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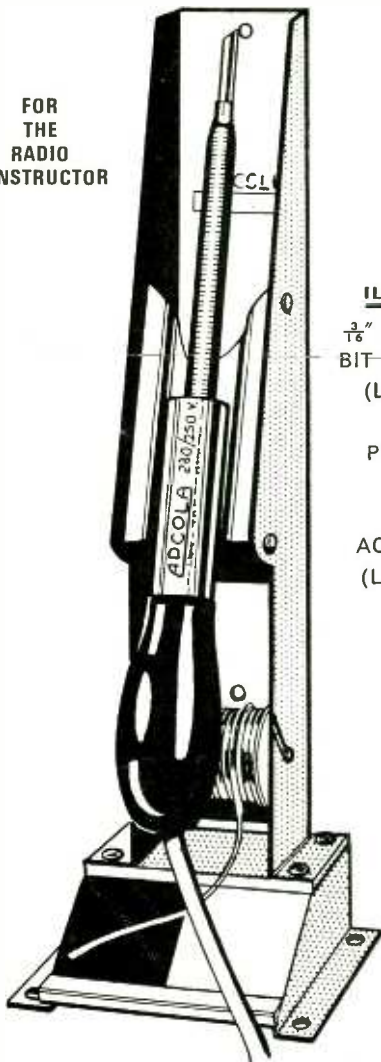
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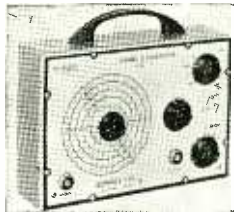
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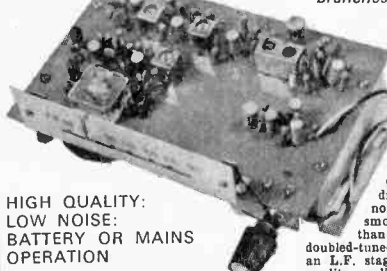
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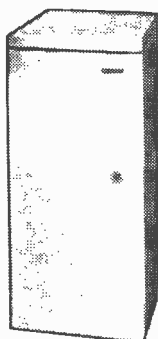
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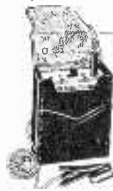
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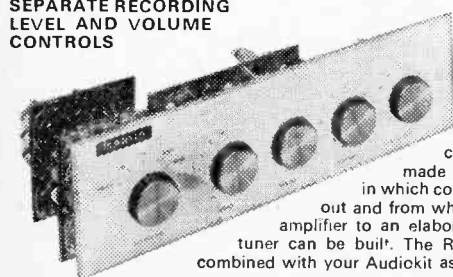
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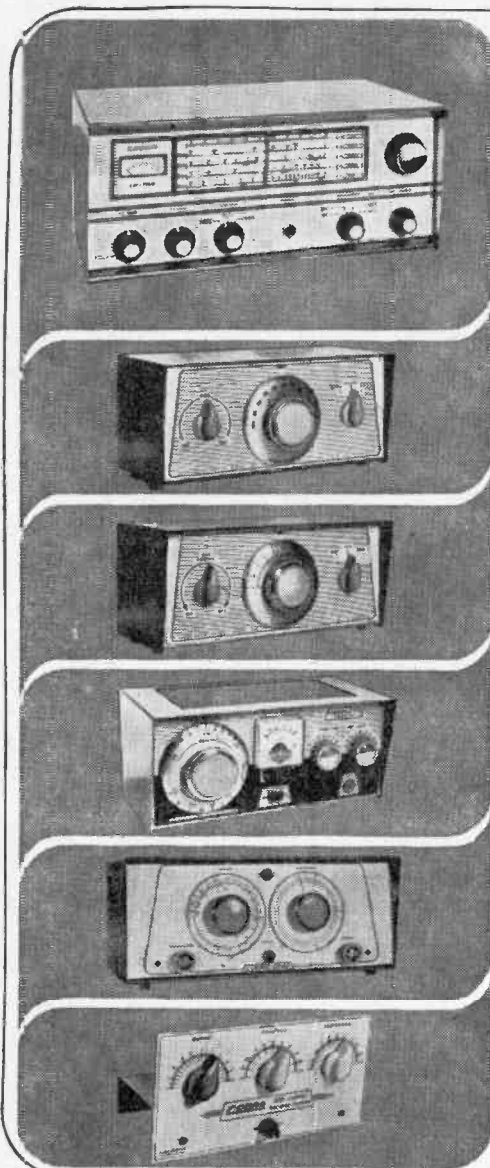
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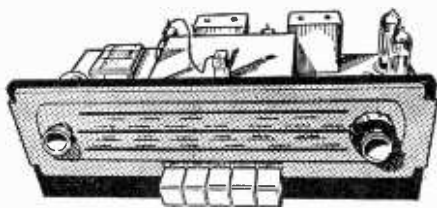
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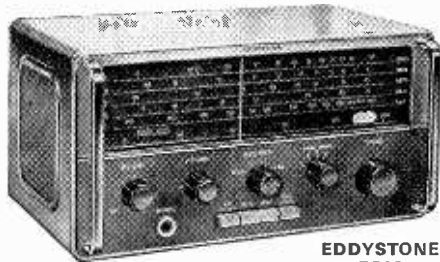
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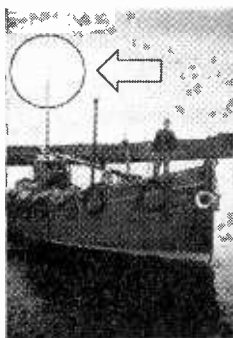
Throughout the development of radio communication the keen private experimenter has contributed largely to the advance of our science. The amateurs of the thirties pioneered reliable shortwave transmission and reception. Basic theories and their practical application are to this day hatched in the fertile minds of ingenious men who are the leading amateurs of our time.

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This VFA system is a remarkable invention and its unique quality of high performance at any selected frequency from 1 M/c to 30 M/cs—particularly from difficult locations—has radically changed the attitude of both the licensed amateur and the shortwave listener towards their aerial problems.

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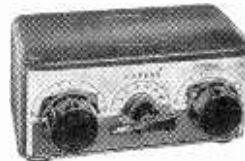


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The Joystick aerial was successfully subjected to the most rigorous tests under appalling weather conditions aboard the MFV *Crystal Sea* OB104 and the MFV *Margaret Ann* OB79 out of Mallaig. Previously the old-fashioned wires had to be lowered every time the ships' derricks were used. Communication with shore stations and other ships was consistently good.



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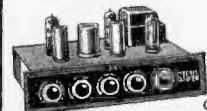
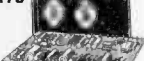


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Kit includes Printed
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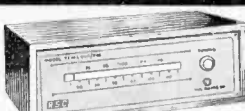
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PROVIDING 10/14 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON
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Employing valves ECC83, ECC83, ECL86, ECL86, ECL86. Frequency
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Total cost of parts
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FULLY TRANSISTORISED 200/250v. A.C. Mains.
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Maximum instantaneous Peak power output 28 watts.
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LATEST MULLARD TRANSISTORS. AD149, AD149.
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CROSS TALK: -52dB at 1,000 c.p.s.
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Complete kit with valves. **£6.19.11**

Miniature Transistorised VHF/FM Tuner Battery operated. In plastic case complete with Telescopic Aerial. Carr. 5/- **£6.19.11**

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, E281. High quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. Frequency response +3dB 30-20,000 c/s. Six negative feedback loops. Hum level -90dB. SENSITIVITY 12 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 provides 300v. 30mA, and 6.3v. 1.5a. for Radio Tuner or Tape Pre-amp. Size approx. 12 x 9 x 7 1/2 in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohm speakers. Kit complete to last out. Chassis fully punched. Full instructions and point-to-point wiring diagrams (or factory built £11.15.0). Metal cover with 2 handles available for 21/-. TERMS ON Carr. 11/6
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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 15in. 30 watt unit PLUS a 4" with extend with extend with extend with extend. ★ 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".

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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 11 in. Send S.A.E. for leaflet. Or deposit 24.14.8 and 9 monthly payments of 66/- (Total 234.8.6). Carr. 17/6



G15 15 WATT AMPLIFIER For Lead or Rhythm Guitar, Mike, Gram or Radio

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 8 in. Deposit 3 gns. 19 1/2 Gns. Carr. 15/- (Total 22.15.3). S.A.E. for leaflet.

LINEAR TREMOLO PRE-AMP UNIT

Suitable for use with any of our Amplifiers. Controls are Speed (frequency of interruptions). Depth (for 4- Gns. heavy or light effect). Volume and Switch.

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1. All an-dry battery eliminator. Size 5 1/2 x 4 1/2 in. approx. Completely replaces batteries supplying 1.5v. and 90v. where A.C. mains 200/250v. 50 c/s is available. Complete kit with diagram 47/9 or ready for use 59/11.

SELENIUM RECTIFIERS F.W. (Bridged)

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

HEAVY DUTY SELENIUM RECTIFIERS 19/9

12v. 15 amps. F.W. (Bridged). Only



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New branches now open — see addresses

R.S.C. COLUMN SPEAKERS

Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. 15 ohm matched. Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5 1/2 in. Or deposit 44/- and 9 monthly payments 31/5 (Total 16.6.9) Carr. 10/-
Type C42, 40 watts, Fitted four 12in. 12,000 line 10 watt speakers. Overall size 56 x 14 x 9 in. approx. Carr. 15/-
Or deposit 23.11.0 and 9 monthly payments of 46/7 (Total 24.10.3).

14 Gns.

21 Gns.

30 WATT HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group

A Four Input, two volume control Hi-Fi unit with separate Bass and Treble "cut" and "boost" controls. Latest type valves. Housed in strong Rexine covered cabinet with twin carrying handles. Attractive black and gold perspex fascia plate. For 200-250v. A.C. mains. Output for 3 or 15 ohm speakers. Carr. 12/6
ers. Send S.A.E. for leaflet. Deposit 23 and 9 monthly payments of 37/5 (Total 219.16.9).

17 Gns.

12in. HIGH QUALITY L'SPEAKERS

In walnut veneered cabinet. 10 Watt Model. Gauss 12,000 lines. 3 or 15 ohms. Carr. 7/6 **£4.19.11**

20 Watt Model. 15 ohm. Size 18x18x10in. Gauss 12,000 lines. **£7.19.11**

Terms available on both. Carr. 10/6

FANE HEAVY DUTY HI-FI SPEAKERS 5 Gns.

12in. 20 watt. Type 122/10. Post 8/9.

12in. 30 WATT HEAVY DUTY 15 ohm LOUDSPEAKERS

Flux Density 17,000 lines. Fully Guaranteed. Outstanding value at normal price of approx. £12. Or deposit 23/10 and 9 monthly payments of 15/6 (Total 23.3.4). Carr. 12/6

R.S.C. GRAM AMPLIFIER KIT. 3 watts output.

Negative feedback. Controls: Vol. Tone and Switch. Mains operation 200-250v. A.C. Fully isolated chassis. Circuit, etc. supplied. Only 49/11.

HIGH QUALITY 12in. 10 WATT SPEAKERS 59/11

Flux Density 12,000 lines. 3 or 15 ohms.

TRANSISTOR SALE

Mullard OC71, OC72, OC81, 2/11, OC44, OC45, 3/11, OC75, 7/9, AF17, 6/9, Ediswan XA101 XA112, XC101A, 3/9. Postage 6d. for up to 3 transistors.

R.S.C. MAINS TRANSFORMERS

FULLY GUARANTEED. Interleaved and Impregnated. Primary 200-250v. 50 c/s. Screened. MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 in. 14/11
250v. 60mA, 6.3v. 2a
250-250v. 60mA, 6.3v. 2a 15/11

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250-250v. 60mA, 6.3v. 2a, 0-5-0-5v. 2a, 2 1/2 x 3 1/2 in. 19/9
250-250v. 100mA, 6.3v. 4a, 0-5-0-5v. 3a, 33/9
300-300v. 100mA, 6.3v. 4a, 0-5-0-5v. 3a, 33/9
300-300v. 130mA, 6.3v. 4a, c.t., 6.3v. 1a. 41/9

For Mullard 510 Amplifier

350-350v. 100mA, 6.3v. 4a, 0-5-0-5v. 3a, 33/9
350-350v. 150mA, 6.3v. 4a, 0-5-0-5v. 3a, 42/9
425-0-425v. 200mA, 6.3v. 4a, c.t., 5v. 3a, 67/9
425-0-425v. 200mA, 6.3v. 4a, c.t., 5v. 3a, 67/9
450-0-450v. 250mA, 6.3v. 4a, c.t., 5v. 3a, 79/9

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250-250v. 100mA, 6.3v. 2a, 0-5-0-5v. 2a, 22/9
350-350v. 80mA, 6.3v. 2a, 0-5-0-5v. 2a, 23/9
250-250v. 100mA, 6.3v. 4a, 0-5-0-5v. 3a, 32/9
300-300v. 100mA, 6.3v. 4a, 0-5-0-5v. 3a, 32/9
300-300v. 130mA, 6.3v. 4a, 0-5-0-5v. 1a, 41/9

Suitable for Mullard 510 Amplifier

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FILAMENT or TRANSISTOR POWER PACK TYPES
6.3v. 1.5a 8/9, 6.3v. 2a 7/9, 6.3v. 3a 9/9, 6.3v. 6a 19/9, 12v. 1a 8/9, 12v. 3a or 5v. 1.5a 19/9, 0-9-18v. 1 1/2a 16/9, 0-25-35-42v. 2a 27/9.

CHARGER TRANSFORMERS 0-15v. 1 1/2a. 13/11

2 1/2a. 16/11, 5a. 21/11, 6a. 25/11, 8a. 31/11
AUTO (Step UP/STEP DOWN) TRANSFORMERS
0-110/120v. 200-250v. 50-80 watts. 14/9
150 watts, 29/11, 250 watts, 49/9, 500 watts, 99/9

OUTPUT TRANSFORMERS

Standard Pentode 5,000Ω to 3Ω or 7,000Ω to 3Ω
Push-Pull 8 watt EL84 to 3Ω or 15Ω 11/9
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Push-Pull 10-12 watt to match 6V6 to 3, 5, 8 or 16Ω 21/9
Push-Pull EL84 to 3 or 15Ω 10-12 watt. 19/9
Push-Pull Ultra Linear for Mullard 510, etc. 35/9
Push-Pull 15-18 watt sectionally wound 6L6, KT66, etc. for 3 or 15Ω 22/9
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HI-FI CENTRES LTD.

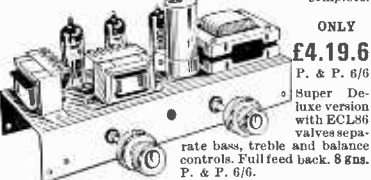
HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1

- Peak out in excess of 14 watts.
- All standard British components.
- Built on printed circuit panel, size 6 x 3in.
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- Output transformer tapped for 3 ohm and 15 ohm speakers.
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- 9 volt operation.
- Everything supplied, wire, battery clips, solder, etc.
- Comprehensive easy to follow instructions and circuit diagram 1/6. (Free with Kit). All parts sold separately.

SPECIAL PRICE 45/-. P. & P. 3/-.
Also ready built and tested, 52/6. P. & P. 3/-.
A pair of TAs is ideal for stereo.

STEREO AMPLIFIER

Incorporating 2 ECL86s and 1 EZ80, heavy duty, double wound mains transformer. Output 4 watts per channel. Full tone and volume controls. Absolutely complete.



ONLY
£4.19.6
P. & P. 6/6

Super Deluxe version with ECL86 valves separate bass, treble and balance controls. Fully featured back 8 pins. P. & P. 6/6.

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 waveband transistor superhet. ● Printed circuit panel (size 8 1/2 x 2 1/2 in.). ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite Rod Aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions. All parts sold separately. Set of parts if purchased at one time ONLY 24.5.0. P. & P. 2/6 (Circuit diagram 2/-). Free with set of parts.)

35 OHM SPEAKERS

Suitable for use with above. 2in. Goodmans. Ideal replacement for most pocket portables. 8/6; 3 1/2 in. 12/6; 7 x 4in. 21/-; P. & P. 2/- per speaker.

PORTABLE CABINET

Size approx. 9 1/2 x 6 1/2 x 3 1/2 in. Suitable for above using 3in. speaker, 25/-; P. & P. 2/6.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 IF transformers one oscillator coil one driver transformer and wound Ferrite aerial (mod. long and car aerial coupling). 32/6 complete post 2/-. 6 transistor printed circuit board to match 8/6. Post 1/-. Circuit diagram 1/6 extra.

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BRAND NEW TRANSISTOR BARGAINS
GET 15 (Matched Pair) 15/-; V15/10p, 10/-; OCT1 5/-; OCT6 6/-; AF117 7/6.
Set of Mullard 6 transistors OC44, 2—OC45 OC81D matched pair OC81 25/-, ORP12 Cadmium Sulphide Cell 10/6.

EDISWAN MAZDA

PXA101 6/6; XA103 8/6.
R.F.I. Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp. (Equiv. OC44 and OC45) 10/6
R.F. 2 Pack: 2—PXA101 I.F. 1—PXA102 Osc. 12/6
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L.F. 6 Pack: Consisting of PXB113 Driver Matched pair. PX171 mounted complete with heat sinks (Equiv. OC81D and OC81) 12/6
ALL TRANSISTORS POST FREE.

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B.S.R. MONARDECK (Single speed) 3 1/2 in. per sec., simple control, uses 6 1/2 in. spools, £6.15.0 plus 7/6 carr. and ins. (Tapes extra).
LATEST COLLARO MAGNAVOX 363 TAPE DECK DE LUXE. Three speeds, 2 track, takes up to 7in. spools. 10 guineas. Plus 7/6 Carr. & ins. on each (Tapes extra).

PORTABLE TAPE RECORDER CASE

Beautifully made and expensively finished in dark grey heavy grade rexine. Satin Chrome metal grille front and chrome fittings. Speaker aperture 9" x 4". Overall size 15 1/2" w. x 15" d. x 7 1/2" h. Will take any standard tape deck or single record player. Limited number only. Worth at least £5. OUR PRICE 49/6. P. & P. 3/-; Brand new and unused.

ACOS CRYSTAL MIKES. High imp. For desk or hand use. High sensitivity. 18/6. P. & P. 1/6.
TEL CRYSTAL STICK MIKE. Listed at 45/-. Our price 18/6. P. & P. 1/6.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier (was used in a 29 gn. record player) employs heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. x 2 1/2 in. d. x 5 1/2 in. h. Ready built and tested. PRICE 89/6. P. & P. 4/9.
ALSO AVAILABLE mounted on board with output transformer and 6in. speaker ready to fit into cabinet below. PRICE 89/6. P. & P. 5/9.

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Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autotuner or Single Record Player Unit. Size 18 x 14 x 8 1/2 in.
Price £23.9.6. Carr. 7/6.

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All brand new in maker's original packaging.
SINGLE PLAYERS
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Latest B.S.R. UA25 Super silu £6.2.6
GARRARD 1000 with special Hi-Fi cartridge £6.19.6
GARRARD AT60 £9.18.6 Carr. 6/6 on each
All the above units are complete with t/o mono head and sapphire stylus or can be supplied with compatible stereo head for 12/6 extra.

BRAND NEW CARTRIDGE BARGAINS!

ACOS GP67-1. Mono complete. List price 21/-. Our price 13/6. P. & P. 1/-.

BRAND NEW 3 OHM LOUDSPEAKERS

5in., 12/6; 6 1/2 in., 15/-; 8in., 21/-; 10in., 25/-; 7in. x 4in., 15/-; 10in. x 6in., 28/-.
E.M.I. 8" x 5" with high flux ceramic magnet, 23/6.
E.M.I. 13 1/2 x 8in. with high flux ceramic magnet, 42/- (15 ohm, 45/-). P. & P. 3/- 2/6; 6 1/2" x 8" 2/6; 10" x 12" 3/6 per speaker.

SPECIAL OFFER!

Limited number of 12in. 10 watt "R.A." Speakers: 3 ohm 25/-; 15 ohm, 27/6. P. & P. 3/6.

E.M.I. PLASTIC CONED TWEETERS. 2 1/2" 3 ohm. Limited number 12/6 each. P. & P. 1/6.

BRAND NEW HEAVY DUTY 12in. SPEAKERS
Response 45 c/s-13 Kc/s. 1 1/2 in. voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE at 89/6. P. & P. 5/-. Also 25 watt Guitar Model available at £5.5.0. And 35 watt Guitar Model £8.5.0.

TYNAR AND REXINE SPEAKER AND CABINET FABRICS

Approx. 54in. wide. Usually 35/- yard. OUR PRICE 13/6 per yard length. P. & P. 2/6 (min. one yd.) S.A.E. for samples.

SPECIAL OFFER!

GENUINE HIGH QUALITY TYNAR FABRIC. 48in. wide. Our price 10/- per foot run. P. & P. 1/6. 30/- per yard run. P. & P. 2/6.

SEMI SHROUDED DROP THRO' MAINS TRANSFORMER. Tapped pri 200/250 v. Sec. 300-0-300 v. at 10mA and 6.3 v. at 3 amp. (E/S screen). Stack size 3 1/2 x 3 1/2 x 1 1/2 in. 30/-; P. & P. 3/6.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9-0-9v. at 500mA. 11/-; P. & P. 2/6.

MAINS TRANSFORMER. For transistor power supplies. Tapped pri 200-250v. Sec. 40-0-40 at 1 amp (with electrostatic screen) and 6.3v. at 5 amp for dial lamps etc. Drop thro mounting. Stack size 1 1/2 x 3 1/2 x 3 1/2 in. P. & P. 4/6.

MATCHED PAIR OF 2 1/2 WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stack size 1 1/2 x 1 1/2 x 2 in. Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair plus 2/-. P. & P.

7-10 watt OUTPUT TRANSFORMERS to match pair of ECL 86's in push-pull to 3 ohm output. ONLY 11/-; P. & P. 2/6.

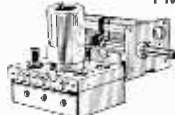
WELL-KNOWN MAKERS SURPLUS! ONE TRANSISTOR PRE-AMP

Suitable for use with Medium or High Impedance mikes, guitars, gram pickups, tape decks etc. For operation from 200/300 volt H.T. rail or 9 volt battery. Gain approx 14:1. Fully isolated input by Mu-Metal screened transformer. Size 4 1/2" x 1 1/2" x 1 1/2". Ready built complete with full circuit diagram and instructions. ONLY 15/-. Post free.

Dual Purpose Bulk Tape Eraser and Tape Head Demagnetiser. 35/-; P. & P. 3/-.

TWIN TELESCOPIC AERIAL. Comprising two 3-section heavily chromed rods. Closed 12-in. each extending to 32in. Completely adjustable from vertical to horizontal. Supplied complete with universal mounting bracket, coax lead and plug. Suitable for F.M. or TV. 12/6. P. & P. 2/6.

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Beautifully designed and precision engineered by Dornier and Wadsworth Ltd. Specially tuned with twin .0005 tuning condenser for AM connection. Prealigned FM section covers 86-102 Mc/s. I.F. output 10.7 Mc/s. Complete with ECC85 (6L12) valve and full circuit diagram of tuner head. Another special bulk purchase enables us to offer these at 27/6 each. P. & P. 3/-. Order quickly! Limited number also available with precision geared 3:1 reduction drive, 30/-; P. & P. 3/-.

MATCHED PAIR AM/FM I.F.'s

Comprising 1st I.F. and 2nd I.F. discriminator (465kc/s /10.7Mc/s). Size 1 x 1 1/2 x 2 1/2 in. high. Will match above tuner head. 11/- pair. P. & P. 2/-.

SPECIAL PURCHASE! TURRET TUNERS

By famous maker. Brand new and unused. Complete with PC884 and PC880 valves 34-38 Mc/s IF. Biscuits for channel 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY 25/- each. P. & P. 3/9.

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88-100 Mc/s 10.7 Mc/s I.F. 15/-, plus 2/- P. & P. (ECC85 valve 8/6 extra).

3-VALVE AUDIO AMPLIFIER MODEL HA34

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2 in. w. x 4 in. d. x 4 1/2 in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 41 watts. Front panel can be detached and leads extended for remote mounting of controls. The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc., wired and tested for only

£45.0
P. & P. 6/-.

HSL 'FOUR' AMPLIFIER KIT

A.C. Mains 200/250v., 4 watt, using ECC83, EL84, EZ80 valves.

- Heavy duty double-wound mains transformer with electrostatic screen.
- Separate Bass, Treble and Volume controls, giving fully variable boost and cut with minimum insertion loss.
- Heavy negative feedback loop over 2 stages ensures high output at excellent quality.
- Suitable for use with guitar, microphone or record player.
- Provision for remote mounting of controls or direct on chassis.
- Chassis size only 7 1/2 in. wide x 4 in. deep. Overall height 4 1/2 in.
- All components and valves are brand new.
- Very clear and concise instructions enable even the inexperienced to construct with 100% success.
- Supplied complete with valves, output transformer (3 ohms only), screened lead, wire, nuts, bolts, solder, etc. (No extras to buy.) PRICE 79/6. P. & P. 6/-.
- Comprehensive circuit diagram, practical layout and parts list 2/6 (free with kit).

This kit although similar in appearance to HA34 employs entirely different and advanced circuitry.

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86, and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts.) All parts sold separately. ONLY £79.6. P. & P. 8/6. Also available ready built and tested complete with std. input sockets, £9.5.0. P. & P. 8/6. Carrying case for above 28/6. P. & P. 7/6.

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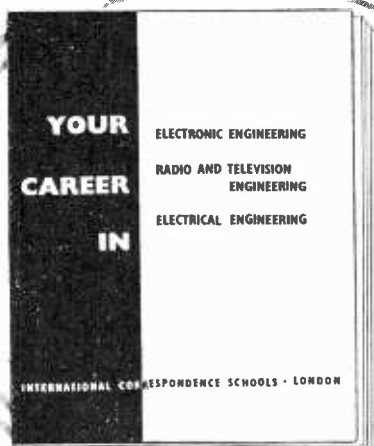
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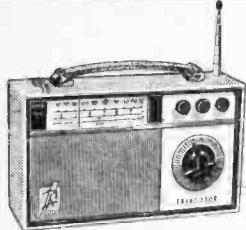
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A simple additional circuit provides coverage of the 1100/1950M. band (including 1500M. Light programme). This is in addition to all existing Medium and Short wavebands. All necessary components with construction data.

Only 10/- extra Post Free.
This conversion is suitable for receivers that have already been constructed.
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All components available separately.

7 transistor plus 2 diode superhet, 6 waveband portable receiver covering the full Medium Waveband and Short Waveband 31-94M and also 4 separate switched bandspread ranges, 13M., 16M., 19M. and 25M., with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow, stage by stage instructions. Superhet, 470 Kc/s. All Mullard Transistors and Diodes. Uses 4 U2 batteries. 5in. Ceramic Magnet P.M. Speaker. Easy to read Dial Scale, 500 MV Output. Telescopic Aerial and Ferrite Rod Aerial. Tone Circuit is incorporated, with separate Tone Control in addition to Volume Control. Tuning Control and Waveband Selector. In a wood cabinet, size 11 1/2 x 8 1/2 x 3in. covered with a washable material, with plastic trim and carrying handle. Car aerial socket fitted.

Can now be built for **£8.19.6** Post 5/- extra
H.P. Terms: 60/- deposit and 11 monthly payments of 18/8. Total H.P.P. £10.0.3.
Four U2 batteries 3/4 extra.

SINCLAIR SUPER MINIATURE KITS

Write for details of Package Deals

THE MICRO-6 miniature radio only 1 1/2 x 1 3/16 x 1 1/4in.	£2 19 6
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THE X-20 20 watt P.W.M. amplifier	£7 19 6
Available ready built, tested and guaranteed	£9 19 6
THE Z-12 12 watt amp. and pre-amp, fully built	£4 9 6
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TAPE RECORDERS

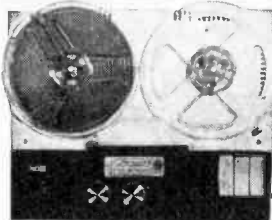
MAGNAVOX 363 TAPE DECKS

The very latest 3 speed model—1 1/2, 3 1/2, 7 1/2 ips, available with either 1 track or 2 track head. Features include: pause control; digital counter; fast forward and rewind; new 4 pole fully screened induction motor, interlocking keys. Size of top plate 13 1/2 x 11in. x 5 1/2in. deep below unit plate. For 200/250v. A.C. mains, 50cps operation. New, unused and fully guaranteed.

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3in. Message tape, 300ft.	7 6	5 1/2in. Long play, 1200ft. Mylar	15 0
3 1/2in. Triple play, 600ft. Mylar	10 0	5 1/2in. Triple play, 2400ft. Mylar	45 0
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
5in. Long play, 900ft. Acetate	10 0	7in. Long play, 1800ft. Mylar	19 6
5in. Standard play, 600ft. PVC	8 6	7in. Double play, 2400ft. Mylar	25 0
5in. Triple play, 1800ft. Mylar	35 0	7in. Long play, 1800ft. Acetate	15 0
5 1/2in. Double play, 1800ft. Mylar	22 6	7in. Triple play, 3600ft. Mylar	50 0

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TRANSISTORISED VHF TUNER

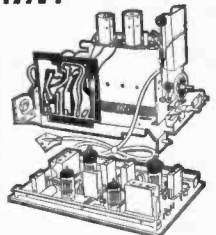
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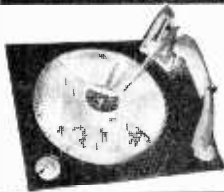
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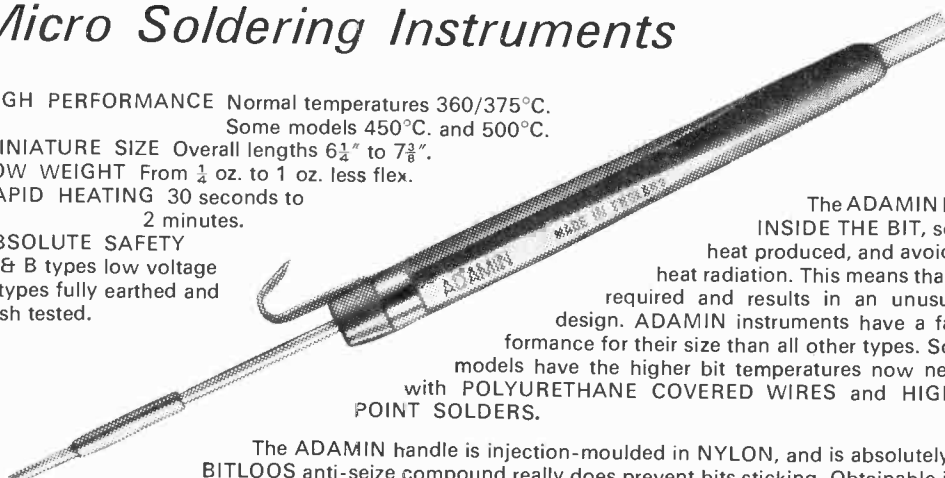
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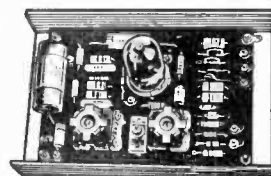
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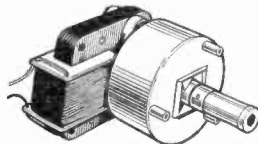
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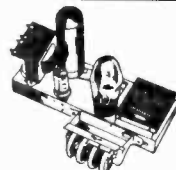
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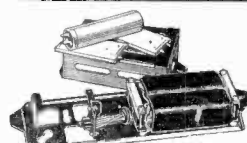
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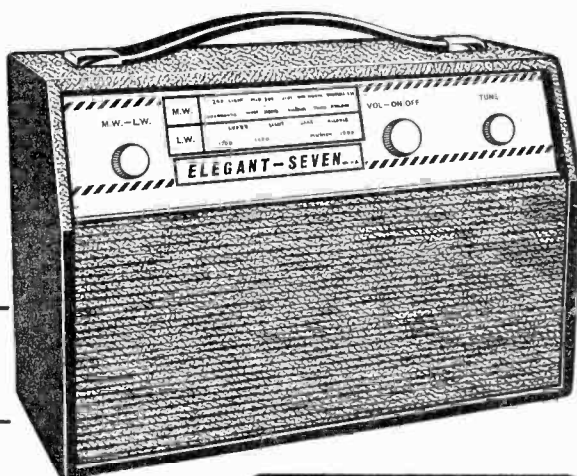
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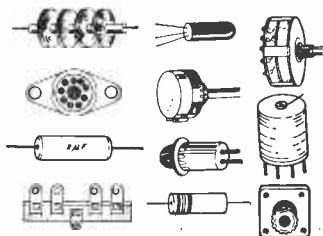


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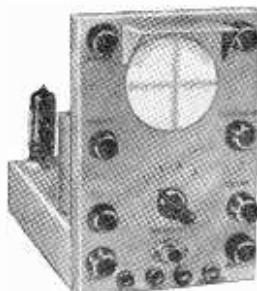
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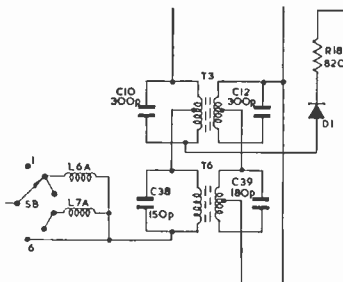
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PRACTICAL WIRELESS

VOL 42 No 11

issue 721

MARCH 1967

TOPIC OF THE MONTH

More 'Pop' & Local Radio

The White Paper issued recently on Broadcasting has done a jolly good job of whitewashing and it is difficult from this document to comprehend the Government's attitude towards broadcasting in the United Kingdom. It has denied Independent Television the right to broadcast in colour (which would not cost the general public an extra penny), yet has permitted the BBC to start a popular music programme in the medium wave band and to run an experimental chain of local radio stations in the v.h.f. band.

