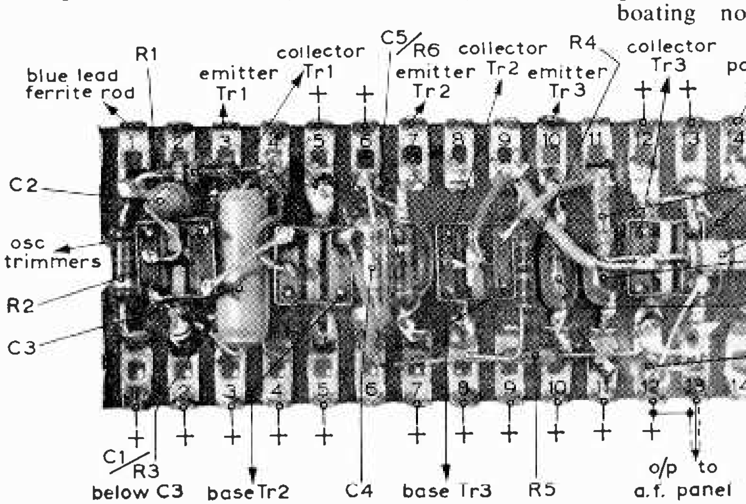


Fig. 5: Connections to the pre-wired audio amplifier.



A circuit diagram is provided with each board so there should be no problems. The input is taken to C1 on this circuit, and the output taken direct from C7, C4 is shorted to the slider of RV2 as advised above.

THE CASE

The case is made from 3-ply covered with Fablon to improve its appearance. The outside dimensions are $7\frac{1}{4}$ x $3\frac{1}{4}$ x $3\frac{1}{4}$in. this being about the smallest size which allowed easy wiring and fitting. The lid is fitted with a pair of small hinges at one end and fastened with a hook and eye at the other. The case is held together with small pins and glue. Inside the case a 2in. square compartment is provided for the battery and this is also made from scrap wood pinned and glued.

There are three holes to cut in the case. One small slot to enable the volume control to project, a round hole for the on/off-station selector switch and a cut-out for the loudspeaker. Some small pieces of wood are cut and shaped for securing the ferrite rod in position but the diagram shows these much clearer than words.

A small piece of paxolin or other insulating material is cut to $2\frac{7}{8}$ x $2\frac{1}{2}$in. and the four trimmers TC1-TC4 are mounted on this. The lugs are doubled back on themselves to allow the trimmers to be mounted in close proximity to each other. Note that the trimmers are mounted with their soldering lugs all pointing inwards.

The various units are all held in position in the case by small strips of scrap wood glued to the case. This is not a very elegant method but does boast simplicity and cheapness coupled with speed. Constructors might consider using countersunk bolts which would make a far superior job. These remarks also apply to the loudspeaker mounting.

ADJUSTMENT

First check all the wiring again, especially all earth returns. Next, ascertain which trimmer is which and make a note of these. With the units lying loose on the bench, switch on the battery and touch the input to the audio amplifier i.e., at the positive pin on C4 on the a.f. circuit diagram. There should be a loud buzzing-cum-motorboating noise from the loudspeaker. Touching the base leads of the transistors in turn from Tr3 to Tr1 should also produce rude noises from the speaker.

The trimmers TC1-TC4 can now be adjusted and in the author's case the oscillator was to be higher than the signal frequency. Thus the first pair of trimmers, one which tunes the rod and its corresponding oscillator trimmer counterpart are selected and the oscillator trimmer is unscrewed. The rod trimmer is screwed right up and from there, by careful adjustment, the desired station can be tuned in. Note that orientation of the ferrite rod will determine the strength of the received signal and this should be borne in mind when tuning up the set. The procedure is now repeated for the other pair of trimmers after which the cores of the i.f.t.'s might require some slight adjustment for optimum performance. This was not found necessary in the prototype and in the absence of suitable test equipment, these cores should be left untouched if performance is reasonable. Needless to add that those constructors who have access to a signal generator will use the recognised techniques to line up the set. This procedure has been outlined in PRACTICAL WIRELESS on numerous occasions and will not be repeated. It is assumed here that the constructor has no such equipment at his disposal.

For those requiring stations nearer to 500 metres than 200 metres, the two trimmers which tune the rod will need to be a little larger in value and 150pF instead of 110pF would be suitable.

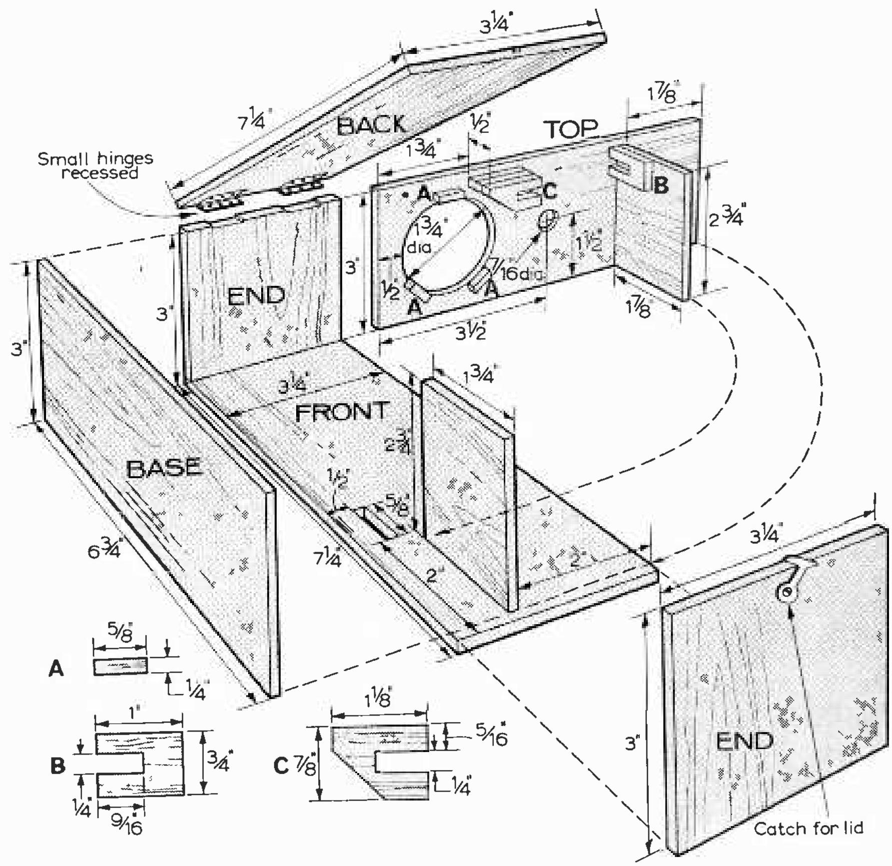


Fig. 6: Constructional details of the case and ferrite rod mounting.

Once the set is functioning satisfactorily the separate units are placed inside the case and fixed in position as advised. It is wise to mount the i.f. strip away from the loudspeaker i.e., fairly close to the a.f. board. This will help to avoid instability due to feedback.

★ components list

Resistors:
All ⅛W except R10.

R1	27kΩ	R6	1kΩ
R2	10kΩ	R7	27kΩ
R3	2·2kΩ	R8	5·6kΩ
R4	6·8kΩ	R9	1kΩ
R5	27kΩ	R10	560Ω ¼W

Capacitors:		**Semiconductors:**	
C1	0·1μF	Tr1	AF115 (OC170)
C2	0·01μF	Tr2	AF117 (OC171)
C3	100μF 12V electrolytic	Tr3	AF117 (OC171)
C4	10μF 25V electrolytic	D1	OA81
C5	0·1μF		
C6	0·1μF	**Inductors:**	
C7	0·1μF	Ferrite rod	Eagle H402
C8	0·001μF	Oscillator coil	Eagle H402
TC1—TC4	110pF trimmers	IFT1	Eagle H402
		IFT2	Eagle H402
		IFT3	Eagle H402

Miscellaneous:
Amplifier parcel including speaker mike and tapehead (Henry's Radio Ltd., 39/6, p. & p. 2/-); 18-way tag-strip; 3 pole 3 way switch; DT7 9 volt battery; Battery clips; Screened lead; Paxolin 2⅞ x 2½in.; Wood for case; Pins; Glue; Small pair of hinges; Hook and eye; Fablon to taste; Knob; Speaker gauze; Solder; Wire etc.

MODIFICATIONS

One small modification which might appeal to some would be to install a 3 pole 4 way switch the extra pole being utilised to switch in the two-gang variable capacitor supplied with the coil kit. Thus the set would then tune the whole medium waveband plus the added attraction of pre-set stations as well.

The particular coil kit specified was used purely because it was the cheapest that the author could find. There is no reason to suppose that other kits would not work but in this instance the mixer stage around Tr1 might require slight modification. Since most kits include a circuit diagram this should not present any problems.

This little receiver is not the last word in portables. However it is very handy as a set which is truly portable and can be toted round the house from the kitchen to the bathroom to provide many happy hours of entertainment. ■

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

AFRICA

Dahomey: *Radiodiffusion du Dahomey* (Boite Postale 366, Cotonou) has been heard on the new frequency of 6,060 with French at 2000.

Morocco: *Radiodiffusion Television Marocaine* (1 Pierre Parent, Rabat) now has English 1630-1800, French 1800-2000, and Arabic 0630-0900 and 1100-1500 on 11,735/15,333. There is also an Arabic programme from 1800-2400 on 9,615. Spanish is aired from 2130-2300 on 15,333.

MIDDLE EAST

Saudi Arabia: *Saudi Arabian Broadcasting* (Ministry of Information, Airport Road, Jeddah) has an Arabic programme from Jeddah on 9,670/11,855/15,150 and a separate programme from Riyadh on 7,220/11,950. Both are on the air from approximately 0500-2300.

ASIA

Pakistan: *Radio Pakistan* (Broadcasting House, Bunder Road, Karachi) now uses 15,335 for its 0030-0115 English transmission beamed to South-East Asia.

Phillipines: *Far East Broadcasting Company* (Box 2041, Manila) now transmits in English: 2155-2330 15,300/17,810; 2330-2345 15,385/17,810; 2345-0630 15,385; 0830-0900 17,810/15,440/15,300/11,890/9,710; 0900-1145 15,440/17,810; 1145-1245 11,920/15,300/15,440; 1245-1400 15,230/15,300; 1530-1630 15,230.

NORTH AMERICA

Canada: *Canadian Broadcasting Corporation* (P.O. Box 6000, Montreal) now using 15,320 for its 0100-0230 TX.

United Nations: *United Nations Radio* (United Nations, New York, U.S.A.) has news in various languages 0630-0700 on 9,610.

U.S.A.: *Radio New York Worldwide* (485 Madison Avenue, New York, N.Y.) appears now to be transmitting in English from 1630-2200 on 15,440/17,845/21,530. For portions of the TX 17,730/17,760/21,520 are also believed to be used. The DX programme is on Saturdays at 1735 and Sundays at 1935. Spanish is aired as follows: 1200-1600 17,730/15,440/15,265/17,845; 2200-2345 15,440/17,760/21,530/17,845; 0000-0100 15,355/11,855/15,215/15,440; 0100-0400 15,355/11,855/15,215/9,615. In September the station is to put 3 × 100kW and 2 × 50kW TX into service.

EUROPE

Albania: *Radio Tirana* (Rue Ismail Quemal, Tirana) transmits in English to Europe at 0000-0030 on 11,715; 0230-0300, 0630-0700, 2200-2230 on 9,715; 2000-2030 on 9,715/11,715 and to Africa and Asia 0400-0430 on 7,265/9,390; and 1500-1530 1,214/9,715.

Austria: *Osterreichischen Reudfunk* (P.O. Box 700A, 1040 Vienna) appears to transmit to Europe 0500-1300 and 1800-2200 on 6,155; 1000-1200 on 9,540; 1300-1700 9,770; 1400-1600 11,735; 1000-2200 7,245; 1500-1700 11,785. Other transmissions are: Australasia 1000-1200 17,755; India 1400-1600 11,730; Middle East 1600-1800 9,610; South Africa 1600-1800 17,750; South America 1900-2100 15,210.

Czechoslovakia: *Radio Prague* (Prague 2, Vinohradska) has English to North America 0100-0200 7,345/11,990/15,368/17,840; 0330-0400 5,930/7,345/11,990/15,368; and 1400-1500. Sundays 15,448/17,705/21,450.

France: *O.R.T.F.* (Maison de l'O.R.T.F., 116 Avenue du President Kennedy, Paris 16) has increased the power of the long wave TX on 164 to 1,100kW, making it the most powerful TX in Europe.

German Democratic Republic: *Radio Berlin International* (116 Berlin, Nalepastrasse 18-50) has English to Europe over 6,080/6,115/7,185/7,300 at 1730-1800, 2015-2045; 2200-2230; 2300-2330. Also on 1,511 at 2015 and 1,430 at 2200 and 2300. Also to North America at 0100-0130 and 0230-0300 on 9,730/11,890; 0345-0415, 0445-0515 11,840/11,920; to Africa 0345-0415 and 0615-0645 11,795; 1215-1245 and 1600-1630 21,600; 1315-1345 17,825; 1915-1945 15,340; 1600-1630 17,805; to South-East Asia 0645-0715 17,700; 1200-1230 17,700/17,880; 1315-1415 17,880; 1415-1445 15,125.

