

PRACTICAL WIRELESS

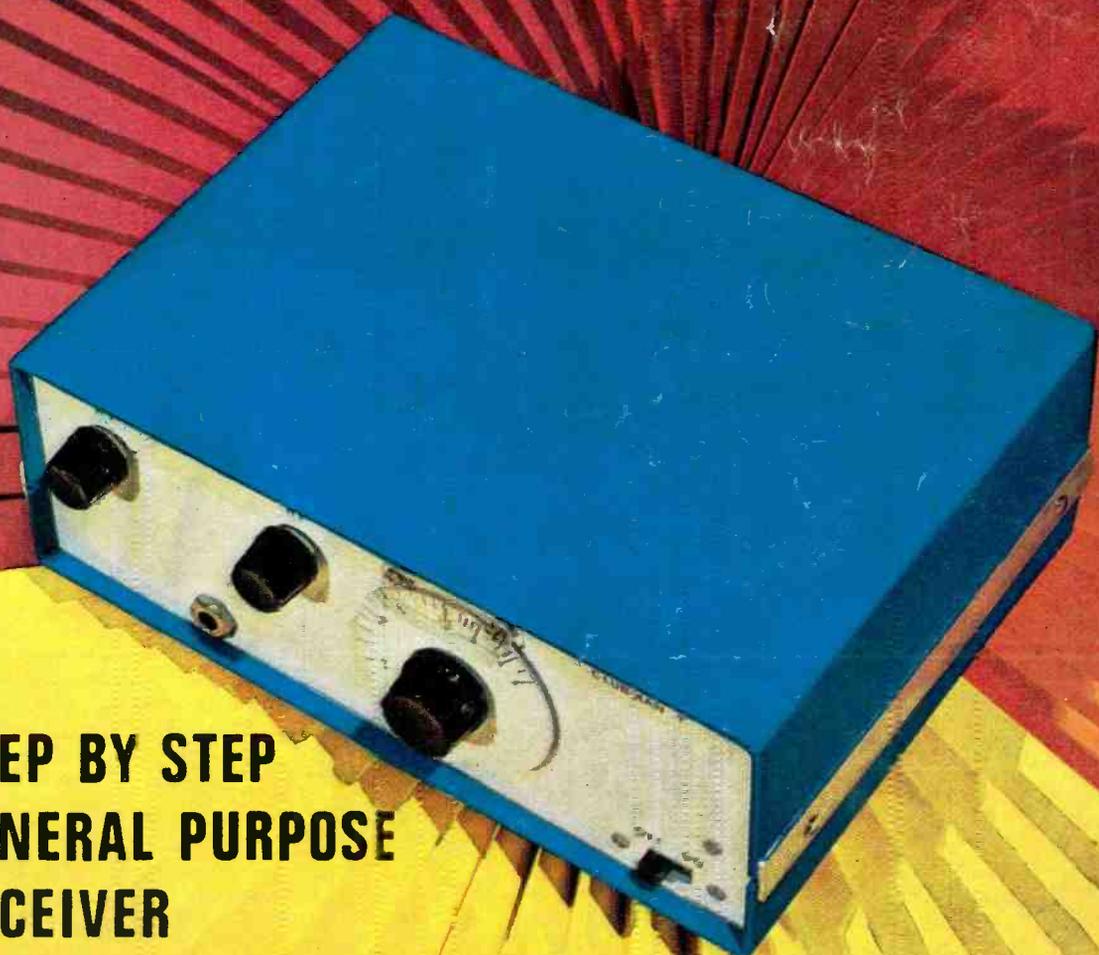
JANUARY
1968

216

Special
IN THIS ISSUE

- INTERMITTENT FAULT LOCATOR
- LEARNING MORSE
- SIMPLE SUBSTITUTION BOX
- LOW COST HI-FI SYSTEM-PART 2
- CRYSTAL TUNER FOR THE NOVICE

THE 'CLUBMAN'

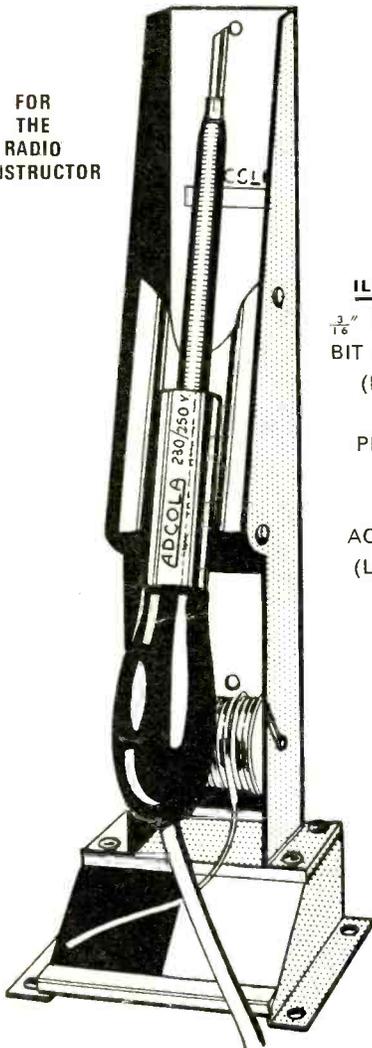


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GENERAL PURPOSE
RECEIVER**



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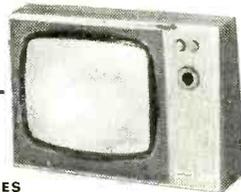
17in.—£11.10.0