"It has of course been the Government's duty," the White Paper explains, "to consider what the proposals for further extending the broadcasting services should seek to serve, and what organisation could best promote these purposes. The Government have also had to consider to what extent it would be in the national economic interest to allow the extensions. It is not enough that they should be desirable in themselves. The overriding consideration is whether the country can afford them."

What a lot of rubbish! The "pirate" radio stations have clearly shown that there is a need for "pop" music and that in general, listeners are not offended by the accompanying advertising. The Government have totally disregarded public opinion in deciding to set up a "popular" music station of a character which will not replace the "pop pirates".

Nine experimental local radio stations operating in the v.h.f. band are to be set up by the BBC in different parts of the country during the year. Locations have not yet been decided, but the stations are hoped to offer a full-scale local service and to be financially supported from local sources. Commercial advertising will not be accepted, yet the BBC will be prepared to accept financial support from local authorities, Chambers of Trade and Commerce, local Councils of Churches, arts associations and other representative bodies active in the social and cultural life of the community. The BBC will not, however, take a direct grant from the local rate fund, but will accept money from local authority departments, such as education. Thus, it would appear that this scheme is just another burden upon the ratepayer.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

Leader	819
News and Comment	820, 844
On the Short Waves <i>by John Guttridge and David Gibson, G3JDG</i>	831
Practically Wireless <i>by Henry</i>	835
The MW Column <i>by Alistair Woodland</i>	843
Future Broadcasting Plans	848
New Books	865

CONSTRUCTIONAL

Top Band Transceiver <i>by T. Simon</i>	822
Balance Controls for Stereo Amplifiers <i>by J. B. Willmott</i>	826
Improving the R1155 <i>by C. Molloy</i>	837
2-Transistor Personal Portable <i>by R. Leyland</i>	840
Low Cost PSU <i>by F. L. Thurston</i>	857
Tape Position Indicator <i>by J. Lowrie, Grad.I.E.E.</i>	866

GENERAL ARTICLES

Solid State Thermometers and Thermostats <i>by K. T. Wilson</i>	846
Pse QSL <i>by David Gibson, G3JDG and Alan Thompson</i>	850

APRIL ISSUE WILL BE PUBLISHED ON
MARCH 3rd

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 36s. per year to any part of the world. © George Newnes Ltd., 1967. Copyright in all drawings, photographs and articles published in "Practical Wireless" is specifically reserved throughout the countries signatory to the Berne Convention and the U.S.A. Reproductions or imitations of any of these are therefore expressly forbidden.

Power supplies

I WAS unable to follow the reasoning in the article by H. T. Kitchen that appeared in the January 1967 issue.

Obviously $\frac{250}{25} \times \frac{60}{230}$ is not equal to 38 ohms as he states. Of course $\frac{250}{25} \times \frac{230}{60}$ is equal to 38 but what happened to the milliamps, that 10^{-3} bit, and how on earth did he come by the equation $\frac{E^1}{1} \times \frac{E^2}{I^2} = R$ (internal) and then confuse the product IR as being internal resistance?

P. Murphy.

Aldermaston,
Berkshire.

The author replies:

I admit guilt in committing the sin of confusing my multiplication and division signs. The error is undoubtedly mine, and as the perpetrator thereof I must, bravely smiling, take the consequences.

It is, I regret, yet another example of the fallibility of human nature; of how a temporary loss of sync between brain and pen can virtually ruin much otherwise painstaking and accurate work.

As I see it, however, the bone of contention is the ultimate equation for calculating IR. Here, of course, I was well and truly up the creek when I used a multiplication sign instead of a minus one. The equation should have read $\frac{E^1 - E^2}{I^2 - I^1}$

Using the new set of rules the IR for my power supply works out at 571 "point something" ohms. And as for forgetting our little milliamp friends, I hang my head in shame.—H. T. Kitchen.

THE P.W. FILM SHOW

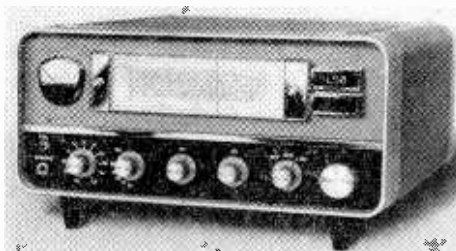
The annual film show, organised jointly by Mullard Ltd. and Practical Wireless, is to be held, as before, at Caxton Hall, Caxton Street, Westminster, London, S.W.1. The date is Friday, April 14th, and the show will start at 7.30 p.m. prompt.

The programme will include a film *Electrons in Harness* and a topical talk on *Transistors and Television*. Refreshments will be served in the interval.

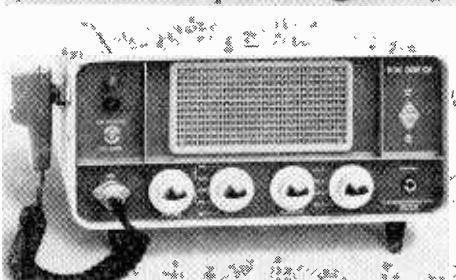
Applications for tickets—which are free—should be made now to Film Show, Practical Wireless, Tower House, Southampton Street, London, W.C.2. A stamped addressed envelope must be included with all applications.

NEWS AND..

TWO NEW MODELS FROM K.W. ELECTRONICS



KW201
Amateur Band Receiver
11 ranges, 1.8—30 Mc/s. Crystal mixer. Crystal BFO. Q Multiplier.
Sens: 1μV/500mW. S/N: 1μV/20dB.



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Transceiver—18 lb. A.C. p.s.u.—23 lb. D.C. p.s.u.—6½ lb.

The KW201 incorporates a mechanical filter which gives an i.f. selectivity of 3.1 kc/s at 6dB and 6 kc/s at 60dB. The Q multiplier (optional extra) gives a range of 3.1 kc/s to 200 c/s selectivity. The slide-rule vernier dial is accurate to 1 kc/s. The KW201, designed for optimum performance on single sideband, measures 13½ x 6 x 12½ in. and weighs 19 lb. Power supply is 200—240V, but a 115V version is available. The price is £105, complete with 13 crystals.

The KW2000CA is a commercial long range unit with a frequency stability of 1 part in 10⁶ in ambients between +70°C to -10°C. Enquiries to K.W. Electronics Ltd., 1 Heath Street, Dartford, Kent.

SILICON PLANAR TRANSISTORS—NEW TYPES

Mullard have added seven new p-n-p types to their range of silicon planar transistors. Because of their linear gain/current characteristics they are all suitable for both switching and linear applications.

The BCY70 and BCY72 are both 350mW type, the former having a high V_{ceo} of 40V and low saturation voltage and intended for medium-speed switching applications. The BCY72 is a general purpose type.

Low leakage current, low saturation voltage and high cut-off frequency (in excess of 200 Mc/s) are features of the new 600mW transistors 2N2904, 2N2904A and 2N3133 (high speed switching and driving) and 2N1131, 2N1132 (medium speed switching).

Mullard also announce new additions to their range of miniature and sub-miniature glass-encapsulated quartz crystal units. An AT-cut unit is available for a range of 1.6—87 Mc/s. There is also a special 10 Mc/s unit for secondary frequency standards (QX3100). A data book with full specifications is available on request.

IMPROVED SURFORM TOOLS

Stanley Works announce a completely redesigned range of their well-known Surform tools which have replaceable blades and can be used on materials from balsa wood to mild steel. Most readers will be familiar with these tools and will be interested to hear that an additional heavy duty blade specifically recommended for use on harder materials such as metals is now available for the first time.

...COMMENT

NEW YORK STATE LAW ENFORCEMENT FACSIMILE SYSTEM

Recently Governor Nelson A. Rockefeller, and Mayor John Lindsay and Commissioner Howard Leary, inaugurated a new communication system to aid New York State criminal justice agencies in fighting crime.

The equipment being supplied by Western Union for New York State Identification and Intelligence System is manufactured by the Muirhead Group of Companies.

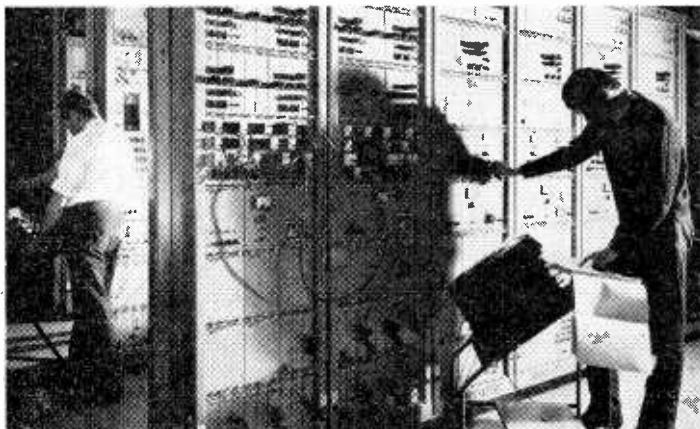
Prior to the installation of this equipment when a suspect was fingerprinted, identification could take 7 to 10 days, it now takes 2 to 3 hours.

The suspect's fingerprint card is placed on a photographic transmitter and within 14 minutes is sent over a telephone circuit to an automatic photographic facsimile recorder. The received copy is automatically processed within the machine to produce a finished photographic copy of the original fingerprint card. This automatic processing takes approximately 12 seconds.

Once the suspect's identity is verified, a copy of his criminal history is transmitted by a rapid message facsimile system to the originating agency in 4 minutes.

The installation is one of some 105 similar systems to be installed during the next 18 months, linking the various criminal justice agencies throughout the State with the State's Division of Identification in Albany.

WORLD'S LARGEST TELEGRAPH CENTRE



Automatic error-correcting telegraph equipment has been installed by The Marconi Company at the GPO's Fleet Building Telegraph Centre, the largest of its kind in the world. Situated in the heart of London, the equipment will provide for a substantial increase in the traffic handling capacity of radio telegraph services. Already the telex calls through Fleet Building exceed the total overseas telephone traffic from the whole of the United Kingdom, and the telex service is still expanding.

The photograph shows the Marconi equipment, which is known as Autoplex, undergoing final acceptance tests at the GPO's Telegraph Centre.

Autoplex is completely transistorised and housed in tall slim racks. At Fleet Building, 36 of these have been installed, increasing the centres radio-telegraph capacity to 296 circuits, each capable of carrying four separate telegraph links.

No news is good news

YOUR editorial and four-column article on the prosecution of pirate radio stations was a waste of space. Everyone interested had heard the outcome on radio, TV and read it in newspapers long beforehand.

I'm not against editorial comment about such issues, after all that is what maintains a magazine's individuality, but a full account and a promise of another detailed case is too much. The space could have been put to better use as constructional articles.

If this is going to be the future policy of P.W. how about the prosecutions of "ham" pirates, not to mention a sound version of Underneath the Dipole (from P.T.)?

A far better policy would be to refuse advertised non-convertible 27 Mc/s walkie talkie spreads unless boldly indicated as such.

I.N.R.W. Newport.

New Marston,
Oxford.

[Although we cannot obviously compete with newspapers in reporting news items we feel it is reasonable to devote some space to important happenings in the radio world. A newspaper is usually thrown away after reading, whereas most readers retain their copies of hobby magazines. This provides a useful reference source for the future.]

With regard to 27 Mc/s walkie-talkies, readers can be left in no doubt of our feelings on this point. Advertisers are asked to state that such equipment cannot be used in the U.K. (for P.W. has a worldwide circulation, including countries where C.B. facilities are available). For the benefit of those who may still be unaware of the facts may we again point out that the use of 27 Mc/s walkie-talkies for communications purposes (however limited the range) is strictly illegal and renders the user liable to prosecution.]—Editor.

Club spot

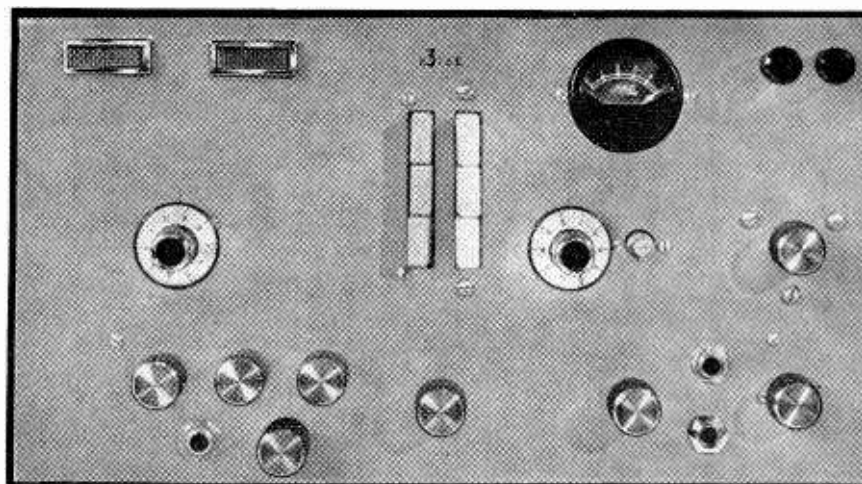
I would like to say how much I enjoy reading the Club Spot feature in this magazine. It is very useful to members of other clubs as it shows the activities that can be enjoyed from club membership and gives club committees ideas for their own organisations.

Brian Smith.

Ilford,
Essex.

[We are pleased to hear that you enjoy the Club Spot feature. We would like to take this opportunity to appeal to clubs to send in information about themselves together with one or two photographs of QTH's and/or members and equipment. All will be considered for publication.]—Editor.

More News and Comment on Page 844



TOP BAND TRANSCEIVER

BY

T. SIMON



THE trend in amateur circles these days is toward compact units as opposed to the huge rack and panel arrangements of earlier years.

In a multi-band transmitter running 150W, it becomes necessary to "loose" 140W if topband is to be included and the 10W power limit observed. The unit to be described is based on observing the first statement above, while avoiding all the complications implied by the second.

The cheapest commercial topband transmitter on the market sells at around £15 and then requires the additional expense of a power supply. The unit described here cost less than £15 to construct and is not merely a transmitter. This price included the power supply unit; built-in frequency marker including crystal; and a receiver to boot. Briefly, the unit comprises a complete self-contained phone/c.w. station for the 1.8—2.0Mc/s amateur band, occupying a space $12 \times 6\frac{1}{2} \times 4\frac{1}{2}$ in. It is based on economy and simplicity and uses only six valves, two in the transmitter, one in the modulator, and three in the receiver.

The circuit diagrams of the complete unit are divided into two sections; transmitter, and receiver plus power unit. Thus just the transmitter could be built, this would form the basis of a useful miniature topband rig, or just the receiver portion might be constructed, this being of particular interest to s.w.l's., and again the unit could be very small indeed.

Receiver Circuitry

This section of the unit employs three valves all Mullard type EFC82/6U8. The aerial input circuit ignores the coupling winding on L1 and the coil is top-capacity coupled to the transmitter tank circuit via C49 and S1e on the T/R switch. In this way the extra stage of selectivity afforded by the tank circuit is utilised on receive. In the writer's area there is strong break-through from the BBC at Brookmans Park (908kc/s 2nd harmonic). This is entirely eliminated by the tank circuit which peaks quite sharply.

V1 is a standard frequency changer circuit but with the inclusion of an extra potentiometer in the cathode of the pentode section. The original idea was to provide variable mute on transmit in order

to monitor one's transmissions on the receiver, but due to the very close proximity of the transmitter this does not function quite as well as was hoped, and the substitution of a fixed resistor of some 10k Ω should prove adequate. An alternative would be complete screening of the receiver section—a complication which did not justify the effort required since the simple arrangement shown does work tolerably well. On receive, the T/R switch shorts the muting resistor to earth via S1a and the circuit functions as a normal frequency changer.

The pentode sections of V2 and V3 are used as i.f. amplifiers at 465kc/s whose gain is effectively controlled by VR2. These stages are quite stable providing the anode and screen volts are not too high, hence the larger than usual values of the screen resistors R7, R12. In the prototype the optimum values for R7/R12 were found to be 82k Ω , however to allow for different layouts, etc., it was considered safer to specify the values shown in Fig. 1. The values quoted are for maximum gain consistent with stability, however, if it is found that on peaking the i.f.t. cores the circuit becomes unstable, then it is better to drop the h.t. to the i.f. stages rather than leave the i.f.t.'s. slightly off tune. If this latter procedure is adopted the receiver will work but the selectivity will suffer.

The triode of V2 is a straightforward audio amplifier fed from the diode detector D1. The triode section of V3 functions as a b.f.o. with VC2 as a pitch control for resolving s.s.b. and c.w. while S2 switches the b.f.o. out for a.m. reception. The high value decoupling and load resistors R10/R11, and the consequent low volts on the anode of V3b were found to be a necessity. Even with two 47k Ω resistors here there was still too much b.f.o. injection. Also note there is no b.f.o. coupling capacitor as such. This proved to be superfluous presumably due to the coupling afforded by the inter-electrode capacity within the valve V3 itself.

Transmitter Circuitry

This section utilises the remaining three valves in which the first stage comprises another ECF82/6U8 as a Clapp v.f.o. and tuned buffer-amplifier/crystal oscillator (V5).

The v.f.o. is cathode coupled to the buffer stage

via the v.f.o. crystal switch S6. With this switch depressed the v.f.o. output is disconnected and the pentode section resonates at 1.9Mc/s thus forming a frequency meter giving a marker right in the centre of the band. It might be possible to use a 100kc/s crystal and get a 1.9Mc/s point plus two very useful band-edge points on 1.8 and 2.0Mc/s but this idea has not been tried.

The p.a. V6 is a 5763, this valve merely because it happened to be in the junk box. Other suitable valves would be the 6BW6 or 6AQ5. Note alternative valves might require adjustment of circuit values, and some are B7G bases not B9A as for the 5763.

Departure from the time honoured pi-tank might shock some, since this has become almost an accepted standard. However the present system does permit odd lengths of wire presenting all sorts of impedances to be matched quite precisely and accurately. Those who still prefer a pi-tank might

p.a. valve to limit the anode current to a safe value during the key-up periods, when there would otherwise be no bias (due to there being no drive) on the 5763 or p.a. valve used. If the v.f.o. were keyed, the buffer amplifier would also require cathode bias, or some means of protection during key-up.

The modulator section V4, provides frequency modulation and uses the two triodes of a 12AX7 in cascade. Doubtless one section might prove sufficient, but with two stages the QSO can be conducted in a confidential whisper with the mike gain half way up. Frequency modulation was chosen mainly because of the modest requirements both in circuitry and components, not to mention its tendency *not* to aggravate t.v.i. as opposed to, say, amplitude modulation. A class A audio amplifier suitable for a.m. would be required to produce around 5 watts of audio with attendant consumption of some 40-50mA of h.t. current plus the heavy and somewhat bulky modulation choke or

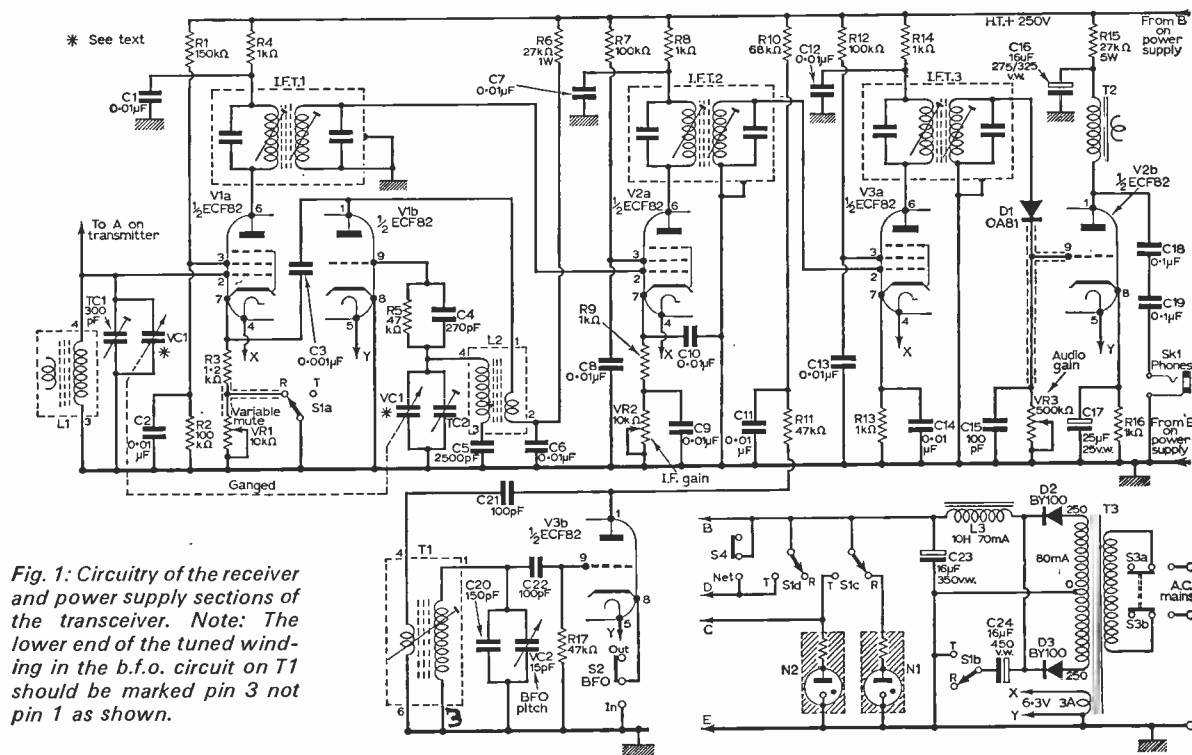


Fig. 1: Circuitry of the receiver and power supply sections of the transceiver. Note: The lower end of the tuned winding in the b.f.o. circuit on T1 should be marked pin 3 not pin 1 as shown.

substitute a 500 + 500 pF variable capacitor, both sections in parallel, for the tank coil tapping switch S7. Due allowance for this should be made in the layout and size of chassis when planning. If this procedure is adopted then VC4 would also benefit from being a higher value, say 200-300pF. In the event of very short antennas such as whips being used, then the 500 + 500pF suggested for the pi-tank modification would benefit from being increased by the inclusion of a 1,000pF capacitor wired in parallel.

The transmitter is keyed in the cathode of the p.a. since this method has proved satisfactory in the past. If keying is inserted in the buffer or v.f.o. then a bias resistor and decoupling capacitor should be included in the cathode return of the

transformer. The 12AX7 on the other hand consumes but a few mA, thus one gets a bonus of being able to use a much smaller mains transformer, less complex circuitry, and fewer components. There has, to date, been no sign of t.v.i. at any time with the prototype.

The input circuit is intended for a crystal mike and although the input impedance is not matched, the 500kΩ pot. VR4 being an abnormally low value for a crystal mike, there is sufficient gain and the speech quality is quite good. The 100pF capacitor across the mike input is included to avoid the BBC being re-radiated due to the mike lead acting as an aerial. The 500kΩ audio gain control is really a luxury, as once set for a particular mike it requires very little adjustment, thus a fixed resistor

could be substituted if desired. The value will depend on the particular mike used, but around 330k Ω would be a good starting point for most crystal mikes.

The modulator receives its h.t. supply whenever

In the prototype design the place now occupied by the crystal held two 85A2 stabiliser valves wired in series to provide 85 volts stabilised to the v.f.o. and buffer screen, and 170 volts stabilised to the buffer anode. The v.f.o. tuned 900kc/s-1Mc/s,

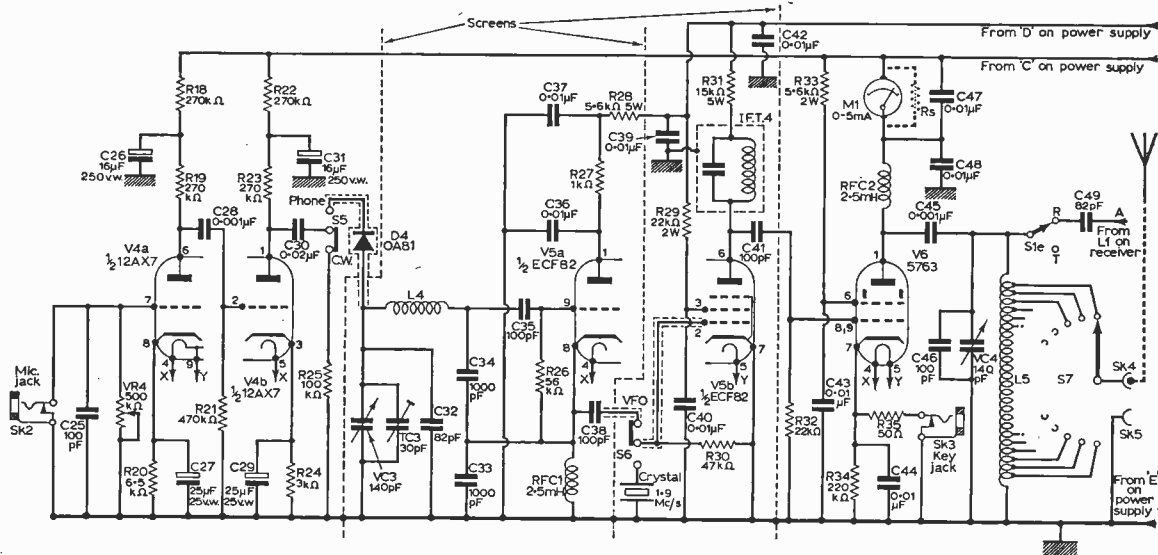


Fig. 2: Circuit of the transmitter and modulator sections. Note complete screening of the modulator diode.

the T/R switch S1c is in the transmit position, but it is not coupled to the transmitter until the phone c.w. switch S5 is depressed.

Although the p.a. tuning capacitor and the modulator section are in the same compartment and are not screened from each other, there is no interaction nor any trace of feedback.

Power Supply Circuitry

This scarcely needs any comment since it boasts well proven circuitry with little originality, consisting of standard full-wave rectification with choke or capacity input.

and its anode load consisted of a 1.6Mc/s i.f.t. modified to form a wide-band coupler. The buffer anode also had one of these and the system worked extremely well. However once the p.a. was brought in, there was so much r.f. in so small a space that the p.a. just could not be tamed. Those who prefer this arrangement might consider using a slightly larger case to allow better screening and improved layout. The stability of the present v.f.o. tuning 1.8-2.0Mc/s was found quite adequate without any stabilisation, thus the 85A2's were omitted.

The two neons in the power unit illuminate to show immediately on the front panel whether the station is on transmit or receive. For those build-

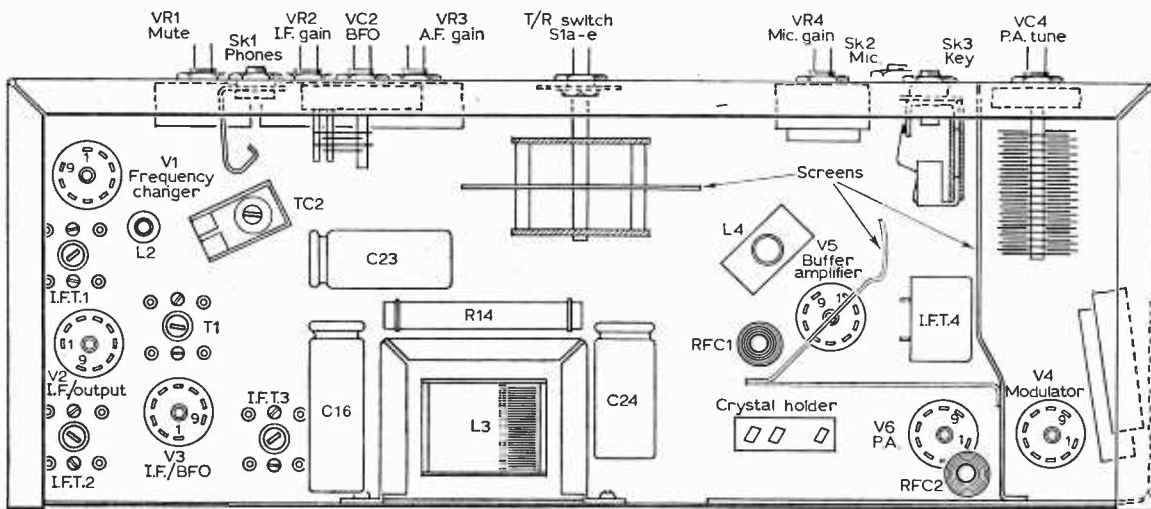


Fig. 3: Under chassis view showing positioning of main components and screens.

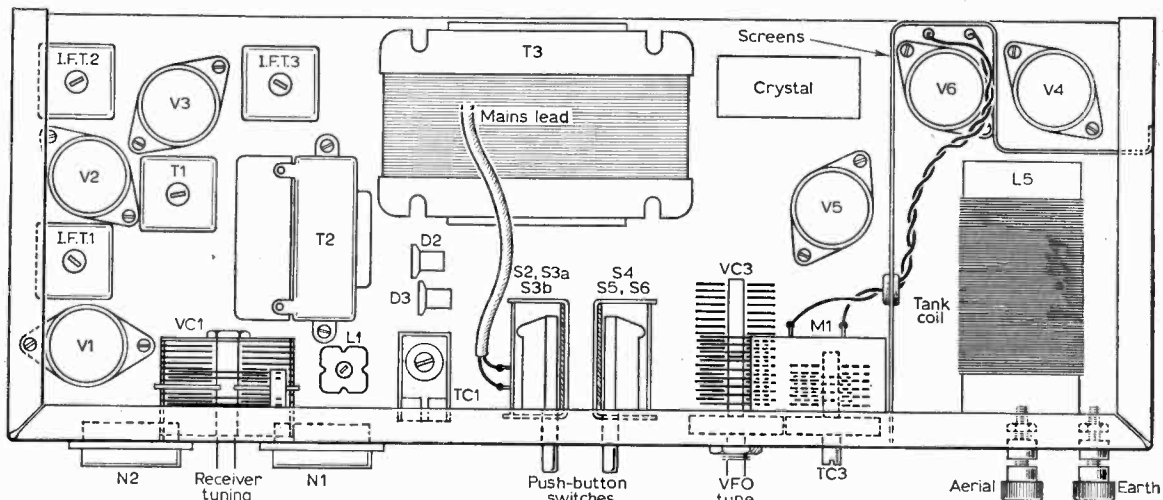


Fig. 4: Layout of the main components above chassis. Smaller items omitted for clarity

ing the rig, a fuse from the mains transformer centre tap to earth is strongly recommended, perhaps on the front panel in place of the variable mute control or the mike gain pot. VR4.

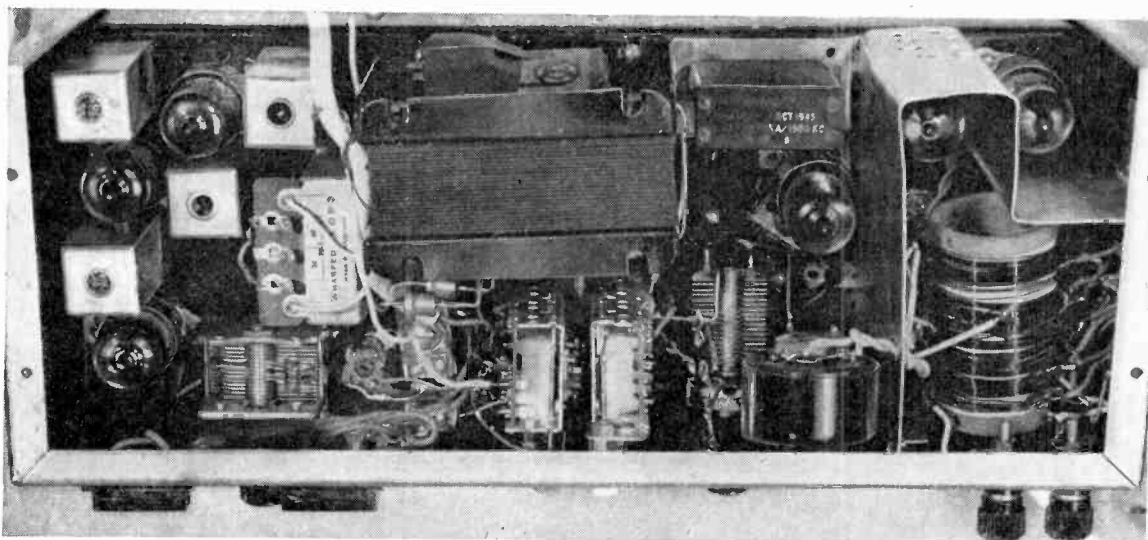
None of the components in the power section are unduly critical, for example any choke that will fit in will suffice from 8-20H providing it is capable of passing some 70mA. A 60mA component might tend to run a little warm.