Luxembourg: *Radio Luxembourg* (Villa Louvigny, Luxembourg) is relaying its French long-wave programme again on 15,350. The frequency is audible at 0500-1400.

Poland: *Radio Warsaw* (Al Niepodleglosii 75/77, Warsaw) has English at 1200 and 1300 and French at 1230 and 1330-1400 on 7,125/11,812/15,275; French 1830 and English 1900-1930 on 11,840/15,275; English 2200-2230 and French 2230-2300 on 7,125/7,145/9,540/9,675. All to Africa.

Sweden: *Radio Sweden* (Box 955, Stockholm) now has the following frequency utilisation: 1,178 2300-2400; 6,065 2015-2115, 2130-2230; 9,625 1000-1200; 11,705 0000-0230, 0300-0430, 2130-2230, 2245-2345; 11,805 2015-2115, 0000-0230; 11,810 1100-1330, 2245-2345; 15,240 1730-1930, 1600-1700; 17,840 0445-0615, 1400-1530, 1600-1700; 21,585 1430-1530; 21,690 0900-1030, 1230-1330 and 1830-1930. Languages are English, Swedish, French, German, Portuguese and Spanish.

CENTRAL AMERICA

Netherlands Antilles: *Trans World Radio* (Bonaire) has French 2015, German 2030 and English 2100-2130 on 15,245. There is a DX programme on Fridays at 2100.

Many thanks this month go to G. Rutherford, D. M. Macleod, David C. Oates, B. C. Dewhurst, J. Horsley, A. E. Roxburgh, A. G. Clarke and the Swiss Broadcasting Corporation.

FUNNY how things change suddenly for no apparent reason at all. Take ten metres for instance. A few months ago this band was really stirring and looked "full of eastern promise". Yet the past month has produced nothing on the '3JDG receiver except a noise like frying eggs. (Large imported.) Looking at the station log for ten weeks back I see W's and PY's plus a good selection from Africa. This lack of activity has proved to be the same for other listeners too so it's not my receiver.

Fifteen has gone all patchy and developed a prima donna temperament. Sometimes there are stations but they're just as likely to vanish while you're listening to them. Faithful old twenty has provided quite a bit of DX and is always a good bet for activity.

On the LF bands 7Mc/s has turned out quite interesting, and for those who listened, there was a fair sprinkling of exotic r.f. on the loose. Topband and eighty didn't get much attention this month from anyone, and my best was a few W stations up in the American segment of the band.

The JDG/M expeditions to the South Coast proved very interesting, and my thanks to those who sent in a report on my sigs. What with fish-phone and pop pirates I did wonder if topband was going to be worth even a quick glance. Surprise surprise, the East Coast has a real following on 160. G3RGF (Danbury) and G3RHO (Silver End) have a regular sked every night at 1900 hrs BST. Look for them around the 1980kc/s mark which might vary depending on where the fish-phone decides to appear. About twenty stations were worked in all, so if you live that way, or you'd like to have a go at something difficult and you're in a different part of the country, try around 1980 at 1900.

News flash. On topband I worked ZD9BE (Tristan da Cunha) and got a 5 and 8 report on a.m. Unfortunately Brian was at Harpenden, some 5 miles away at the time home on leave. By the time you read this he will be on his way back. Listen for him between 14200—14300 on s.s.b. from ZD9 land.

TWENTY

By far the most popular band this month, and not surprising considering the state of the other bands like 15 and 10.

N. Ghani (Penang, Malaysia) has a modified transistor superhet with a "horribly mismatch antenna for 14Mc/s". Mismatch or not, the following were logged on 20 s.s.b. AP2ND, CP5AD, CR7FL, CT1BW, DM3RMA, DU1FH, EA3JE, EI4AZ, EP2BI, FH8CD (Comoro Is.), FR7ZN (Reunion Is.). Many G's, GM3KAI, HA5CQ, HB9ABV, HC1XC, HK3RQ, HL9TJ, HV3SJ, UA1CK/JT1, KC6BY. KG6NAC, KG6IF (Marcus), KH6BB, KJ6BZ, KL7FSP, KP4AST, KW6EJ, KX6BU, LA2LL, LU1DAB, LZ2KS, MP4BCC, OA4BS, OA6AD, OE1GWA, OHØAA, OK2OP, ON4IV, OY3H, PJ2CH, PY1CLI, SM2BHT, SP8AJK, G3LQB/SP5 (reciprocal licence), TI2PZ, UB5JW, UC2CW, UF6KPO, UI8AG, UJ8AC, UL7ND, UO5BM, UP2KNP, UT5RO, VE6AO, VP2AA (Antigua), VQ8AC, VQ9HJB, VS9ABL, W—2, 3, 4, 5, 6, 7, 8, Ø, XE1KB, XV5PJ, K8NHW/XV5, YA1DAN, YA5RG, YU2RAK, ZC4AK, ZD3G, ZE1AE, ZS2HI, ZS3JJ, 3C7CE, 4W1C, 4X4HQ, 5U7AL, 5Z4KL, 7Q7EC, 8R1C, 9G1GA, 9J2AB, 9N1MM, 9Q5CM, 9U5SK. Excuse me a minute while I nip out and mismatch my 14Mc/s antenna.

David Henbry (Sussex) O-V-O, Joymatch No. 3 and 7ft. vertical at 30ft. snapped up this little bunch on twenty s.s.b.—DU9PET, JA1AEA, JX5AK, OHØAA, VP6WR, 4X6SW (Gaza Strip), 5Z4IR, 9Q5EP. Wait till he gets that HA500!

R. Street (Surrey), says that his receiver was built out of the junk box and sent a circuit too. Armed only with this O-V-2 and 110 feet of wire Roger invaded twenty and captured—AP2NMK, CR6GQ, CR7FM, DU1FH, EP2BQ, F2WS/P/FC, HC5EJ, HS4AK, JA3RQ, JA6BZI, KR6KN, OA6BN, PZ1AG, TF3EA, TG9RN, VE7PV, VK2ALR, VK3AHO, VK4TY, VK5HV, VK7RX, VS9MB, VU2BK, WØJKV/MM, W7YCH/MM, XE1AK, YN1BKC, ZF1GC, ZP3AL, ZS8L, 4U1ITU, 4X4AS, 4Z4HO, 5Z4IR, 6O1GB, 6Y5AK, 9G1KT, 9M2XX, 9V1NT, 9X5CE.

FIFTEEN

S. Herod (Suffolk), R.A.P. 6 valve s/het, 15ft., wire, logged these on a.m.—CE3BV, CT2AP, CR4BJ, CR6JB, CR7GS, CP4NA. CO2AV, CN8CL, EA6BF, EA8EB, HI1CN, HK3RS, KR6EE, LU3AS, MP4QED, PJ3HRA, PY3OCA, PZ1AR, ST2FM, TT8GT, VE3KOO, VP9DL, XE1OH, YV4IB, ZS6JW, 4Z4GF, 5N2ABN, 9H1AV.

G. Andrews (Yorks), RA 1, pre-selector, 20 metre dipole heard—CE3CZ, CN8CS, CR7FM, HI8XDA, HK4VP, KP4CRD, KR6UD, KV4BW, KZ5NS, PY1BIM, PY2SD, SVØWFF, ZC4MO, ZP5JB, 4X6GU (occupied Sinia).

FORTY

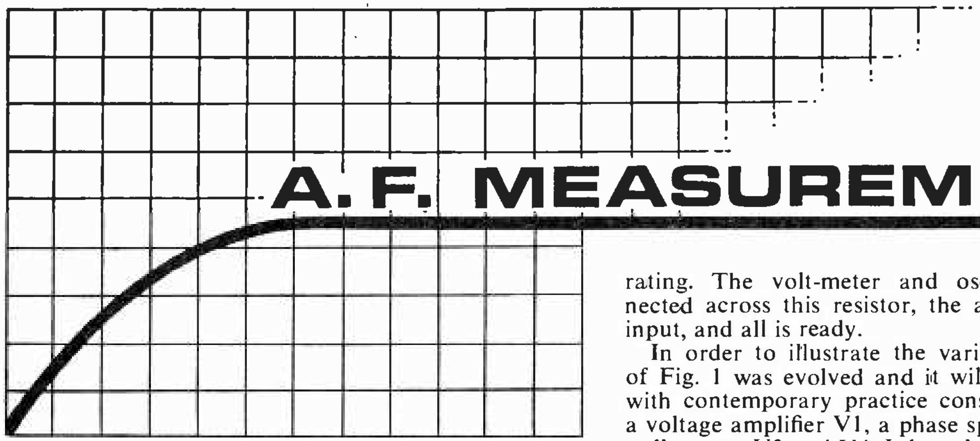
Frank Simpson (Yorks.) braved 7Mc/s all alone this month. Not only braved it but brought back some scalps too. These include—CX2AL, CX7BW, IS1DMN, KZ5GN, K4ZAW, LU1DZK, OHØAA, OA4NXS, PJ2MI, PJ3CC, PY1CNK, PY2EGH, PY3APH, PY4ND, PY7ARP, W1AW, W4AJJ, WA2KYU, WA4WKM, WB2NVJ, YV4IQ. The set up is an HA700 receiver and longwire plus a Joymatch a.t.u.

NEWS

Quite a few big ones this month. September 10th, RSGB mobile rally at Woburn Abbey, Beds; 10th, 3.5Mc/s field day; 24th, Harlow mobile rally; 27th—30th, International Radio Engineering and Communications Exhibition (the "RSGB do") at the Royal Horticultural New Hall, Victoria, London. PRACTICAL WIRELESS will be at this one, how about looking us up on the stand?

In early October the busy days are the 7th and 8th. Three things on the go—RAEN contest, 1296Mc/s contest. and the VK/ZL Oceana phone contest.

H.T.KITCHEN



A.F. MEASUREMENTS

MANY people have been interested in the realistic reproduction of speech and music in the past but it is only in the last few years that the hi-fi cult has spread to the public at large; assisted by the advent of stereo to a very great extent. In hi-fi, as in other aspects of electronics, the home constructor has been well to the fore, being catered for by the circuits originating from the various valve manufacturers and radio periodicals, as well as home-made amplifiers and kits offered by several large concerns. Many constructors are quite happy once the amplifier works, while others are curious to know if their particular amplifier is up to specification. There are also the unfortunate few whose amplifiers work indifferently or do not work at all. It is hoped that this article will aid the curious and help the unfortunate.

What are the tests the amateur can carry out and what will they reveal? It will probably be simplest to draw up a short list and then discuss the tests in turn starting with: (1) Frequency; (2) Power response; (3) Power output reserve and overload point; (4) Input required for maximum output; (5) Negative feedback; (6) Harmonic distortion; and (7) Hum and noise. Before delving into the various tests it is advisable to discuss the necessary equipment and the preparations that precede the measurements.

TEST EQUIPMENT

All the suggested tests can be carried out with a wide range a.f. generator and millivoltmeter, though an oscilloscope is a useful extra for detecting distortions of fairly large percentage and instability, both of which fail to show up otherwise. Needless to say, all the test equipment must be faultless, and in this context the author invariably carries out a frequency test on the a.f. generator and mV meter by feeding the former into the latter and varying the frequency from one extreme to the other. Thus any peaks or troughs that may exist are discovered and can subsequently be allowed for.

The preparations preceding a series of measurements are most important and deserve some care. All the equipment to be used should be at hand and allowed ample warming up time; half an hour is not too much. The loudspeaker should be replaced by a resistor of equal value and adequate power rating. The volt-meter and oscilloscope are connected across this resistor, the a.f. generator to the input, and all is ready.

In order to illustrate the various tests the circuit of Fig. 1 was evolved and it will be seen to comply with contemporary practice consisting as it does of a voltage amplifier V1, a phase splitter V2, and push-pull output V3 and V4. It has also been lettered from A to M in order to illustrate the various test points.

FREQUENCY RESPONSE

To measure the frequency response an output of some two watts from the 10-watt amplifier will be required and the output of the a.f. generator is adjusted until the voltmeter shows a reading of 5·5V for the 15Ω output or 2·5V for the 3Ω output at which level the oscilloscope should display a perfect sine wave. This is at a reference frequency of 1,000c/s after which the generator is tuned below and above the reference frequency until the desired bandwidth has been covered, during which time the voltmeter reading should be noted at every octave change. These readings can then be converted to dB ratios for which purposes the dB ratio table will be found useful.

The procedure for measuring the power frequency response is basically similar except that the a.f. generator is set to provide the full rated output from the amplifier at 1,000c/s: the voltmeter will read 12·5V for 15Ω or 5·5V for 3Ω. Again the a.f. generator frequency is varied to cover the desired bandwidth. Unless the output transformer is a very good one (often judged by its price tag) it is likely that the extremes of the bandwidth will be considerably less than the reference frequency.