3 Star Guarantee
★ Tube ★ Valves
★ Components Carr. 30/-

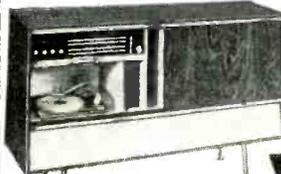
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FREE ILLUSTRATED
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17" —19" —21" —23"
WIDE RANGE OF MODELS
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**TWO-YEAR GUARANTEED
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14in.—69/6 17in.—89/6
21in. and ALL SLIMLINE TUBES 99/6
EXCHANGE BOWLS. Carr. 10/6
EX MAINTENANCE TESTED TUBES
17in.—35/- 14in.—15/- Carr. 5/- (not slimline)



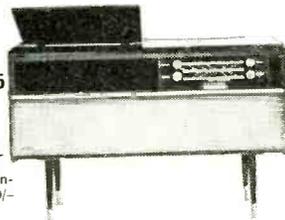
COCKTAIL/STEREOGRAM CABINET £25



Polished walnut veneer with elegant glass fronted cocktail compartment, padded. Position for two 10in. elliptical speakers. Record storage space. Height 35½in., width 52½in., depth 14½in. Legs 1 gn. extra

**STEREO RADIO-
GRAM CABINETS £15**

Superbly made and styled in
Veneered English Walnut
LIFT UP LID TO CHANGER AND
RECORD STORAGE COMPARTMENT
Position 8" x 5" Twin Speaker. Dimen-
sions: 45 x 15½ x 15½. Legs 1 gn. Carr. 30/-
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Sensational ALL-TRANSISTOR Communications
Receiver, for use in the home, caravan, car or boat, etc.

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Standard Play		Long Play	
3in. 150ft.	2/3	3in. 225ft.	2/9
4in. 300ft.	4/6	4in. 450ft.	5/6
5in. 600ft.	7/6	5in. 900ft.	10/6
5in. 900ft.	10/6	5in. 1,300ft.	13/-
7in. 1,200ft.	12/6	7in. 1,800ft.	18/6
Double Play		Triple Play	
3in. 300ft.	4/-	4in. 900ft.	13/-
4in. 600ft.	8/-	5in. 1,800ft.	25/-
5in. 1,200ft.	15/-	5in. 2,400ft.	34/-
5in. 1,800ft.	19/6	7in. 3,300ft.	44/-
7in. 2,400ft.	27/-	7in. 3,600ft.	51/6

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

MAINS-BATTERY Microsonic 7

7 TRANSISTOR RADIOS

Superhet. full medium wave coverage, amazing volume, clarity and sensitivity from built-in PM speaker. Solid leather pocket wallet. Fabulous present. Huge purchase enables us to offer at a fraction of market value. (If not amazed by the value and performance your money will be refunded, if returned within 29/- 14 days).

2 SETS of rechargeable Cadmium Cells to fit. Only 10/- extra.

CHARGER: 20/250V A.C. for Cadmium Cells. Charges 2 batteries at once. Complete with 5 amp plug. 10/- extra.

100 HI-STABS 9/-
1% to 5% 100Ω to 5 mΩ.
CO-AX. low loss. 6d. yd. 25 yds 11/6;
50 yds. 22/-; 100 yds. 42/6. Plugs 1/3.

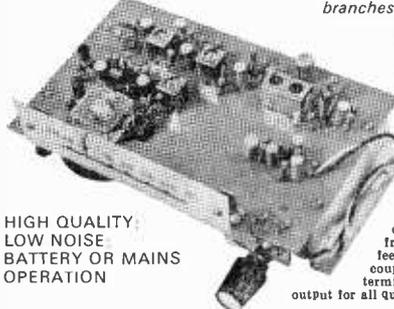
100 RESISTORS 6/6
SIZES -j-3 watt.
MICROPHONE CABLE. Highest quality black. Grey. white. 9d. per yard.