It is not advisable to use a larger value electrolytic for C24, 16 μ F being considered rather high by some and 8 μ F is perhaps a safer value. It will be noted that on receive the power unit uses choke input, whereas on transmit, capacitor input is used by switching in C24 via S1b on the T/R switch in order to obtain a higher h.t. voltage. This is optional and if preferred choke input can be successfully employed on both functions. In addition to switching the neons the T/R switch also provides h.t. to the p.a. and modulator via S1c, and

h.t. to the v.f.o./b.a. via S1d. When the T/R switch is in the receive position, the Net switch, when depressed, supplies h.t. to the v.f.o. and buffer stages. This allows the operator to zero beat the v.f.o. with an incoming signal on the receiver without radiating a note which could annoy others. (V.F.O. swishers please note.) This facility also allows the crystal oscillator to be used to line up the receiver dial. Also, if the transmitter is now zero beat with the note from the crystal oscillator, it is possible to line up the transmitter dial at the same time.

Next month, the layout and constructional details will be given, and would-be constructors are urged to wait for these before attempting construction as certain snags could arise which can be avoided if they are known in advance.

to be continued



Photograph of the top chassis. Compare this with Fig. 4 above. Receiver section is on the left, transmitter and modulator on the right, power supply in the centre.

BALANCE CONTROLS

for stereo amplifiers

By J. B. Willmott

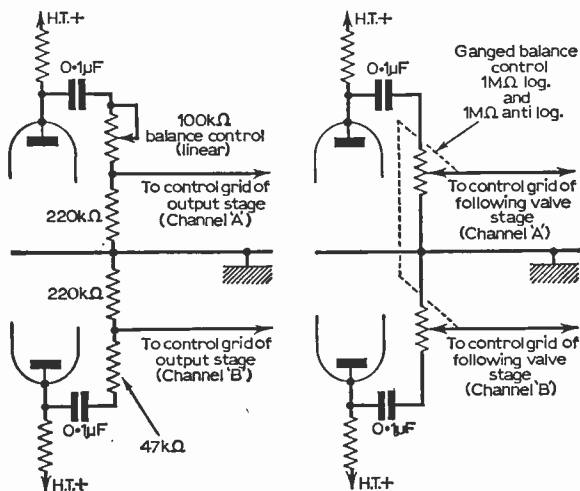
ADDDING a stereo balance control unit to a hi-fi installation often improves the end product. It is not readily appreciated that a pair of amplifiers of the same make and type do not necessarily have the same gain characteristics. Nor, for that matter, do the other links in the chain (such as loudspeakers, preamplifiers, microphones, etc.) of the same make and type always match up. In order to overcome this difficulty, one can adjust the individual controls of the main amplifiers, but this is rather a clumsy way of doing things when it is relatively simple to add a balance control which will increase the gain of one amplifier and at the same time reduce the gain of the other.

Nine different circuits are touched upon in this article. This is by no means all, but should fire the imagination of the serious constructor and give the novice a good insight.

Before considering the various circuits, one must also appreciate that environment is important. Most hi-fi installations are accommodated in rooms that are not acoustically perfect, and the positioning of the loudspeakers in relation to the furnishings can have a marked effect on the end product. Also it is worth considering your own hearing; possibly that is not perfectly balanced. So to obtain the best results, why not let your ears be the judge?

SUGGESTED CIRCUITS

Possibly the simplest system of all is that shown in Fig. 1, in which the the gain of channel "A" is made variable by the insertion of a 100k Ω potentiometer, in place of the 47k Ω fixed resistor used in the same position in channel "B". However, it may be found that there is insufficient variation of gain of channel "A" to achieve balance under certain conditions. In Fig. 2 use is made of a twin-gang potentiometer wired up so



that channels "A" and "B" are controlled in reverse (i.e., as the gain of one channel is increased, that of the other is correspondingly decreased). This, however, requires the use of a specially designed twin potentiometer, known as "log./anti-log.", obtainable from most component suppliers. The advantage of this system is that either channel can be reduced to "zero" (with a corresponding rise to maximum gain in the other channel) so that even the most widely differing output requirements can be met, the only drawback is that at no setting of the control can both channels be working at full gain simultaneously.

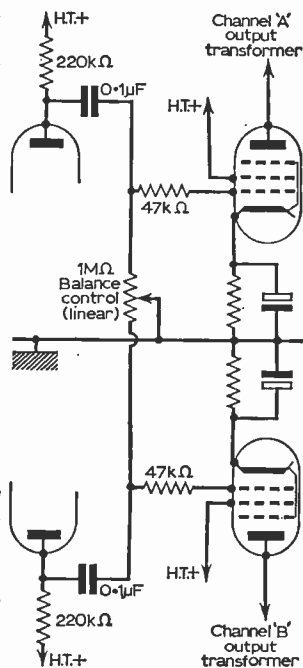
Figure 3 depicts a very simple but effective inter-stage control of balance, in which only a single linear law 1M Ω potentiometer is used. The slider of this control is connected to earth (chassis) line, and the control grids of the following valve stages are fed from the "top" and "bottom" of this same potentiometer. Note the inclusion of 47k Ω resistors in the grid leads to each of the subsequent valves. These should be connected as close as possible to the valveholder grid tag; the components serve as grid stoppers (reducing the danger of instability) and prevent the control grid of the succeeding valve from being connected directly to chassis (and thus cutting off grid bias) should the balance control be adjusted to the limit of its setting in either direction. Component values of the cathode bias resistor and capacitor are not shown, as these will depend on the type of valve employed in the output stages. With the popular EL84, suitable values would be 150 Ω and 25 μ F (25 VW). The previous valve stage can be any high or medium impedance triode (or the two halves of a double triode such as an ECC83).

By way of a change, Fig. 3 shows a circuit for incorporation directly across the pick-up, and for sake of completeness, the associated volume and tone (top cut) controls are included in

Fig. 1 (far left): Simple form of balance control.

Fig. 2 (near left): A ganged log./anti-log. potentiometer is needed for this circuit.

Fig. 3 (right): A single linear potentiometer is used in this circuit to vary the bias to the p.a. valves.



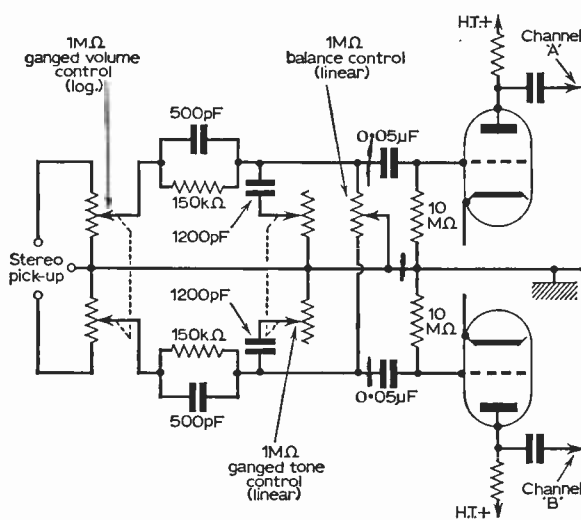
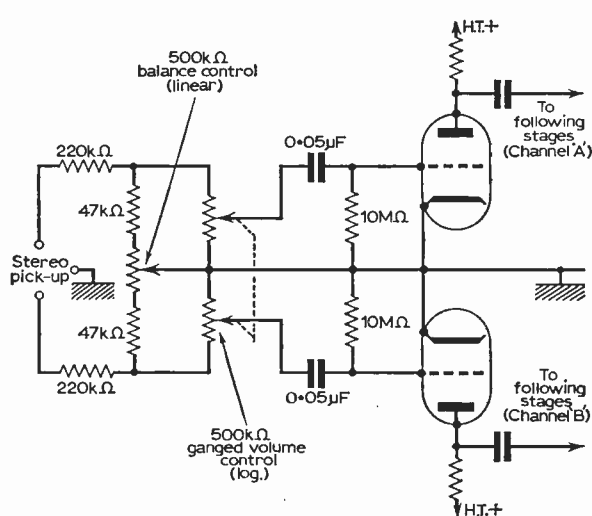
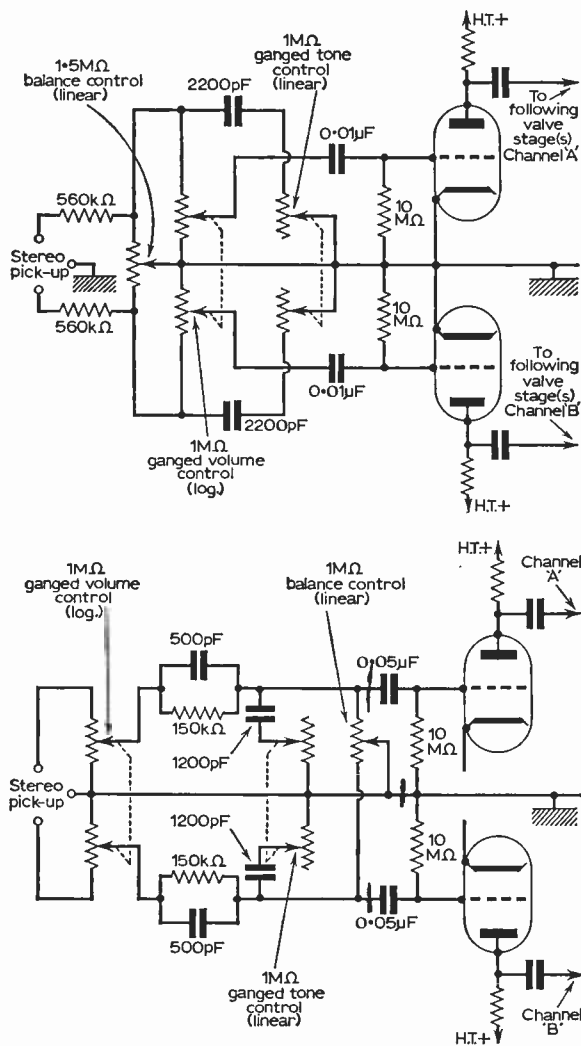
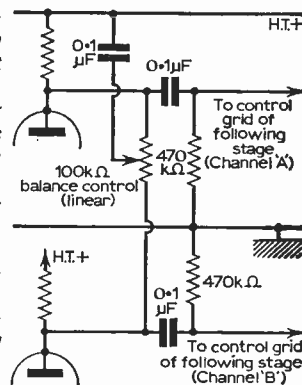


Fig. 4 (top left): Tone and volume controls are included in this circuit which balances the signals at the pick-up.

Fig. 5 (top right): Another circuit in which the signals are balanced before being amplified.

Fig. 6 (lower left): In this circuit the tone and volume controls are also directly connected across the pick-up.

Fig. 7 (lower right): Part of the signal is shunted through the h.t. rail to achieve balance.



the circuit diagram. The system would be ideally suited to a simple inexpensive two stage amplifier. Note that the grid bias for the first valve stage is provided by the voltage resulting from the minute grid current flow through the high value grid leak resistor (10MΩ). No cathode bias components are then required for this stage, and this system works very well indeed in stages where the signal level is quite low. The component values suggested have been used by the author in an amplifier fed from a crystal pick-up in a B.S.R. "Monarch" auto-changer unit, and should suit any of the popular crystal pick-ups in the modest price range.

A further circuit suitable for insertion directly across the pick-up is shown in Fig. 4. In this circuit, the tone controls, either a simple "top cut" or more elaborate separate Bass and Treble, would be incorporated in the coupling between the valve stage shown and that following.

As in the previous circuit, bias for the first valve is obtained through a high value grid leak resistor. The component values of the anode load resistors and coupling capacitors to the following stage are not given, as these will vary according to the type of valve employed. Practically any

triode or pentode valve can be used, but for convenience, the use of one half of a double triode (such as an ECC83 or 6SL7) in each channel is recommended.

Another design eminently suitable for two stage audio amplifiers is shown in Fig. 6. In this arrangement the volume and "top-cut" tone controls are connected directly across the pick-up (which with the component values suggested, should be of the high output crystal type referred to earlier), followed by the balance control, which is a 1MΩ linear potentiometer. The 500pF capacitor paralleled by a 150kΩ resistor (in between the volume control slider and the coupling to the grid of the first valve in each channel) are inserted to provide a degree of frequency correction from the pick-up.

Figure 7 and the following two circuits, represent a less conventional approach to the control of balance. In the first circuit, the 0.1μF capacitor connected to the slider of the balance control (100kΩ linear), shunts a proportion of the audio signal away from the following stage to the h.t. line, and eventually via the power supply smoothing capacitor, to "earth". The proportion of signal so by-passed depends on the position of the balance control slider; movement of this decreases the signal passed on from channel "A", for example, at the same time as increasing that passed on from channel "B", or vice versa. Whereas all the

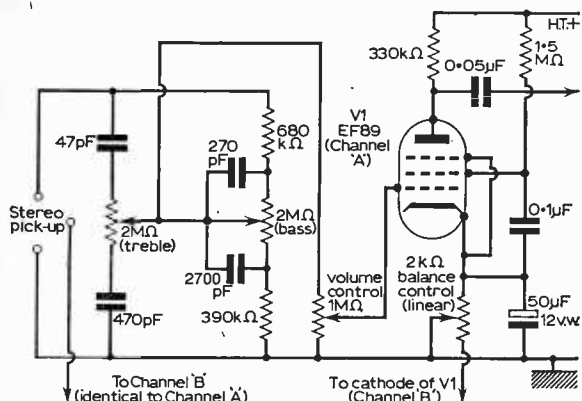


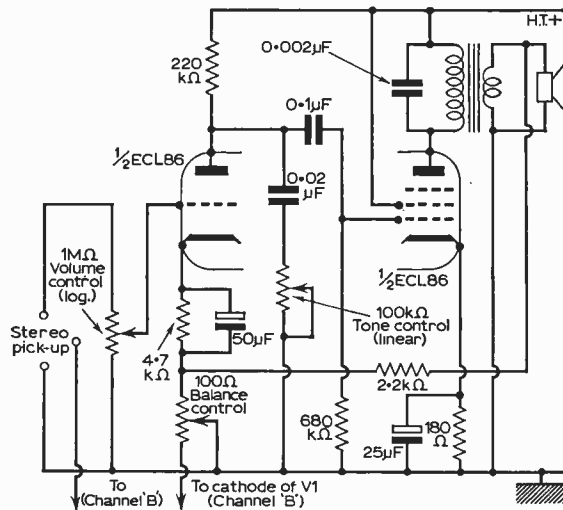
Fig. 8 (above): This circuit shows how it is possible to vary gain using vari-mu valves.

Fig. 9 (right): The level of negative feedback is varied to achieve balance in this circuit.

Note: The Channel 'B' circuits to match those given in Figs. 8 and 9 are identical, with the volume and tone controls ganged with those of Channel 'A'.

previous circuits have made use of potentiometers varying the signal strength fed between one valve and the next, or between pick-up and first amplifier valve stage, Fig. 8 shows how it is possible to vary the gain of an amplifier with vari-mu valves. This is, of course, common practice in r.f. and i.f. circuitry in radio receivers; it is not always realised that vari-mu valves can, in certain circumstances, be used in audio frequency circuits. The main proviso is that the signal level should be fairly low, as any attempt to deal with large swings of signal voltage in a vari-mu valve will introduce an intolerable level of distortion. However, if such a valve is used at low signal level, quite satisfactory control of gain can be secured by varying the grid bias. In the example shown, the author used EF89 valves, with very satisfactory results. Bass, treble and volume controls are shown and the circuit will give all the necessary controls for an inexpensive stereo amplifier. A valve such as the popular EL84 could follow the EF89's in each channel, and would provide some 4 watts output. The actual control of balance is provided by the 2kΩ linear wirewound potentiometer, which should have a rating of about 5 watts. The slider is connected to chassis, and variation of its setting will vary the bias between wide limits. *One word of warning*, operation of the amplifier with the balance control set at the extreme ends of its track will leave one valve with zero bias, and if operated for any length of time in this position, will damage the valve. This can be avoided, if thought necessary, by inserting a fixed value resistor of say 100Ω between each valve cathode and the balance control.

There is another method of varying the gain of an amplifier, Fig. 9, and that is by adjusting the amount of negative feedback. In the example shown, the balance control is a 100Ω wirewound potentiometer inserted between the junction of the negative feedback line (the 2.2kΩ resistor from output transformer secondary to the lower end of the cathode bias resistor of the first valve stage) and chassis. Variation in the setting of this control



changes the amount of negative feedback applied; it will be seen that both channels are controlled simultaneously, but in an inverse manner, i.e., increased feedback in channel "A" would be accompanied by simultaneous decreased feedback in channel "B", and vice versa. The purist will no doubt exclaim that variation in negative feedback not only varies the gain of an amplifier, but also affects the frequency response; a greater degree of feedback giving a better low frequency response, so that relative volume levels will be controlled. This does not appear to have any serious effect in practice, at any rate in amplifiers in the inexpensive class. Indeed a system similar to this has been used by a number of commercial manufacturers of stereograms. The circuit diagram represents one complete channel of a stereo amplifier, using the two halves of an ECL86 valve; the second channel is identical, and only a power supply is needed to complete the equipment. As in all circuits using negative feedback, it is important to ensure that the feedback is correctly phased, otherwise positive feedback, resulting in uncontrollable oscillation, will result. The amplifier should be first constructed with the connections to the secondary of the output transformer (other than the speaker speech coil of course) omitted, and once tested and found to be working satisfactorily, the earth and feedback connections can be made temporarily to the output transformer secondary. If an uncontrollable howling results, the connections to the output transformer should be reversed.

One word of warning, the control potentiometers used should be of first class manufacture, and in the case of "ganged" components, must be properly matched during manufacture. Cheap surplus, or salvaged, potentiometers just will not do; they will lead to more annoying intermittent faults and noisy operation and can ruin the enjoyment of reproduction from an otherwise impeccable amplifier system.

Finally, don't let your enthusiasm for straining your ears to hear every grain of "movement" hamper your enjoyment of listening to stereo recordings. Get your tone and balance controls adjusted to your liking, and then leave them well alone.



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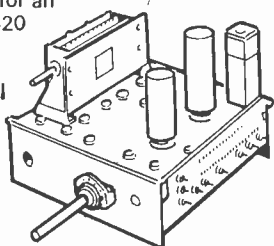
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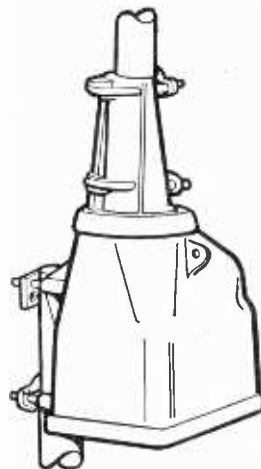
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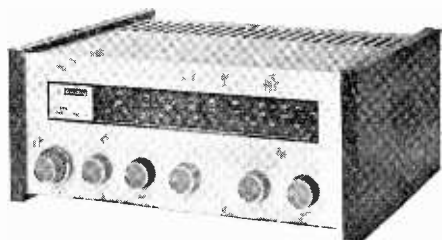
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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

Times in GMT
Frequencies in kc/s

THE BROADCAST BANDS

by JOHN GUTTRIDGE

EUROPE

DENMARK: *Radio Denmark* (Shortwave Department, Radio House, Copenhagen V) now transmits on 15,165 to South America in Danish at 1600-1645 and Spanish at 1645-1715.

German Federal Republic: *Deutsche Welle* (Brueckerstrasse 1, Postfach 344, 5 Köln) has made changes recently:—the following English transmissions: 0300-0345 7,160/9,530; 1550-1630 11,765/9,535; 0130-0250 9,735.

German Democratic Republic: *Radio Berlin International* (116 Berlin Nalepastrasse 18-50) now uses 1,430 / 6,080 / 6,115 / 7,185 / 7,300 for the 2200-2230 English transmission.

Radio Volga (Menzelstrasse 5, Potsdam) is now using shortwave as well as the 263 long wave outlet. Has been heard in Russia in evening on 9,680.

Italy: R.A.I. (Via del Babuino 9, Rome) now uses following outlets for English transmissions: 2115-2135 (Europe) 7,240/6,050; 2205-2225 9,710/6,010; 2020-2040 7,265/5,990; 0100-0120 9,630/6,010. New languages introduced are Maltese 1225-1230 on 9,575/7,235 and Amharic 2020-2040 15,150/11,810/9,570.

Norway: *Radio Norway* (Oslo) now using two 11 m.b. outlets. Schedule is 0300-0430 9,550/9,610/11,850/1,578; 0700-0830 21,670/11,850/9,610/17,825/25,900; 1100-1230 9,610/11,850/21,730/25,730/25,900; 1300-1430 21,670/21,630/17,825/25,730/25,900; 1500-1630 21,670/15,175/17,825/25,730/21,730; 1700-1830 21,670/15,175/17,825/11,850; 1900-2030 11,850/15,175/9,610/21,670/21,730; 2100-2230 11,850/9,610/11,735; 2300-0030 11,850/9,550/9,610.

Poland: *Radio Warsaw* (Al Niepodleglosci 75/77, Warsaw) now transmits in English as follows: To Europe 1830-1857 7,145/6,135; 1930-2000 9,540/7,145/6,135/1,502; 2030-2100 7,125/5,950; 2130-2155 7,145/6,135; 2230-2300 5,950/9,540/1,502; 2303-2330 818; To Africa 1200-1230 and 1300-1330 7,145/11,840/15,275; To Australasia 0730-0800 and 0830-0900 9,675/11,840/15,275.

Rumania: *Radio Bucharest* (P.O.B. III, Bucharest) now has six new QSL cards which may be obtained by sending six reception reports numbered one to six.

Sweden: *Radio Sweden* (Box 955, Stockholm 1) has completely revised English schedule which includes use of 13 m.b. for first time. Times and frequencies are 0900-0930 6,065/21,690; 1100-1130 6,065/9,705; 1230-1300 9,705/21,690; 1400-1420 11,810/17,840; 1600-1630 11,705/17,840; 1900-1930 6,065/11,705; 2245-2315 7,270 11,705; 0030-0100, 0200-0230, 0330-0400 5,990; 0515-0545 11,705; 2015-2045 6,065/11,705; 2330-2400 1,178.

U.S.S.R.: *Radio Moscow*. There is a new service entitled "Radio Station Peace and Progress, the Voice of Soviet Opinion". Programmes are English 0900-1000 and French 1000-1030 on 12,060/15,200/15,360/15,450/17,710/17,795.

Radio Minsk (Minsk) may be heard in Bielorrussian from 2130-2200 on 5,940.

Yugoslavia: *Radio Belgrade* (2 Hilendrarska, Belgrade) now using 6,100/7,200 only for the 1830-1900 English transmission.

AFRICA

Cape Verde Islands: *Radio Clube de Cabo Verde* (Casilla Postale 26, Praia) gives good reception on 3,883 in Portuguese 2000-2200.

Ethiopia: *Radio Voice of the Gospel* (P.O. Box 654, Addis Ababa) has changed the following English transmissions recently: 1345-1400 15,315; 1900-1910 9,705; 0430-0455 11,810; 0530-0555 11,785; 1655-1710 6,065; 1900-1945 15,115; 1630-1645 11,925; 1755-1810 9,565.

Morocco: *Radiodiffusion Television Marocaine* (1 Pierre Paient, Rabat) now transmits English at 1800-1900 over 15,408.

Voice of America relay, Tangier (Washington 25, D.C., U.S.A.) now using the new outlet of 9,660 to Eastern Europe.

Nigeria: *Nigerian Broadcasting Corporation* (Broadcasting House, Lagos) now carrying foreign service from 1300-2200 over 7,275/9,690/11,900. English is at 1500-1600, 1700-1900, and 2100-2200.

Rwanda: *La Voix de l'ém Fé* (Kigali) broadcasts from 2000-2200 over 9,575/11,715 in French.

South Africa: *Radio South Africa* (P.O. Box 8606, Johannesburg) has replaced 15,205 by 15,215 for the 2200-2255 European English transmission. Other frequencies are 9,720/11,785.

Tanzania: *Radio Tanzania* (Box 9191 Dar es Salaam). Test transmissions over a 240kW transmitter have been reported as follows 0930-1000 21,600; 1000-1300 15,435; 1530-1600. Reports are wanted. It is believed a regular service may now be in operation.

ASIA

Saudi Arabia: Saudi Arabian Broadcasting (Ministry of Information, Airport Road, Jeddah) is now using 9,670 after the scheduled 2100 close down time.

Ceylon: *Radio Ceylon* (Department of Broadcasting, P.O. Box 574, Colombo 7) broadcasts in its External Service as follows: 0700-0815 to Europe, West Africa and Middle East on 15,330; 0915-1030 to South Asia on 17,850. The station is considering changing the times of its broadcasts and would appreciate listeners' views. QSL cards for the station commercial service may be obtained from Radio Advertising Services (Radio Ceylon) Cecil Court, Lansdowne Road, Bombay, India.

News was received this month from J. D. Ashworth, T. Ibbitson, D. Hobro, S. L. Brunt, A. B. Thompson, World Communications Club of G.B., P. Quin, International Short Wave Club, J. N. Newport, Radio New York Worldwide, Swiss Broadcasting Corporation W. E. Bartlett J. W. Smith S. Ormerod.

ONE puzzling question posed to experts and laymen alike is "Where do all the flies go in the wintertime?". Variations on a theme now prompt me to enquire "Where do all the s.w.l.'s go at Christmas?". Either nobody listened, or else you've all gone shy and are not going to confess to Auntie Dave what you got up to in the festive season. Only a handful of letters in the postbag this month (sobs quietly into dirty hanky), so let's hope you are all saving those lovely logs for next month.

Top band has been surprisingly good at times and GDX has been about at quite good signal strength. GM stations and the North and Midlands have been heard near London at 5 and 6 on a.m. phone. Topband addicts might be interested to hear that G3JDG is now mobile/M on 160 and many Northern stations have been received on the loaded whip.

Frank Videan (St Albans) AR88, long wire, listened on 160 in the wee small hours. His log for the period 0103-0630 however is certainly neither wee nor small—DJ4SS, HB9CM, OK2KHF, OL9-KRA, PAØPN, VP6TK, W1HGT, W1BTK, W8A-NO, ZD8J, 9H1AE. Who said 160 has had it? When one considers that these stations were received through fish-phone, Loran, v.f.o. swishers and all the other noise on 160, it's a very fine effort indeed.

Mc/s Mixture

Often an s.w.l. will send in a log for several bands, and in order to get in as many logs as possible I usually take one or perhaps two bands from each report. This month however, I thought I'd put in the complete log, just to show how seriously and diligently some s.w.l.'s listen.

Robert Iball (Notts), AR88D, 80ft. top and 35ft. of 72Ω co-ax feeder running S/N. Bob skimmed just the cream from his logs and offers—1.8 Mc/s—K8CRJ, K8HKB, K8RRH, K9PAW, OE5KE, VE3-BWY, VO1FB, W1BHQ, W1HGT, W1WY, W2FYT, W8EMJ, W8GDQ, W8HGW. 3.5Mc/s—VE2BZL, W4YWX, W8JMC, W9BGX, YV2GC. 14Mc/s—KL7EB, LA2NK/MM, TN8AA, VE5US, VE8BB, VP9FK, VP9DH, YV5ALK, 5Z4SS. 28Mc/s—CR-7CZ, CX2CO, H18XAL, HKØAL, KP4CQZ, KZ5-TW, LA2MA/MM, UA9EU, UA9WJ, VK5DS, VK7SM, 4X4DH, VS9AJC.

N. Henbrey (Sussex), EA12, 20 metre dipole at 25ft. Offers a five-band log starting with 80—H18X-AL, K2DXV, K2ISP, K2RBT, K8YWG, UAØBP, VE1ABZ, VE2KC, VE3XK, VO1FX, VO2AW, VS-9AJC, W1FZJ/KP4, W3BMS, W4GFW, YV5BTS. 40—CN8AW, EP2BV, IS1DMN, K5HWA, PY6WA, PY7KOG, UA9BE, UW9AF, VK2AVA, VP2AA, VP6KL, W3BMS, W4AZK, ZD8ARP, 5A3TW, 5N2AAS, 9H1AL, 9H1AM, 9X5MH. 20—CE6EZ, CR5SP, HP9FC/MM, KR6CO, KL7EBK, OD5AR, U5ARTEK, UA9YO, ZP3AB, ZS3XG, ZD8L, 3A-2CQ. 15—K2UTC, K3TGS, K4DI, K8RHK, K9HCG, MP4BBA, UF6FE, UL7JA, VE1AIT, VE2BDT, VE3FJZ/SU, VP5RB, WA1FDU, W5P-MZ, YA1FV, ZS4MZ. 10—FH8CD, OD5CN, VE3-WQ, VK6CF, ZC4CI, ZC4CN, ZC4RM, ZE5JS, 4U1SU.

J. Farrer (Herts), HMV domestic receiver, 90ft.

l.w. says W6 and W7 are now breaking through on 28Mc/s, while down the other end John remarks on the increase in s.s.b. stations on topband. His log for 3.5Mc/s reads—CN8AW, CT1EE, DJ1SU, EA-2FF, EI4J, F2MO, H18XAL, K3UZE, K4YGU, K8YWG/P (using 50 watts), LA2PM/MM, MP4T-BO, OZ1SF, SV2MB, UA3TN, UC2LVK, UP2OJ, UR2REK, VE1AIJ, VE2AUU, VE3DMU, VO1FG, VS9AJC, W1DRS, W2ZPO, W3AQH, W4RNG, W4UHA/P, ZL1BDW, ZL3AKJ, ZL3JC, ZL3RK, ZL4KE, ZL4OD, 4X4OV.

Higher up

I did wonder, some little while ago, if 14 and 21 were dying or losing their popularity. Not so, as some logs prove a different story.

Paul Baker (Mon.) HE30, 45ft. l.w. sends in a log for 14 and 21 of stations heard at various hours. 20—FB8YY, HL9TH, HS4AK, UAØEH, VK9AG, VP-8CW, VS9OC, YK1AA, 4S7PB. 15—CO8RA, CR3K-D, CR4BC, FL8RA, KL7CSR, KV4CX, MP4BBA, OH2BBF/MM, PX1PA, ST2SA, TF2WK, VEØMB, K4OMM, VK9XI, W7ETD, YA5RG, ZL1AFN, ZL2AJV, ZL2KP, 5N2AAR, 6Y5RS, 7XØWW, 9M2DQ. Paul reckons to hear Australia, New Zealand and Japan on 15 metres between 0830—0930 and very often from 1200—1500 during a second opening.

J. Dunnett (Singapore), Racal 17, 7Mc/s dipole at 70ft. for all bands writes in with a report on 14 and 21Mc/s from way out East. All that lovely sunshine and he has to pinch my best DX too! On 14 c.w. Jim logged—EA8FG, EA9EO, FK8AH, FM7-WP, MP4MAW, VP6PJ, ZD8J, 5R8AW, 6W8CQ. While on 14 s.s.b.—CN8CB, CT2YA, CT3AU, G5A-AV/K5ZKN, KJ6BZ, KG6IJ, KL7FRY, KW6EG, U5ARTEK, VK9XI (Christmas Is.), 3W8AD, 7Q-7EC, 9Y4AR. On 21Mc/s c.w.—HP1RP, PZ1BX, VS6FS, 5N2AAW, 5Z4JW, 9G1RW. With a b.f.o. in, s.s.b. stations heard were CR7AN, CT3AU, GB3MM, VK9CJ, (Papua), 6O6BW, 9M1AF. Jim says "We also hear lots and lots of G's here".

Mumblings

News and natterings from here and there. First, for those trying to brush up their c.w. The RSGB organise slow c.w. most evenings on topband. The ARRL station has set sessions on most bands most days and does a special run at up to 35 w.p.m. for those who really reckon they can take c.w. Ten metres, still going strong. An interesting letter from **Barry Tew** (G8AVW). Barry says he tuned his CR150 down below 28 and heard American Citizens Band Stations between 27 and 28Mc/s. He thinks these stations are restricted to 5 watts and a 60 inch antenna. Anyone else heard anything? Mind you don't pick up 28Mc/s image if it's a single conversion superhet. Contests for the chilly 4 weeks called February: 4th.—5th., ARRL phone contest; 12th., First 70Mc/s contest; 18th.—19th., First 1.8Mc/s c.w. contest; 18th.—19th., ARRL c.w. contest; March 4th.—5th., Second 2 metre contest. The deadline for reports this month is the 20th. How about an epistle from you?

stern-clyne

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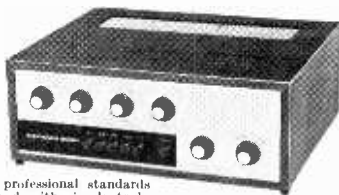
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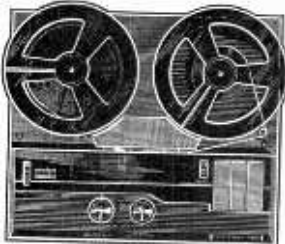
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P. & P. 3/6

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*** TAPE RECORDING EQUIPMENT



MAGNAVOX 363 TAPE TRANSPORTER

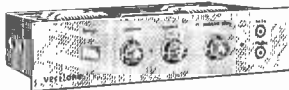
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With 1/2 track heads **£10.10.0**

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TYPE 'C' TAPE PREAMPLIFIER



Specially developed by Mullard Laboratories for use with high quality replay systems and supplied specifically matched for use with the Magnavox 363 tape deck.