OVERLOAD

Having measured the frequency and power response curves we can now measure the overload point and the power reserve. Figure 2 shows the the power output curve of a typical amplifier which steadily rises with increasing input until the nominal maximum output is reached: in this case at some 10 watts, after which it gently rolls off to a maximum of 15 watts. This power output curve should gently roll off to a maximum as in A rather than abruptly level off as in B. In order to measure the power reserve and overload point the a.f. generator should be set to 1,000c/s and the output slowly increased until 10 watts is approached during which period the oscilloscope should show little or no distortion. If after the 10-watt level is reached the input is still steadily increased the output will increase slowly and some limiting may be apparent on the oscilloscope. After 13 or 14 watts the curve will be almost flat and 15 watts may only just be obtained no matter how much the input is increased whilst the wave form will be almost square due to the severe limiting action of the amplifier. A graph of input voltage against output watts can be plotted by using the arrangement shown in Fig. 3 where a single-pole two-way switch is used to switch the voltmeter from input to output as required. As soon as the oscilloscope begins to show any limiting or if the wave form departs from the ideal sine wave, one must treat the voltmeter readings with suspicion. Any graph plotted from distorted waveform readings will be inaccurate and must not be relied upon.

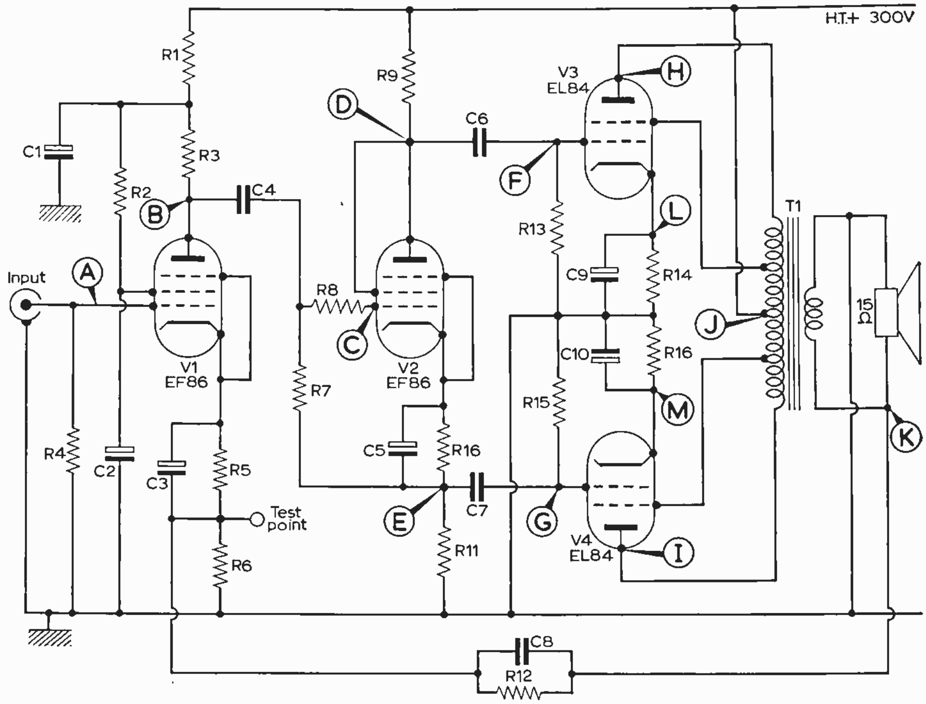


Fig. 1: Typical audio amplifier with suggested test points.

NEGATIVE FEEDBACK

The benefits of negative feedback are too well known to be repeated here so we will concentrate on the measurement of it. The amount of feedback in a circuit is quoted as a dB ratio and is the input required to provide a given output with and without feedback. In the circuit of Fig. 1 the feedback is from the secondary of the output transformer to the cathode of V1 via R12 and C8. In order to measure the amount of feedback it is necessary to disconnect R12 and C8 from the circuit, thus removing the feedback loop. The a.f. generator is set to provide the rated output from the amplifier, R12 and C8 are reconnected and the input again increased to provide the same output as before. The difference in the two inputs converted to a dB ratio is the amount of feedback present. The level of feedback can be changed by altering R12, but since R12 and C8 are chosen to provide a certain time constant any change in R12 must be accompanied by an opposite change in C8 in the same ratio.

DAMPING FACTOR

Closely allied to the amount of negative feedback is the damping factor of the amplifier. This is, quite simply, the nominal output impedance divided by the actual internal resistance of the amplifier at the output terminals. Thus, an amplifier with a nominal 15Ω output impedance and an internal resistance of 0·5Ω would have a damping factor of ($15 \div 0{\cdot}5$) 30.

The output resistance can be measured in one of two ways, both simple, both possessing good and bad points. Figure 5 shows one method. Resistors R1 and R2 are somewhat similiar in value to the output impedance of the amplifier, say 15Ω and 10Ω for an amplifier having a nominal 15Ω output. The generator is adjusted to provide a suitable output from the amplifier which is monitored on the voltmeter. The current flowing through R1 can be calculated by Ohm's law. The switch is then thrown to bring R2 into circuit. Again, the voltage is measured and the current flowing through R2 is calculated. The output resistance is now given by $\frac{E1}{I2} - \frac{E2}{I1}$, where E is voltage and I current.

The second method is in principle simple. The voltage at the output terminals at the valve amplifier is measured without any load connected. Then, either a low value pot, or a collection of resistors (in parallel) is connected across the output terminals. The resistance is adjusted until the o/p voltage is exactly half its previous value. The principle will now become evident.

Since the voltage across the load resistor RL (Fig. 6) is now only half its previous open circuit value, it will be obvious that the "missing" voltage has been "lost" across the internal resistance IR of the amplifier; in other words IR=RL. All that is required is a low resistance bridge or ohmmeter to measure RL, and there we have IR.

CAUTION

A timely word or warning would not be out of place at this juncture. No amplifier should be operated at its maximum output with the secondary of the output transformer open circuit, i.e. without a load, for any length of time. Should this be done, very high voltages will be set up across the primary which can, if allowed time, destroy the output valves

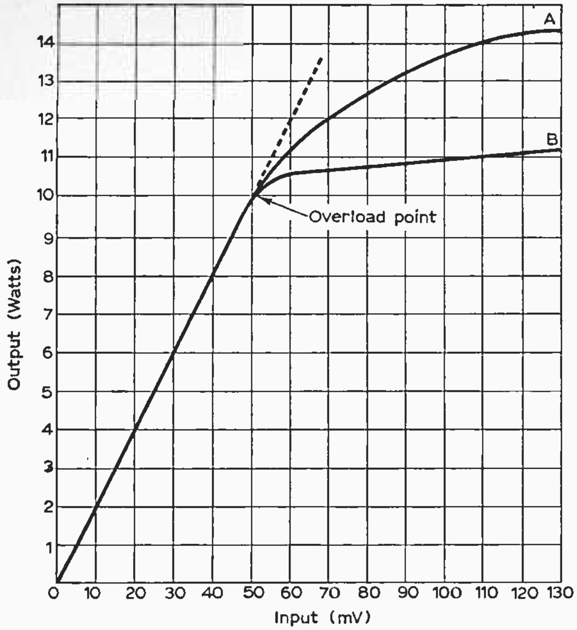


Fig. 2: Typical power output curve.

and/or the output transformer itself. With cheap transformers which have not been impregnated it is possible to hear laminations vibrating in sympathy with the output signal. If the laminations are very loose they will still vibrate even if the valve is correctly loaded.

Dummy load resistors must be selected to match the power amplifier in respect of resistance and power rating. Ideally, they should be non-inducting, which implies carbon composition types. In practice, wirewound types are often easier to obtain. The effect on ultimate accuracy is not great and they should suffice in the majority of amateur applications. The accurate measurement of distortion by the amateur is not easy, for it is difficult to convert theory into practice and somewhat expensive when expressed in terms of £ s d.

HARMONIC DISTORTION

In professional circles it is customary to measure the harmonic content of the signal and to express it as a percentage of the fundamental frequency, for example, one may have 1% first harmonic, 1·5% second harmonic and so on. This the amateur cannot easily do since the steep cut filters required to suppress the fundamental frequency, plus all harmonics except the one being measured, are somewhat complex and therefore expensive. If he cannot measure the exact quantities of the individual harmonics separately, he can, however, suppress the fundamental frequency and measure the remaining harmonics as a "lump sum". The success of this operation will depend upon the sensitivity of his instruments for, if the test frequency is reasonably pure, the harmonics remaining after the removal of the fundamental will be of a very low order of magnitude. Assuming a pure signal and a good amplifier, the harmonics, as a "lump sum", should not exceed 1% at the amplifiers maximum output. Reducing the output level should bring the distortion level to the "copywriters delight" of 0·1%.

Perhaps one of the simplest "lump sum" methods capable of giving reasonably accurate results is that illustrated in Fig. 6 L1 C1 C2 and VR1 form a bridge T filter. If C1=C2, the frequency at which the bridge offers maximum attenuation to the output frequency is given by $nf = \frac{1}{19{\cdot}75\ f^2L}$ where C is in Farads, L in Henrys and f in c/s.

The a.f. generator is set to the resonant frequency of the bridge and its output controls adjusted to provide the required level from the amplifier under test. This output is developed across Rn, which should be equal in resistance to the output impedance of the amplifier, and of adequate wattage, as a voltage which is monitored by the voltmeter and/or 'scope. This voltage is designated E1 in Fig. 6. Next S1 is thrown to bring the bridge into circuit, VR1 is adjusted for maximum null (minimum o/p voltage), the voltage remaining is monitored and is designated as Eo. Knowing E1 and Eo, we can calculate the total distortion as a percentage by multiplying $\frac{EO}{E1}$ by 100.

OSCILLOSCOPE HELPS

In many audio applications, a 'scope possessing an *accurate attenuator* is superior to a millivolt meter because the waveform can be examined and because distorted waveforms which can cause the voltmeter to be inaccurate can be allowed for. It is useful to check the distortion level of the test generator before starting to use it. A good generator should supply a pure mid range (1,000c/s) output. It will require a very good generator to maintain a low distortion output over the range of, say, 100c/s to 10kc/s. Only an exceptionally fine generator will be distortionless over a wider range, typically 10c/s to 100kc/s. It is, therefore, vitally important not to place undue reliance on any distortion readings taken on any amplifier, unless the generator used is known.

HUM AND NOISE

Accurate measurement of hum and noise is not easy for the ordinary amateur for special "weighting" networks are necessary to equalise the response. This is due to the frequency characteristics of the human ear which may not hear a low-pitched buzz though its amplitude may drive the voltmeter off its scale and which may be annoyed by a higher frequency sound whose amplitude may be considerably less. The amateur is obliged to measure the total amount of hum and noise and express it as a "lump sum" though an oscilloscope will help to decide which is greater since hum will show up a distorted sine wave and noise as "grass", both terms being self explanatory.

In order to measure the amount of hum and noise the a.f. generator output is set to provide the rated output from the amplifier, which will be given by an output of 12·5V if the amplifier is rated at 10 watts and has a 15Ω output. The a.f. generator is removed from circuit, and the sensitivity of the

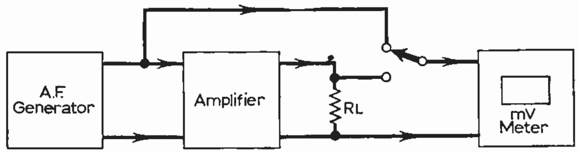


Fig. 3: Method for checking overload.

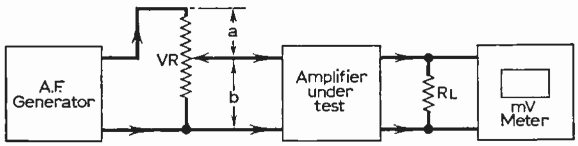


Fig. 4: Simple attenuator to assist users of unknown test equipment.

voltmeter increased until it gives a reading which for the sake of explanation we will assume to be 12·5 mV, giving a "before and after" ratio of 1000:1 or 60dB. In the light of previous remarks this should be taken as approximate and it is the author's opinion that lacking suitable test equipment a silent (when it should be!) amplifier is a good amplifier.

ACCURATE ATTENUATORS

Throughout, the assumption has been made that the voltmeter and possibly the a.f. generator, are equipped with accurate attenuators. With borrowed, unfamiliar, or improvised test equipment, it is useful to be able to cross check the results obtained without going to a lot of trouble or expense. Figure 4 shows how this can be done. All that is required is a potentiometer of suitable value with a linear track and of as large a diameter as possible. As an example, suppose we want to know the amount of feedback in an amplifier. With the pot. at maximum the a.f. generator is set to provide the amplifier's rated output, the pot. turned down, C8 and R12 are removed from circuit and the pot. again adjusted till the amplifier is delivering its rated output. The amount of feedback will be equal to the pot. ratio a/b. A number of precautions are advisable, such as reducing the pot. before R12 and C8 are disconnected, otherwise the amplifier will be severely overloaded. The test frequency should be fairly low, such as 1,000c/s, so that Miller losses in the pot. are reduced to a negligible proportion.

SERVICING TESTS

So far we have assumed that the amplifier has been working satisfactorily and that the tests were conducted out of sheer curiosity. But suppose all is not well and the amplifier works indifferently or not at all. Here a stage-by-stage check should quickly find the cause, the circuit of Fig. 1 will be used as an example. In the following explanation it will be assumed that an oscilloscope is available, amateurs lacking this most useful tool will have to disregard any remarks that specifically apply to it. There are two basic methods of working, (1) in which the a.f. generator is left connected to the input and the oscilloscope transferred from point to point until the output is reached and (2) where the oscilloscope is left connected to the output and the a.f. generator transferred from point to point until the input is reached. Although both methods have their adherents the author prefers the first method, and this accordingly will be the one to be discussed.