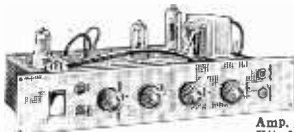
Features include: Ferroxcube pot core inductors for treble equalization, push-pull oscillator incorporating ferroxcube transformer, adjustable output for matching to existing high-quality amplifier systems, inputs for Mic. Pick-up, Radio, etc. Valves: 3 x EF86, EC82 and EM81. Totally enclosed in case. Size 1 1/2 x 6 1/2 x 3 1/2 in. high (Panel 1 1/2 x 3 1/2 in.). Power supply of 300 v. d.c. at 25 mA. and 6.3 v. at 1.5 A. is on separate sub-chassis. Size 6 1/2 x 4 1/2 x 4 1/2 in. high to facilitate remote location from tape heads.

Pre-amp. and power **£14.10.0** Assembled and tested **£20.10.0**

Add 7/6 carriage

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HF/TR3 TAPE AMPLIFIER



Easily the best complete tape amplifier available to the home builder. Supplied already matched for the Magnavox 363 tape deck, but may be readily matched to most other decks. Features include: switched equalization for all speeds (CCIR standards at 7 1/2 l.p.s.). Treble boost incorporated during Record. Bass boost during playback, speaker output matched for 3, 7.5, and 15 ohms, additional outputs for extension speaker, phone monitoring on Record and Hi-Fi playback through existing systems. Inputs for Mic. Pick-up, and VHF Radio. Valves: EF86, EC83, EL84, EM81, EZ81. Size overall: 11 x 6 x 6 in. (Panel 13 1/2 x 3 in.). Power pack on separate chassis size 7 1/2 x 3 x 4 1/2 in.

Amp. power pack. **£14.10.0** Assembled and tested **£20.15.0** Add 7/6 carr.

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3in.	250ft. Long Play ..	..	..	5 6
5in.	600ft. Standard ..	..	..	8 6
5in.	900ft. Long Play ..	..	..	10 0
5 1/2in.	1,200ft. Long Play ..	..	..	12 6
7in.	1,200ft. Standard ..	..	..	12 6
7in.	1,800ft. Long Play ..	..	..	15 0

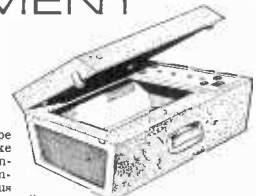
TENSILIZED POLYESTER

3 1/2in.	600ft. Double Play ..	..	..	11 6
5in.	1,200ft. Double Play ..	..	..	15 0
5 1/2in.	1,800ft. Double Play ..	..	..	22 6
5 1/2in.	2,400ft. Triple Play ..	..	..	37 6
7in.	2,400ft. Double Play ..	..	..	25 0
7in.	3,600ft. Triple Play ..	..	..	50 0

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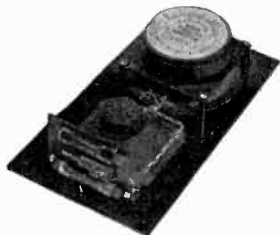
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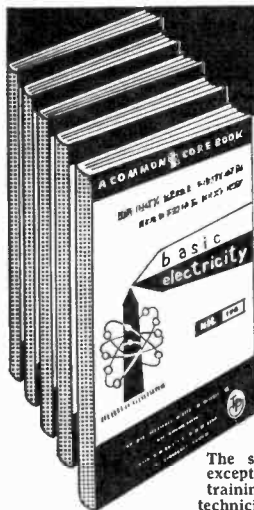
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commentary by HENRY

No 31

To Kit Or Not

WE began this series—so long ago, it seems—with a passing glance at the kitmaker. From time to time we have taken a harder look. Now, with the glittering commercial confections of the Radio Show behind us, and our corns beginning to heal, we may return to glare more closely at the subject. Recently, the need arose for an inexpensive portable amplifier. Inexpensive, for Henry's relations all appear to be touchingly impecunious. Portable, because the thing had to be lugged around the country as an aid to illustrated lectures.

Obviously, a transistorised version was called for. Equally obviously, the various commercial products had to be ruled out—first because their prices indicated the parts were at least gold-plated, and second because no manufacturer considered that mono production was worthwhile. The answer—build it yourself.

But the particular kit that seemed appropriate for the purpose, and remarkably cheap, was from a firm a little less illustrious. A preliminary (unofficial) glance

at the circuit showed it to come from a fairly trustworthy stable. The advertisement showed an

attractive finished job. So Henry showed his money and plunged . . . up to his top-knot in trouble!

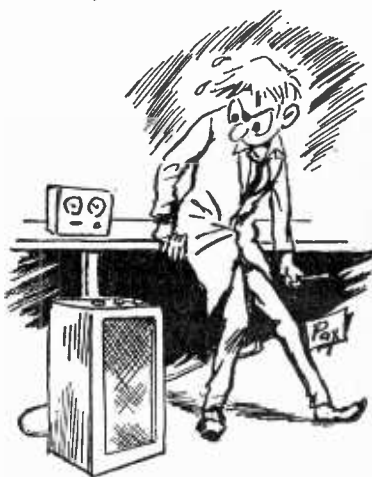
The kit came in a tatty cardboard box, each piece wrapped in a screw of crumpled paper. Careless unpacking could easily have whittled away half the contents. But the greatest disappointment was the literature that pretended to be a guide to construction.

Apparently run off by a shell-shocked operator of an old Caxtonian duplicator, on Government surplus blotting paper, pinned in a Chinese order of page numbering, it should have deterred us from the start.

Between us we managed to make some sense of the hieroglyph and laid out the parts for checking against the list. (My typewriter nearly wrote 'lost'—and it would have been more appropriate.) Several components were missing, and remained so, despite a ferreting amidst the packing. Others had been substituted, which only became confirmed as we ploughed through the barely legible text. We made up the missing quantity—secretly commiserating with some innocent not blessed with a pretty full spares box. Then we amended the given list, if only for the sake of posterity.

The actual building was not too bad, provided one already had a fair knowledge of the techniques. The absolute beginner, despite what the advertisements claimed, would have been bogged down before the third page. The selector switch was physically different from the diagram, and connections had to be worked out. One or two unexplained wires appeared, and the projected colour coding could not be followed because different lengths of different colours had been included. Again, no obstacle to the experienced, but . . .

We shall skate mercifully over some other points—vital paxolin spacers missing; too many nuts of one size, not enough of another; an extra switch on the

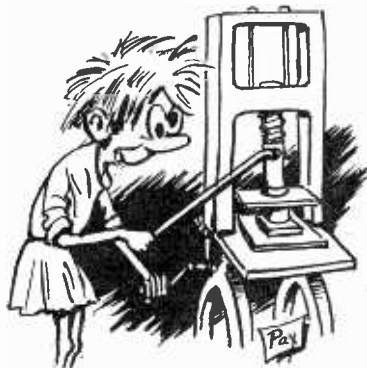


The thing refused to work

diagram, not mentioned in the text; no flats on the control spindles; no spigot holes drilled, and chassis holes out of alignment. And, incidentally, no solder!

The important point was that the thing refused, pointblank, to work. At this stage, the novice slings it back to his supplier and pays the fee he could have laid out *before* his hair went grey, to have his pet rebuilt. We reverted to first principles and cast aside the instructions, checked the diagram against the original design in an old technical magazine, made due allowances for the alterations that had obviously been done more with a view to economy than efficiency, and eventually got results.

An unlucky case? Maybe, but we would like to hear of other experiences. We would even like to see a Constructors' Guide to Kits. Henry reckons he knows which firms would top the list as 'Best Buys'.



An old Caxtonian duplicator

at the circuit showed it to come from a fairly trustworthy stable. The advertisement showed an

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IMPROVING THE R1155

C. MOLLOY

ALMOST twenty years have gone by since the first R1155 communications and direction finding receiver became available to the public through the surplus market. Since that time a lot of useful information has been published on this R.A.F. aircraft h.f. receiver in the technical journals, but often in issues that are now out of print. This article does not include a complete circuit diagram, but gives general information plus details of improvements that the author has made to his own receiver.

The standard model covers the range 75kc/s to 18.5Mc/s in 5 bands, with a gap from 500kc/s to 600kc/s and another from 1.5Mc/s to 3.0Mc/s. A second, less common version, designated L or N, omits the lowest range, 75kc/s to 200kc/s, but covers the Trawler Band, 1.5Mc/s to 3.0Mc/s. The two types are otherwise identical, having a single r.f. stage, mixer, two i.f. stages, a b.f.o. and a triode output stage feeding high impedance phones. An external power unit is used.

REMOVAL OF D.F. COMPONENTS

As the R1155 is a dual purpose receiver, many of the d.f. components can be removed without affecting the performance of the communications section leaving space for additional items to be added and, incidentally, reducing the total power consumption. A circuit diagram of the R1155 together with notes, is available from an advertiser in PRACTICAL WIRELESS. From this the readers can locate the d.f. components and decide which of them he would like to remove. The associated valves are V1, V2 and V8 and these are shown in Fig. 1. The meter balance control, meter amplitude control, meter deflection switch, aural sense switch, and associated wiring also can be taken out, to give extra front panel space.

The job of removing the d.f. components should

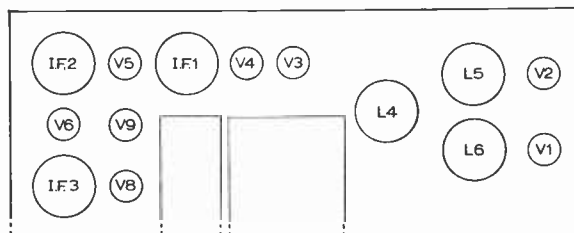


Fig. 1: Top view of the receiver showing position of the major components.

be tackled systematically, removing one item at a time and checking in each case that the receiver's performance is unaffected. If a mistake is made it should then be easy to pin point where it occurred. Care should be taken, especially at valve bases, not to break the continuity of the heater and h.t. lines.

DECOUPLING CAPACITORS

At this stage a check of all paper decoupling capacitors is advisable. There are two types, both of which are metal cased. Those mounted above the chassis are easily found, being cylindrical (½in. diameter, 3in. high) and secured to the chassis by a large nut. Age may have brought about leakage and an easy method of checking is to use a voltmeter set to a range suitable to measure the h.t. supply. Connect the meter positive lead to the receiver's h.t. positive line and the negative to the capacitor to be tested after electrically removing it from the h.t. line. A good capacitor will make the meter needle kick and then return to zero; this is caused by the charging current flowing into the capacitor. A faulty capacitor will either give a steady reading or the needle will gradually fall to a low value. Any faulty capacitors should, of course, be replaced. The lot had to be changed on the author's receiver (using modern components of the same value).

A number of smaller cylindrical decouplers can be found in several places within the coil compartment. These seem to be less prone to leakage and can probably be left alone. But it is well worth checking all the paper decoupling capacitors, as a defective one can make a considerable difference to the performance of the receiver.

LINING UP

No difficulty should be experienced lining up the i.f. stages. Figure 1 shows the position of the three i.f. transformers and the dust cores are readily accessible through the screening cans. The i.f. frequency is 560kc/s.

Disconnect the top cap of the frequency changer valve V4 and apply 560kc/s to the valve from a signal generator. The magic eye can be used as a peaking indicator, but make sure the a.v.c. is inoperative by turning the master switch to either the OMNI or O position. Set the volume control to maximum (reducing signal generator output as necessary) and adjust the cores of each i.f. transformer in turn, starting at the last stage (number 3) and working towards the front end.

The r.f., mixer and oscillator circuits can be lined up on each band in turn by choosing alignment points near the ends of the bands and inject-

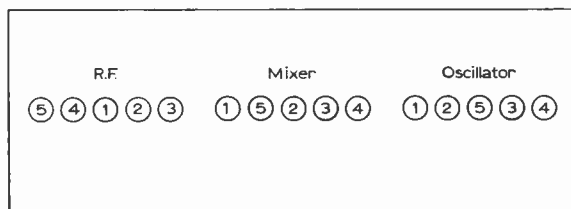
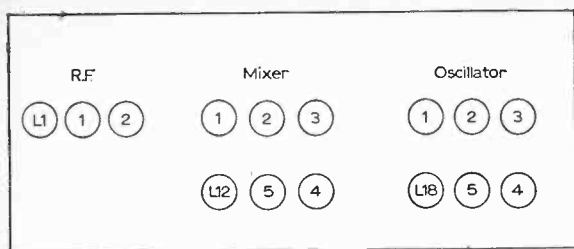


Fig. 2: Layout of the trimmers, viewed from the front of the receiver.



trimmers will now have to be re-adjusted on all bands and this is done with the aerial trimmer set to minimum capacitance (vanes out). The aerial trimmer is used to peak signals after they have been tuned in and the effect will be most apparent at the h.f. end of each band.

BANDSPREADING

Although the slow motion drive, especially the later type, is excellent, a bandspread control is a definite advantage on the higher frequencies. It can also be used for dial setting to counter the effects of oscillator drift on lower frequencies. Ideally, a twin-gang variable capacitor of about 20pF per section can be used, mounted below the chassis underneath the main tuning capacitor. One section should be connected in parallel with the oscillator (front section) and the other to the mixer (centre section) of the main tuning capacitor. The writer was unable to obtain a twin-gang capacitor of suitable dimensions and as two single variable capacitors were to hand, decided to use these instead. It was found advantageous to have two controls instead of one, though of course they were less convenient to use. After making this modification, the oscillator and mixer trimmers have to be re-peaked and this should be done at the h.f. end of each band with the vanes of the band spread control fully open.

Care should be taken when drilling through the front panel as it is of double thickness at this point. Swarf may fall between the inner and outer sections and later find its way into other parts of the receiver. It is not too difficult to remove the outer panel including the scale cover, if the slow motion drive is taken off first.

VOLTAGE STABILISER

Frequency drift, especially on the higher frequencies, can be a nuisance and a considerable improvement can be obtained by stabilising the voltage at the oscillator anode. A type VR150/30 voltage stabiliser was used (Fig. 4 shows the connections). This stabiliser has an octal base and can be plugged into the valveholder previously used for V8. All the d.f. wiring should, of course, be removed from this valveholder including the heater supply. The 22kΩ resistor (R28) in the oscillator anode circuit has to be replaced with a 1.5kΩ ½ watt resistor. Resistor R28 is located inside the coil pack on a small tag-board which is mounted on the chassis at the left hand side as viewed from the rear of the receiver. One side of this resistor is connected to h.t. positive and the other side goes to a common lead which runs between L15, L16, L17 and L18. Remove the strap to the h.t. positive line and run a wire to pin 5 on the base of the stabiliser.

It was thought worthwhile to stabilise the voltage at the screened grid of the frequency changer too. Voltage changes on the screen grid can cause small changes to the oscillator frequency. Since the screen grid voltage can vary in sympathy with the a.v.c. voltage it is possible for some kinds of fading to produce variations in the oscillator frequency which will give rise to objectionable distortion. The majority of receivers do not apply a.v.c. to the mixer valve, probably for this reason. An obvious solution is to disconnect the mixer from the a.v.c.

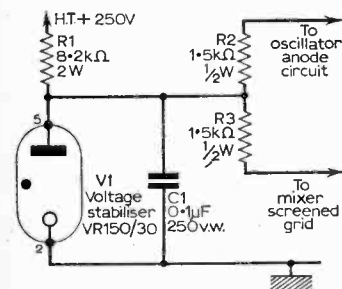


Fig. 3 (above): Side of the coil compartment viewed from front of the receiver.

Fig. 4 (left): Simple voltage stabiliser, see text for details.

ing an appropriate signal to the aerial input. If a signal generator is not to hand tune to a broadcasting station of known frequency and use it instead. This is not really a satisfactory method owing to the difficulty of obtaining a steady signal, but at a pinch it will do. Switch off the a.v.c., turn the gain control to maximum and use the tuning indicator. The trimmers are adjusted at the h.f. end of the band and the dust cores at the other. It will not be necessary to touch the oscillator section unless the scale calibration is out of adjustment: often peaking the r.f. and mixer trimmers will suffice. The location of all trimmers is shown in Fig. 2. A 4BA box spanner will be required to adjust the majority of them. The layout of the coils is shown in Fig. 3. The cores can be adjusted without removing the cover of the coil compartment.

L18 comprises 2 tuned chokes which assist in maintaining a constant oscillator voltage throughout ranges 1 and 2. They should not be adjusted.

L12 is an i.f. rejector and is connected to the mixer grid circuit on ranges 3 and 4. To adjust, inject 560kc/s to the r.f. circuits, then tune the receiver to the l.f. end of range 3 or the h.f. end of range 4 and adjust the core for *minimum* output.

L1 is only used on d.f. and can be ignored.

L4, L5 and L6 are the r.f. coils for ranges 3, 4 and 5 respectively. These are located above the chassis inside large cylindrical cans (see Fig. 1) and the cores are accessible from the top.

AERIAL TRIMMER CONTROL

A simple but very useful addition to any receiver is an aerial trimmer. A small variable capacitor of 50pF will do, connected in parallel with the r.f. section of the main tuning capacitor. It is used to counteract any loading effect the aerial may have on the first tuned circuit. The capacitor can be mounted on the front panel in the space vacated by the meter deflection or aural sense switches. The moving vanes are connected to chassis and a short length of coaxial cable is run from the fixed vanes to the rear section of the main tuning capacitor; the cable braiding should be earthed. The r.f.

line, however, the a.v.c. on the R1155 is very efficient and rather than disturb it, it was thought better to stabilise the screen grid voltage. Only one additional resistor is required to do this and it is shown in Fig. 4 connected between pin 5 of the stabiliser valve and pin 4 of V4. The two resistors connected to pin 4, a 22k Ω and a 27k Ω , should be removed but the connection to the decoupler should be left.

R.F. GAIN CONTROL

The volume control on the R1155 is a little unusual as it consists of a twin-gang potentiometer. One section (0.5M Ω) is an audio volume control while the other (50k Ω) controls the gain of V3, V4, V5 and V6 by applying a steady controllable voltage to the a.v.c. line. When the master switch is in the a.v.c. position only the audio gain control is effective, V3 to V6 being controlled by the normal a.v.c. voltage. When the master switch is in the OMNI position, the 0.5M Ω section is out of circuit allowing maximum audio gain. Also, the a.v.c. line is disconnected from the a.v.c. diode load and joined to the 50k Ω section which then forms part of a biasing network situated between h.t. negative and the chassis.

In short, when the a.v.c. is *on*, the receiver output is controlled manually by the audio gain control. When the a.v.c. is *off*, the audio gain is fixed and the combined r.f./i.f. gain control is effective. This is a sensible arrangement and is more or less how one would use a receiver with separate r.f. and audio gain controls. There are occasions though when one wants to reduce only the r.f. gain to avoid overloading the frequency changer with a strong signal. However, to do this with the R1155, the i.f. gain has to be reduced too.

A separate r.f. gain control will solve this problem and one can be installed quite easily by placing a 5k Ω potentiometer between the chassis and pin 8 of V3. The potentiometer can be fitted underneath the chassis so that the shaft projects through the front panel below and to the right of the main tuning capacitor, maintaining symmetry of control layout (including the two bandspread controls). Alternatively, the potentiometer can be fitted in one of the spaces along the top of the front panel which were previously occupied by d.f. components.

The left hand terminal of the potentiometer as viewed from the rear, is connected to chassis. The strap from V3 pin 8 to chassis is removed and a

wire is run to the central terminal of the r.f. gain control. A 0.1 μ F decoupling capacitor must be connected from pin 8 to chassis and it is essential to connect this component direct to pin 8 and not to the centre terminal of the potentiometer, otherwise instability will occur.

TAPE OUTLET

The phones output from the R1155 is suitable for direct connection to a tape recorder. In a previous article a description was given of how to fit a front panel phones socket. Adjacent to this, a second socket can be fitted for use as a tape outlet. A 0.1 μ F 350VW capacitor was used to isolate the headphones from the input of the tape recorder and it was wired between the line terminals of the phones and tape socket, at the rear of the front panel. The second terminal of each socket was connected to the chassis which should be earthed.

An attenuator may be required for some recorders. Figure 5 shows a simple attenuator which, if it is required for permanent use, can be wired between the tape and phones socket.

NOISE LIMITER

A subject that is almost certain to start a discussion among radio enthusiasts is that of noise limiters. Many circuits have appeared: some are good, others not so good; the method of operation of some is simple, of others it is obscure; some operate on the i.f. stages of the receiver, others are used on the audio; some automatically adjust themselves to the signal level, others have to be set manually; and so on. Unfortunately there are snags of one sort or another connected with many noise limiters. To be effective, some of them have to be set so that they tend to clip the signal causing distortion, which may, of course, be acceptable. It is obviously better to have a partly distorted signal that is audible, than one which is lost in noise.

It was finally decided that a simple audio limiting circuit applied to the phones output of the R1155 would probably be as good as any. Figure 6 shows the circuit of a parallel type of audio limiter. Either valve or semiconductor diodes can be used but in each case the main drawback of this circuit is the same. The diodes have to be reverse-biased so that they will only conduct when the bias voltage is exceeded. If 1.5V dry cells are used, the limiter will not act until 3V peak-to-peak is applied to it, which is ample to drive a pair of headphones.

It is possible to throw away the biasing batteries and use silicon diodes in the noise limiter circuit; since these devices do not conduct in the forward direction until a forward bias is applied (the level of which varies according to type). Figure 7 gives details of such a circuit using OA202 diodes. Germanium diodes were tried, but discarded as they distorted the output.

The limiter is connected between the output transformer and the phones socket; it is convenient to mount the components at the rear of the socket itself. The effect of the limiter is immediately apparent, removing the usual clicks, bangs and static crashes. As the volume is turned up a point is reached where no further increase in output is obtained. Any further advance of the volume control only brings about distortion.

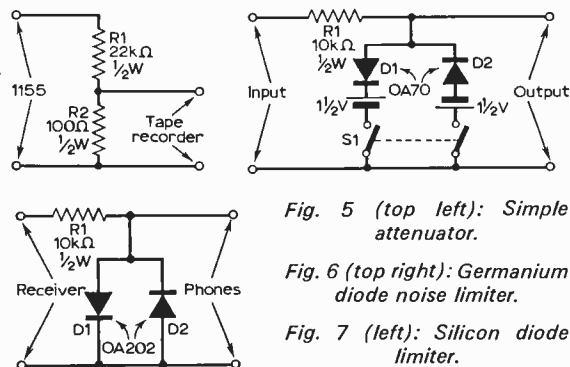


Fig. 5 (top left): Simple attenuator.

Fig. 6 (top right): Germanium diode noise limiter.

Fig. 7 (left): Silicon diode limiter.

a two-transistor PERSONAL PORTA

R. L.



REFLEXING in this personal radio makes two transistors do the work of four. Often it is not easy to carry out successfully, but works reasonably well in this circuit, even over an output stage feeding an earpiece. The quality depends upon using a good earpiece and the type specified is Arden ER250.

Alignment problems do not exist in a receiver that has only one tuned circuit. On the other hand, as it takes as many as four tuned circuits to suppress a powerful transmission and enable a weak signal to be heard, it is mainly a local station receiver. Reaction could be added to sharpen selectivity, but risks instability, and there is probably some r.f. feedback already. It is almost unavoidable when a t.r.f. circuit is put into miniature form, since the input and output of the r.f. amplifier are working at the same frequency, and are close together.

With a ferrite aerial, an r.f. amplifier is essential, because a detector can only respond effectively to strong signals. At low signal levels the detector is insensitive and produces increased distortion. A.F. amplification cannot, in general, make up for a lack of r.f. amplification.

and increased volume could have been obtained on a 3-volt supply, but this would have involved extensive modification. Most of the difficulties of a t.r.f. circuit would disappear if it were designed to receive a single frequency like the i.f. amplifier of a superhet. Instead it has to be tunable over a wide frequency band, and conditions vary considerably over the tuning range. Here the circuit is aperiodic except for the input, although L3 with only 20 turns should assist in maintaining the r.f. gain at the high-frequency end.

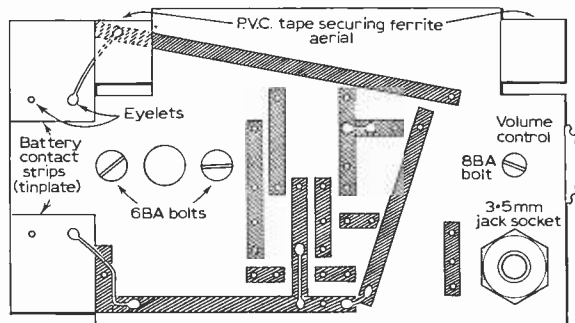


Fig. 2: Mounting board using "Cir-kit".

Tuning is effected by a 300pF miniature plastic dielectric capacitor across a 70 turn winding on the ferrite aerial, and this is coupled by a coil of five turns to the base-emitter input of Tr1. The two transistors serve first as r.f. stages feeding the detector via a small step-up transformer, and then as a.f. stages amplifying the a.f. from the detector. The overall a.f. gain is about 40 times with negative feedback applied by means of R5 to reduce distortion in the output stage. A step-up ratio to the detector is possible because the detector is working at a rather low signal level at which its impedance is fairly high. Ideally there would be a further step-up to a tuned circuit, but this, though desirable, would involve the complication of ganged tuning.

R.F. TRANSFORMER

The r.f. transformer is wound on a $\frac{1}{2}$ in. ferrite ring because this has very little external field and avoids r.f. instability through magnetic feedback to the ferrite aerial. It is more compact than a ferrite pot core, and can be wound fairly easily. Very little of the a.f. at the collector of Tr2 can reach the detector via this transformer, although winding the coils L3 and L4 on separate rings coupled by a

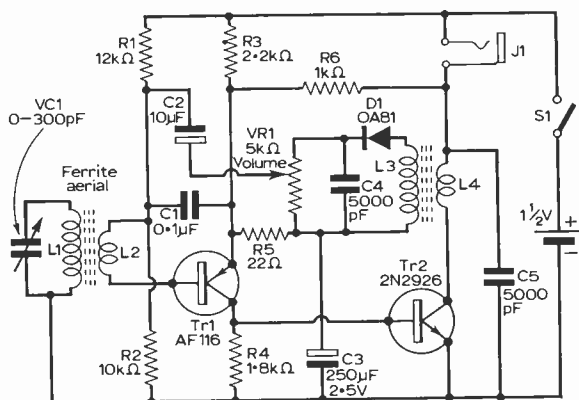
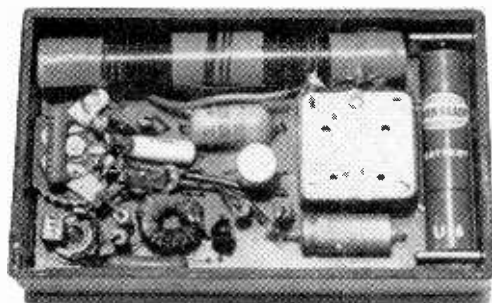


Fig. 1: Circuit diagram of the two-transistor radio.

A 1.5V battery is capable of providing all the volume needed in an earpiece. The low voltage, however, accentuates the non-uniformity of gain over the medium waves, and sensitivity decreases towards the high-frequency end. Improved sensitivity



capacitor of about 200pF might be a better arrangement, and would still give a step-up to the detector. The r.f. at the collector of Tr2 is passed via the transformer to the detector, but after the modulation is extracted, it too must be filtered out, and only the resulting a.f. is passed back to the base of Tr1 so that the transistors can now function as a.f. amplifiers.

The success of reflexing depends upon this sequence of filtering, and r.f. current must also be kept out of the earpiece leads in order to prevent re-radiation and hand-capacity effects when tuning. This is the purpose of the bypass capacitor C5.

TRANSISTORS

A direct-coupled circuit requires fewer components, and a complementary arrangement of a p-n-p transistor followed by an n-p-n can take a form which does not require any adjustment. D.C. feedback to overcome drift is applied via R6 to the emitter of Tr1. The potential divider consisting of R1 in series with R2 provides a "reference voltage". The resistance R3 is necessary mainly because of the low supply voltage. D.C. stability would be somewhat better on a higher supply voltage, because the base-emitter potential drops of the transistors would be a smaller part of the total voltage.

A silicon transistor 2N2926 is deliberately chosen for Tr2 because of its large base-emitter drop. This permits a larger current in Tr1 for a given load resistance R4. The total current of the receiver is under 2mA and of this about one-third of a milliamp flows in Tr1. The first transistor could also be

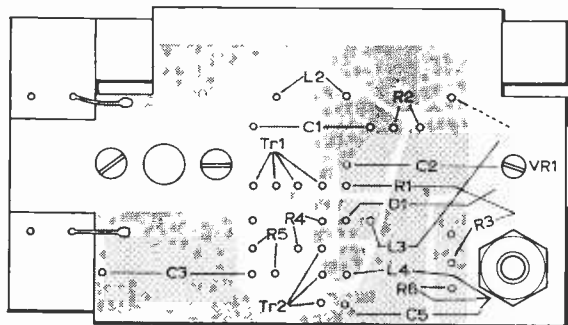


Fig. 3: Printed circuit as alternative to Fig. 2.

a silicon transistor, but of the p-n-p type, such as 2N3702. However it was found that the germanium r.f. transistor AF116 gave a larger output. Complementary circuitry can be confusing, and the lead

arrangements of the two transistors should be studied carefully before insertion into the circuit. The lead arrangements of the silicon and germanium transistors are depicted in Fig. 5 which also shows the positions of the corresponding holes in the mounting board.

The detector diode D1 is connected with the red end towards the volume control. The polarities on the electrolytic capacitors should also be carefully observed, otherwise the circuit will stop working in a short time. The metal case of C2 is connected to the junction of R1 and R2, while that of C3 is connected to the negative side of the battery. The battery itself must be correctly inserted, although no damage appears to occur from an accidental reversal when the rest of the circuit is in order.

CONSTRUCTION

The components are assembled on a small mounting board of $\frac{1}{16}$ in. insulating material. "Cir-Kit" strip on the underside is an alternative to a printed circuit, although rather close spacing is involved. Holes for component leads are drilled with a No. 60 drill. Guide marks are then made

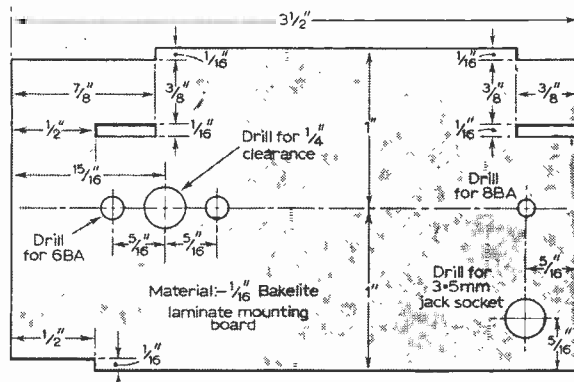


Fig. 4: Details of the mounting board.

with a scriber for the edges and ends of the strips. The "Cir-Kit" strip is cut to length, then the paper backing is prised off with the point of the scriber, holding the end of the strip with small forceps or tweezers. When all the strips have been pressed down in position, the mounting board is placed with the copper side downwards on a flat wooden surface, and the holes can then be drilled through the strips, smoothing them afterwards where necessary. Joins between adjacent strips can be made by soldering short pieces of 24s.w.g. tinned copper wire across them, and in one or two instances, gaps between the strips can be widened by cutting away some of the strip.

FERRITE AERIAL

The 3 x $\frac{3}{4}$ in. ferrite rod is a piece broken off from a longer rod. A method of doing so is to wind two turns of $\frac{1}{4}$ in. Sellotape tightly round at the point where the break is required. Place the rod on a hard surface and position a metal chisel at the edge of the Sellotape. A sharp tap with a hammer will usually produce a clean break at this point. The ferrite rod is then covered with p.v.c. tape and wound with 70 turns of 24s.w.g. enamelled wire. The ends of the wire are fixed with a strip of p.v.c.

tape. A piece of the tape is then applied around the middle of the winding and the five-turn coupling is then wound on top. Owing to the shortness of the aerial the winding has to be in the middle for maximum signal. The ferrite aerial is fastened on to the

applied around the perimeter of the ring and folded inwards. It can be pushed into the centre from each side to cover the ring completely. The 40-turn winding requires 27in. of 36 s.w.g. wire. Double silk-covered may be used, but should be waxed

before winding since the wire has to be threaded through the core 40 times and this can impair the insulation. The 20-turn winding may consist of 15in. of 30s.w.g. wire.

Battery contacts may be formed by folding strips of tinplate to the shape shown in Fig. 6, and are attached underneath the mounting board by small eyelets. The smallest eyelets obtainable are the type made for insertion in Veroboard, and are thus suitable for $\frac{1}{16}$ in. material. In assembly, the component leads are passed through their respective holes, bent over, clipped, and soldered to the copper strips with printed circuit

solder. Ease of construction is more important than the ultimate in compactness. Resistors stand vertically on the board. A heat shunt, e.g., the Antex type, can be used when soldering the transistors and diode. Special care is needed as the leads are made very short so that the transistors project no higher than the variable capacitor. Although it takes longer, the best method is perhaps to apply the soldering iron for a second at a time, followed by an adequate cooling interval. The high frequency performance of transistors seems often to be impaired by soldering without adequate precautions.

CABINET

The case is made from $\frac{1}{16}$ in. material glued at the edges with Bostik clear adhesive. A strip of leathercloth is glued round the sides of the box and trimmed with scissors. A piece is glued over the top and trimmed neatly round the edge so that the join is almost imperceptible. The back, too, is covered with leathercloth, and is removable by giving a small screw half a turn with a screwdriver. The locking device consists of an eccentric disc which enters a slot in the side. The three slots required in the sides are made before assembly by drilling series of holes with a No. 60 drill. These can then be merged by inserting the tapered end of a nail file.

There is an opening in the end of the case for the edge-type volume control, which also incorporates the on-off switch; and to enable the chassis of the receiver to drop into place, the hole in the case for the tuning shaft is elongated slightly. This can be done by using the $\frac{1}{4}$ in. drill in the manner of a saw.

A combined tuning knob and dial is constructed from three discs as shown in Fig. 8, and is fixed on the shaft by a piece of wire through a hole drilled in

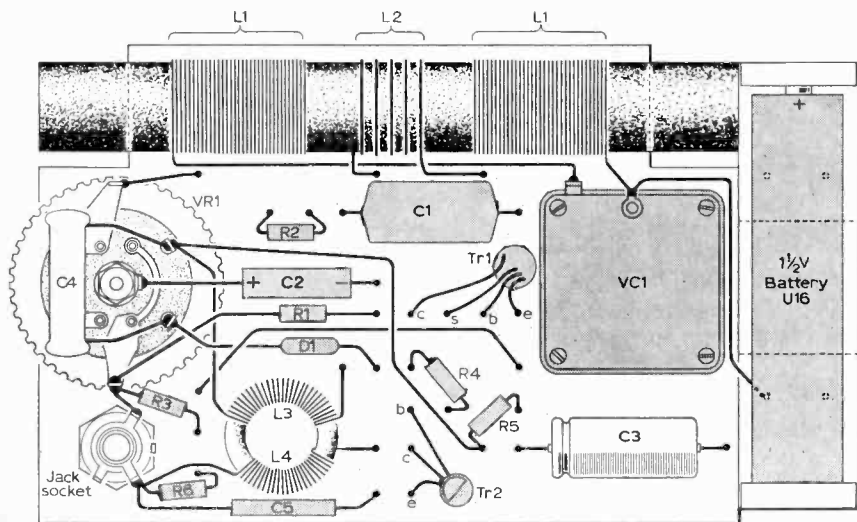


Fig. 5: Component arrangement above circuit board.

mounting board by strips of p.v.c. passed through slots in the board. It is raised above the surface by $\frac{3}{8}$ in. squares of the $\frac{1}{16}$ in. material cemented to the mounting board under the ends of the rod.

TUNING CAPACITOR

The round-head screws supplied with the 300pF Dilemin capacitor are too short for mounting on the $\frac{1}{16}$ in. material and can be replaced by similar 6BA screws $\frac{1}{4}$ in. long. The washers supplied are

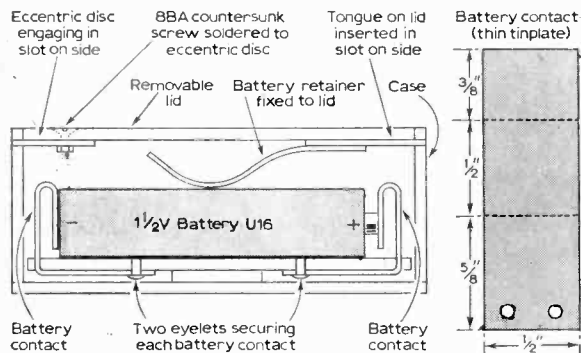


Fig. 6: Sectional elevation showing battery contacts.

placed between the capacitor and the board, as it requires to be raised slightly to clear a ridge around the tuning shaft. A check should be made on the length of the screws projecting through the board, as the capacitor will be damaged if these screw in too far. It should also be kept in mind that the end stops of the capacitor will be damaged if the shaft is turned beyond its normal range, especially as it is a little stiff to turn at first.

Before winding the two single-layer windings on the ferrite ring (type FX1593), $\frac{1}{4}$ in. Sellotape is

★ components list

Resistors:

R1 12kΩ
R2 10kΩ
R3 2.2kΩ
R4 1.8kΩ
R5 22Ω
R6 1kΩ

Capacitors:

C1 0.1μF 125V polyester
C2 10μF 15V electrolytic
C3 250μF 2.5V electrolytic
C4 5,000pF tubular ceramic
C5 5,000pF tubular ceramic
VC1 300pF Jackson "Dilemin"

Coils:

L1 70 turns 24swg enam. wire
L2 5 turns 24swg enam. wire
L3 20 turns 30swg dsc wire
L4 40 turns 36swg dsc wire

see text

Miscellaneous:

Earpiece, Arden type ER250 with cord and 3.5 mm jack plug. Jack socket 3.5 mm. Ferrite rod. Ferrite ring core type FX1593. Battery, 1.5V type U16. Edgewise pot. (Volume and on/off switch) 5kΩ with switch.

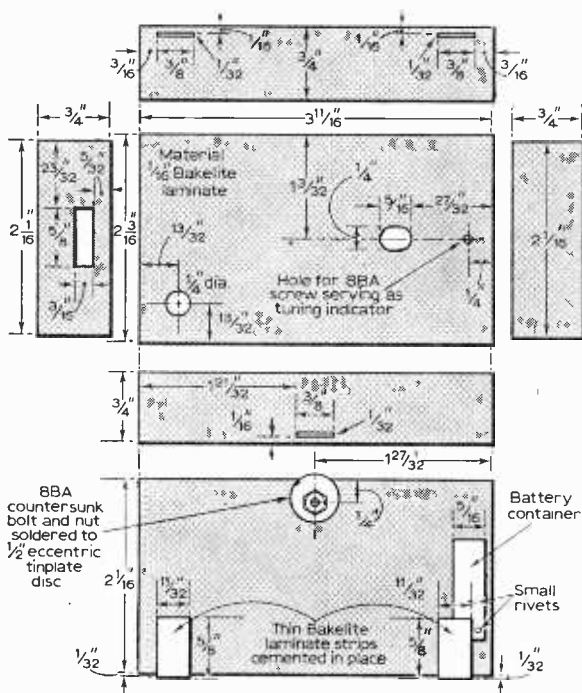
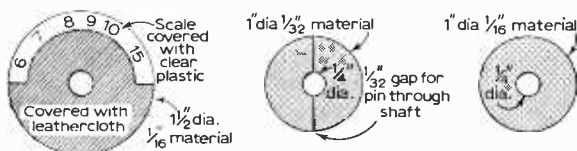


Fig. 7: Constructional details of the case.

Fig. 8: Individual parts for the tuning scale.



the shaft with the No. 60 drill. The knob is covered with leathercloth to match the case, except for the end of the shaft exposed in the centre for decorative effect. The scale round the edge is marked approximately in hundreds of kilocycles and is covered with clear plastic.

THE MW COLUMN

THIS month we will take a look at the Americas. The prolific stations of South America are usually best heard in the spring, when North America is less favourable. Some of the most consistent are PRG3 (1280kc/s), PRA3 (860); YVQO (650), HJED (820), LR4 (910), LR1 (1070), PRF4 (940), PRA2 (1040), ZFY (760).

Central America and the Caribbean are usually more difficult to hear except for a few outstanding ones such as Radio Americas, Swan Island (1157, but frequency varies) and PJB Bonaire (800). Others to look for include CMBC Havana (690), CMCA (830), Jamaica (650), St. Lucia (840), Guadeloupe (640), ZBM1 Bermuda (1235—together with spurious pop pirate signal!), HOL55 (1315), TGRB (1120) TIRICA (625), PJD2 (1295), Belize (834) and the regular St. Pierre et Miquelon on 1375. A consistent one last season was XEW Mexico City, now suffering from splash from Milano; however it is often strong from 0500.

The east coast USA and Canadian stations, of course, can be heard very early in the evening when conditions are good, long before the Europeans sign off and loggings have occurred as early as 1730! With peak conditions they can be heard as late as 0900. Early arrivals to look for include WHDH (850), CJCH (920), CJON (930), WAVY (1350), WINS (1010), CBA (1070), CJCB (1270). Even mid-West stations have been heard comparatively early—WOAI (1200) and KMOX (1120) both before 2300.

Some channels are known as "graveyards" because they are occupied by dozens of low-powered local stations and no dominant station is apparent—just one weak signal on top of another. 1240, 1340 and 1400 are examples. Some stations make use of two frequencies (shared time), e.g. WFAA and WBAP both operate on 570 and 820. Other stations operate during daytime only. Also remember that on many channels both USA and Canadian stations operate. Which makes it important to take care in identification.

Some easy ones are WNBC (660), WCBM (680), WABC (770), WCBS (880), WBZ (1030), WHN (1050), WBAL (1090), WNEW (1130), WCAU (1210), WKBW (1520), WQXR (1560). More difficult high power stations include WFAA/WBAP (820), WCCO (830), WJR (760), WSB (750), WOWO (1190), WLS (890), WHO (1040).

You should add a few Indian stations to the log this month in the early hours between 0030—0200. Most have some English programmes (mainly newscasts). Most likely ones are Rajkot (910), Lucknow (760), Sangli (1250), Ajmer (600), Ahmedabad/Baroda (in parallel on 850), Delhi (1070), Bombay (1040). Several others have been logged. Radio Pakistan is more difficult but look for Lahore (630), Quetta (750), Rawalpindi (1150).

Japan is heard only rarely in Britain (but often in Sweden due to polar paths reflection). But try around 1500 on 1250 for Vladivostok, a good catch.

Alistair Woodland

Cycles for ever

WHAT a strange point of view Mr. Covington has (PRACTICAL WIRELESS, January, 1967). Surely, the only sane outlook is to have descriptive terms wherever possible. Everyone who can remember back must realise the difficulty a beginner has in memorising a multitude of non-descriptive terms. If all Mr. Covington is worried about is verbal speed, what can be quicker than the usual "cycles"?

Regarding written speed, surely the three letter m.p.h. is simpler than the five letter plus oblique mile/h.

I think that the answer to the change for changings' sake group is to simply ignore them—I shall certainly continue to write c/s and say cycles for cycles per second.

W. Lee.

Hull.

R1155 information

RECENTLY there have been letters in this magazine concerning the R1155, from Mr. Tye and myself. I would like to state that although I said I would get copies made of any information I received, I cannot get them done free. Many readers have written asking for the information and only one has sent the money for the copying. The charge for this is 1s. per page.

A. R. Preston.

London, S.E.8.

Phonetics again

I AGREE entirely with the letter of Charles Mitchell (November 1966 issue). Most amateur radio operators operate fairly powerful transmitters. They are fully competent to operate their equipment or else they wouldn't be licensed amateurs. The one quality they lack, is use of codes and abbreviations. Mr. Mitchell says he had heard a ham on 80m using very different phonetics when repeating his callsign in the same transmission. I have listened to hams doing this many a time. Sometimes the callsign is given without the use of phonetics, and we, the S.W.L. fraternity and the amateur who he is in QSO with, are subject to "garbled" call signs. I think that before licences are granted the applicants should be tested on their knowledge of abbreviations, etc., set down in the Geneva Radio Regulations, 1959. It would be interesting to hear what other readers think of my idea.

S. Haagenzen.

Grimsby,
Lincolnshire.

Price correction

The price of the Electronics (Croydon) Ltd., "Supertone G.C.V." radio, as advertised on page 779 of February issue, should be £3 19s. 6d. and not as printed.

NEWS AND..

COBRA AND THE COMMODORE FROM K-B



The latest in the K-B range of portable radios are the Cobra (left) and Commodore (right). Both models feature modular construction which makes servicing a very easy job—the r.f., i.f. and a.f. sections being three plug-in units. The transistor complement is the same in both receivers: 2 × AF117, OC70, 2 × AC127 and 2 × OC81.

The Cobra embodies a 5in. speaker and cabinet dimensions are $5\frac{1}{2} \times 10\frac{1}{8} \times 2\frac{3}{8}$ in. and the Commodore having a $7 \times 3\frac{1}{2}$ in. speaker, measures $7 \times 12\frac{3}{8} \times 2\frac{3}{8}$ in. Both receivers cover long waves and have bandspread on the medium wave band and have provision for an earpiece which is provided as an optional extra and both sets have a car aerial socket. Tape recordings can be made from the Commodore.

The cabinet of the Cobra is Arabian blue plastic with a chrome plated fascia and satin finished aluminium fold-down handle. The Commodore is in a wooden cabinet covered in grey leathercloth with chrome finished knobs and trim. The Cobra costs 12½ gns. plus 3s.8d. surcharge and the Commodore 18 gns. plus 5s.3d. surcharge.

CHRISTMAS MAYDAY CALL FOR RARE DRUG

A ham radio broadcast from Vienna promptly translated into action by a Swedish newspaperman resulted in the emergency despatch from the Wellcome Chemical Works, Dartford, on Christmas Day of 100 tablets of a rare drug which may be the last hope of prolonging the life of a patient in Zagreb, Yugoslavia.

The emergency call, put out on behalf of Dr. Otto Schinkler of Vienna, was for the drug Alkeran needed by his sister, a doctor at the 1st Polyclinic in Zagreb, to treat Eviord Stork, a 35-year-old patient suffering from cancer. With pharmacies closed and continental telephone lines jammed with Christmas goodwill messages, Dr. Schinkler enlisted the help of Friedrich Stobel, a ham whose Mayday call was picked up by a fellow ham in Stockholm.

Action began when Fred Bramberg, on duty at the Stockholm newspaper "Expressen", received news of the broadcast by telephone. At about 4 p.m. Bramberg was able to reach by telephone Dr. Fred Wrigley, Overseas Director of The Wellcome Foundation Ltd.

With the aid of Mr. W. L. Jeffrey, general manager in the overseas unit and Mr F. G. Rundall, General Works Manager, the tablets were located in the Wellcome Chemical Works. They were handed to Mr. Alan Stubbs, head of the Works despatch section who, despite having one leg in a plaster cast, delivered them to B.E.A. Export Cargo Unit to be put on the first connecting plane for Zagreb.

...COMMENT

THE BRITISH ACOUSTICAL SOCIETY

A significant milestone in the history of British Acoustics has been the formation of the British Acoustical Society. This resulted from meetings arranged by the Royal Society between representatives of architecture, engineering, medicine and pure science.

Appropriately, in view of its importance to large sections of the community, the first meeting was a two-day symposium on aircraft noise. Subsequently, symposia have been held on such diverse subjects as underwater acoustics and acoustical investigations of defects in solids.

For full particulars of membership apply to Dr. R. W. B. Stephens at the Physics Department, Imperial College, London, S.W.7.

RADIO 390 LOSE APPEAL BUT BACK ON THE AIR

An order of *certiorari* to quash the convictions against Radio 390 and two Company directors (see last month's issue for court report), was dismissed by a two-to-one majority in the High Court of Justice on 13th December. Estuary Radio Ltd., who own Radio 390, switched their transmitter on again New Year's Eve in open defiance of the Post Office, and are now broadcasting as before from the former anti-aircraft fort on Red Sands in the Thames Estuary. The other 'pirate' radio station BBMS, which was also prosecuted for illegally broadcasting from another fort in the Thames Estuary, is still, as far as we know, operating in the medium wave band.

GRUNDIG SV80 POWER AMPLIFIER



Grundig announce a range of high quality Hi-Fi units, amongst which is the SV80; a fully transistorised mains powered stereo amplifier with a transformerless output stage. Provision is made for the connection of a radio tuner, tape recorder and record player and there are output sockets for loudspeaker assemblies and headphones. Finished in light walnut or teak the cabinet matches other items in their Hi-Fi range.

Technical specification: Mains voltage, 110—130—220—240V 50/60c/s; Power Consumption, 120W max.; Transistors, 14 × BSY76—4 × BSY51—2 × BSX40—AD152—8 × 2N2148; Diodes, 2 × ZF27—2 × GF580—2 × ECO1106—8 × ECO3390—DZ62; Channel Separation, better than 46dB; Frequency Response, 20—20,000c/s ±1dB; Damping Factor 20 at 5Ω, 60 at 15Ω; Input Sensitivities, Mic 7.5mV/100kΩ, P.U. (Magnetic) 4mV/47kΩ, P.U. (Crystal) 220mV—3V/1MΩ, Radio/Tape Recorder 250mV/470kΩ; Output Sockets, Speaker 2 × 5Ω (4—16Ω), Headphones 2 × 300Ω; Output Power is 2 × 40W (Music Power) and Controls are: Volume, Stereo Balance, Bass and Treble; Distortion Factor is less than 0.5%; Power Bandwidth, 10—50,000c/s—1% distortion; and Balance Regulation, up to 10dB.

Starting a club

I WAS glad to read the letter from G3VLJ last month, and I would like to encourage any young reader in that area to contact him. There may be older readers who know young beginners and who could tell them of the proposed club. Mr. Hansen and I have corresponded earlier on the topic, and I know he is keen.

I have always thought and hoped that the next move in the youth service would be a growth of radio and science clubs, so best wishes to the Croydon area.

By the way, if there are any interested young people in the Holloway/Camden Town area who would like to contact me, I would be very pleased to hear from them.

Ken Smith, G3JIX. 82 Granville Road, Walthamstow, E.17.

Foreign equipment

FROM time to time I have observed letters published in your journal from readers who have purchased foreign-made receivers and equipment which have broken down and been left inactive due to requirement of special parts which the suppliers are unable to supply or have a "I couldn't care less" attitude when letters are written to them requesting data and availability of parts in the country the product is marketed in.

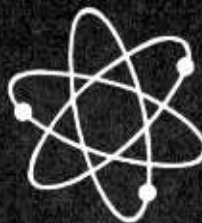
I am surprised to see, why persons in Great Britain who have such an abundant source to draw from in their own country, purchase products made abroad. It could be in my opinion, the price at which they are sold. A similar product made at home (Great Britain) does cost more, I agree, but there is always the dependability of the manufacturer being able to supply the necessary parts if they are of a special nature to the instrument concerned.

I have had similar experiences with American-made products, which I ordered from New York. Certain parts in an oscilloscope purchased in kit form were missing when the parcel arrived, and after a correspondence that lasted over a period of years, I was told that the kit-maker had gone out of business and they were sorry they couldn't supply parts; would I be interested in ordering another kit!!!! The result has been that I have a white elephant in the house.

I have, however, experienced that the British manufacturers are most co-operative in supplying technical information of their products, and any special parts for many of the test equipment that I own, and service has been very prompt.

S. M. Sharifi.

Teheran,
Iran.



SOLID STATE THERMOMETERS AND THERMOSTATS

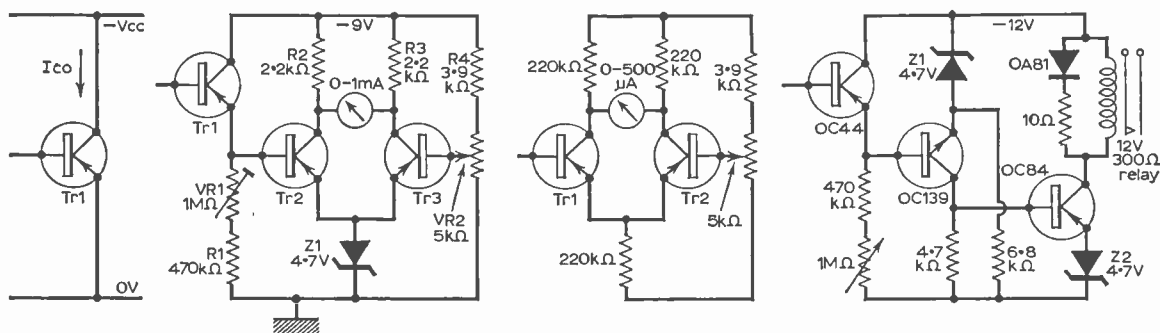
K. T. WILSON

MOST textbook descriptions of transistor action pay a fair amount of attention to the effect of varying temperatures on the operation of transistor circuits. As far as the normal operation of circuits is concerned, the temperature dependence of all the transistor parameters is a problem which must be taken care of in the design of equipment. If we wish to use transistors as temperature detectors, however, we must find a way to obtain the maximum temperature sensitivity in order to make the thermometer action as sensitive as possible.

The most temperature dependent parameters of any transistor are the leakage currents, and of the two leakage currents of importance, the more sensitive is the collector leakage current in the common emitter connection with the base open cir-

one milliamp flows in the collector of Tr2 at room temperature. VR2 is then adjusted so that the meter reads zero at room temperature.

The circuit as drawn provides a range of ten degrees centigrade (eighteen degrees Fahrenheit) for full scale deflection. It is therefore very suitable for interior use where temperatures fall within this range (15-25 degrees centigrade). The experimenter can readily devise methods of extending this range; for example the collector loads of Tr2 and Tr3 could be dropped to 680Ω and a 5mA meter used. Alternatively, the circuit of Fig. 3 could be used. Here the temperature sensitive transistor forms one of the long-tailed pair of the meter circuit, and the Zener diode has been replaced by a resistor. It should be noted that these circuits are entirely unsuitable for car radiator measurements,



Left to right. Fig. 1: Path of leakage current I'_{co} . Fig. 2: A simple thermometer circuit using I'_{co} to record temperature fluctuations. Fig. 3: Alternative circuitry using a long tailed pair. Fig. 4: Circuit of a simple thermostat. (Tr1, Tr2, Tr3—OC70, 71, 44 etc).

cuted. This mouthful is usually shortened to I'_{co} . For most germanium transistors, the value of I'_{co} approximately doubles for every ten degrees centigrade rise in temperature; or, to put it another way, the I'_{co} increases by about ten per cent per degree centigrade.

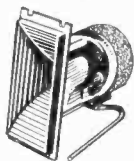
A thermometer circuit using this principle is shown in Fig. 2. Tr1 is the temperature sensitive transistor with the base open-circuited. VR1 is adjusted so that the leakage current at room temperature produces a voltage I'_{co} . ($R1 + VR1$) which is slightly greater than the stabilising voltage of the Zener diode Z1 (4.7 volts in this case). This voltage produces a current in the base of Tr2, and hence an amplified current in the collector of Tr2. The value of VR1 should be adjusted so that

as the temperatures encountered may be destructive to the transistors.

Finally, Fig 4 shows a sensitive thermostat using the same principle. In this case the resistance in the emitter of the sensing transistor is high for the maximum sensitivity. To enable the first stage to be coupled directly to the second, Tr2 is an n-p-n type. In some cases where great sensitivity is not required and a low-current relay is available, the n-p-n transistor can operate the relay directly. As shown, the output of Tr2 is directly coupled to a power transistor Tr3 which operates the relay. This arrangement is capable of controlling temperature very closely, the only backlash being due to the relay.

RADIO • HI-FI • COMPONENTS • TEST EQUIPMENT

H.T. 20 Rectangular Horn Tweeter



Ideal for 2-way and 3-way speaker systems ensuring smooth and clear reproduction. Output 20 watts. Impedance 16 ohms. Response 1,500-18,000 cps. £4.2.6.

CROSSOVER NETWORK CN23, 3 Ω 2 way 14/8. CN216, 16 Ω, 2 way, 14/6. £2.2.6.

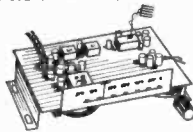


ALL TRANSISTOR MONO & STEREO PRE AMPLIFIERS

Provide extra stage of amplification for use with magnetic cartridges, tape and microphone inputs. Both models feature wide band pass range, 20,000 cps. As reviewed in *The Gramophone*, Dec. 1966.

PRE 301 MONO £4.12.6

PRE 302 STEREO £5.15.0



EAGLE FMT41. FM TUNER

Sub-miniature 6 transistor 3 diode F.M. Tuner. Covers 88-108 Mc. Operates from 9-volt battery, micro miniature circuit giving brilliant FM reception. Ready to use, simply connect to your Hi Fi amplifier. Instructions supplied.

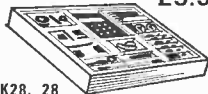
£8.10.0



REMOTE CONTROL STEREO HEADPHONE STATION LS.2

A junction box for connecting stereo headphones to a stereo or monaural system. Separate controls for each channel. On/off switch. Stereo sockets allow two sets of headphones to be used. With instructions and 20ft. of 5 conductor cable.

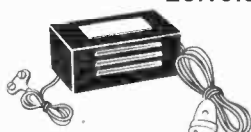
£3.5.0



EEK28. 28 PROJECT CONSTRUCTIONAL KIT

This advanced educational kit is excellent for beginners as well as the more advanced experimenter. Not even a soldering iron is needed. Complete with 60 page booklet giving full details of suggested circuits.

£6.10.0



LA9P. AC ELIMINATOR

With a double wound step down transformer to operate 9v. Radios, etc., from AC Mains.

£1.8.6

TAPE HEAD DEMAGNETIZER

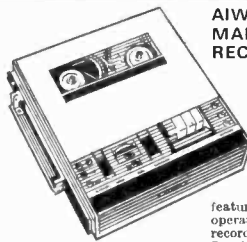
MODEL TD. 79



Compact, easy to handle. Will remove magnetism from tape heads permitting improved recordings. Reduces harmonic distortion and noise level, 35/8. Also Two Probe version TD 109, 35/8

ALL ITEMS SENT POST FREE

AIWA TP.712 2-SPEED 5" REEL MAINS AND BATTERY TAPE RECORDER



26 1/2 Gns.

Loaded with features hitherto only found in more expensive tape recorders: AVC system automatically adjusts recording volume level. TWO-WAY OPERATION: A.C. mains or batteries TWO HOURS OF RECORDING TIME: Using 1.5 mil 600 ft. tape. REMOTE CONTROL: TONE CONTROL: LEVEL METER: Indicates recording and battery levels. Other features include 1 1/2 and 3 1/2 i.p.s. speeds, smooth operating push-button keyboard, input for radio, record player, TV, etc., socket for an external speaker. Complete with Dynamic microphone, earphone, 5in. 600ft. tape, sin. empty reel batteries and A.C. lead. Size: 12 1/2in. x 10 1/2in. x 3 1/2in.

EAGLE PRODUCTS

MAGNETIC STEREO CARTRIDGES

M1007G GOLD

Response: 20-20,000 cps

Output: 5MV at 1Kc/

5cm/sec.

Stylus: 0.5 Mil diamond

Tracking Pressure

1-2.5 grams.

£6.12.6

M1007F SILVER

Response: 20-18,000 cps

Output: 10MV at 1Kc/

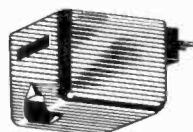
5cm/sec.

Stylus: 0.7 Mil diamond

Tracking Pressure

2-4 grams.

£5.14.6



As reviewed in *Hi Fi News* Sept. 1965. Both feature singularly smooth reproduction and incisive separation of stereo channels

EAGLE SA100. 10W INTEGRATED STEREO AMPLIFIER



A compact, versatile integrated unit for monaural or stereophonic reproduction from record player, tape recorder and tuner. Power output 8 watts per channel. Frequency response 40-20,000 c.p.s.

£18.0.0

EAGLE AFM100. AM-FM TUNER

Combines a host of advanced features that easily make it the finest AM-FM tuner in its class. A tuned RF stage on FM, AFC circuit and a heavy flywheel giving smooth but effortless tuning, built in AM Ferrite aerial. FM 88-108Mc.

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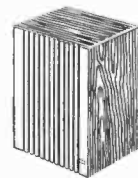
MS80. 20W ROSEWOOD SPEAKER SYSTEM

The perfect answer for the music lover who wants full range fidelity in a compact system. Features an 8in. full range high compliance speaker with an output capacity of 20 watts RMS. Frequency response: 30-20,000 c.p.s. Resonant frequency: 30-40 c.p.s. Sensitivity: 97 db/w. Flux density: Over 12,000. Impedance: 16 ohm. Size 14 1/2in. high x 10 1/2in. wide x 8 1/2in. deep.

£14.14.0

As well as this beautifully designed speaker there are two other models MS65. 10 watts RMS at £12.12.0 and MS40 5 watts RMS £8.10.0.

All three speakers are finished in magnificent rosewood and the entire cabinet filled with acoustic damping material.



UD40H CARDIOD DYNAMIC MICROPHONE

Features a pop-proof diaphragm and superior anti-feed-back properties, reduces feedback and room reverberation. O/p: -42 db. Response: 60-12,000 cps; 50K ohm impedance £6.6.



27 other microphones available.

SR165. ALL BAND COMMUNICATION RECEIVER

This entirely new professional type communication receiver features frequency coverage of 535 Kc/s-30 Mc/s for complete general coverage. In particular ham bands are arranged in the same calibration scale, so that the band switching can be accomplished rapidly.

£48.0.0



FOR FULL DETAILS OF THESE AND MANY OTHER ITEMS SEND FOR FREE COMPREHENSIVE CATALOGUE, EAGLE NEWS AND ORDER FORM. ALL ITEMS AVAILABLE POST FREE AND COVERED BY 12 MONTHS' GUARANTEE.

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RELDA RADIO LTD

(Dept. P.W.15) 87 Tottenham Court Road, London, W.1.

TT.144 DYNAMIC TRANSISTOR TESTER

Tests in-circuit or out of circuit. Identifies PNP and NPN types. Indicates electrode open circuits, short circuits and current drain. Complete with instructions.

£4.10.0



TT.145 DE-LUXE TRANSISTOR DIODE TESTER

£9.7.6

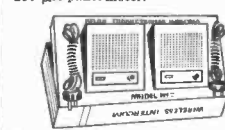
MULTI METERS

T-20A 1,000 o.p.v.	£2.15.6
TK.25 1,000 o.p.v.	£2.15.6
EP.10K 10,000 o.p.v.	£4.17.6
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EP.20K8 20,000 o.p.v.	£6.8.0
EP.30K 30,000 o.p.v.	£7.18.6
EP.30KN 30,000 o.p.v.	£9.0.0
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RF. 40 RF FIELD INDICATOR

Broad tuning covers 1-250 Mc/s in five calibrated bands. Can also be used as frequency checker. Detects undesired radiation or spurious frequencies. RF is measured on an accurate 200 μA panel meter.

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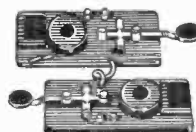
WI-2. TRANSISTORISED WIRELESS INTERCOM

No wires, no installation needed, simply plug them into AC power point and talk. Units have pre-set-to-talk lock switch and on-off volume control. Ideal Intercom or Baby Alarm for home, office, £14.12.0 complete.

DP303. DOOR PHONE INTERCOM

Ultra sensitive transistorized intercom designed so that you may answer the door from within for greater convenience and safety.

£4.12.6 Other intercoms available.



MCK.2. MORSE CODE KIT

Two station morse code kit supplied with instructions, 50ft. of connection wire and morse code charts.

£2.2.0

WIRELESS MICROPHONES

WM909 (as illustrated) Pocket FM Wireless transmitter complete with tie-pin microphone. Transmits clearly up to 100 yds. and is fully tunable over the entire FM band. Simply used with an FM radio or tuner.

£14.0.0

Also available WM808

£21.0.0

Professional stick type FM Wireless Microphone. These cannot be operated in U.K.



FUTURE BROADCASTING PLANS

THE Postmaster General, Mr. Edward Short, has at last presented Parliament with the long overdue White Paper dealing with broadcasting. Although the contents of this Paper (Cmmd. 3167, obtainable from Her Majesty's Stationery Office, price 1s. 6d.) will not affect many readers directly, it is interesting to note the Government's views on broadcasting.

"The Government have under review various major aspects of broadcasting policy," the White Paper states. "First among them was the question of the BBC's finances. Besides this, there were various proposals for the further extension of the broadcasting services; that there should be a fourth television service; that a service of local sound broadcasting should be introduced; and that there should be an extra service of sound broadcasting entirely given over to music . . .

"In reaching the conclusions announced in this review, it has of course been the Government's duty to consider both what purposes the proposals for further extending the broadcasting services should seek to serve, and what organisation would best promote those purposes. The Government have also had to consider to what extent it would be in the national economic interest to allow these extensions. It is not enough that they should be desirable in themselves. The overriding consideration is whether the country can afford them."