As in previous measurements, the speaker is replaced by a dummy load and the a.f. generator is connected to the input test point A across which are connected the voltmeter and oscilloscope. These are transferred to B where an increase in signal strength should be obtained. Then on to C with loss of signal unless C4 is low capacity or open circuit. The signals at D and E should be equal and slightly less than C. Any inequality will be due almost certainly to the anode and cathode load resistors R9 and R11. Whether the phase splitter is a concertina type as here, or a paraphase, the output signals should be substantially equal, certainly not more than 5 per cent difference. The signals at F and G should be almost equal to those at D and E and if not a check made on C6 and R13 and C7 and R15. From F and G we go next to H and I with a considerable increase in signal amplitude though once again the signal equality is vital, any deviation being due to V3, V4 or T1. The cathode decoupling capacitors C9 and C10 also affect the balance so the voltmeter and oscilloscope are next transferred to L and M in turn where a signal of any magnitude will almost cer-

Fig. 5: One method of determining the damping factor.

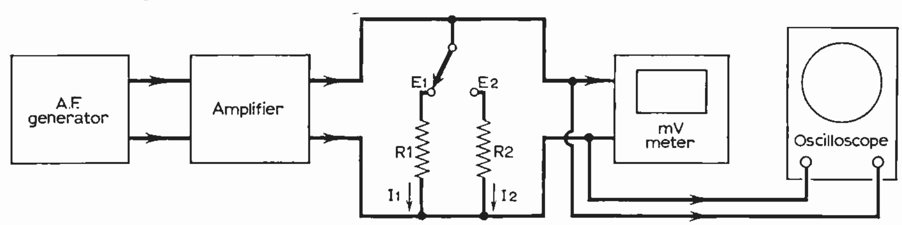
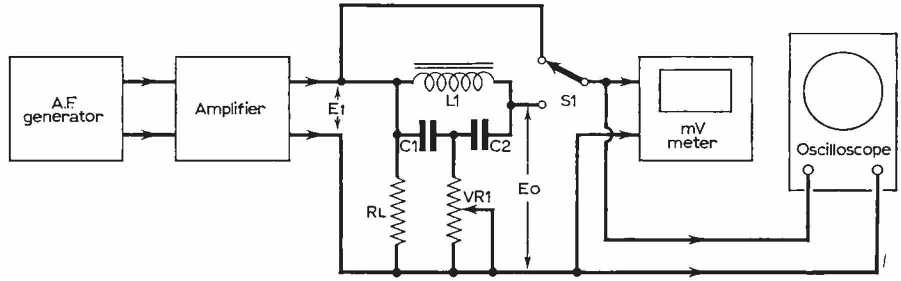


Fig. 6: Alternative method of finding the damping factor, using a variable resistor.



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6B7	6/-
6B8G	2/6
6BA6	5/-
6BA7	5/-
6BE6	6/6
6BJ6	7/6
6BJ7	7/-
6BN6	8/-
6BQ7A	8/-
6BR7	9/-
6BR8	5/-
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6F7	6/-
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6F12	4/-
6F13	5/-
6F14	5/-
6F32	4/-
6F33	20/-
6G6G	2/6
6H6GT	1/9
6H6M	2/-
6J4WA	10/-
6J5	6/-
6J5G	2/-
6J6	3/6
6J6W	6/-
6J7G	5/-
6J7M	8/-
6K6GT	5/6
6K7	4/6
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9006	2/6

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5FP7	25/-
88D	80/-

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714AY	£4
725A	£5
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INSET MICROPHONE for telephone handset 2/6. P. & P. 2/-.

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

FIELD TELEPHONES TYPE "L". As above but in portable metal cases. Per pair including batteries and 1/6th mile field cable on drum. £3.15.0. Carriage 10/-.

COLLINS TCS MICROPHONE TRANSFORMERS. Turns ratio 41:1 Test voltage 1,000v. 1¾ x 1¾ x 2¼in. Ideal for mobile and portable installations. Brand new, 10/-. P. & P. 3/-.

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

LABORATORY TYPE VOLTMETERS 160V AC/DC 8" mirror Scale in wooden boxes, 9½" x 8¾" x 3¼" with carrying handle, brand new, 32/-. P. & P. 3/-.

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

METERS, 4½" x 4½" x4" long mirror scale panel mounted, calibrated 0–1mA, 55/-. P. & P. 3/-.

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

MINIATURE METERS
General Electric 1¼" round flush, clip mounted: 1mA DC, 22/6; 25mA DC, 20/-; 75mA DC, 18/-; 150mA DC 16/-. P. & P. 3/-.

A.R.88D. RECEIVERS. Fully reconditioned, £55. Rebuilt model £85. Carriage paid U.K.

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

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

P. C. RADIO LTD.
170 GOLDHAWK RD., W.12
SHEpherd's Bush 4946

MINIATURE MULTIMETER TYPE ITI-1. DC voltage 0–2, 45kV (20,000 ohm per volt). AC voltage 0–1000V (10,000 ohm per volt). DC current 0–250mA. Resistance 0–6 megohms. Capacitance 10pF to ·1mfd. Decibels —20 to +22dB. Dimensions 4½ x 3½ x 1in. Price £3.16.6. P. & P. 3/6.

MOVING IRON METERS

15 VAC	2½" round panel	27/6
500 VAC	2½" round clip fix	25/-

P. & P. all the above 3/- each

RADIO FREQ.: THERMO-COUPLE METERS

350mA	2" round plug-in	14/6
1 Amp	2½" round proj.	17/6

P. & P. 3/- each

DC MOVING COIL METERS

0-5µA	2½" round proj.	25/-
200µA	2" round panel sealed Calibre-30..	22/6
200µA	3½" round panel	32/6
750–0–750µA	2" round plug-in	20/-
1mA	2½" round clip fix, metal clad ..	27/6
1mA	2½" round panel	30/-
1mA	2" round panel sealed	27/6
1mA	3½" round panel	30/-
5mA	2" round clip fix panel or proj. ..	20/-
5–0–5mA	1½" round panel	17/6
10–0–10mA	2½" round panel	17/6
0–30mA	2½" round panel	17/6
75mA	2½" plug in	14/-
100mA	1½" proj.	17/6
100mA	1½" round panel	17/6
100mA	2½" square panel	19/-
100mA	3½" round panel	25/-
2 Amp	2½" round panel	22/6
5–0–5 Amp	2½" round panel	25/-
8 Amp	2½" round panel	25/-
25 Amp	3½" round proj.	27/6
50 Amp	2½" round panel	27/6
20 VDC	2" square panel	19/-
150 VDC	4" round panel	25/-
1·5K V	with res 2" round panel	27/6
1500 V	Electrostatic 2½" round plug in ..	25/-

Open 9-5.30 p.m. except Thursday 9-1 p.m. PERSONAL CALLERS WELCOME

tainly be due to the respective capacitor being o/c or low in value. A further check for unbalance can also be carried out by checking point J which will also reveal the purity or otherwise of the h.t. smoothing.

A close watch should be kept on the wave forms displayed by the oscilloscope as it is transferred from stage to stage. Whilst the amplitude will vary the shape should not, from input to output. Any limiting at the anode of a valve could be due to the coupling capacitor from the previous stage being leaky or the cathode decoupling capacitor being short circuit since both affect the valve's bias voltage. The amateur who notices (and investigates) a change in shape, and sometimes the amplitude, of a displayed waveform is on the way to mastering the oscilloscope.

RECORD THE RESULTS

Having performed the various measurements the amateur will perhaps want to record his findings and a timely word or two of advice may not be out of place. First as to plotting frequency response, and for this a piece of log-linear graph paper is required, on which the frequency is drawn on the log part which runs horizontally and the output level in dB's is drawn on the linear part which runs vertically. Decibels are ratios of something to something else, and are calculated from the expression

$$20 \log \text{is} \frac{E1}{E2} \text{ for voltage, or}$$

$$20 \log \text{is} \frac{I1}{I2} \text{ for current, and}$$

$$10 \log \text{is} \frac{W1}{W2} \text{ where power is concerned.}$$

Constructors who are mentally idle like the author can use the dB table given which goes up to 20dB. Values not given can be found by adding the dBs to multiply and subtracting to divide. Thus a dB ratio of 26dB is equal to 20dB + 6dB = 2 × 10 = × or divided 20. Similarly

$$14\text{dB is } 20\text{dB} - 6\text{dB} = \frac{2}{10} \text{ or } \frac{10}{2},$$

depending on whether there is a gain or loss to be considered.

Bearing in mind that dB's are ratios we must remember never to give, for example, hum and

DECIBEL TABLE

Voltage or current loss	*dB's ratios*	*Voltage or current gain*
0·989	0·1	1·012
0·977	0·2	1·023
0·955	0·4	1·047
0·933	0·6	1·072
0·912	0·8	1·096
0·891	1·0	1·122
0·841	1·5	1·189
0·750	2·5	1·334
0·631	4·0	1·585
0·501	6·0	1·995
0·398	8·0	2·512
0·316	10	3·162
0·224	13	4·470
0·178	15	5·62
0·126	18	7·94
0·100	20	10·00

noise figures without quoting the output level. "A hum level of 60dB" is useless but a "hum level of 60dB at 10 watts o/p" is more useful since we know the reference level. On the other hand it is correct to say an amplifier has a gain of 60dB for we can assume the reference level is 0dB, if the input and output impedances are equal. Otherwise the correct formula is

$$20 \log 10 \frac{E2}{E1} + 10 \log 10 \frac{R1}{R2}$$

where R1 and R2 are the resistive components of the respective impedances. For practical amateur purposes however it is probably harmless to ignore the impedances and use the "ordinary" dB calculations. ■

an in-line audio AGC unit

by L. McNamara B.Sc.

(Published in the July 1967 issue of Practical Wireless *page 204).*

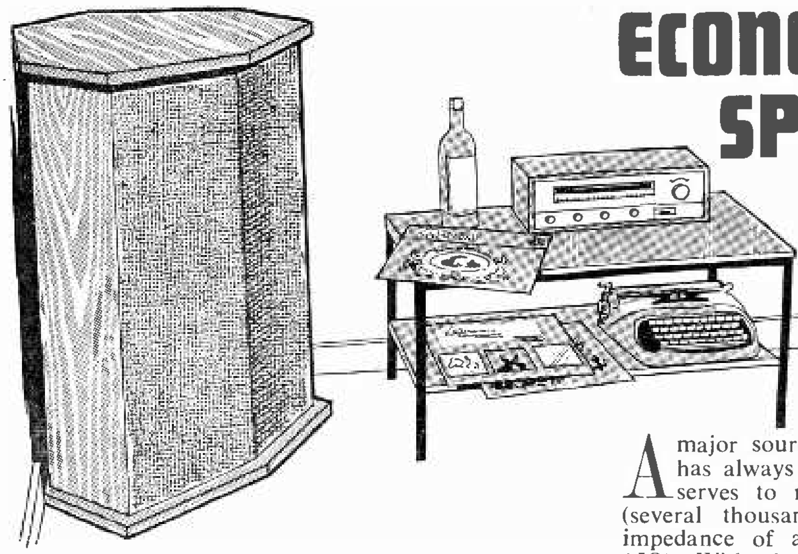
The author has drawn our attention to two errors that appeared in his article. These were on page 207 and concerned Figs. 2 and 3. In Figure 2, the emitter and collector symbols for Tr2 are shown reversed—the emitter should be towards the negative line as this device (AC127) is an NPN transistor, with the transformer as the collector load. The text actually makes mention that the transistor is in the ordinary common emitter mode.

Figure 3: Again in connection with Tr2, the diagram is correct, but the letters identifying the collector and emitter are shown reversed.

Three-legged men, unite!

Oh, dear! Mr. Roy Macdonald must have read our leader about gunboats up the Rhine. Mr. Macdonald is a member of the House of Keys, the local government of the Isle of Man. He is also chairman of the Isle of Man Broadcasting Commission. This in itself is a somewhat quaint coupling, but not so quaint as Mr. Macdonald's vigorous campaign against the enforcement of the new legislation against pirate radio stations.

He not only objects to the outlawing of Radio Caroline and other pirates but is not satisfied with the low power allocation of Radio Manx. He says that his 2,800 constituents are 100% with him and that "most of them are related to me"! But despite being "loyal to the Queen" and "proud to be British" he first wanted to take the matter up at the United Nations to stop Britain interfering with Manx domestic policy but has now settled for the Commonwealth Secretariat.



ECONOMICAL SPEAKER ENCLOSURE

C. R. BRADLEY

A major source of distortion in valve amplifiers has always been the output transformer which serves to match the output stage impedance (several thousand ohms) to the necessarily low impedance of a moving coil loudspeaker (3Ω to 15Ω). With the elimination of the output transformer, made possible by transistor amplifiers which match directly to the speaker, very fine frequency response and distortion figures are possible. The Sinclair Z12 is a transformerless transistor amplifier of this type which has been advertised in this magazine; having bought one, the author had the problem of finding an economical loudspeaker of comparable quality.