FINANCES OF THE BBC

The first thing the White Paper looks at in detail is the finances of the BBC. Reference is made to the fact that the BBC have already started another television service (BBC-2); that they are providing self-contained television services for Scotland and Wales; that they have greatly increased the number of hours of broadcasting on the Third Programme and in Network Three; that more time has been allocated to adult education on television; that a colour service is to start on BBC-2; and that the BBC are developing stereophonic broadcasts in the v.h.f. transmission of the Third Programme.

To carry out these improvements, it is recorded in the review that the BBC now receive the full proceeds of the £5 combined sound and television licence and of the sound only licence, which now costs £1 5s. In mentioning that the Government have completed their enquiry into the BBC's finances, the review continues, "Practically speaking, the only possible ways of providing finance for the BBC are: by direct Government subvention, by the sale of advertising time in the Corporation's services, or by the licence fee system.

"A Government subvention would be liable to expose the Corporation to financial control in such detail as would prove incompatible with the BBC's independence. The money would, of course, have to be found from general taxation.

"Under their Licence and Agreement (Cmmd. 2236) the BBC are not allowed to broadcast commercial advertisements without having sought and obtained the Postmaster General's permission. Because of the probable long-term effect on the

character of their services, the BBC have never sought this permission. The BBC have reported that, by making special economies they will—on certain assumptions—be able to do so until 1968 when they would need an increase of £1.

"In order to make these special economies, the BBC will restrict activities which they have hitherto considered well justified but which, against the background of continued financial stringency, can be sacrificed to the overriding national need for economy. The Corporation have conducted a searching examination of all their ancillary services and operations, with a view to making the maximum retrenchment in detail. By itself, however, this will not suffice. Some larger scale projects, desirable in themselves, for enlarging and modernising the Corporation's programme production capacity, will be foregone for the present. But the BBC will be able to maintain their present level of programme output and to proceed with extensions and developments of their services already authorised or about to be authorised.

"One assumption on which the BBC have based their undertaking to manage without an immediate increase in the licence fee is that counter measures against licence evasion will prove effective. It has been reliably estimated that, of the gross revenue amounting to some £80M, payable in a full year, some £10M is lost through evasion. This is far too much to be tolerated. Honest viewers and listeners are, in effect, paying for the dishonesty of the evaders.

"Steps have already been taken by the Postmaster General to tighten up counter evasion measures, but, by themselves, they will not suffice. Further measures are required. The Government are reviewing the penalties which Magistrates may impose on convicted evaders, and are discussing with the associations representing retailers and the rental companies ways in which dealers could help in the enforcement of the licence system. The Government will announce their proposals as soon as these discussions have been completed; and legislation will be brought before Parliament in the current session. The Government recognise the effort which the Corporation are making . . . and are satisfied that no increase in the fee will be required before 1968."

A FOURTH TELEVISION SERVICE

Explaining the Government's decision not to alter the present number of television services, the White Paper suggests that there is room for only one more television service in the next ten years or so, since two of the allocations in the u.h.f. bands will be needed for the changeover of the two present 405-line television services to 625 lines. The review continues, "When the Television Act 1963 was before Parliament, the Government of the day stated their intention to allocate this service [the vacant channel in the u.h.f. bands] to a second programme of independent television during 1965 unless the financial or other obstacles were insurmountable. However it were allocated, a fourth

television service would make large demands on resources. The three main services of television already provide a large volume of programmes of various kinds and the Government do not consider that another television service can be afforded a high place in the order of national priorities.

"Moreover, before deploying the last frequencies certainly available for television for many years to come, the Government would need to be satisfied that the case for committing them to any new service had been fully established. The Government have decided that no allocation of frequencies to a fourth television service will be authorised for the next three years at any rate.

"Besides the claim of independent television to the frequencies required for a fourth television service network, there is also the possibility that the network would be required for a specialised service of educational television, forming part of the structure of the Open University. The decision to reserve the fourth network would enable the requirements of the Open University to be appraised more closely in the light of practical experience."

COLOUR TELEVISION

The White Paper restates the Government's intentions to start a colour service on BBC-2 during 1967. "It is the Government's view that the cost of colour programmes, which are likely at the outset to be available only to a small minority of viewers because of the cost of the receivers, should not fall upon viewers in general. Accordingly a supplementary licence fee of £5 will be required from those equipped to receive colour programmes."

POPULAR MUSIC PROGRAMME

Introducing a new popular music programme, the White Paper claims the fact that there is a ready-made audience for continuous popular entertainment is not new. "What is new is that, by appropriating wavelengths allotted to other countries and by largely disregarding copyright in gramophone records, the pirate stations have been able to exploit the fact. Legislation to end the activities of these stations has been introduced. The Government recognise that there is, however, a need for a new service devoted to the provision of a continuous popular music programme. The question is how the need can legitimately be met: legitimately in that it would be broadcast only on wavelengths available under international agreement to this country, and in that it would respect the rights of performers, composers and others in the material broadcast.

"It is necessary to weigh also any implications for present services to the listening public generally; and, in particular, whether the need to provide frequencies on which to transmit a popular music programme would involve an unacceptable curtailment of the present services of sound broadcasting.

"Because a popular music programme does not need to differ from place to place, the most economical way of broadcasting it will be by relatively few stations, each with a large transmission area. The characteristics of wavelengths in the

medium wave band suit them to this objective. But, as the medium wavelengths available to this country are already intensively used, room for an extra service can only be found by redeploying them. There is not room enough in them for all the present sound radio services and for a popular music programme with anything like sufficient coverage.

"The Government have therefore discussed with the BBC what rearrangement of their services they would need to make in order to find room for the additional service. In the past, the Corporation have considered that they could best serve their various audiences by providing the Light Programme on both long and medium wavelengths, in order to attain the widest possible coverage at an acceptable standard of reception. Now, however, that the long wave transmission of the Light Programme is reinforced by the BBC's v.h.f. transmissions, which have themselves attained virtually complete population coverage, and now that portable v.h.f. transistor sets, at reasonable cost, are available, the Corporation feel free to devote the medium wave channel of 247 metres to a popular music programme.

"The BBC have informed the Government that, on weekdays, the programme would broadcast popular music continuously from 5.30 a.m. to 7.30 p.m. and again from 10 p.m. to 2 a.m., and on Sundays, for most of the day's broadcasting. Over six hours of music each day would be played from gramophone records. The remainder would be either live broadcasts or BBC recordings of popular music especially made for the service. The programme would provide each day a blend of output to meet the needs of the audience for popular music.

"In the Government's view, the provision of a popular music programme on the medium wavelength, 247 metres, would, on an overall appraisal, provide an extension of choice to the listener. They will authorise the BBC to provide the new service at an early date."

LOCAL SOUND RADIO

"No general service of local sound broadcasting, which would be available during the hours of darkness as well as in daylight, can be provided only on medium wavelengths allotted to the United Kingdom," the White Paper states. "The only possibility for such a service lies in v.h.f. In practical terms, some 150 towns and cities could be served. Of the proposals put to the Government for the provision of a service, some advocate that it should be provided by commercial companies, others that it should be provided by the BBC.

"In a worthwhile service of broadcasting a local station should, the Pilkington Committee concluded, transmit for a sufficient part of the broadcasting day (material) of particular interest to the community served by that station rather than to other localities. In their White Paper of July 1962 (Cmmd. 1770) the Conservative administration agreed that the justification for local sound broadcasting would be the provision of a service genuinely 'local' in character. The Government share this view.

—continued on page 854

PSE QSL

Will You Please QSL . . .

MANY newcomers must have looked at John Guttridge's page and asked themselves, "How do they pick up so-and-so, when I only hear the same stations over and over again?" This article is not intended to teach old-hands new tricks or newcomers old tricks but is simply an account of one man's methods of receiving, and obtaining verification from some of the less common stations heard on the shortwave broadcasting bands.

First of all, it is necessary to have the kind of receiver and aerial which give one a sporting chance of receiving the less common station. The depth of one's pocket and personal choice influence the selection, as does the question whether one should build or buy. What is important is that the receiver should have adequate selectivity and sensitivity to enable the weak signal to be heard through the strident blasts of the major broadcasters on both sides of the Iron Curtain, and also it should have reasonably accurate tuning calibration.

Secondly, the idea should be laid to rest that one person hears all the DX that is going whilst another just does not have the luck. The real answer is that the "lucky" man is usually the one who sets a trap for the DX and then waits for his quarry to appear in it. This is the purpose of this article—to suggest a way in which the trap may be baited, without moving from the fireside, and even without the receiver being switched on. If the "shack" is in an uncomfortable location it makes a pleasant way of pursuing the hobby when the fireside, slippers and background tele are more inviting.

Another myth is that one must speak—or at least understand—a number of languages. This just is not so. What is important is that one should be able to recognise a number of languages, and this ability comes with practice. Very soon one finds that one has a working knowledge of the words which make up station identifications in a number of languages, and as this knowledge is gained it becomes easier to identify stations using languages other than English.

So far as reporting to DX stations is concerned, English is almost universally acceptable, and only a small number of stations ask for reports in other languages. Several short-wave clubs issue QSL report forms in a number of languages, and these help to overcome the language difficulty.

The first 20 or 30 overseas stations can be logged and reported without any difficulty—even if the

A QSL card is a written confirmation of either a contact with, or the reception of, a Radio Station. On the Medium and Short Wave bands, broadcasting stations will often send their QSL cards on receipt of a report. This also applies to "Ham" Stations. However the reports received must be of some use to the station concerned, merely to inform briefly that "I heard you Thursday at 0745 hrs" is virtually useless. The following article is split into two sections. Alan Thompson describes some techniques for the 'commercial' enthusiasts, and David Gibson, G3JDG writes from the amateur's point of view.

receiver and aerial fall far short of the ideal. As the QSL cards for these begin to come in, you will begin to notice some significant—and surprising—gaps in your list. The answer is likely to be that they are countries—not necessarily difficult to receive in themselves—which either do not use English, use low-powered transmitters or only broadcast for a short time each day. It is now that the fireside work begins and perhaps an actual example of the writer's method will best illustrate what is involved.

An essential tool is the "World Radio TV Handbook". This is published in Denmark annually, but is written throughout in English. It can be obtained through all booksellers, but any good reference library should have a copy. The Handbook lists all the radio stations of the world and gives details of their programme schedules and frequencies.

Another invaluable publication is the "Kurzwellensender Frequenzliste" which is issued free by Sender Freies Berlin two or three times a year. This list is in German—with English notes—and gives, in frequency order, brief transmission details of the main radio stations heard in Europe (excluding Radio Moscow, Radio Peking and Radio Free Europe). Armed with one, or preferably both, of these publications one can settle down and set the "trap".

Let us say that one is anxious to hear Saudi Arabia. A glance at the WRTH will show that the foreign service is carried in a group of Middle Eastern and Indian languages and is clearly not destined for the U.K. Since transmitters are normally beamed to the area in which reception is intended such services are not likely—as a general rule—to be heard or heard well in a totally different direction. (This is a dangerous generalisation, but the exceptions are outside the scope of this article).

There is, however, a Saudi Arabian General Service in Arabic which is clearly intended for the Middle East and North Africa—an area much nearer the U.K. Both the WRTH and the "Frequenzliste" publish tables showing the broadcast bands which are most likely to give good reception in a particular area at any time, and these show that the Middle East is likely to be best heard in the U.K. on the 9Mc/s band in the evening.

Reference back to the WRTH shows that Saudi Arabia uses two frequencies in the 9Mc/s

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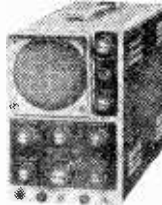
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50μF ..	6 volt	10μF ..	25 volt
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40μF ..	6.4 volt	3.2μF ..	64 volt

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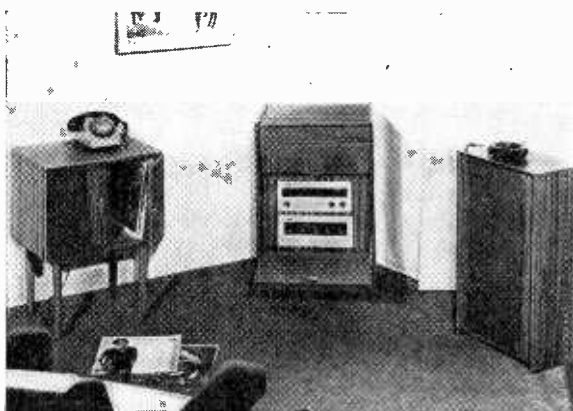
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band in the evening—9,670 and 9,720kc/s. The WRTH will also show that the Swiss Broadcasting Service utilises 9,665kc/s for its evening service to the U.K. from 1845 to 2015 G.M.T. in English.

This transmission can hardly be missed and it then becomes a question of finding the Swiss programme, waiting for the close down and then listening for a station using Arabic as its main language on a channel only 5kc/s away. With the bandwidth of the average receiver, as S.B.C. leaves the air so Jeddah will (one hopes) be heard, and the tuning knob will only need to be moved a fraction to bring it in at maximum strength.

It should be mentioned that S.B.C. uses the same channel again at 2030 G.M.T. for its Spanish and Portuguese service, so one must look snappy and get the pencil recording details of the Saudi Arabian programme if one is to submit a report and ask for a QSL.

The instance mentioned is an actual case history, and the same method has been used on numerous occasions to locate the less familiar countries. At the time this article was written the frequencies mentioned were in use by the stations concerned but they may, of course, be changed when this article appears.

A "scientific approach often pays off, but luck can also play a part. The author, while on holiday, was determined to find four elusive countries. The approved method produced not a flicker of the "S"-meter, not a sound. A fortnight later, idly tuning the bands, not looking for anything in particular, three of the countries concerned were logged and the fourth followed, on a similar occasion, a week later. The best laid schemes of DX listeners often fail to trap the quarry, but when they do succeed (or even if it is just luck) it is nice to write "Will you please QSL?"

Finally a word regarding reception reports. Most of the world's broadcasting stations require a minimum of 10 minutes programme details before they will verify a report, and some require longer. Essential information in a report is:

- (a) the date and time (in G.M.T.).
- (b) the frequency or wavelength of the broadcast.
- (c) details of the receiver and aerial used and
- (d) a report in the SINPO code, or else a general indication of the strength of the signal, the interference and noise level (identifying the source of interference, if possible) together with an estimate of the overall quality of reception.

In addition brief programme details should be given together with the times of the various items—for example:

- 1955 G.M.T.: Station identification in French and News (give items if possible).
- 2000 G.M.T.: Time signal (pips) and station identification.
- 2001 G.M.T.: Announcement—Frank Sinatra song (give titles of musical items if possible).

Before sending off a report—indeed, before even writing it, if only to save the cost of Air letters—it is essential to consider whether you have given all the information one can to enable the station to be certain that you have received their programme. You must provide sufficient definite data to permit a check against the station log.

Making SWL Reports . . .

OVER the past years, the writer has received a large number of s.w.l. reports. It is an unhappy fact that out of every hundred received only about two are of any real use and warrant the sending of a QSL card. This startling figure (2%) is borne out in conversations with other amateurs who also appear to be inundated with useless scraps of paper.

If a station receives a useful report from an s.w.l., it is highly probable that a QSL card will be sent. The following notes are intended as a general guide for those s.w.l.'s. who don't get replies, or for those just starting to listen on the amateur bands and short-waves.

1. First, the report should be legible. About 10% fail on this count. Remember that amateurs in other countries may not speak or read fluent English, so legibility is of paramount importance.

2. The time should be specified in G.M.T. using the 24-hour system and the letters G.M.T. written after to avoid any misunderstanding.

3. Your QTH or locality. If you live in a small village, then a reference to the nearest large town should be included i.e. Harpenden—6 miles N.W. of St. Albans. Also if possible the height a.s.l.

4. Equipment in use. Don't just put "superhet" for the receiver. It might be a simple 3 valve job or a 16 valve triple-conversion unit.

5. Aerials are very important. The type of aerial, and the length in the case of a longwire should be noted. Also, most important, the direction it points, that is looking straight down the wire. The height is also a useful item to put down, too. An example of this, for a longwire might be—68ft. end fed running N.E./S.W., 30ft. high. Again if a dipole is used this fires broadside to the direction of the wire, i.e., 90° to it and this should be remembered when giving a report.

6. The following are the standard items and are usually the only things put down. Those s.w.l.'s. who only include these items and nothing else can be congratulated on producing a near useless report in most cases. By themselves they aren't much use, but with all the other information referred to they are vital.

- (a) RST. Readability, Signal strength, and (in the case of c.w.) Tone.
- (b) QRM. Interference.
- (c) QRN. Atmospherics.
- (d) QSB. Fading.
- (e) QRG Frequency.

Relevant reports on other signals received during the same period are very useful too, especially from the same area if the station happens to be either very strong, very weak, or perhaps fading compared with the other signals on the band.

7. The frequency should be given accurately. If possible a simple crystal frequency standard should be fitted to the station and the receiver dial calibrated against it. At each session of listening, after the receiver has warmed up, the dial should be checked and adjusted to ensure that the receiver dial reads accurately.

8. S-Meter readings should be qualified. Many S-meters are included in the receiver in such a

way that they are affected by different settings of the various controls. Perhaps the best way is to set the controls to a particular setting and feed in a signal of known strength, i.e. so many microvolts and mark this on the meter as say S9 plus 40dB.

Or perhaps a signal with an S9 carrier could be used to make some form of calibration. This reference, however the meter is set up, should be put in the report. The signal level of the other station in the QSO together with callsign should also be included, if it can be heard.

The above notes are not rigid. However a report based on these would stand a very much greater chance of a QSL than the more usual "Heard you 5 and 7 here on a superhet, please QSL".

An example report is given below in order to show the general pattern. Compare this with the classic "Heard you here 5 and 7" etc.

M. Jenkins, 38 Malsen Road, Menton, Bedfordshire, England. Six miles S.W. Bedford. Latitude Longitude Approximately 300 ft. a.s.l.

Equipment.

Seven valve single conversion superhet. One r.f., f.c., two i.f., two a.f., b.f.o. Headphone reception.

Antenna.

Half wave dipole co-ax fed plus balun, 40ft. high running N.E./S.W.

Date/Time/Frequency.

Monday 28th March, 1966. 0022 G.M.T. 14155 kc/s.

Signal Report.

W6ZZZ/P. Your a.m. signals RST 58. In QSO with—AP2XXX. His a.m. signals RST 55.

QRN/QRN/QSB.

QRN: Nil. QRM: Slight/moderate from local G 5 kc/s h.f. QSB: Slight from 57/58.

S-Meter.

S-Meter calibration, 1 μ V in reads S9.

Remarks.

Also heard W6XXX/M at 5 and 5 but no QSB. W1/W2's received 0001-0130 all average 5 and 7, no QSB. Heard you on March 20th, 1966 in QSO with ZL9XXX when you were 559, conditions about the same as above.

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FUTURE BROADCASTING PLANS

—continued from page 849

"They consider that this objective would prove incompatible with the commercial objectives of companies engaging in local sound broadcasting; and that, in result, the former would be likely to suffer. While the Government do not, in principle, rule out advertising as a means of financing broadcasting stations in public ownership, it is in their view of first importance to maintain public service principles in the further development of the broadcasting services; and accordingly they reject the view that a service of local sound radio should be provided by commercial companies.

"Evidence of the expertise and professional enthusiasm which the BBC could bring to local sound broadcasting is to be found in the 'trial programmes' they have prepared. They lend much support to the view that, properly organised, local radio would provide a valuable service to the local community; and, by giving a new means of expression to its particular interest and aspirations, serve to reinforce its distinctive character and sense of identity.

"The Government believe that local radio organised and produced as a public service, would be most likely to realise those social purposes to the full; and would at its best prove an integrating and educative force in the life of the local community. But it is, they consider, important to establish how far the claim for a local station is likely to rest on genuinely local initiative having these purposes as its objectives; and how far local sources of finances are likely to be available to meet the expenditure required by such an initiative. In sum, not only is it important to establish that a local service of high quality could be maintained, month-in, month-out. There is also the question whether it would command enough support, including financial support, to justify the development of a service on a widespread and permanent footing . . .

"In considering how an experiment should be conducted, the Government have had regard not only to the need to avoid an excessive diversion of resources for the purpose but also the undesirability of entering into a commitment at this stage to any permanent form of constitution and organisation. They conclude that these various requirements will best be met if the experiment is conducted by the BBC as a venture in co-operation with local interests; and they have therefore decided to authorise the BBC to go ahead with a nine-station project in v.h.f. The stations would offer a full-scale local service. They would come into operation after about a year; and after a year or so of operation, should have provided the information on which to found the final solution . . .

"The Government reserve until the conclusion of the experiment any decision on the question whether a general and permanent service should be authorised, and, if so, how it should be constituted, organised and by whom provided, as well as how it should be financed. The decision that the BBC should conduct the experiment implies no commitment that the Corporation should provide a permanent service; if it were decided to authorise one."



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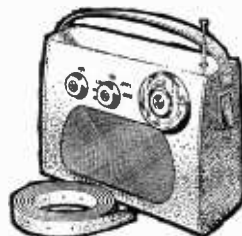
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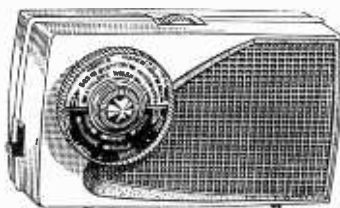
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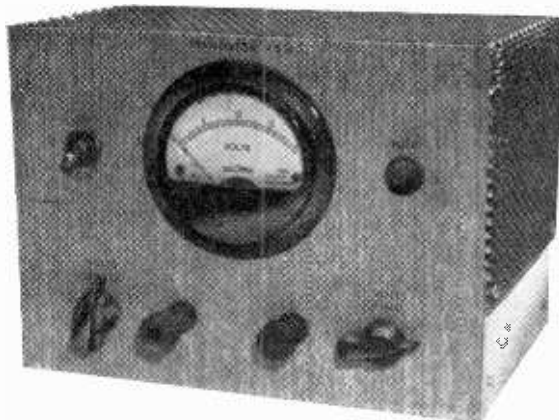
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To be really useful, a variable voltage power supply unit should have an output impedance, or effective internal resistance, that is comparable to that of a conventional battery, and should be reasonably well stabilised against changes in mains supply voltage, etc. The unit that forms the basis of this article has been designed with these points in mind.

Simplest form

The simplest way of obtaining a variable voltage power supply is to wire a variable resistor across a normal power supply, and take the output from across the slider, as shown in Fig. 1a. This, however, is rather wasteful of power, gives a high effective internal resistance, and does not guard against changes in the supply voltage. An improvement over this basic system is shown in Fig. 1b. Here Tr1 is wired as an emitter follower, with its base connected to the slider of VR1, and the output voltage is taken from across R1 in the emitter line of Tr1. The emitter voltage of this transistor "follows" very closely the voltage on the base. Taking very little power from VR1, the transistor presents a high input impedance while at the same time giving a low output impedance, and thus presenting a low effective internal resistance.

A further improvement which is shown in Fig. 1c, increases the effective gain of the transistor. Here, Tr1 and Tr2 are connected as a Darlington (or Super-Alpha) pair, the emitter current of one transistor feeding directly into the base of the other, with a current gain equal to the product of the individual gains of Tr1 and Tr2.

For example, if both transistors have current gains of 50, the effective current gain of the combination "transistor" will be 2,500 and the output impedance of the circuit will be correspondingly low.

Both of these transistor circuits give a variable voltage output with little power wastage and have reasonably low effective internal resistance, but neither circuit is stabilised against changes in supply voltage. This problem can be overcome by modifying the circuit as shown in Fig. 1d. Here, the voltage that is used to feed VR1 and the base of Tr1, is stabilised by the Zener diode, D1, the actual supply that is connected across the transistor circuit is not. However, the output voltage is approximately the same value as that at the slider of VR1 and is thus stabilised against changes in the mains voltage. This circuit (shown in Fig. 1d) is very useful, but its power handling requirements are limited by the output transistor, Tr2. If the unit is to give output voltages up to 18 volts, it is necessary to use an unstabilised input supply of at least 22 volts. If an output of 6 volts is required, 16 volts must be dropped across the output transistor. This means Tr2 will have to dissipate 16 watts with a 1A output current.

Finalised circuit

These problems are overcome in the circuit of the finished power supply unit, as shown in Fig. 2. Here, the output voltage is varied in three ranges, and the unstabilised input voltage is varied to suit the range in use, thus ensuring that a minimum of power is lost across the output transistor Tr3. A complete description of the circuit follows:

The mains supply is connected to transformer T1 via switch S1. Switch S2a selects either the 5, 11, or

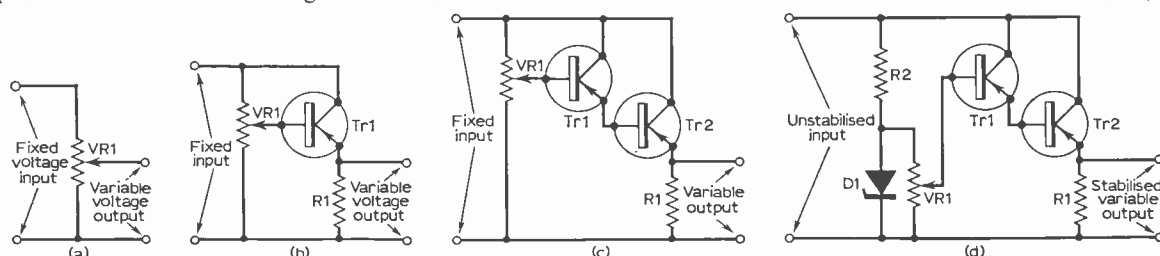


Fig. 1: (a) Basic circuit, (b) improvement by the addition of an emitter follower, (c) replaced by super-alpha pair emitter follower, (d) the Zener diode stabilises the circuit against changes in the supply voltage.

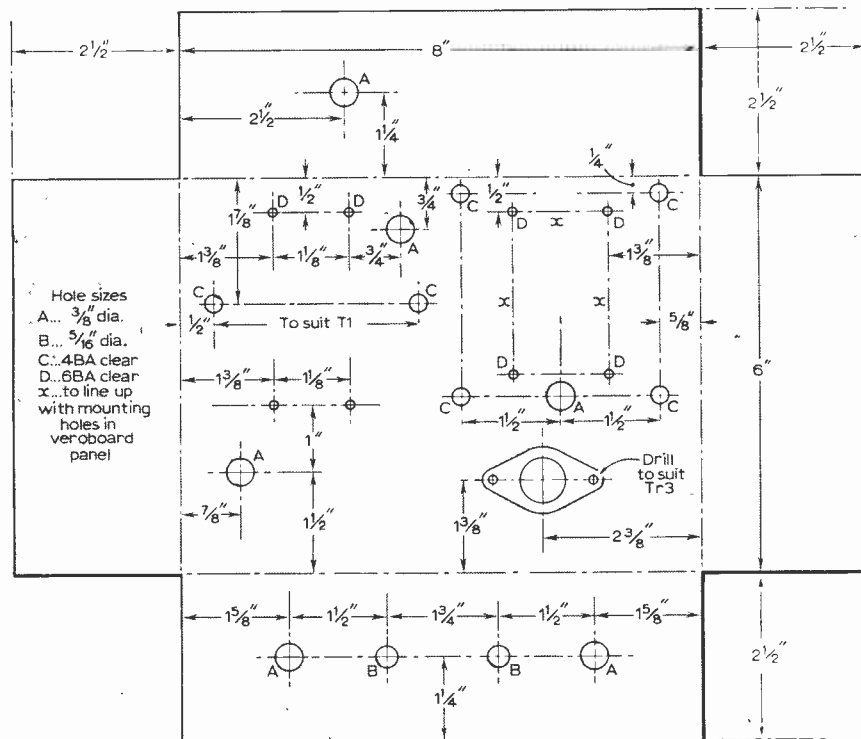
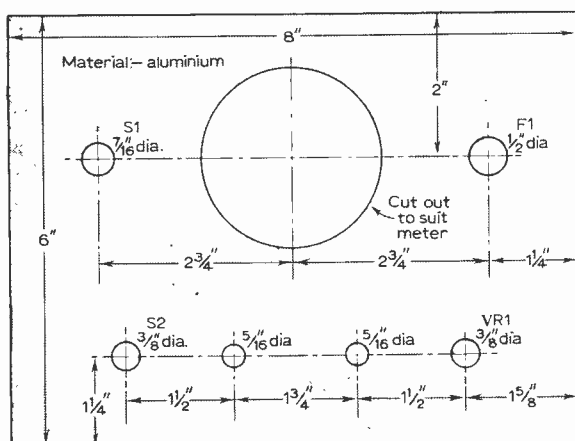


Fig. 3 (left): The main chassis dimensions. Note that Tr3 is insulated from the chassis by the use of insulated washer and spacers.

Fig. 4 (bottom left): The front panel dimensions.



An additional line is taken from the 17V tap on the secondary of T1 to D5, and the resulting rectified a.c. is smoothed by C3 and fed to the R2-D6-D7 network, to give a final stabilised reference voltage across the Zener diodes. This stabilised voltage is applied across VR1, making a variable stabilised output available at the slider; the available voltage swing of VR1 is limited on each range by the R4—R8 series resistors.

The voltage from the slider of VR1 is fed to the base of Tr1, which is wired as an emitter follower with emitter load R3. The voltage at Tr1 emitter is fed to the Super-Alpha pair, Tr2—Tr3;



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"C" CORE POTTED OUTPUT TRANSFORMER. Made by the famous "Farneco" company these are the best money can buy, we can offer a bargain 15 watt rating, centre tapped primary with secondary for 3 ohm speaker. Potted and in black stove enamelled case for upright mounting these will make your amplifier or rig look perfect at only 12/6 plus 3/6 carriage and insurance—hurry for these.

1 MEG. POTS. By Erie, standard 1in. spindle, 1in. long, 7d. each in doz. lots, otherwise 10d.

1 MEG. POTS WITH D.P. SWITCH. Again by Erie, Standard size spindle 1in. length, 10d. each in doz. lots, otherwise 1/3 each.

MINIATURE PICK-UP. For pop records—this is made by Cosmocond—has a crystal cartridge and long play saddle stylus—offered for less than the wholesale price of the stylus only—namely 3/6 each or 38/- doz.

MINIATURE RELAYS with removable covers. Very sensitive (will close on only 20 mA). Coil resistance 10,000 ohms—contacts are three sets; triple set for change over pair to open circuit and the third pair to close circuit—perfect order unused (removed from equipment), 7/6 each.

CAR CHARGER OUTFIT 1 amp. transformer and selenium full wave rectifier only 27/6 plus 3/6 post.

FLUORESCENT LIGHT KITS. Comprising choke, lampholders, starter and two chrome tube clips. 20 watt 19/6, 40 watt 11/6, Super Silent 40 watt 17/6, 80 watt 17/6. All 4/6 P. & P.

SEMI-CONDUCTOR BARGAINS

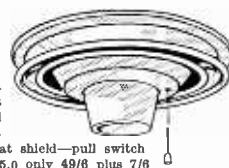
Type No.	Price	Type No.	Price	Type No.	Price
2N1727	15/-	MAT101	8/6	OC71	4/-
2N1728	10/-	MAT120	7/6	OC72	5/-
2N1742	25/-	MAT121	8/6	OC73	6/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	5/-	OC77	7/-
AC107	9/-	OA47	3/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
ACV17	8/6	OA79	2/6	OC81	5/-
ACV18	5/6	OA81	2/6	OC81D	5/-
ACV19	6/6	OA85	3/-	OC82	5/-
ACV20	5/6	OA90	2/6	OC83	5/-
ACV21	6/6	OA91	2/6	OC84	6/-
ACV22	4/6	OA200	3/3	OC139	8/6
AF114	7/-	OA202	4/3	OC140	12/6
AF115	6/6	OC22	10/-	OC170	5/-
AF116	7/-	OC23	17/6	OC171	6/-
AF117	5/-	OC24	22/6	OC200	9/-
AF118	12/6	OC26	7/6	OC201	12/6
AF139	17/6	OC28	15/-	OC202	13/6
AF186	19/6	OC29	17/6	OC203	13/6
AFZ12	15/-	OC35	12/6	OC271	19/6
AS221	15/-	OC36	15/-	ORP12	8/6
BC107	14/6	OC42	6/6	ORP60	5/-
BY100	5/6	OC44	5/-	SB078	6/6
BY213	7/6	OC45	4/-	SB805	8/6
MAT100	7/6	OC70	4/-	SB251	10/-

100v. S.C.B.'s THYRISTORS. 1 amp. 6/6, 3 amp. 7/6, 12 amp. 15/-, 400v. 1 amp. 15/-, 3 amp. 17/6, 5 amp. 22/6, 25 amp. £3.50. 1 amp. 6/6, 3 amp. 7/6, 10 amp. 10/-, 25 amp. 20/-.

Where postage is not definitely stated as an extra then orders over £3 are post free. Below £3 add 2/6.

HEAT AND LIGHT UNIT

Bring luxury to your bathroom—have comforting heat where you now only have light—all the parts to build a full size (16in. diameter) model are now available—you will build it in an hour—12in. 750 watt circular silica glass encased element—opal bowl for up to 100 watt lamp—non-rust spun reflector—white enamelled base heat shield—pull switch magnificent unit as sold normally at £45.0 only 49/6 plus 7/6 carr. and insurance.

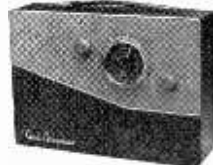


SUPERTONE G.C.V.

Saves you work—

It's partly built like its predecessors this latest Companion has full fi performance—such as only a good wooden cabinet and biflux speaker can give, and due to its being partly built you will have it going in an evening. Note these features:

- All Mullard Transistors including 3 x AF117.
- Two-tone Cabinet, size 11 x 8 x 3in.
- All circuit requirements—Push-pull output—A.V.C. and feedback etc.
- Printed circuit board all wired up connections, e.g. to Volume control—W.C. Switch and Tuning Condenser.
- Pre-aligned IF stages complete with full instructions. Price only £3.19.6 plus 6/6 post and insurance.



THIS MONTH'S SNIP

3M SCOTCH TAPE

brand new, unused and guaranteed perfect and not second in any way—a connoisseur's tape on normal spools.

Standard Play 5in.	600ft.	9/-	Long play 5in.	900ft.	11/6
5in.	900ft.	11/6	5in.	1,200ft.	16/-
7in.	1,200ft.	16/-	7in.	1,800ft.	23/-

£3 post free otherwise add 2/- post and ins.

INFRA-RED HEATERS

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watts element, all parts, metal casing as illustrated. £1/6, plus 3/6 post and insurance. Full switch 3/- extra.



F.M. TUNER

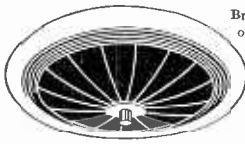
of exceptional quality, giving really fantastic results with virtually no noise. Suitable for mains or battery operation. 6 transistors—three IF stages—double tuned discriminator. Complete, new, and built up all ready to work on chassis. Size 6in. x 4in. x 2in. with tuning scale and slow motion drive. A £12.12 tuner for only £3.10.0.



NOW INSTANT START

CIRCULAR FLUORESCENT

Brings sunshine into your home. 150 watts of light but uses only 40 w. Beautiful fittings with glass, non-plastic centre, fluorescent tube and choke control. Made by Philips. Regular price £4.15.0.



Special budget price 65/-, plus 8/6 c. and ins. Please state colour of glass centre, white, pink, blue, red, black, yellow or cream. Also whether

plug into lamp holder or ceiling mounting model. 80 watt model 99/6. 10/- carr. & ins.



FINE RECORD PLAYERS ARE GARRARDS

and because they have been making record players for so long, GARRARD are your best choice—big range always in stock.

2000	£6 9 6	LAB80	£25 0 0
3000	£7 19 6	SRP12	£3 9 0
AT60	£11 11 0	Complete with service sheet and template.	
SP25	£10 9 0		

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6 v. 9 v. 12 volts for up to 500 mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer-rectifier, smoothing and load resistor, 5,000 and 500 mfd. condensers, Zener diode and instructions. Realign at only 14/6, plus 3/6 post.

BATTERY CHARGER — FREE

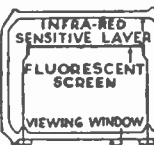
9v. Nickel Cadmium Battery type PP3 (its all popular pocket transistors.) Can be recharged 800 times. Price with battery charger, only 37/6, p. & i. 3/-. Chargeable replacements also in stock for U7 12/6; U11 23/-; U2 22/-.

See in the Dark INFRA-RED BINOCULARS

These infra-red from a high voltage source will enable objects to be seen in the dark, providing the objects are in the rays of an infra-red beam. Each eye tube contains a complete optical lens system as well as the infra-red cell. These optical systems can be used as lenses for T.V. cameras—light cells, etc. (details supplied). The binoculars form part of the Army night driving (Tabby) equipment. They are unused and believed to be in good working order, but sold without a guarantee. Price £2.17.6, plus 10/- carr. and ins. Handbook 2/6.



SNIPSCOPE



Famous war-time "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver osmium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it.

A golden opportunity for some interesting experiments. 5/- each, post 2/-. Data will be supplied with cells, if requested.

TUBULAR HEATERS

New and unused made by G.E.C. rated at 60 watts per ft.—these are ideal in airing cupboards, bedrooms, offices, stores, greenhouses, etc., curtains or papers can touch them without fear of scorching or fire. Supplied complete with fixing brackets and available in the following sizes. Prices which are about 1/2 of list price includes carriage by B.R.S. 5ft. 50/-; 10ft. 36/-; 12ft. 42/-; 14ft. 48/-; 16ft. 54/-; 18ft. 60/-; 20ft. 66/-; 22ft. 72/-; 24ft. 78/-; 26ft. 84/-; 28ft. 90/-; 30ft. 96/-; 32ft. 102/-; 34ft. 108/-; 36ft. 114/-; 38ft. 120/-; 40ft. 126/-; 42ft. 132/-; 44ft. 138/-; 46ft. 144/-; 48ft. 150/-; 50ft. 156/-; 52ft. 162/-; 54ft. 168/-; 56ft. 174/-; 58ft. 180/-; 60ft. 186/-; 62ft. 192/-; 64ft. 198/-; 66ft. 204/-; 68ft. 210/-; 70ft. 216/-; 72ft. 222/-; 74ft. 228/-; 76ft. 234/-; 78ft. 240/-; 80ft. 246/-; 82ft. 252/-; 84ft. 258/-; 86ft. 264/-; 88ft. 270/-; 90ft. 276/-; 92ft. 282/-; 94ft. 288/-; 96ft. 294/-; 98ft. 300/-; 100ft. 306/-; 102ft. 312/-; 104ft. 318/-; 106ft. 324/-; 108ft. 330/-; 110ft. 336/-; 112ft. 342/-; 114ft. 348/-; 116ft. 354/-; 118ft. 360/-; 120ft. 366/-; 122ft. 372/-; 124ft. 378/-; 126ft. 384/-; 128ft. 390/-; 130ft. 396/-; 132ft. 402/-; 134ft. 408/-; 136ft. 414/-; 138ft. 420/-; 140ft. 426/-; 142ft. 432/-; 144ft. 438/-; 146ft. 444/-; 148ft. 450/-; 150ft. 456/-; 152ft. 462/-; 154ft. 468/-; 156ft. 474/-; 158ft. 480/-; 160ft. 486/-; 162ft. 492/-; 164ft. 498/-; 166ft. 504/-; 168ft. 510/-; 170ft. 516/-; 172ft. 522/-; 174ft. 528/-; 176ft. 534/-; 178ft. 540/-; 180ft. 546/-; 182ft. 552/-; 184ft. 558/-; 186ft. 564/-; 188ft. 570/-; 190ft. 576/-; 192ft. 582/-; 194ft. 588/-; 196ft. 594/-; 198ft. 600/-; 200ft. 606/-; 202ft. 612/-; 204ft. 618/-; 206ft. 624/-; 208ft. 630/-; 210ft. 636/-; 212ft. 642/-; 214ft. 648/-; 216ft. 654/-; 218ft. 660/-; 220ft. 666/-; 222ft. 672/-; 224ft. 678/-; 226ft. 684/-; 228ft. 690/-; 230ft. 696/-; 232ft. 702/-; 234ft. 708/-; 236ft. 714/-; 238ft. 720/-; 240ft. 726/-; 242ft. 732/-; 244ft. 738/-; 246ft. 744/-; 248ft. 750/-; 250ft. 756/-; 252ft. 762/-; 254ft. 768/-; 256ft. 774/-; 258ft. 780/-; 260ft. 786/-; 262ft. 792/-; 264ft. 798/-; 266ft. 804/-; 268ft. 810/-; 270ft. 816/-; 272ft. 822/-; 274ft. 828/-; 276ft. 834/-; 278ft. 840/-; 280ft. 846/-; 282ft. 852/-; 284ft. 858/-; 286ft. 864/-; 288ft. 870/-; 290ft. 876/-; 292ft. 882/-; 294ft. 888/-; 296ft. 894/-; 298ft. 900/-; 300ft. 906/-; 302ft. 912/-; 304ft. 918/-; 306ft. 924/-; 308ft. 930/-; 310ft. 936/-; 312ft. 942/-; 314ft. 948/-; 316ft. 954/-; 318ft. 960/-; 320ft. 966/-; 322ft. 972/-; 324ft. 978/-; 326ft. 984/-; 328ft. 990/-; 330ft. 996/-; 332ft. 1002/-; 334ft. 1008/-; 336ft. 1014/-; 338ft. 1020/-; 340ft. 1026/-; 342ft. 1032/-; 344ft. 1038/-; 346ft. 1044/-; 348ft. 1050/-; 350ft. 1056/-; 352ft. 1062/-; 354ft. 1068/-; 356ft. 1074/-; 358ft. 1080/-; 360ft. 1086/-; 362ft. 1092/-; 364ft. 1098/-; 366ft. 1104/-; 368ft. 1110/-; 370ft. 1116/-; 372ft. 1122/-; 374ft. 1128/-; 376ft. 1134/-; 378ft. 1140/-; 380ft. 1146/-; 382ft. 1152/-; 384ft. 1158/-; 386ft. 1164/-; 388ft. 1170/-; 390ft. 1176/-; 392ft. 1182/-; 394ft. 1188/-; 396ft. 1194/-; 398ft. 1200/-; 400ft. 1206/-; 402ft. 1212/-; 404ft. 1218/-; 406ft. 1224/-; 408ft. 1230/-; 410ft. 1236/-; 412ft. 1242/-; 414ft. 1248/-; 416ft. 1254/-; 418ft. 1260/-; 420ft. 1266/-; 422ft. 1272/-; 424ft. 1278/-; 426ft. 1284/-; 428ft. 1290/-; 430ft. 1296/-; 432ft. 1302/-; 434ft. 1308/-; 436ft. 1314/-; 438ft. 1320/-; 440ft. 1326/-; 442ft. 1332/-; 444ft. 1338/-; 446ft. 1344/-; 448ft. 1350/-; 450ft. 1356/-; 452ft. 1362/-; 454ft. 1368/-; 456ft. 1374/-; 458ft. 1380/-; 460ft. 1386/-; 462ft. 1392/-; 464ft. 1398/-; 466ft. 1404/-; 468ft. 1410/-; 470ft. 1416/-; 472ft. 1422/-; 474ft. 1428/-; 476ft. 1434/-; 478ft. 1440/-; 480ft. 1446/-; 482ft. 1452/-; 484ft. 1458/-; 486ft. 1464/-; 488ft. 1470/-; 490ft. 1476/-; 492ft. 1482/-; 494ft. 1488/-; 496ft. 1494/-; 498ft. 1500/-; 500ft. 1506/-; 502ft. 1512/-; 504ft. 1518/-; 506ft. 1524/-; 508ft. 1530/-; 510ft. 1536/-; 512ft. 1542/-; 514ft. 1548/-; 516ft. 1554/-; 518ft. 1560/-; 520ft. 1566/-; 522ft. 1572/-; 524ft. 1578/-; 526ft. 1584/-; 528ft. 1590/-; 530ft. 1596/-; 532ft. 1602/-; 534ft. 1608/-; 536ft. 1614/-; 538ft. 1620/-; 540ft. 1626/-; 542ft. 1632/-; 544ft. 1638/-; 546ft. 1644/-; 548ft. 1650/-; 550ft. 1656/-; 552ft. 1662/-; 554ft. 1668/-; 556ft. 1674/-; 558ft. 1680/-; 560ft. 1686/-; 562ft. 1692/-; 564ft. 1698/-; 566ft. 1704/-; 568ft. 1710/-; 570ft. 1716/-; 572ft. 1722/-; 574ft. 1728/-; 576ft. 1734/-; 578ft. 1740/-; 580ft. 1746/-; 582ft. 1752/-; 584ft. 1758/-; 586ft. 1764/-; 588ft. 1770/-; 590ft. 1776/-; 592ft. 1782/-; 594ft. 1788/-; 596ft. 1794/-; 598ft. 1800/-; 600ft. 1806/-; 602ft. 1812/-; 604ft. 1818/-; 606ft. 1824/-; 608ft. 1830/-; 610ft. 1836/-; 612ft. 1842/-; 614ft. 1848/-; 616ft. 1854/-; 618ft. 1860/-; 620ft. 1866/-; 622ft. 1872/-; 624ft. 1878/-; 626ft. 1884/-; 628ft. 1890/-; 630ft. 1896/-; 632ft. 1902/-; 634ft. 1908/-; 636ft. 1914/-; 638ft. 1920/-; 640ft. 1926/-; 642ft. 1932/-; 644ft. 1938/-; 646ft. 1944/-; 648ft. 1950/-; 650ft. 1956/-; 652ft. 1962/-; 654ft. 1968/-; 656ft. 1974/-; 658ft. 1980/-; 660ft. 1986/-; 662ft. 1992/-; 664ft. 1998/-; 666ft. 2004/-; 668ft. 2010/-; 670ft. 2016/-; 672ft. 2022/-; 674ft. 2028/-; 676ft. 2034/-; 678ft. 2040/-; 680ft. 2046/-; 682ft. 2052/-; 684ft. 2058/-; 686ft. 2064/-; 688ft. 2070/-; 690ft. 2076/-; 692ft. 2082/-; 694ft. 2088/-; 696ft. 2094/-; 698ft. 2100/-; 700ft. 2106/-; 702ft. 2112/-; 704ft. 2118/-; 706ft. 2124/-; 708ft. 2130/-; 710ft. 2136/-; 712ft. 2142/-; 714ft. 2148/-; 716ft. 2154/-; 718ft. 2160/-; 720ft. 2166/-; 722ft. 2172/-; 724ft. 2178/-; 726ft. 2184/-; 728ft. 2190/-; 730ft. 2196/-; 732ft. 2202/-; 734ft. 2208/-; 736ft. 2214/-; 738ft. 2220/-; 740ft. 2226/-; 742ft. 2232/-; 744ft. 2238/-; 746ft. 2244/-; 748ft. 2250/-; 750ft. 2256/-; 752ft. 2262/-; 754ft. 2268/-; 756ft. 2274/-; 758ft. 2280/-; 760ft. 2286/-; 762ft. 2292/-; 764ft. 2298/-; 766ft. 2304/-; 768ft. 2310/-; 770ft. 2316/-; 772ft. 2322/-; 774ft. 2328/-; 776ft. 2334/-; 778ft. 2340/-; 780ft. 2346/-; 782ft. 2352/-; 784ft. 2358/-; 786ft. 2364/-; 788ft. 2370/-; 790ft. 2376/-; 792ft. 2382/-; 794ft. 2388/-; 796ft. 2394/-; 798ft. 2400/-; 800ft. 2406/-; 802ft. 2412/-; 804ft. 2418/-; 806ft. 2424/-; 808ft. 2430/-; 810ft. 2436/-; 812ft. 2442/-; 814ft. 2448/-; 816ft. 2454/-; 818ft. 2460/-; 820ft. 2466/-; 822ft. 2472/-; 824ft. 2478/-; 826ft. 2484/-; 828ft. 2490/-; 830ft. 2496/-; 832ft. 2502/-; 834ft. 2508/-; 836ft. 2514/-; 838ft. 2520/-; 840ft. 2526/-; 842ft. 2532/-; 844ft. 2538/-; 846ft. 2544/-; 848ft. 2550/-; 850ft. 2556/-; 852ft. 2562/-; 854ft. 2568/-; 856ft. 2574/-; 858ft. 2580/-; 860ft. 2586/-; 862ft. 2592/-; 864ft. 2598/-; 866ft. 2604/-; 868ft. 2610/-; 870ft. 2616/-; 872ft. 2622/-; 874ft. 2628/-; 876ft. 2634/-; 878ft. 2640/-; 880ft. 2646/-; 882ft. 2652/-; 884ft. 2658/-; 886ft. 2664/-; 888ft. 2670/-; 890ft. 2676/-; 892ft. 2682/-; 894ft. 2688/-; 896ft. 2694/-; 898ft. 2700/-; 900ft. 2706/-; 902ft. 2712/-; 904ft. 2718/-; 906ft. 2724/-; 908ft. 2730/-; 910ft. 2736/-; 912ft. 2742/-; 914ft. 2748/-; 916ft. 2754/-; 918ft. 2760/-; 920ft. 2766/-; 922ft. 2772/-; 924ft. 2778/-; 926ft. 2784/-; 928ft. 2790/-; 930ft. 2796/-; 932ft. 2802/-; 934ft. 2808/-; 936ft. 2814/-; 938ft. 2820/-; 940ft. 2826/-; 942ft. 2832

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CV4049 6/8	EY148 9/8	EP183 6/8	K7C 22/-
CV31 6/8	EY148 9/8	EP183 6/8	K7C 22/-
D1 1/8	EY148 9/8	EP183 6/8	K7C 22/-
D41 6/8	EY148 9/8	EP183 6/8	K7C 22/-
D61 6/8	EY148 9/8	EP183 6/8	K7C 22/-
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DF91 3/8	EY148 9/8	EP183 6/8	K7C 22/-
DF96 6/8	EY148 9/8	EP183 6/8	K7C 22/-
DH63 5/8	EY148 9/8	EP183 6/8	K7C 22/-
DK92 6/8	EY148 9/8	EP183 6/8	K7C 22/-
DK96 6/8	EY148 9/8	EP183 6/8	K7C 22/-
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EP91 3/8	EP92 2/8	EP95 5/8	EP183 6/8
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EP183 6/8	EP183 6/8	EP183 6/8	EP183 6/8

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6B85 7/8	6V6 3/8	30C18 11/-	885 2/8

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OC44 6/8	OC83 5/-	OC905 12/8	XC156 22/8
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OC72 5/8	OC122 5/-	OC907 12/8	XC156 22/8
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6B86 7/8	6V6G 7/8	25Z5 7/8	830B 4/-
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6B90 7/8	6V6 3/8	30C15 10/-	884 10/-
6B91 7/8	6V6 3/8	30C18 11/-	885 2/8
6B92 7/8	6V6 3/8	30C18 11/-	885 2/8
6B93 7/8	6V6 3/8	30C18 11/-	885 2/8
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the final output voltage is taken from Tr3 emitter to the output terminals via fuse F1. R10 is a small permanent load resistor connected across the output terminals.

A voltmeter, comprising M1 and R9, is built into the unit and permanently wired across the output terminals for monitoring purposes. Although the prototype unit was found to give output voltages from zero to 18V in three ranges, at currents up to 1A, the maximum output voltage and available current can be increased simply by changing component values.

Construction

The prototype unit was built up on a standard 8in. × 6in. chassis, with angled corner brackets. Construction should be started by drilling this chassis as shown in Fig. 3. Next, drill and cut the front panel, as indicated in Fig. 4. The hole for the meter is best cut by first marking the panel and then cutting away the unwanted metal with the aid of a fret-saw fitted with a metal-cutting blade.

When the front panel is complete, it can be covered with one of the decorative self-adhesive plastic materials before it is secured to the main chassis. It should be noted that the actual front panel controls, VR1, S2, and the two output terminals, can be used to secure the front panel to the chassis, thereby eliminating unsightly bolt heads, etc. Grommets should now be fitted in all suitable holes in the chassis, and transformer T1 and all tag strips should be bolted in place.

★ components list

Resistors: (all 5%, ½W except where otherwise stated)

R1 1Ω, 3W	R6 2.2kΩ
R2 470Ω, 10%	R7 2.7kΩ
R3 1.2kΩ, 10%	R8 1kΩ
R4 3.9kΩ	R9 18kΩ + 1.8kΩ, 1%
R5 1.8kΩ	R10 560Ω, 10%, 1W
VR1 2.5kΩ, wire-wound, linear	

Capacitors: (all electrolytic, 30VW)

C1 1000μF	C3 500μF
C2 2000μF + 2000μF	C4 100μF

Semiconductors:

Tr1 OC71 or OC75	D5 OA200 or OA202
Tr2 OC81 or OC72	D6 9V, ½W, 10%, Zener
Tr3 OC22 or OC23	D7 9V, ½W, 10%, Zener
D1—4 1A, 50 p-i-n, silicon	

Miscellaneous:

Battery charger transformer with 1.5A output at 5V, 11V and 17V; two-way, two-pole on/off switch; 1A fuse and holder; 1mA meter movement (see text); two output terminals; 8in. × 6in. chassis; strip of Veroboard (see Fig. 5); tag strips; rubber grommets; control knobs; wire; sleeving; and expanded metal speaker gauze.

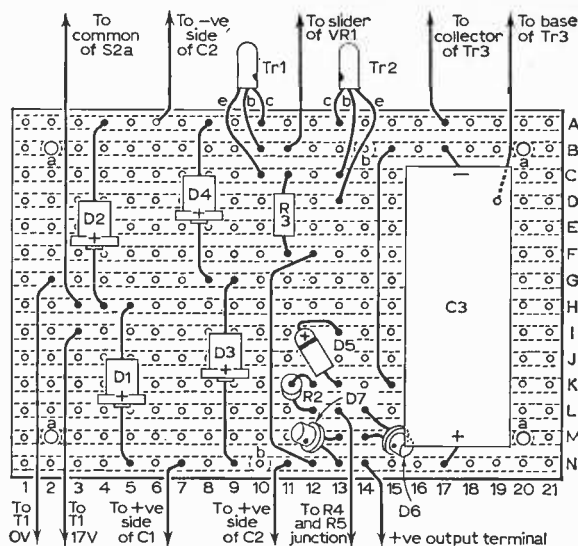


Fig. 5: Veroboard assembly details.

Cut the small Veroboard sub-panel to size as shown in Fig. 5, and break the copper strips where indicated with the aid of a small drill or the special cutting tool that is available. Now assemble all components and leads to the board as indicated. It should be noted that on the prototype two Zener diodes have been used, but these can in fact be replaced by a single 18V Zener diode, if available. When complete, the Veroboard sub-panel should be bolted in place on the underside

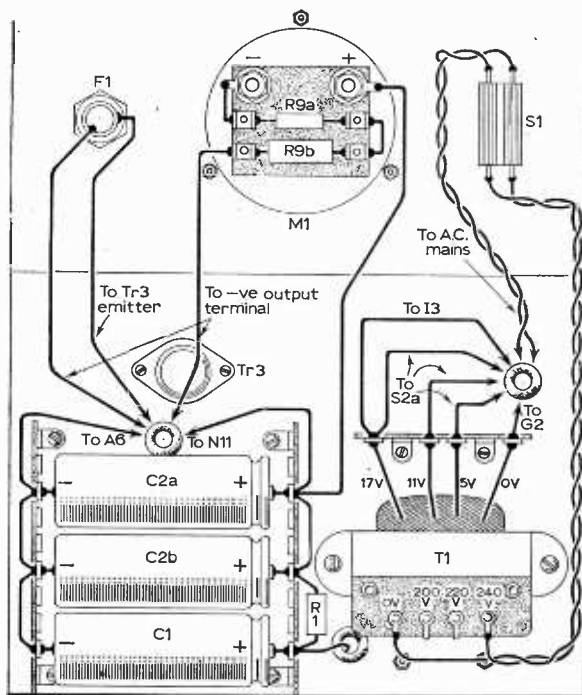


Fig. 6: Above-chassis wiring.

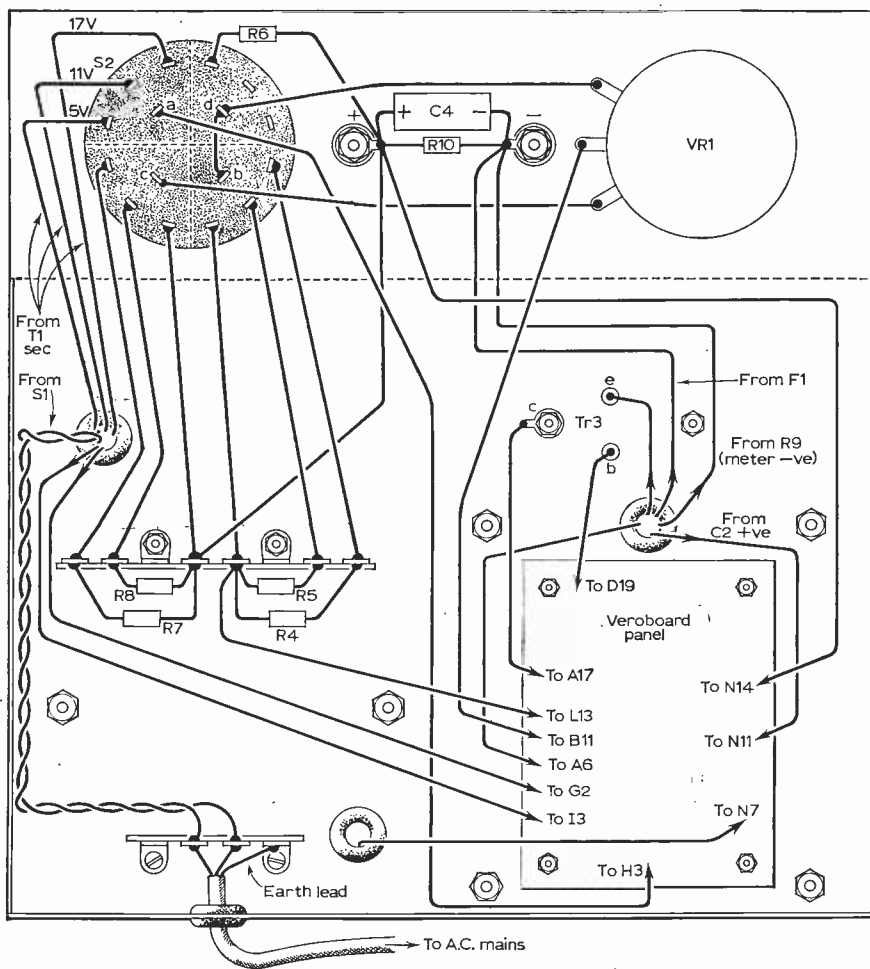


Fig. 7: Wiring of the under chassis.

of the chassis with the aid of small 6BA screws, taking care to use rubber grommets as spacers between the Veroboard and the main chassis to prevent short circuits occurring.

Now, using insulated washers and spacers, bolt transistor Tr3 in place on the top of the chassis, and complete the under-chassis wiring as shown in Fig. 7. Secure the F1 fuse holder, switch S1, and the moving coil meter to the front panel, and complete the wiring of the top of the chassis as shown in Fig. 6. When complete, double check all wiring and then carry out a functional test, checking the output voltages and currents on all ranges. With the component values shown, the voltage swings should be as follows: Range 1, 0.5—3.5V, Range 2, 3—10.5V, Range 3, 9—18V. These voltages are without external load.

The meter circuit

On the prototype, a 1mA moving coil meter was used as the monitor, wired as a 20V (f.s.d.) d.c. voltmeter. It is not essential to use a 1mA meter movement and in fact almost any meter may be used for this job, but one must know the sen-

sitivity of the movement. If it is not marked on the face of the instrument in ohms-per-volt, but the internal resistance is given, it is a simple matter of Ohm's law: $E = I \times R$. For example, a 1mA movement with an internal resistance of 1,000Ω, will drop 1V and, thus, have a sensitivity of 1,000Ω per volt. To increase the voltage range of the movement to 20V f.s.d. the total series resistance has to be increased by the same factor—twenty. Thus an external series resistor of 19,000Ω is required (20,000Ω less the 1,000Ω internal resistance).

Usually, the internal meter resistance will be indicated on the face of the meter, but if it is not it can be determined by connecting the meter in series with a 4.5 to 12V battery and a high value series resistor and variable resistor, and adjusting the values of these two resistors until the meter reads f.s.d. A variable resistor should now be connected in parallel with the actual meter and adjusted until the meter pointer falls to half f.s.d., at which point the values of the internal meter resistance and the

parallel resistance will be equal. Thus, the internal meter resistance can now be determined by removing the parallel variable resistor and measuring its resistance on an ohmmeter. It should be noted that, if any attempt is made to measure the internal meter resistance directly with the aid of the ohmmeter, severe damage may result.

The specified transformer is capable of supplying currents up to 1.5A. If higher currents are required, an alternative transformer should be used, and the four rectifiers, D1—D4, should have suitably increased ratings.

The transistor types used are not critical. Tr1 may be any small a.f. transistor capable of working with a collector voltage of approx. 25V or greater, but should preferably be a fairly high gain type. Tr2 may be any type capable of working with a collector voltage of approx. 25V, and able to handle powers of at least 100mW. Tr3 may be any power type capable of working at collector voltages of approx. 25V or greater, able to handle emitter currents of at least 1A, and dissipating powers of 16W or more on a large heat sink. If larger currents are required, the ratings of Tr3 should be suitably increased, or, alternatively, two or more power transistors wired in parallel. ■

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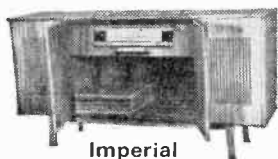
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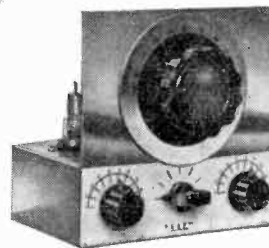
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TRANSISTORS CHEAPER by the DOZEN

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new books

NEWNES RADIO AND TELEVISION SERVICING (1965-66 Models) By J. P. Hawker and J. Reddihough. 496 pages, 9 x 6in. Now published by Buckingham Press Ltd. Price 85s.

EVERY year a new edition of Newnes well-known Radio and Television Servicing is published. Always in great demand, these annual volumes contain a wealth of circuits, data and repair hints for popular television and radio receivers, tape recorders and record reproducers. The new 1966 edition has just been published and deals with 1965-66 models, nearly 50 principal makes.

The publishers, Buckingham Press Ltd. who are the successors to S.B. Division of George Newnes Ltd. have asked us to mention that their address has not changed, it remains—15-17 Long Acre, London, W.C.2. Copies of Radio and Television Servicing are available on free trial, direct from Buckingham Press Ltd.—PEM.

THE LAW AND YOUR TAPE RECORDER By Andrew Phelan. Published by Print and Press Services Ltd. 30 pages. 7 x 5in. Paperback. Price 3s. 6d.

IN these days of rules and regulations it is almost impossible to draw breath without breaking some law or other; and ignorance is no excuse. Practically every time the enthusiast uses his tape recorder he is inviting prosecution—or so it would appear after a perusal of this interesting little booklet.

The author is a barrister-at-law, and the text occasionally betrays this, but otherwise, a lucid account of the pitfalls of the laws of copyright as related to tape recording will be found here.

It is perhaps unfortunate that amid all this frightening legal stricture we find no hint of aid. "This is the law"—says Mr. Phelan, in effect, without adding that application to the Performing Rights Society, or Phonographic Performances Ltd., would solve many of the immediate problems of the local impresario.

For the ordinary user, the problem seldom arises: one can take down broadcast material for one's private enjoyment so long as it is not covered by a separate copyright, but as this permission *does not* extend to gramophone records, whether broadcast or not, Junior is contravening the Acts of 1956, 1958 and 1963 every time he tapes down "Top of the Pops". Replaying his recording to someone else compounds the felony and accepting payment for the privilege is so reprehensible that we shudder to think of the consequences!

Whether one intends to make a business of tape recording or simply indulges in the hobby for pleasure, it is wise to know the legal limitations and this pocket book is a cheap and easy introduction.—MAQ.

SHORT WAVE LISTENING By J Vastenhoud. Published by Iliffe Books Ltd. 107 pages. Size 8½in. x 5½in. Price 12s. 6d.

IF the PRACTICAL WIRELESS feature "On the Short Waves" has given you an appetite for listening to foreign radio stations this book will provide a meaty dish. All the beginners' questions—What frequency bands should I listen to and when? What is a QSL card? How do I send a reception report? Can I join the DX Club?—are well answered. Established DXers will not be surprised for the author is Jim Vastenhoud, regularly heard on Radio Nederland's DX programme.

As well as the chapters dealing with the practical side of DXing the book contains chapters on the principles of short wave transmission, the aerial and the correct choice of receiver, which seems to be a standard in any book dealing with radio these days. Other useful selections include comprehensive frequency prediction tables, an English-French-Spanish dictionary of commonly used DX terms, and DXing with a tape recorder.

I started by saying that this was the book for the newcomer. Old hands shouldn't be put off by this as they will find new ideas here. I certainly did.—JMG.

SILICON CONTROLLED RECTIFIERS By Allan Lytel. Published by W. Foulsham & Co. Ltd. 128 pages. Size 8½ x 5in. Price 16s.

THOSE who are not aware of the importance of silicon controlled rectifiers in power switching and control applications should find this book most rewarding. SCR's, or thyristors, operate in much the same way as gas filled thyatrons, but are much simpler to use and have many more applications. In fact, it is possible to control kilowatts of power with these four-layered semiconductor devices from extremely small signals—i.e., the output of a photocell or a thermocouple.

Silicon controlled rectifiers are comparatively new in this country—outside the professional and industrial fields—and it will not be too long before the majority of domestic electrical appliances and electronic equipment make use of them. They are ideal for controlling electric motors.