CHOICE OF SPEAKERS

Most good quality loudspeakers have a 15Ω impedance. Although the Z12 will give very good (by conventional standards) performance with such a load, the best results are obtained with a very low impedance (about $1\frac{1}{2}\Omega$ to 2Ω). As the prospect of wiring ten Goodmans or Wharfedale 15Ω units in parallel seemed hardly practical and financially distasteful the author decided on a different approach.

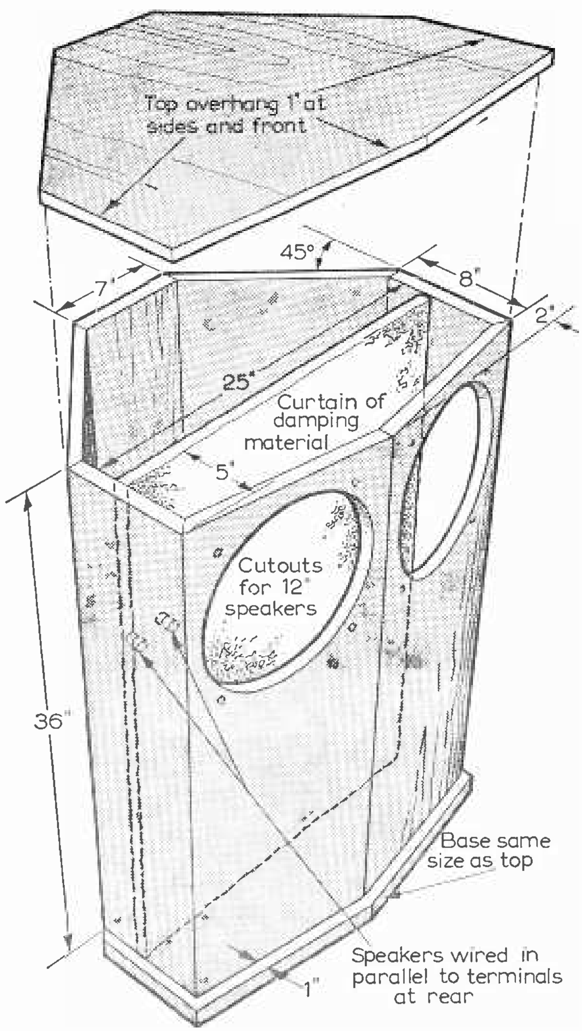
Twelve-inch loudspeakers of 3Ω impedance and fair quality are available cheaply on the surplus market or may be cannibalised from ancient console televisions. Try to choose ones with non-flabby cones and more than miniscule magnets. By avoiding the modern trend for miniature cabinets and mounting a pair of these speakers in an ample enclosure of the infinite baffle (completely sealed) type, really good results are obtainable. By wiring the speakers in parallel a $1\frac{1}{2}\Omega$ impedance is achieved, ideal for the Z12.

CONSTRUCTION

The construction and outer dimensions of the cabinet are shown in the diagram. It is designed for standing in a corner of the room. The speakers are pointed in different directions for wide treble dispersion and good presence when a pair of cabinets is used for stereo. Construction must be very rigid, preferably using 1 in. chipboard or timber. Speaker mounting details are not shown as these will depend on the speakers used; make sure the circular cut-out clears the cone completely.

As the aim is an absolutely rigid airtight enclosure, joints should be both screwed and glued. Line the entire inside surface of the cabinet with 1 in. thick acoustic damping material such as Wharfedale

—continued on page 442



The diagram shows constructional details of the cabinet. The size of the speaker cut-outs will depend on the actual speakers used.

DE LUXE PLAYERS

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

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

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

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

SINGLE PLAY MONO		AUTOCHANGE MONO	
BSR GU7	£4.19.6	BSR Superslim	£5.19.6
Garrard SRP12	£4.19.6	Garrard 1000	£5.19.6
Garrard SP25	£10.19.6	Garrard 2000	£6.19.6
Philips AG1016	£12. 9.6	Garrard 3000	£8. 9.6
Garrard A.70	£19.19.6	Garrard AT60 Mk. II	
Garrard LAB80	£24.19.6	diecast turntable	£12.19.6
Garrard 401	£29.19.6		

All with mono cartridge (Stereo 12/6 extra)

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

A.18 TRANSCRIPTION TONE ARM with tracking template and two plug-in shells. Original price £13.19.6. OUR PRICE **90/-**
Decca Deram Stereo Diamond Cartridge £4.10.0 extra.

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Complete: a die, a punch, an Allen screw and key
½in. 14/6 ⅝in. 15/9 1⅛in. 18/- 1⅜in. 20/6 2$^{3}/_{32}$in. 37/9
¾in. 14/9 1in. 18/- 1¼in. 18/6 1½in. 22/6 2¼in. 44/3
⅞in. 15/6 1$^{1}/_{16}$in. 18/- 1⅝in. 20/- 2in. 34/3 1in. sq. 31/6

BARGAIN XTAL PICK-UP ARM Complete with ACOS LP-78 Turnover Head and Stylii 20/-; Stereo 30/-.
SPEAKER FRET Tygan various colours, 52in. wide, from 10/- ft.; 26in. wide from 5/- ft. SAMPLES S.A.E.
EXPANDED METAL Gold or Silver 12 × 12in. 6/-.
NEW GARRARD GRAM MOTORS 2,500 r.p.m. 100-130v. 15/- pair for 200/250v. A.C. (in series), or 10/- ea. Post 2/6.

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

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

NEW MULLARD TRANSISTORS

OC71 6/-; OC72 7/6; OC81D 6/-; OC81 6/-; AF115 8/-; AF114 8/6; OC44 8/-; OC45 8/-; OC171 9/-; OC170 8/6; AF117 7/-. OC26 12/6; AD140 15/-; OC35 15/-. Holders 1/3.

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SPECIAL 9 VOLT 500mA POWER PACK........ 49/6

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

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

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

COAXIAL PLUG 1/-. PANEL SOCKETS 1/-. LINE SOCKETS 2/-. OUTLET BOXES, SURFACE OR FLUSH 4/6. BALANCED TWIN FEEDERS 1/- yd., 80 or 300 ohms. TELESCOPIC CHROME AERIALS. 6in. extends to 23in. 6/6 each. CAR AERIAL PLUGS 1/6. Sockets 1/3.

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B.S.R. GU7
9 volt Battery
Operated Record
Player Decks

4 speeds, automatic stop. Plays any size record. Complete with mono LP/78 xtal and sapphire stylus. (With stereo cartridge 12/6 extra). ONLY **69/6** P. & P. 5/6

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4/350 v.	2/3	250/25 v.	2/6	16/600 v.	12/6
8/450 v.	2/3	500/15 v.	3/-	16+16/500 v.	7/6
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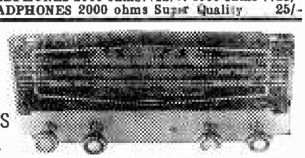

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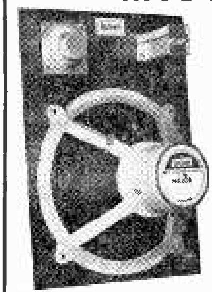

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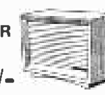

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LETTERS...

Electronic rat scarers

It is often reported that rats and mice abandon houses when v.h.f. radio is installed. These receivers differ from normal medium and short wave sets in sending out electromagnetic radiations and frequencies between 90Mc/s and 180Mc/s, though the means by which rodents could sense this radiation is as yet unknown. There is scope here for research of very great economic importance.

Before any work can be done we need authentic and detailed accounts of rats leaving the "vhf'ed" house and observations of any effects on rabbits, hamsters and birds, especially bullfinches and sparrows in the garden and caged budgerigars. Do pets and dogs become agitated when the set is adjusted and calm down when it is operating without attention?

The damage done to India's grain crops by birds, mice and rats costs more food than all the West can give. As a Registered Charity, not a commercial firm, may we appeal to your readers to help us make a modern version of the proverbial "better mousetrap" that could beat a new pathway towards more food for a hungry world?—**L. D. Hills,** Director-Secretary, Henry Doubleday Research Association (20 *Convent Lane, Bocking, Braintree, Essex*).

A senior reader comments

As an older reader of P.W. I am tempted to comment on some of the points raised by recent correspondents.

The question of kits which don't or won't, work is a perennial one; I recall similar complaints as a pre-war constructor. Any• firm which means to *stay* in business cannot afford to sell faulty kits. It is largely a process of weeding-out the firms into sheep and goats; only possible the hard way—by bitter experience!

It would appear that the most extravagant and usually sensational claims are made for the more suspect kits, so it seems that quality is inversely proportional to the "Fantasmania" employed in the adverts.

I have made up several different kits which are regularly advertised in P.W. and have only experienced difficulty with one. This was an alignment problem and was effectively dealt with by the firm concerned.

In short, one gets what one pays for, and the best value is undoubtedly obtained from firms which will give after-sales service.

The whole industry of kit supplying is very complex, and I am perfectly certain that scores of would be constructors are permanently deterred by the absence of firms supplying *complete* kits of designs appearing in P.W. and other magazines.

On the "Japanese" question, surely the main issue is simply—"prejudice". It is only fair to say that many products of top quality and exceptional performance and value are marketed under Japanese brand-names. If difficulty is encountered in obtaining spares and service the only remedy is in buying where these facilities are available. The market will eventually differentiate this point on its own.—**R. P. Neave** (*Chelmsford, Essex*).

It's not such a grouse!

Might I be permitted to reply to T. Hawker's pet grouse (P.W. July, 1967)? Where is the sense in being denied Amateur radio when one merely fails the RAE? Well, a brief look at the examination will show him. Failure in the first section implies lack of knowledge of the terms of the licence and of the circumstances of causing interference to others. Failure in section two means an ignorance of the basic principles of radio. Since I passed this section from scratch by reading two years of PW, I suggest Mr. Hawker reads this excellent magazine rather than writing to it.

Imagine the QSO's without these simple requirements . . . "Well, OM, the rig here is all shop-bought . . . no idea how it works and I'm not sure how to work out what power I'm running . . . probably less than the limit, whatever that is. Parasitics? Rubbish, I'm perfectly healthy."

As for Mr. Hawker's prowess with radio telephone, that is just push-to-talk cocoa tins with invisible string, bearing no comparison with Ham radio.

Where is the sense in it all? Without the barely adequate safeguard of the RAE, the pleasure of the hobby would be lost in the grim struggle through QRM and ignorance, and when novice meets emergency frequency, the result might well be fatalities and, of course, no licences for anyone.—**C. J. Webster,** G3TBJ (*Ringwood, Hampshire*).

A good idea

I have found the following procedure invaluable as a method for substantiating whether or not the operations of wiring, wirechecking, or functional testing of simple or complex electronic equipment has been performed satisfactorily to the relevant specifications.

In effect I make use of the property in which ball pen ink shows up exceedingly well on polythene sheet, with the added advantage that the markings can easily be erased using a rubber or piece of tissue paper, and the sheet used many more times.

I place a piece of polythene sheet, held in position by 3 or 4 paper clips over the theoretical and wiring diagrams. I also possess a crocodile clip to which a piece of coloured P.V.C. wire is clenched.

So I wire, wire check or functionally test (crocodile clip not used) the equipment I mark the appropriate wire or device on the diagram, at the same time moving the crocodile clip on the unit under examination in synchronisation with the marking of the diagram. (The crocodile clip with the attached coloured wire gives an immediate location of the device in the unit in relation to the markings on the diagram.) On the completion of operations I check my diagrams for any device not bearing a mark such as links or even a small component may have been omitted, therefore since the diagram would bear no marking for this component, the error would be quickly observed.

Further, a wire checking operation might have been omitted or a particular alignment instruction inadvertently overlooked. — **E. Martinho** (*Manchester* 16).

MAKING A TRAPPED DIPOLE

by A. S. Carpenter G3TYJ

A symmetrical dipole that will match into 75Ω coaxial cable on both twenty and forty metres may be of interest and even more so if the fifteen metre band can be accommodated. Trapped dipoles, although considered mainly in transmitter connections may also be used for reception and do offer some advantages over simpler types.

The length of a $\frac{1}{2}\lambda$ dipole for the 7Mc/s amateur band is approximately 67ft. and at this frequency an excellent match into 75Ω cable results from making a centre point connection as shown in Fig. 1a. At a working frequency of 14Mc/s however the same aerial becomes effectively a two $\frac{1}{2}\lambda$ in-phase type (see Fig. 1b) and could be used for this amateur band provided the central point was connected to high impedance—600Ω—feeders. Changing over the feeders when band changing is clearly an inconvenience and an unnecessary one if frequency traps are made use of when at least two-band working into coaxial cable becomes possible apparently. To this end a practical trapped dipole has been constructed and tested and although no exotic rare DX has been worked many interesting QSO's have been enjoyed.

The overall dimensions of the finalised aerial are shown in Fig. 2 and as may be seen the inter-trap dimensions are those of a conventional $\frac{1}{2}\lambda$ dipole for 14Mc/s working. The traps are each pre-tuned to 14·1Mc/s precisely, and r.f. fed to the aerial at this

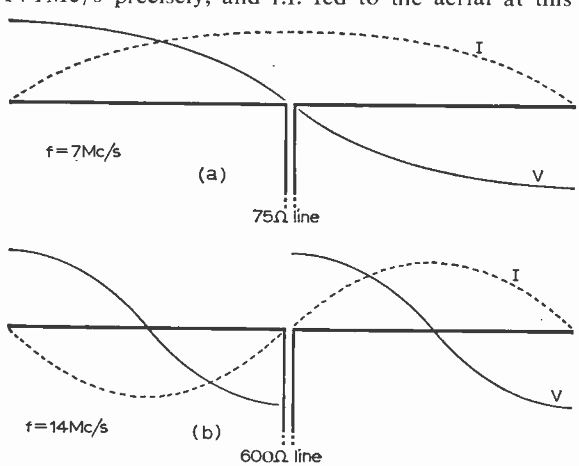

Fig. 1: Voltage and current distribution for (a) 7Mc/s and (b) 14Mc/s dipoles.

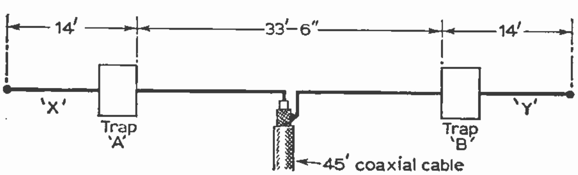

Fig. 2: Dimensional details of the complete trapped dipole.

frequency "sees" sufficient opposition therefrom as to render the remainder of the aerial ineffective; lengths "X" and "Y" then become to all intents and purposes no more than support wires. The central feed point of this 14·1Mc/s dipole is of low impedance and suitable to take normal coaxial cable.

Constructional Details

If the traps are to be effective they must possess a high "Q" and whilst commercially made coils may be used suitable items can be home made. One essential item required is a good and reasonably accurate grid-dip oscillator whilst a crystal calibrator and a s.w.r. bridge also prove useful.

The prototype coils are air-cored with turns spaced to give a length/diameter ratio of 1:1 or thereabouts. Each coil is tuned with the aid of a short length of coaxial cable open-circuited at the end remote from the windings. Weatherproofing is secured by using plastic drain piping as containers.

For the coil "formers" pieces of 0·125in. thick perspex, cut and drilled as shown in Fig. 3 may be used, the "formers" being made just deep enough to form a firm fit inside the containers. "Formers" are provided with a lug at each end to act as lock-points for paxolin end-cheeks eventually placed at container ends; the lugs also provide convenient anchor points for internal and external connections. In the "formers" some thirty small holes are drilled as shown, each hole being just large enough to accommodate No. 18 s.w.g. copper wire. Using a "dummy" former some 2·125in. diameter approximately fourteen turns of 18 s.w.g. tinned copper wire are wound tightly on and then allowed to spring

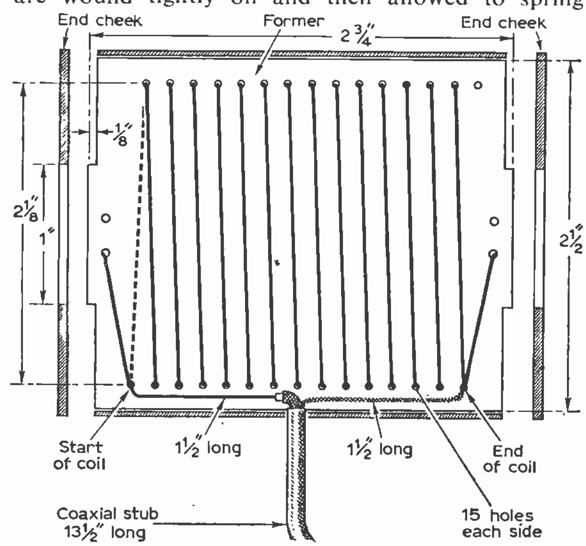

Fig. 3: Drilling dimensions and constructional details of the loading coils.

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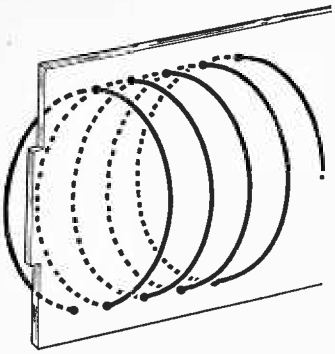
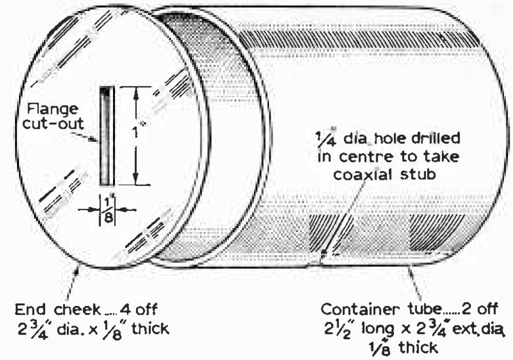


Fig. 4: (left) Winding the coil on to its former (see text).

Fig. 5: (right) Details and dimensions of the plastic containers and end cheeks.



off! The rather floppy spiral obtained is then taken carefully in one hand and a "former" in the other when by using a screwing action the turns are slowly fed through the holes provided (Fig. 4). When both windings have been positioned correctly turns are secured with a modern adhesive.

With coil assemblies dry two 15in. lengths of coaxial cable are cut. The braid and inner conductor are separated at *one* end of each length to form 1·5in. lead-outs and these are soldered one to each end of a winding.

Container and end-cheeks dimensions are given in Fig. 5 and the 0·25in. diameter hole drilled centrally along the length of each container will enable the free cable ends to be fed through from the inside.

The coils are positioned as shown, the paxolin end cheeks being so placed as to align with the "former" lugs.

With trap assemblies lightly secured a g.d.o. is brought into use to discover the approximate resonant frequency of each coil, and if these are found to lie slightly low of the desired final frequency, all is well. In the case of the traps described an 11-13Mc/s indication would be excellent but if the readings tend to be lower than 11Mc/s a turn may be removed from each coil and a fresh check made.

Later, with external connectors provided on each coil lug, the end cheeks are glued firm and the containers sealed and painted.

Resonating the traps

The station receiver and the g.d.o. are switched on for about half an hour, after which the receiver is tuned precisely to 14Mc/s using as an aid a crystal frequency marker. The g.d.o. is then tuned to the receiver after which it is introduced to a trap coil. Initially the g.d.o. will show no dip and it then becomes possible to prune the appropriate length of coaxial cable until the g.d.o. gives an indication. Pieces no longer than 0·25in. approximately should be snipped away at a time, successive cuts causing the trap frequency to rise. By utilising the receiver/crystal frequency marker/g.d.o. combination judiciously it is found that the traps can be resonated precisely at the desired point in the band—say 14·1Mc/s—but it should be noted that it is not possible to go lower in frequency once the cable has been shortened! In the prototype traps the remaining lengths of coaxial cable were approximately 12·5in. for 14·1Mc/s.

The dipole may now be finalised to the dimensions given and erected using a nylon rope and pulley arrangement to permit of subsequent modifications, since lengths "X" and "Y" may require shortening. In this connection a s.w.r. meter is useful in association with the station transmitter.

Conclusion

Using the simple dipole described via a "Z"-Match unit for maximum efficiency many interesting "key contacts" have been made running some 50W input in A1 on the 20- and 40-metre bands. The aerial also seems to work quite nicely on "15" which is of course in odd-harmonic relationship to "40". ■

Clause 7 — Last Round!

Further to our recent editorial comments on the subject of Clause 7 of the Wireless Telegraphy Bill, 1967, this Bill has now passed its third reading in the House of Commons. The cause of the radio amateur was taken up by several MP's either through their own misgivings, due to representations from organisations such as the RSGB, from reading criticisms in PRACTICAL WIRELESS and other technical journals and by having their attention drawn to the dangers by individual radio enthusiasts.

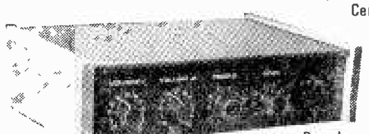
Reference to Hansard will show that careful consideration has been given to the cause of the radio amateur. The PMG has agreed that before any Orders are made specifying apparatus to be banned, the situation will be discussed with the RSGB as the amateur's representative body. Amateurs, he said, stand to gain from the Clause, as do other licensed users of radio apparatus.

For the Opposition, the Shadow PMG, said he was satisfied that the doubts on Clause 7 no longer existed and that the amateur, whose rights we all wish to safeguard, should now be protected.

The RSGB, in a leading article, says: "The position has been completely clarified by several statements which appear in Parliamentary records and a potentially dangerous situation has been dissipated in a manner which must surely bring satisfaction to all concerned."

For our part we heave a sigh of relief and wish to thank those readers who took the trouble to write to us and to take up the matter with their local MP's. It is gratifying to observe that amateur radio enthusiasts rose to the challenge and that our legislators on both sides of the House energetically brought the matter to a satisfactory conclusion.

TRANSISTOR STEREO 8+8



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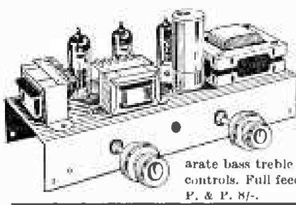

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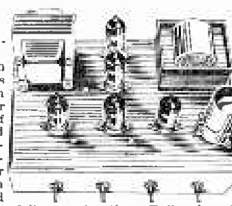

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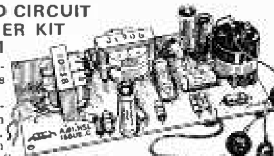

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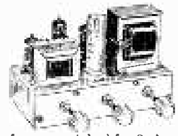

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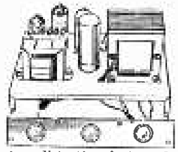

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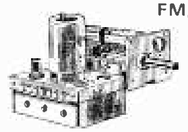

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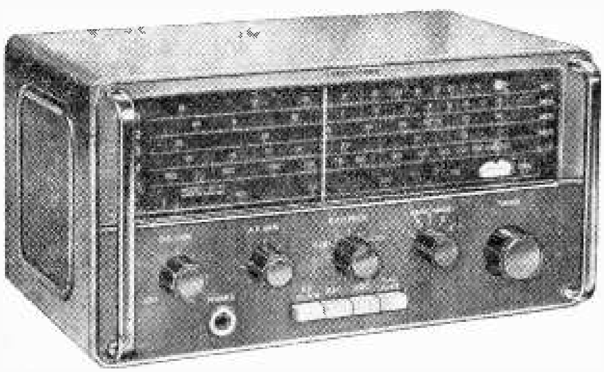

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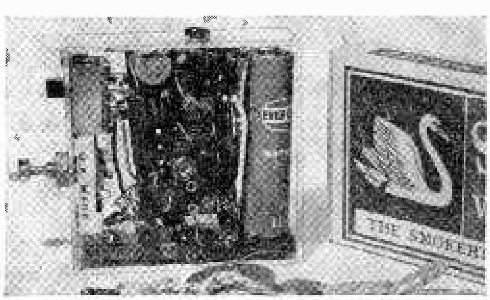

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2/6 SEPTEMBER ISSUE 2/6

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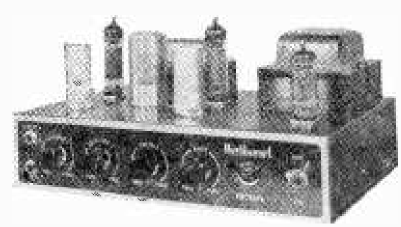

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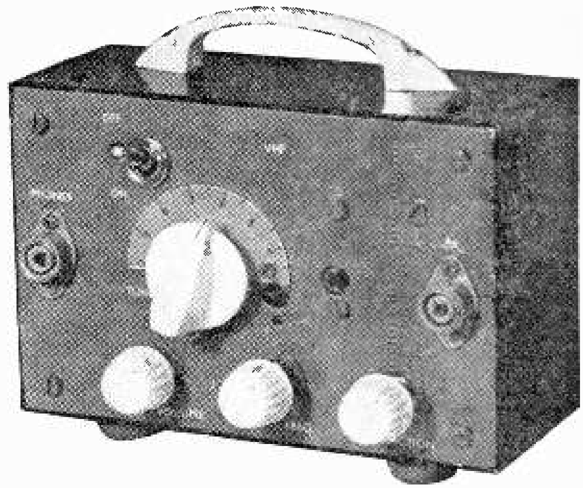
THE explorer

AM/FM VHF RECEIVER

By W.E.BARDGETT

Published in the January 1967 issue



THE V.H.F. Explorer, a four transistor a.m. and f.m. receiver employing a self-quenching super-regenerative detector and covering 65 to 170Mc/s in the v.h.f. band, was described in the January 1967 issue of this magazine. It occasioned considerable interest and was built successfully by a number of readers, although some had difficulty with the r.f. stage adjustments. More recently several constructors have been unable to make the receiver work at all, and this has now been traced to the fact that the Sinclair transistor marketed currently as the ADT140 is different from the ADT140 marketed by the same firm about a year ago, when the prototype V.H.F. Explorer was built. The early type of ADT140, which works outstandingly well in this receiver, has the same gold-coloured capsule and leads of the later type, but may be identified by the off-white or polythene colour of the insulation through which the leads pass into the capsule. The later ADT140, which works in many applications for which it was designed but which will not, unfortunately, operate in the super-regenerative circuit of the Explorer, has a brownish-red insulating material, but is otherwise similar to the earlier type.