This book first deals with the theoretical aspects, of SCR's, then goes on to explain in detail how they work, with various types of triggering circuits, necessary.

As the book originates from the United States, the publishers have thought it necessary to include a specially written chapter for the English reader. It states, in three pages, that the mains supplies are different and that American components are used throughout. It also gives an incomplete list of British suppliers to the home constructor.—JRC.

MAKING THE MOST OF TAPE POSITION INDICATORS

By J. LOWRIE Grad I.E.E.

MOST tape recording enthusiasts keep a detailed record of each tape with a list of the material recorded on it. In order to spot individual items some method of cataloguing must be used. Coloured indicators can be attached to the tape or note taken of the scale reading on the tape usually marked from 0 to 10. Most modern tape recorders are, however, fitted with a rev. counter



After one revolution the tape unwound at A is much longer than that at B. Length unwound = $2\pi R$ where R is radius from centre of tape spindle to outer layer of tape.

Dial reading	0	45	92	145	208	279	370	420
Time (minutes)	0	5	10	15	20	25	30	32

Fig. 1: Diagram and Table showing why the relationship between dial reading and footage is not linear.

which is geared to the tape spindle and automatically records the number of revolutions. The disadvantage of this method is that dial readings do not correspond directly to the footage of tape which has passed the head. Why this is so can be seen from Fig. 1. As the tape runs off the spool the length of tape which unwinds gets less—length of tape unwinding = $2\pi \times$ radius of outside of tape.

The person using the tape then faces an obvious difficulty: if the rev. counter shows a reading of say 400 at the end of the tape and after a recording has been made the reading is 200, how much recording time is left? At first sight it would appear that only half of the tape has been used whereas more than half has been run off as can be seen when the situation represented in Fig. 1 is considered. It is possible to time the first recording and subtract this from the total playing time but it becomes tedious if this has to be done for each tape; it is much better to compile a graph relating tape footage to dial reading and reference to this will show at a glance the time difference between various dial readings.

The procedure for making a graph is as follows;

Take a full spool of tape and set it into position for playback.

Set dial readings to zero.

Start playing back at fastest speed on machine.

Note time at start and take dial readings every five minutes.

Note the time when all the tape has been used.

The results obtained will form a table similar to the table, Fig. 1, which was obtained using 1,200ft. of L.P. tape on a $5\frac{3}{4}$ in. spool running at $7\frac{1}{2}$ in./sec. The results of Table 1 are plotted on a graph to give Fig. 2. It is easy to see at a glance the recording time represented by various dial readings. Thus for example, if recording started at 180 and ended at 310 the recording time would be $27-18=9$ minutes.

If the relationship between recording time and dial reading had been direct the graph would have been straight as shown by the dotted line. Thus after reading 100 serious errors would arise if the correction supplied by the graph were not applied. The graph can be adapted for other speeds simply by multiplying the time scale by the correct factor (e.g. $3\frac{1}{2}$ in./sec. would require scale to be doubled) leaving the dial reading unchanged. The exact figures on the graph are affected by the spool size and whether L.P. or standard tape is used. Thus graphs should be drawn up for each spool size used, one for standard tape and one for L.P. tape.

Once armed with these graphs the enthusiast can

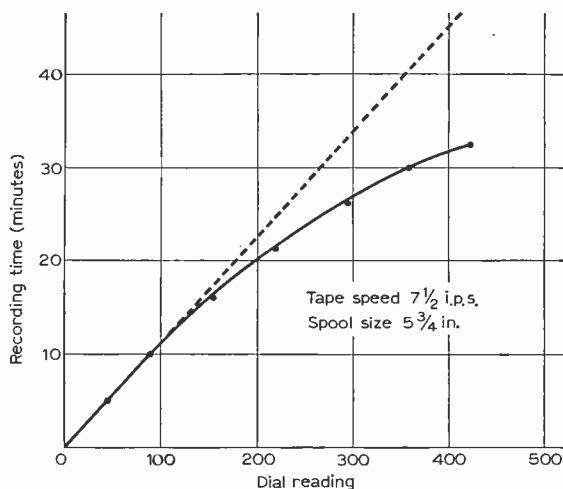


Fig. 2: Graph showing variation of recording time with dial reading.

safely record new material in between two sections which he wishes to preserve knowing exactly how much recording time is available and being certain that there is no danger of inadvertently erasing material which he wants to keep.

NEW!



THE WORLD'S SMALLEST RADIO

Photograph shows actual size

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- ★ ONLY ONE CONTROL
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- ★ AMAZING RANGE POWER & SENSITIVITY
- ★ NEW CIRCUITRY
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- ★ A.B.C.
- ★ IN KIT FORM OR READY BUILT
- ★ 5 YEAR GUARANTEE

THE SINCLAIR MICROMATIC is a brand new design from an organisation world-famous for its production of micro-electronic equipment for constructors. It has behind it the Sinclair tradition of specialisation in micro-radio circuitry which, in the MICROMATIC, reaches fantastically high levels of performance. We have combined new circuitry with new elegance to make the SINCLAIR MICROMATIC professionally right in every detail whether you build it yourself or buy it complete in presentation case. This makes the perfect personal radio, ready to serve wherever and whenever required.

Its minutely proportioned case houses transistors, ferrite rod aerial and batteries and yet is considerably smaller than an ordinary matchbox. The MICROMATIC has an elegantly designed aluminium front panel with matching calibrated slow motion dial. New circuitry assures reception from a wide range of stations over the medium waveband, with excellent selectivity and quality. Here is a new set you will be proud to be seen using. You will also find it an ideal gift to give anyone. YET THIS BRILLIANT NEW DESIGN IS THE EASIEST OF ALL SINCLAIR RADIO SETS TO BUILD—AND IT IS BRITISH!

TECHNICAL DESCRIPTION

The Sinclair Micromatic is housed in a neat plastic case with attractive aluminium front panel and aluminium tuning dial to match, calibrated in Kc/s and metres. Three special Sinclair transistors are employed in a six stage circuit of exceptional power and sensitivity. Two stages of powerful R.F. amplification are followed by a double diode detector from which the signal tuned in is passed to a high gain three stage audio amplifier. Automatic Gain Control counteracts fading from distant stations and maintains signal strength. The set is powered by two Mallory Mercury Cells Type ZM.312 which are readily obtainable from radio shops, Boots Chemists, Stores, etc., and cost 1/7 each. The cells will give approximately 70 hrs. continuous working life. Inserting the earpiece plug switches the set on, withdrawing it switches off.

Complete kit of parts to build Sinclair Micromatic including lightweight earpiece, case and instructions

59/6
79/6

Sinclair Micromatic ready built with lightweight earpiece, in presentation case.

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Order form and more Sinclair designs on pages following



SINCLAIR STEREO 25 DE-LUXE PRE-AMP CONTROL UNIT

THE SINCLAIR STEREO 25 has been designed specially to ensure the highest possible standards of reproduction when used with two Z.12s or any other first class stereo power amplifier. Best possible components are used in the construction of this superb unit, whilst its appearance reflects the professional elegance characteristics of all Sinclair designs in hi-fi, radio and TV. The front panel of the Stereo 25 is in solid brushed and polished aluminium with beautifully styled solid aluminium control knobs. Mounting the unit is simple, and power is conveniently obtainable from the Sinclair PZ.3 which can also be used to supply two Z.12s to make a complete stereo assembly. Hi-fi enthusiasts seeking the ultimate in domestic listening will find all they want from this combination of Sinclair units. With a Micro-FM for tuner, they will have an installation to compare favourably with anything costing from four to five times as much.

FOR USE WITH ANY GOOD STEREO SYSTEM

TECHNICAL SPECIFICATIONS

Performance figures obtained using Stereo 25, two Z.12s and a PZ.3.

- **SENSITIVITY** for 10 watts into 1.5 ohms load per channel.
Mic.—2 mV into 50K ohms.
Pick-up—3 mV into 50K ohms.
Radio—20mV into 4.7K ohms.
- **FREQUENCY RESPONSE** (Mic. and Radio)—25 c/s to 30 kc/s ± 1 dB extending to 100 kc/s ± 3 dB.
- **EQUALISATION** — Correct to within ± 1 dB on RIAA curve from 50 c/s to 20 kc/s.

■ TONE CONTROLS

Treble +12dB to -10dB at 10 kc/s.
Bass +15dB to -12dB at 100 c/s.

■ **SIZE**—6 $\frac{1}{2}$ in. x 2 $\frac{1}{2}$ in. x 2 $\frac{1}{2}$ in. overall, plus knobs.

■ **FINISH** — Front panel sectioned in brushed and polished solid aluminium with solid aluminium knobs. Black figuring on front panel.

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"Although a complete novice to radio I was able to assemble it (Micro-FM) without undue difficulty thanks to your clear and lucid instructions. I receive all B.B.C. programmes etc. very strongly."

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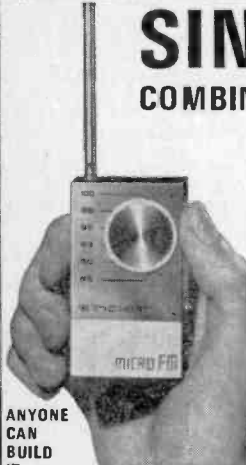
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"I consider your after sales service is excellent. I wish very much that other suppliers treated their customers in the way you do. I have tried out the Micro-FM with the Z.12 and my Quad speaker and am very pleased with the results."

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SINCLAIR MICRO-FM

COMBINED FM TUNER AND POCKET FM RECEIVER



7 TRANSISTORS
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NO ALIGNING
•
PULSE COUNTING
DISCRIMINATOR
•
A.F.C.
•
TUNES 88-108 Mc/s
•

SIZE—less than 3" x 1 $\frac{1}{2}$ " x $\frac{1}{2}$ "

This unique, superbly engineered FM superhet is the only set in the world which can be used both as an FM tuner and an independent FM pocket receiver just whenever you wish. Problems of alignment have been completely eliminated making the Micro-FM ready for use the moment you have built it. The pulse counting discriminator ensures best possible audio quality; sensitivity is such that the telescopic aerial included with the kit assures good reception in all but the very poorest reception areas. The Sinclair Micro-FM will give you all you want in FM reception and the satisfaction of building a unique design that will save you pounds.

FM superhet using 7 transistors and 2 diodes. The R.F. amplifier is followed by a self-oscillating mixer and three stages of I.F. amplification which dispense with I.F. transformers and all problems of alignment. The final I.F. amplifier produces a square wave which is converted to produce the original modulation exactly. A pulse counting discriminator ensures better audio quality. One output is for feeding to amplifier or recorder and the other enables the Micro-FM to be used as an independent self-contained pocket portable. A.F.C. "locks" programme tuned in. Signal to noise ratio 30dB at 30 microseconds.

Complete kit, including transistors, case, aerial, earpiece, etc.

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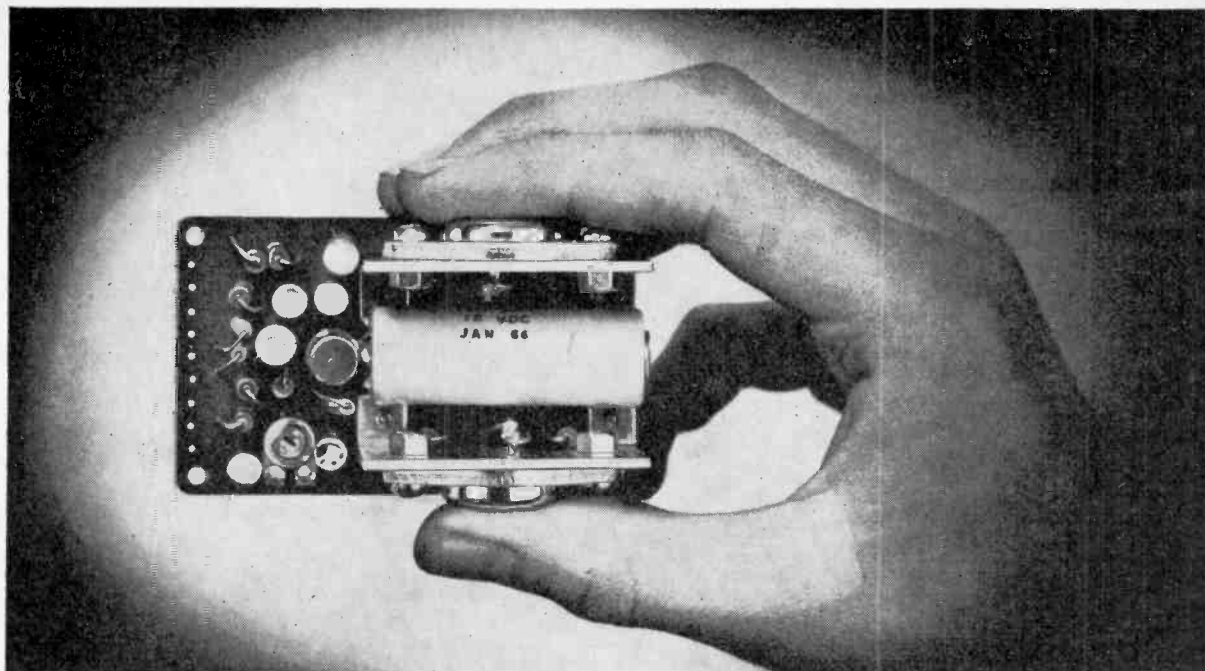
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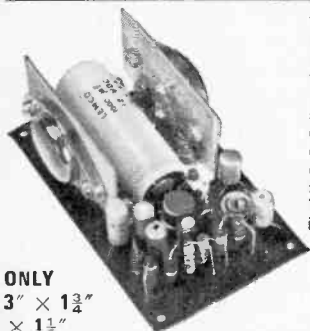


SINCLAIR Z.12 COMBINED 12 WATT HIGH FIDELITY AMPLIFIER AND PRE-AMP

12 WATTS R.M.S. OUTPUT
CONTINUOUS SINE WAVE (24W. PEAK)

**8 TRANSISTOR CIRCUIT WITH
CLASS B ULTRALINEAR OUTPUT**

IDEAL FOR HI-FI (STEREO OR MONO)
CAR RADIO, ELECTRIC GUITAR, P.A.,
INTERCOM, ETC.



ONLY
3" x 1 1/2"
x 1 1/4"

PZ.3 MAINS POWER SUPPLY UNIT

This special power supply unit uses advanced transistorised circuitry to achieve exceptionally good smoothing. Ripple is a barely measurable 0.05 V. The PZ.3 will power two Z.12s and a Stereo 25 with ease.

79/6

The amazing adaptability and rugged construction of this very powerful and exceptionally compact amplifier make it possible to use just one type of unit with outstanding success in an unusually wide variety of applications. Eight special H.F. transistors are used in a highly original circuit to achieve the characteristics demanded of any quality amplifier irrespective of price, yet this Sinclair unit costs well under £5, including its own integrated pre-amplifier. The Z.12 accepts radio, microphone and pick-up inputs. Detailed instructions for connecting

these in mono and stereo are given in the manual supplied with every unit. A number of different control networks are also shown. The Z.12 will operate efficiently from any supply between 6 and 20 V. d.c. making it very convenient to run the amplifier from a car battery. Where it is required to run the Z.12 from mains supply, the PZ.3 is recommended. Those wishing to have a ready made pre-amp control unit can feed inputs via the Stereo 25, which, with two Z.12s will provide the finest stereophonic hi-fi possible—and the saving in cost is fantastic.

TECHNICAL SPECIFICATIONS

- Size 3 in. x 1 1/2 in. x 1 1/4 in.
- Class "B" ultralinear output.
- RESPONSE 15-50,000c/s $\pm$ 1dB.
- Suitable for 3, 7.5 or 15 Ω speakers. Two 3 Ω speakers may be used in parallel.
- INPUT—2mV into 2k Ω .
- OUTPUT—12 watts R.M.S. continuous sine wave (24 w. peak); 15 watts music power (30 w. peak).
- Signal to noise ratio better than 60dB.
- Quiescent current consumption—15mA.

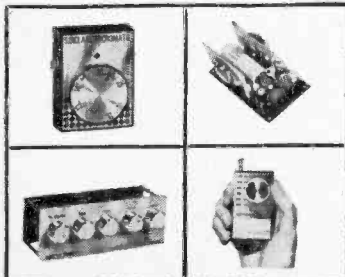
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Ready for
immediate use.
With Z.12
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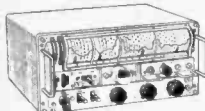
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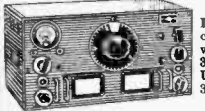
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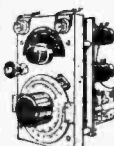
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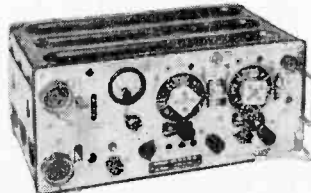
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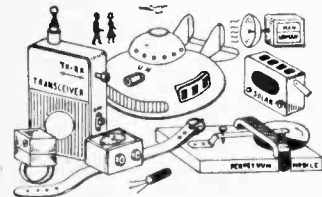
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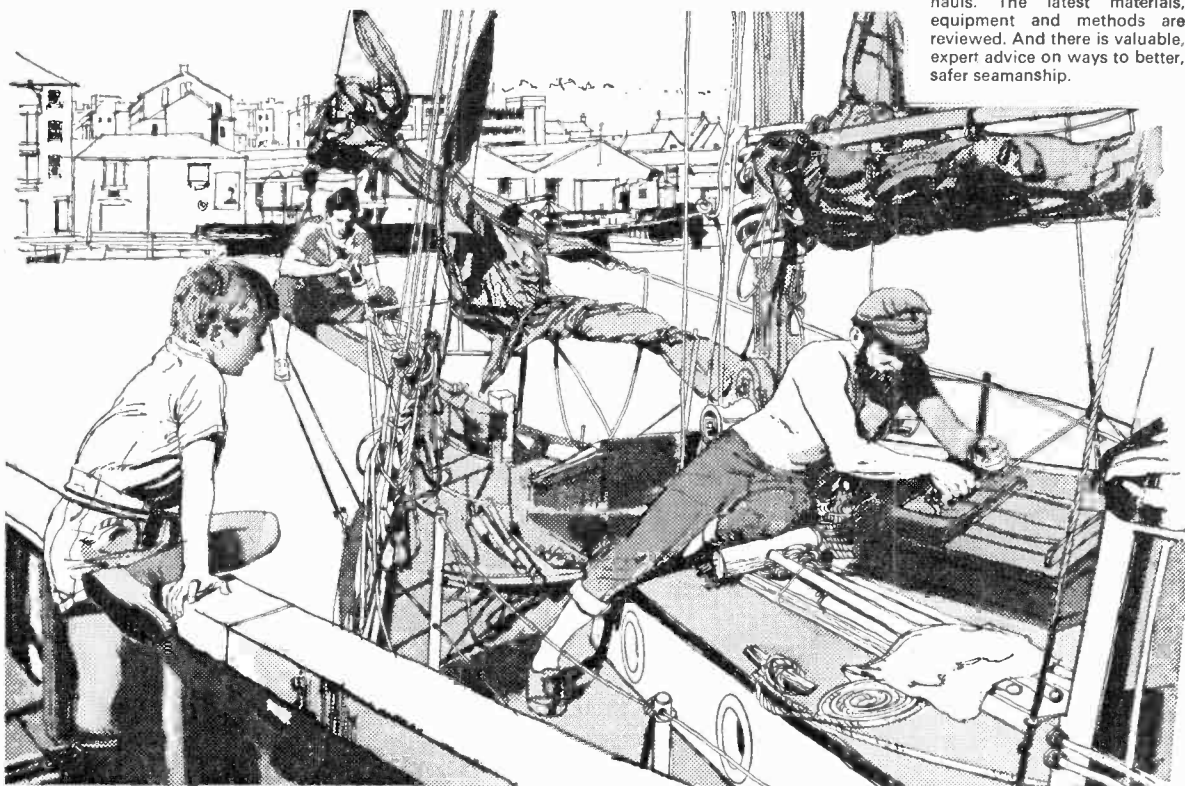
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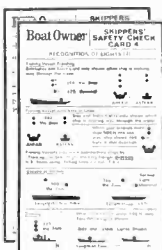
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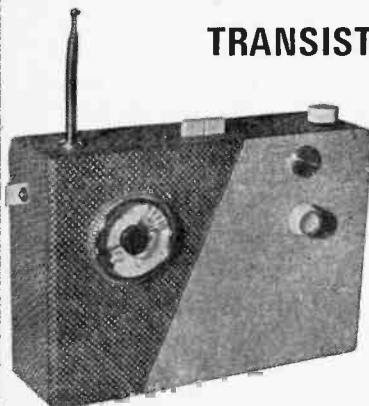
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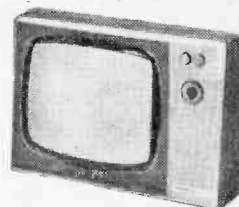
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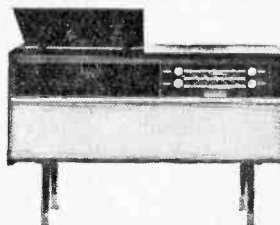
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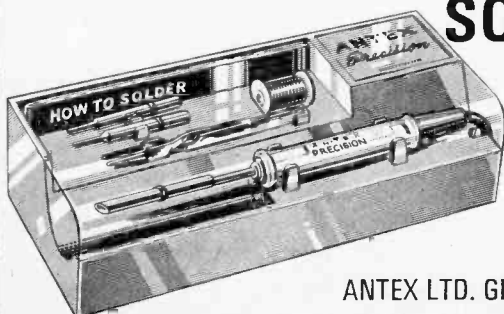
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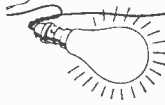
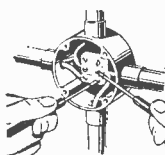
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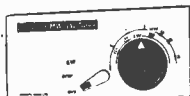


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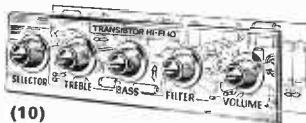
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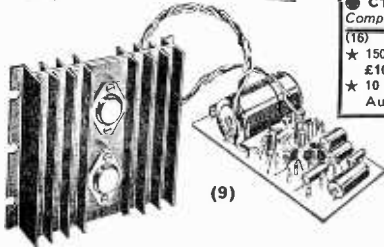
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3A4	4/-	6BK4	22/6	6Q5G	15/-	12K8	8/-
3A5	7/-	6BL7A	9/-	6Q7	7/-	12L7GT	7/-
3A8GT	8/-	6BL7GT	9/-	6Q7	7/-	12M7	7/-
3A76	6/6					12M7	7/-
3B5	5/-	6BN6	7/6	6H5	6/-	12M7	7/-
3B28	40/-	6BQ7A	7/-	6H7	7/-	12M7	7/-
3D6	4/-	6B3	8/-	6H7	7/-	12M7	7/-
3D29	60/-	6B8	5/-	6H7	7/-	12M7	7/-
3Q4	7/-	6B87	17/-	6H7	7/-	12M7	7/-
3Q5GT	6/6	6B7	7/-	6H7	7/-	12M7	7/-
3S4	5/-	6B7	10/-	6H7	7/-	12M7	7/-
3V4	6/-	6B7	10/-	6H7	7/-	12M7	7/-
4-65A	80/-	6B7	10/-	6H7	7/-	12M7	7/-
4E27	60/-	6C4	3/6	6H7	7/-	12M7	7/-
4TFA	8/-	6C5	8/-	6H7	7/-	12M7	7/-
4T8P	8/-	6C5GT	6/-	6H7	7/-	12M7	7/-
4X150A	100/-					12M7	7/-
4X250B	120/-	6C6	5/-	6H7	7/-	12M7	7/-
5R4GY	9/-	6C6	5/-	6H7	7/-	12M7	7/-
5U4G	5/-	6C6	5/-	6H7	7/-	12M7	7/-
5U5B	6/6	6C6	5/-	6H7	7/-	12M7	7/-
5U6	8/-	6C6	5/-	6H7	7/-	12M7	7/-
5V4G	8/-	6C6	5/-	6H7	7/-	12M7	7/-
5Y3GT	5/-	6C6	5/-	6H7	7/-	12M7	7/-
5Z3	7/6	6C6	5/-	6H7	7/-	12M7	7/-
5Z4G	7/6	6C6	5/-	6H7	7/-	12M7	7/-
6-30L12	8/6	6C6	5/-	6H7	7/-	12M7	7/-
6A8	8/-	6C6	5/-	6H7	7/-	12M7	7/-
6A8A	6/6	6C6	5/-	6H7	7/-	12M7	7/-
6A87	4/-	6DQ6G	11/-	7Y4	8/-	30FL12	14/-
6AC3GT	10/-	6D8	15/-	7Z4	6/-	30FL13	8/-
6AC7	4/-	6EG5GT	8/-	9B3W	7/-	30FL14	13/-

30L1	5/6	872A	40/-	DF33	8/-	ECC84	6/6
30L15	15/-	884	15/-	DF64	5/-	ECC85	5/-
30L17	15/-	955	3/-	DF91	3/-	ECC86	7/-
30L18	15/-	956	2/-	DF92	2/6	ECC88	8/-
30L19	15/-	957	5/-	DF93	7/-	ECC89	3/6
30L20	15/-	958	4/-	DF94	5/-	ECC90	11/-
30L21	15/-	959	8/-	DF95	8/-	ECC91	10/-
30L22	15/-	960	7/-	DF96	7/-	ECC92	10/-
30L23	15/-	961	7/-	DF97	6/-	ECC93	7/6
30L24	15/-	962	6/-	DF98	6/-	ECC94	7/6
30L25	15/-	963	6/-	DF99	6/-	ECC95	7/6
30L26	15/-	964	6/-	DF100	6/-	ECC96	7/6
30L27	15/-	965	6/-	DF101	6/-	ECC97	7/6
30L28	15/-	966	6/-	DF102	6/-	ECC98	7/6
30L29	15/-	967	6/-	DF103	6/-	ECC99	7/6
30L30	15/-	968	6/-	DF104	6/-	ECC100	7/6
30L31	15/-	969	6/-	DF105	6/-	ECC101	7/6
30L32	15/-	970	6/-	DF106	6/-	ECC102	7/6
30L33	15/-	971	6/-	DF107	6/-	ECC103	7/6
30L34	15/-	972	6/-	DF108	6/-	ECC104	7/6
30L35	15/-	973	6/-	DF109	6/-	ECC105	7/6
30L36	15/-	974	6/-	DF110	6/-	ECC106	7/6
30L37	15/-	975	6/-	DF111	6/-	ECC107	7/6
30L38	15/-	976	6/-	DF112	6/-	ECC108	7/6
30L39	15/-	977	6/-	DF113	6/-	ECC109	7/6
30L40	15/-	978	6/-	DF114	6/-	ECC110	7/6
30L41	15/-	979	6/-	DF115	6/-	ECC111	7/6
30L42	15/-	980	6/-	DF116	6/-	ECC112	7/6
30L43	15/-	981	6/-	DF117	6/-	ECC113	7/6
30L44	15/-	982	6/-	DF118	6/-	ECC114	7/6
30L45	15/-	983	6/-	DF119	6/-	ECC115	7/6
30L46	15/-	984	6/-	DF120	6/-	ECC116	7/6
30L47	15/-	985	6/-	DF121	6/-	ECC117	7/6
30L48	15/-	986	6/-	DF122	6/-	ECC118	7/6
30L49	15/-	987	6/-	DF123	6/-	ECC119	7/6
30L50	15/-	988	6/-	DF124	6/-	ECC120	7/6
30L51	15/-	989	6/-	DF125	6/-	ECC121	7/6
30L52	15/-	990	6/-	DF126	6/-	ECC122	7/6
30L53	15/-	991	6/-	DF127	6/-	ECC123	7/6
30L54	15/-	992	6/-	DF128	6/-	ECC124	7/6
30L55	15/-	993	6/-	DF129	6/-	ECC125	7/6
30L56	15/-	994	6/-	DF130	6/-	ECC126	7/6
30L57	15/-	995	6/-	DF131	6/-	ECC127	7/6
30L58	15/-	996	6/-	DF132	6/-	ECC128	7/6
30L59	15/-	997	6/-	DF133	6/-	ECC129	7/6
30L60	15/-	998	6/-	DF134	6/-	ECC130	7/6
30L61	15/-	999	6/-	DF135	6/-	ECC131	7/6
30L62	15/-	1000	6/-	DF136	6/-	ECC132	7/6
30L63	15/-	1001	6/-	DF137	6/-	ECC133	7/6
30L64	15/-	1002	6/-	DF138	6/-	ECC134	7/6
30L65	15/-	1003	6/-	DF139	6/-	ECC135	7/6
30L66	15/-	1004	6/-	DF140	6/-	ECC136	7/6
30L67	15/-	1005	6/-	DF141	6/-	ECC137	7/6
30L68	15/-	1006	6/-	DF142	6/-	ECC138	7/6
30L69	15/-	1007	6/-	DF143	6/-	ECC139	7/6
30L70	15/-	1008	6/-	DF144	6/-	ECC140	7/6
30L71	15/-	1009	6/-	DF145	6/-	ECC141	7/6
30L72	15/-	1010	6/-	DF146	6/-	ECC142	7/6
30L73	15/-	1011	6/-	DF147	6/-	ECC143	7/6
30L74	15/-	1012	6/-	DF148	6/-	ECC144	7/6
30L75	15/-	1013	6/-	DF149	6/-	ECC145	7/6
30L76	15/-	1014	6/-	DF150	6/-	ECC146	7/6
30L77	15/-	1015	6/-	DF151	6/-	ECC147	7/6
30L78	15/-	1016	6/-	DF152	6/-	ECC148	7/6
30L79	15/-	1017	6/-	DF153	6/-	ECC149	7/6
30L80	15/-	1018	6/-	DF154	6/-	ECC150	7/6
30L81	15/-	1019	6/-	DF155	6/-	ECC151	7/6
30L82	15/-	1020	6/-	DF156	6/-	ECC152	7/6
30L83	15/-	1021	6/-	DF157	6/-	ECC153	7/6
30L84	15/-	1022	6/-	DF158	6/-	ECC154	7/6
30L85	15/-	1023	6/-	DF159	6/-	ECC155	7/6
30L86	15/-	1024	6/-	DF160	6/-	ECC156	7/6
30L87	15/-	1025	6/-	DF161	6/-	ECC157	7/6
30L88	15/-	1026	6/-	DF162	6/-	ECC158	7/6
30L89	15/-	1027	6/-	DF163	6/-	ECC159	7/6
30L90	15/-	1028	6/-	DF164	6/-	ECC160	7/6
30L91	15/-	1029	6/-	DF165	6/-	ECC161	7/6
30L92	15/-	1030	6/-	DF166	6/-	ECC162	7/6
30L93	15/-	1031	6/-	DF167	6/-	ECC163	7/6
30L94	15/-	1032	6/-	DF168	6/-	ECC164	7/6
30L95	15/-	1033	6/-	DF169	6/-	ECC165	7/6
30L96	15/-	1034	6/-	DF170	6/-	ECC166	7/6
30L97	15/-	1035	6/-	DF171	6/-	ECC167	7/6
30L98	15/-	1036	6/-	DF172	6/-	ECC168	7/6
30L99	15/-	1037	6/-	DF173	6/-	ECC169	7/6
30L100	15/-	1038	6/-	DF174	6/-	ECC170	7/6

EL22	15/-	KT32	6/6	PL302	13/-	U251	6/-
EL33	12/6	KT36	17/6	PL500	13/6	U281	12/-
EL34	9/6	KT41	7/6	PL515	15/-	U282	12/-
EL35	5/-	KT44	5/-	PL520	20/-	U301	11/-
EL36	8/6	KT45	15/-	PL525	15/-	U403	7/-
EL38	12/6	KT66	16/-	PL532	8/6	U404	5/-
EL41	8/6	KT67	45/-	PL538	8/6	U407	5/-
EL42	7/6	KT76	8/-	PL540	8/6	U408	17/6
EL43	9/-	KT88	23/-	PL542	8/6	U409	8/-
EL44	8/-	KT92	7/-	PL545	8/6	U410	10/-
EL45	7/6	KT94	5/-	PL548	8/6	U411	8/-
EL46	4/6	KT96	9/-	PL550	8/6	U412	8/-
EL47	4/6	KT98	9/-	PL552	8/6	U413	8/-
EL48	4/6	KT99	9/-	PL555	8/6	U414	8/-
EL49	4/6	KT99	9/-	PL558	8/6	U415	8/-
EL50	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL55	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL56	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL57	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL58	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL59	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL60	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL61	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL62	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL63	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL64	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL65	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL66	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL67	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL68	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL69	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL70	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL71	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL72	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL73	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL74	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL76	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL83	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL89	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL90	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL91	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL105	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL112	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL113	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL126	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL127	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL128	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL185	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL187	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL192	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL193	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL195	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL201	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL202	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL203	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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EL206	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
EL207	5/-	MP/PENT 8	7/6	PY800	6/-	UB121	10/-
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