Transistor equivalents

With the help of a number of readers who have built the Explorer, it has been ascertained that the circuit will work with the following Mullard transistors in place of the ADT140's for positions Tr1 and Tr2: AF118—AF117—AF115—OC171—OC170.

The only essential change to the original circuit is an adjustment of the base bias control VR1, which initiates regenerative action at quite a different setting from that required by the early ADT140.

A transistor which might have been expected to work well at v.h.f. but which does not appear to function at all in the super-regenerative circuit described is the AF183.

Circuit improvements

As was explained in the April 1967 issue of PRACTICAL WIRELESS, four of the component values in the original circuit diagram and one in the component list were incorrect. To put matters right R4 should be 100Ω, C4—2·2pF, TC2—3 to 8pF and the value of R9 should be 4·7kΩ.

The values of R1 and R2 should also be transposed so that R1 is 4·7kΩ and R2 is 33kΩ. Whilst the above are the only necessary corrections, further experiment with the receiver has shown that its functioning may be improved by a number of other circuit variations.

Firstly, the feedback capacitor C4 on the super-regenerative detector stage Tr2 may be replaced with advantage by an adjustable 3 to 8pF beehive trimmer. This is mounted from the fixed vanes of VC1 to the fixed vanes of VC2 across which the transistor holder for Tr1 is soldered as well. Adjustment of this trimmer allows an optimum setting to be found which is something which will vary slightly when different transistors are employed.

Secondly, the use of a single battery to energise both the r.f. stage and detector and the audio stages has resulted in some interaction between VR2 and VR1 so that, particularly when a battery is partly discharged, the increase in volume for the audio stages by VR2 may stop the super-regenerative detector operating at all. This can best be overcome by employing two separate batteries for the audio section and the r.f. and detector section. If both these are 9 volt batteries the negative lead to the detector stage should continue to be fed through a 4·7kΩ resistor. Both a PP7 battery and a PP4 battery (the latter for the r.f. and detector stage) may be housed within the original case but improved results have been obtained from having two PP7 or even two PP9 batteries in a separate case fixed to the back of the receiver screening box.

Thirdly, performance is improved by including a second choke in the super-regenerative detector circuit. This is inserted between the 4·7kΩ resistor coming from the negative supply line to this stage and the end of L4 and side of VC1 which are remote from the collector of Tr2. The choke should be the same size as L5, i.e. 28 turns of 30 s.w.g. enamelled copper wire wound in the screw thread of an 0BA bolt and then removed. Alternatively, as with L5, it may be wound around a short length of plastic tuning spindle and the ends fixed with cellulose tape.

Fourthly, a modification which may improve working consists of the replacement of C3, the 200pF capacitor linking the base of Tr2 with the positive line, by a 47pF ceramic or disc capacitor linking the base of Tr2 with the end of L4 and side of VC1 which are remote from the Tr2 collector. If the original physical layout is followed this is a connection with very short leads. It appears to introduce a measure of neutralisation to Tr2 in the same way as this is provided by TC2 for the r.f. transistor Tr1.

Loudspeaker operation

A number of readers have fed the output of the Explorer into transistor amplifiers to provide loudspeaker reception. Most have used English or Japanese package amplifiers for this purpose, the author having used a 1½ watt transformerless package amplifier. With most such amplifiers the audio stages included in the original receiver circuit will be unnecessary and the input to the amplifier may be taken from either C9 (dispensing with the last audio stage Tr4) or from C7 (dispensing with both audio stages Tr3 and Tr4). The volume control VR2 should, of course, be retained.

Getting the receiver going

For those who have made the essential circuit corrections mentioned earlier, the following procedure should be used to get the receiver going. It is based on the experience of a number of readers.

Ensure that the proper size of v.h.f. half-wave dipole or $\frac{1}{4}\lambda$ whip aerial is attached to the aerial socket. The length in inches is found by dividing 5616 by the frequency in megacycles. This gives the dipole length across both elements: the appropriate quarter-wave whip aerial would be half this length. A long wire aerial is quite useless, but some results may be obtained from a TV or f.m. aerial array.

Having connected an amplifier or headphones, advance the volume control VR2 and then adjust the super-regeneration control VR1 until a fierce fairly high-pitched hissing noise is heard. There may be some other less fierce hissing at other settings of VR1. If the fierce hissing is not heard, unbolt the r.f. panel, maintaining a lead to chassis for the positive power supply, and move L3 away from L4. If regeneration then commences at some setting of VR1 bring L3 close to L4 until it just fails to quench the oscillations. Alternatively, dead spots in the regenerative action may possibly be eliminated by adjusting VC2—this is its main function.

Tuning by VC1 should then resolve some signals but if this does not happen several readers have overcome the difficulty by temporarily cutting out the r.f. stage and connecting the aerial coil L1 directly to the super-regenerative detector tuning coil L4. It must be emphasised, however, that this will cause at least some local radiation and possibly interference. Builders of the set who have done this have brought L1 close to L4 until it quenches the super-regenerative hiss and have then moved it away again until the hiss just begins. The set is then most sensitive to signals. By tuning in a fairly strong signal and leaving the detector stage tuned to it some builders have found that the r.f. stage may then be re-inserted and the trimmers and cores adjusted on the signal which is breaking through.

A number of experimenters have tried other r.f. stage circuits including those employing the common base configuration—often considered more suitable for v.h.f. work. These have included the circuit of the 70cm preamp described by J. L. Oliver in the July 1967 issue of this magazine, and the pre-amplifier described by J. W. Thompson in the July 1967 issue of PRACTICAL TELEVISION, both with appropriate adjustments in the size of the coils. It has to be admitted, however, that there is relatively little improvement obtainable from any r.f. stage in the Explorer circuit, but it is essential to retain it as a buffer stage to prevent radiation from the super-regenerative detector via the aerial. ■

COMMUNICATIONS RECEIVERS

—continued from page 415

Modifications: The usual modification is to replace the valves with miniature types, although this is rather an extensive modification and should not be undertaken lightly. A Q-multiplier is often added. Local oscillator and b.f.o. drift can be corrected by stabilising the h.t.

The HRO Senior can be used very effectively without any modification at all.

Availability: The HRO Senior is easily available both on the surplus and the second-hand markets. A large number have been released in the last few years.

Grade 1 HRO5T's with a set of 9 standard coil units, but without power supply, can be obtained for about £25. Grade 2 specimens are priced at about £20. HRO5R's are about £2 less than the 5T. A power unit for 250V a.c. can be obtained for about £2 or £3. Standard coil units are about £1 each, although these are not usually sold separately. Bandspread coil units are scarce and can usually only be obtained privately, when they are priced at £2 or more each. It is possible to make bandspread coil units from the standard units, but this is not a simple task.

Manuals are not normally supplied with HRO's, even when sold brand new, but they do exist and can be obtained secondhand.

to be continued

ECONOMICAL SPEAKER ENCLOSURE

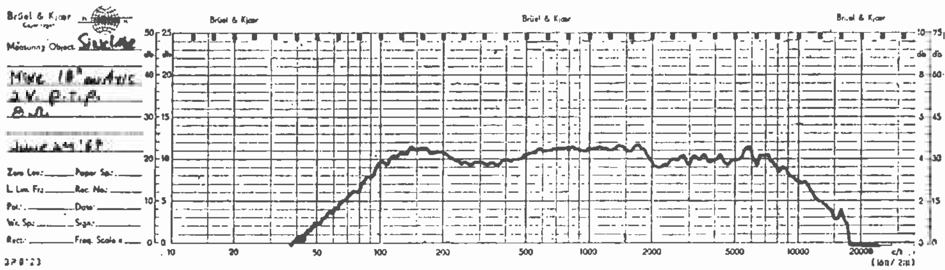
—continued from page 430

"Bondacoust", felt or even "Cosywrap" fibreglass attic insulation material. A curtain of damping material is hung in the centre of the cabinet as shown and of course should not be liable to disintegrate.

The speakers are wired in parallel with substantial gauge wire and the connections brought out to terminals on the back of the cabinet. Before final glueing of the cabinet check that the speakers are in phase. This is easiest done by connecting a 1·5V torch battery across the terminals. Both cones should move forward (or backward) together. If not, the speakers are out of phase and the connections to *one* should be reversed. Finally the front and sides of the cabinet are covered with a single piece of speaker fret. If the wood is painted black the speaker cutouts will not show through the weave.

The author has obtained excellent performance with a cabinet of this type and a pair of Richard Allen speakers costing 32/6d. each. Bass is very good for such cheap speakers and the sound has a good crisp quality. The unit currently provides both orchestral entertainment and Beatle torture at high level for opposing family factions. An important point to remember is that the connecting lead between the Z12 and the speaker should be mains cable rather than light "bell cord", a few yards of which may absorb as much power as the speaker. ■

NEW LOUDSPEAKER



Unretouched reproduction of performance curve taken from a Sinclair Q.14 from stock. Scale reference 0-25.

INDEPENDENT TEST REPORT

The above curve, which is better than that obtainable from any speaker up to £25, was taken by an independent testing laboratory and shows clearly why the Q.14 achieves such remarkable standards of reproduction. Superb response is maintained between 60 and 15,000c/s, completely covering listening requirements and assuring the user of getting the best from the equipment to which the speaker is coupled.

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The sound, or pressure chamber and mounting baffle are of special high-density ultra-low resonant materials made possible by modern bonding and processing techniques. The sound chamber is of seamless construction and the loudspeaker mounted to ensure complete freedom from spurious "coloration".

LOADING

The Sinclair Q.14 has an input impedance of 15 ohms and will comfortably accept loadings in excess of 28 watts music power. This rating is far greater than that required for average listening requirements. However, using the Q.14 in module formation (a unique Sinclair facility) enables a very powerful system to be built up efficiently and economically. This make an ideal quality P.A. system.

FREQUENCY RESPONSE

As the independently made curve shows, a remarkably smooth response is maintained between 60 and 15,000c/s. This extends comfortably beyond either end of the audio spectrum to provide true hi-fi standards.

REPRODUCING UNIT

A specially designed driver unit is used. It has an exceptionally high compliance in the cone suspension, a massive 11,000 gauss ceramic magnet and an aluminium speech coil. The cone is treated to ensure brilliant transient response.

CONTOURED PRESSURE CHAMBER

The shape and proportions of the sealed sound or pressure chamber have been determined mathematically thereby ensuring maximum energy to sound conversion ratio with forward sound "presence" and freedom from directional effect. This is why the Sinclair Q.14 is ideal for stereo. Connections at the rear are marked for correct phasing when using two or more Q.14's.

SIZE

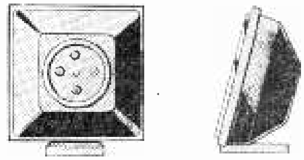
$9\frac{3}{4}$in. x $9\frac{3}{4}$in. x $4\frac{3}{4}$in. deep. A separate base for free standing position is provided as well as a template for wall or flush mounting. A neat solid aluminium bar inset is used to embellish the front of the speaker.

SEND FOR YOURS TODAY

Try the Q.14 in your own home. Your money will be refunded in full (inc. postage) if not satisfied.

£6.19.6

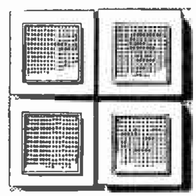
AN ALL-BRITISH SINCLAIR GUARANTEED PRODUCT



USING A SINCLAIR Q.14 SYSTEM

The size and form of the Sinclair Q.14 permit it to be used in a far wider variety of applications than with conventionally designed loudspeakers. This makes it possible to match the speaker to its environment much more easily and to achieve performance standards far better than anything in its size or price group. Here are some typical ways of using the Q.14. The enthusiast for hi-fi will find many more.

FREE STANDING
BOOK SHELF ASSEMBLY
Ideal for stereo. A detachable base is supplied with the Q.14, for this purpose.



CORNER SPEAKER AT ANY HEIGHT
The Q.14 will fit comfortably into a wall corner, taking up a minimum of space. The wall surfaces then contribute to the sound radiation.

MULTI UNIT ASSEMBLY
Any number of Q.14's can be flush mounted on to a flat surface, such as a false wall or room divider. They can also be arranged for P.A. work.

sinclair

Order form and more Sinclair products on next pages

SINCLAIR MICROMATIC

Actual Size

To the fantastically small size of the Sinclair Micromatic must be added its brilliant performance. This British made set assures you at all times of choice of B.B.C. and many other stations in the medium waveband. After dusk, even more stations come in all around the dial with amazing power and excellent quality. Vernier type tuning takes full advantage of the set's selectivity. This remarkable set provides good listening no matter where you are—indoors, in car, bus, train—everywhere. The Sinclair Micromatic brings a refreshingly new approach to personal listening and for its size, appearance, price and performance there is nothing to equal it anywhere in the world.

- CALIBRATED SLOW-MOTION DIAL
- BANDSPREAD AND A.G.C.
- FANTASTIC POWER. SELECTIVITY & QUALITY
- TUNES OVER MEDIUM WAVEBAND
- EASILY BUILT IN AN EVENING
- GUARANTEED 5 YEARS

Complete kit in new "see-for-yourself" fitted pack, with instructions and solder **59/6**

Built and tested with earpiece and batteries. **79/6**

6-stage receiver having two R.F. stages, a double diode detector and a powerful three stage A.F. amplifier, the output from which feeds into a specially matched high quality lightweight earpiece. The MICROMATIC has its own built-in ferrite rod aerial and uses vernier type tuning over the medium wave band. A.G.C., counteracts fading from distant stations. The beautifully styled case, size $1\,{}^4/_5$ x $1\,{}^3/_{10}$ x $\frac{1}{2}$in., is faced with an artist designed aluminium front panel of outstanding elegance, with aluminium tuning dial to match.

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Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full at once and without question. FULL SERVICE FACILITIES AVAILABLE TO ALL PURCHASERS.

SINCLAIR MICRO FM

An amazing dual-purpose FM tuner-receiver

NEEDS NO ALIGNING WHEN BUILT

Less than 3in. x $1\frac{3}{4}$in. x $\frac{3}{4}$in. F.M. Superhet using pulse counting discriminator for superb audio quality. Low I.F. makes alignment unnecessary. Tunes 88–108 Mc/s. The telescopic aerial suffices for good reception in all but poorest. areas. Signal to noise ratio —30dB at 30 microvolts. Takes standard 9 v. battery. One outlet serves for feeding to amplifier or recorder, the other allows set to be used as a pocket portable Brushed and polished aluminium front, spun aluminium dial. A fascinating set to build which gives excellent reception by any standards.

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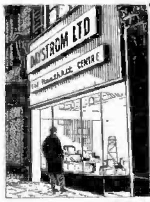

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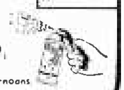

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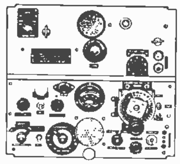

MURPHY B40 NAVAL RECEIVERS

5 bands 650Kc/s–30Mc/s. 10 valves. Built in speaker, phones output. 2 R.F. and 3 I.F. stages, xtal bandpass filter, noise limiter etc. etc. 150/230v A.C. Size 19½ x 13½ x 16in. Cost well over £500. Supplied tested, working with circuit diagram **£22.10.0.** Carr. 30/–. Also B41, L.F. version **£15.** Carr. 30/–.

SPECIAL OFFER: Both above receivers **£30.** Carr £3.

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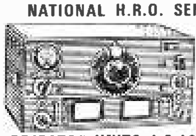

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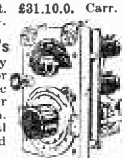
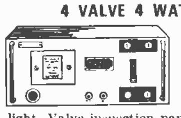


4 VALVE 4 WATT AMPLIFIER



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Calibrated scale, ideal 160/80/40 metres. Limited number only. Brand new with instructions, **17/6.** P. & P. 7/6.

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EF80	4/–	PCC84	5/–	PY33	7/6
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EB91	2/–	PY81	5/–	U191	7/6
EF85	5/–	PY800	5/–	U310	7/6
EY86	5/6	PL36	7/6	PCL83	7/6

Radio chassis, modern valve type in clean condition. Less valves, **25/-** post paid.
Fireball tuners complete with valves, **£1** post paid.
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465 Kc I.F. trans. size 1½ x 1½ x 3½in. New, boxed, **7/-** per pair. Min. panel meters 500 μA scaled 1 mA 1¾in. OSD, **14/-.** Whip aerials 12ft., 3 screw sections in case with insulated base **18/-.** B.N.C. co-ax plugs and Sks **2/6** each. Motors 12V with G.B. 6 r.p.m. **16/6.** 24V 200 r.p.m. **12/6.** Trans. 230V to 28V at 1 amp **17/-,** 230V to 6·3 ct twice at 3 amps and 6·3 1 amp **17/-.** Head and mike sets used, **11/6.** Co-ax cable, 30ft. lengths, ⅜in. dia. 80 ohm **17/-.** Aerial wire, 100ft. coils insulated with 3 chain link insulators, **10/-.** Headphones HS33 600 ohm, used cond. **15/-.** 45 Mc/s miniature I.F. strip 10 valves, new **39/6.** 24V Blowers 5in. dia. 6in. long, 7,600 r.p.m., ex equip. **37/-.** Tuning conds. 500 pF fitted auto stop **7/6.** Dipole aerial 80ft. with 2 chain link insl. **11/6.** Control box with 5 swts, 8 pots, push swt, dial lamp **8/6.** Meters 2¼in. Fl Rd 350 mA and 50 mA **15/-,** 12 amp R.F. **10/-.** All prices include post or carriage. Send **6d.** for lists.

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HURRY, HURRY. Stocks good but selling fast.

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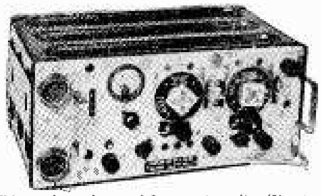
JOHN'S RADIO (Dept. B)

OLD CO-OP, WHITEHALL ROAD, DRIGHLINGTON, BRADFORD

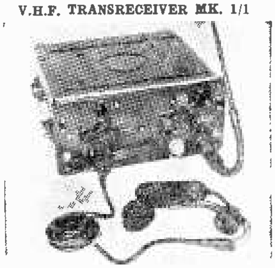
FAMOUS ARMY SHORT-WAVE TRANSRECEIVER MK. III



This set is made up of 3 separate units: (1) a two valve amplifier using a 6V6 output valve: (2) (some only, not built in the very latest models) a V.H.F. transreceiver covering 229–241 Mc/s using 4 valves; (3) the main short wave transmitter/receiver covering in two switched bands, just below 2 Mc/s–4½ Mc/s, and 4½ Mc/s–8 Mc/s (approx. 160–37·5 metres) using 9 valves. For R.T., C.W. and M.C.W. The receiver is superheterodyne having 1 R.F. stage, frequency changer, two I.F. (465 Kc/s) signal detector, A.V.C. and output stage. A B.F.O. included for C.W. or single side-band reception. T.X. output valve 807, other valves octal bases. Many extras, e.g. netting switch, quick flick dial settings, squelch etc. Power requirements LT 12 volts, HT receiver 275 volts D.C. HT transmitter 500 volts D.C., size approx. 17½ x 7½ x 11ins. Every set supplied in new or as new condition in carton with book including circuits, only **£4.10.0d.**, or Grade 2 slightly used **50/-** carriage both 15/-.

A FULL KIT of brand new attachments for this set including all connectors, control box, headphones and mike, aerial tuning unit, co-axial lead etc. at only **45/-** carriage 5/-. WE MAKE A MAINS 200/250 VOLT POWER UNIT in louvred metal case to plug direct into set power socket to run (1) receiver, **70/-** post 5/-. (2) TX and RX, **£6.10.0** post 7/6d. (3) 12 Volt DC P.U. for receiver, **50/-** carriage 5/-. A charge of 10/- to unpack and test the receiver of these sets is made only if requested.

V.H.F. TRANSRECEIVER MK. 1/1



This is a modern self contained tunable V.H.F. low powered frequency modulated transreceiver for R.T. communication up to 8–10 miles. Made for the Ministry of Supply at an extremely high cost by well known British makers, using 15 midget B.G. 7 valves, receiver incorporating R.F. amplifier. Double superhet and A.F.C. Slow motion tuning with the dial calibrated in 41 channels each 200 Kc/s apart. The frequency covered is 39 mc/s–40 mc/s. Also has built-in Crystal calibrator which gives pips to coincide with marks on the tuning dial. Power required LT 4½ volts, HT 150 volts, tapped at 90 volts for receiver. Every set supplied complete with valves and crystals. New in carton, complete with adjustable whip aerial, and circuit. Price **£4.10.0** carriage 10/-. Headset or hand telephone **30/-**. Internal power unit stabilised for 200/250 volts AC input **£6.10.0** extra.

Resistors. ¼W, 10%, High Stab. **3/-** per doz. **18/6** per 100.
Capacitors. Min. Electrolytic. Pack of 12 **9/-**. Polyester and foil. Pack of 12 **6/-**.
Transistors. (See Lists for large selection). Matched Output Kit. OC81D+2xOC81. **7/6** per set.
Type 1020 PNP Germ. AF.50mW. **8/-** per doz. OC44, OC45, OC70, OC71, OC81, OC81D **2/3** each. BC108, **5/6** each. OC25, **7/6**. OC36, **10/-**.
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Ex. Equipment. 3 months' guarantee

10F1, EF80, EB91, ECL80, EF50, PY82, PZ30, 20P3. All at **10/-** per doz. Post paid. Single valves post 7d.

ARP12	1/6	PL36	5/-	10P13	2/6
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ECC83	4/-	PY82	1/6	20P3	2/6
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EF80	1/6	U191	5/-	6B8	1/8
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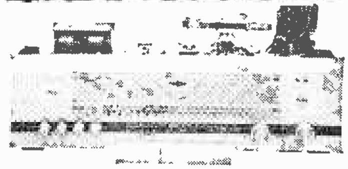
HI-FI KUBA ROYAL STEREOPHONIC TUNER AMPLIFIER



High Fidelity stereo/tuner amplifier. A four wave band tuner unit integrated with a powerful 16 watt high fidelity push-pull stereo amplifier. The most advanced comprehensive chassis yet designed.
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£24.15.0 deposit followed by 24 Monthly Payments of £2.11.7 (total H.P. £86.13.0)+17/6 P. & P. Send £25.12.6 NOW.
For other stereophonic equipment see page 454.

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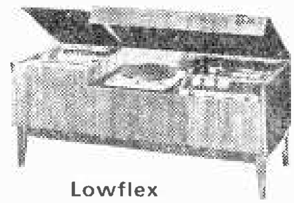

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Personal callers welcome

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LEWIS RADIO, 100, CHASE SIDE, SOUTHGATE LONDON, N.14. Telephone: PAL 3733/9666

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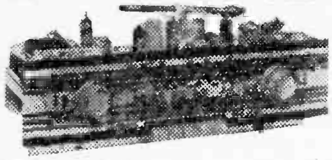
SPECIAL RADIO CHASSIS OFFERS

HI-FI CONTINENTAL STEREOPHONIC RADIOGRAM CHASSIS



Magnificent 'Continental' Stereophonic Radiogram Chassis with piano key switches, built-in ferrite rod aerial. Comes complete with two 10" elliptical loudspeakers, plus a mono/stereo 4-speed automatic record changer. Complete 29½ gns. (Units available separately if required. Chassis only, 21 gns.).
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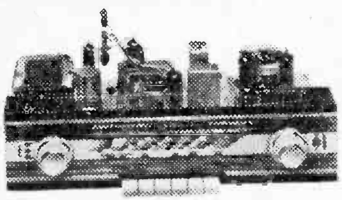

This most advanced radiogram chassis with automatic push button selection covers short, medium and long wavebands plus V.H.F./F.M. Offered complete with 2 10 x 6 speakers 4 speed Stereo/Mono autochanger only £35.19.6. Chassis only, 25½ gns. Special terms available of £12 deposit followed by 18 monthly payments of £1.11.7. (total H.P. £40.8.6)+17/6 P. & P. Send £12.17.6 now.
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Send your cheque or P.O. today while stocks last to Dept. P.107.

Personal callers welcome

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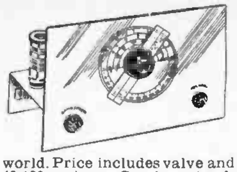
LISTEN TO THE WORLD on TELSTAR our 1-VALVE SHORT WAVE RADIO



Receives speech and music from all over the world. Price includes valve and one coil covering 40-100 metres. Can be extended to cover 10-100 metres. Can be converted to 2 or 3 valve and all-mains speaker use.
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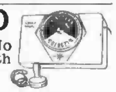

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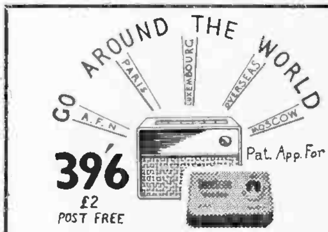

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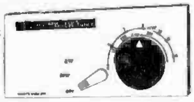

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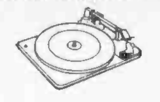

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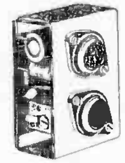

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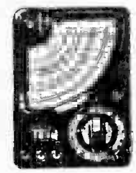

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6L18	6/-	DL35	4/9	ECL82	6/-	KT61	6/3	PL84	6/-	UCC85	6/-
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PRACTICAL WIRELESS, OCTOBER 1967

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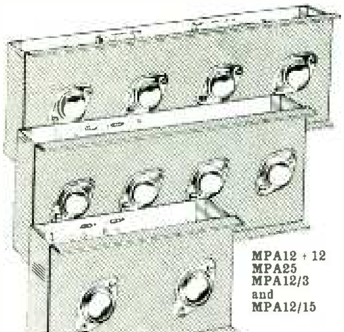

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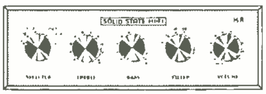

◀ MP3

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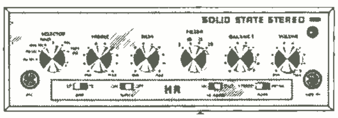

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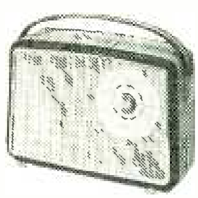

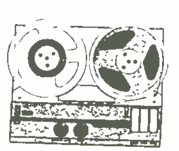

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