100 CONDENSERS 9/6
Miniature Ceramic. Silver. Mica. etc.. 3pF to 5μF. LIST VALUE OVER 24.

25 ELECTROLYTICS 9/6
Assorted 2 to 500 μF to 4 volt. LIST VALUE OVER 25.

Transistorised FM Tuner

CALLERS WELCOME Demonstration without obligation at all branches



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SRP12	£4.78
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AT5	£5.10.0
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Model 2.000	£6.10.0
Model 3.000	£8.10.0
AT60 Mk. II	£12.19.0
A70	£18.10.0
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401 Stereo ceramic cartridges	12/6
Stereo ceramic cartridges	19/6

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Universal fitting de luxe Teak for SP25. 1,000. 2,000. 3,000. AT60 Ditto Perspex Clear **£5.15.0** Value Cover. Complete LAB80. 401. Superb Teak/Perspex top finish plinth **£9.19.0** Normally £12.10.0

This beautifully compact 6 transistor machine (size 6 x 4 x 2 1/2 in.) will give quieter, more interference free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise freq. changer. Smooth 2 rang tuning feeding no less than three I.F. stages coupled to a double-tuned discriminator terminating in an L.F. stage giving ample output for all quality amplifiers.

REDUCED PRICE DUE TO HUGE SALES **£6.10.0** (3 FOR £18)

2-BAND AM/FM RADIOS
Well-known Caroline Portable covering L.W., M.W. and F.M. Bands. Gets all the BBC programmes. complete with leather case and accessories. **8 Gns.** amazing value.

RADIOGRAM CHASSIS
With Ceramic 10 x 5in. full range speaker. All wave. current manufacture. heavy A.C. type with large full-view dial. De luxe type at fraction of list. Complete valves. **MONO 8 Gns.** (List 14gns) **STEREO 12 Gns.** (List 20gns)

With two 10 x 5in. speakers.

PLINTH RECORD PLAYERS
Type AM90 4-watt amplifier, Garrard SRP12 Deck with dual cartridge, with elliptical **8 1/2 Gns.** speaker. Dust cover, worth double.

2-SPEAKER VERSION—As above in Vyanide, dove grey finish with 2nd speaker in detach. **9 1/2 Gns.** able cover. Wonderful present.

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Including variable condensers, i.f. coils, loudspeaker plug/sockets, knobs, pots, condensers, resistors, nuts, bolts, cabinet fittings, switches, transformer choke, rectifier, transistors at a small fraction of list value. Due to heavy demand we now pack them in several sizes—be amazed—try one now.

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

25 POTENTIOMETERS 9/6
Including with switch, long and short spindle, pre-sets, log and lin. LIST VALUE APPROX. 24.

CONNECTING WIRE 4/-
P.V.C. Bright Colours. Five 25ft. coils only.

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6J7GT	9/6	14S7	14/6	EB91	2/9	EY51	7/6	PY32	9/6	UL64	8/6
8K7G	2/8	19AQ5	5/6	EBC33	7/6	EY86	7/6	PY33	7/6	UM80	9/6
8K7GT	5/9	20D1	8/9	EB41	9/6	EY88	8/6	PY80	5/9	UY21	8/9
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6L1	9/6	20L1	16/-	EBF80	7/9	EZ41	6/6	PY82	5/6	UY85	5/6
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GUARANTEED TOP QUALITY Mullard Matched Output 12/6 Kits OCL8D and 2-OC81 R.F. Kits OC41, OC45 (2) 11/- 3 transistors.

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General Purpose miniature 8d. detector or 6/6 doz. Gold Bonded Top Grade 1/- (9/6 doz.)

SILICON RECTIFIERS
(Guaranteed performance. Top Makes. Tested 250v. working 100mA 2/9 500mA 5/- (3 for 6/6) (3 for 12/6)

SPECIALS!

Factory fresh less Cartridges.

SRP12 110/230V **59/-**

AT6 Mk.IIA **9 gns**

Mono first-grade Cartridges.....12/6
Stereo Ceramic Cartridges.....19/- extra.

EM1 4-spnd heavy turntable player 200/250V with lightweight pick-up (dual cartridges 10/- extra) **49/-**

COLLARO 4-speed Battery Model worth £7 with lightweight pick-up (matching dual cartridge 10/- extra. Postage 5/- extra all models) **49/-**

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MINI-MOTORS 3V to 4.5V operation. Ideal for mini-racing cars, etc. "Large" (1 1/4 x 7/16 x 1 1/2 in.) 3/11. Medium (1 x 2 1/2 x 1 1/2 in.) 3/9. Small (1 1/8 x 1/2 x 1 1/2 in.) 3/3. P. & P. 9d.

GENUINE DIAMOND STYLUS at 7/11 plus 6d. P.P. Available as replacements for the following popular types only at present: BSR TCSLP—BSR TCS STEREO—BSR TCS LP/STEREO—COLLARO STUDIO "O" LP/ROSETTE—GARRARD GCS LP—ACOS GP65/67 LP—ROSETTE BF40/LP—GARRARD G02 LP.

SPEAKERS. 12in. round high quality British fitted tweeter cone, 5 watts, in 3Ω or 15Ω. 35/-, P. & P. 3/6. ROUND 12in. R. & A. 3Ω. 25/6, P. & P. 3/6. 2 1/2in. round speaker 80Ω. 4/-, P. & P. 1/-. Many other speakers from 2in. to 13in. available.

TWEETER. 2 1/2in. Black plastic cone. Square Frame, E.M.I. 3Ω. 12/6, plus 1/6 P. & P. MICROPHONES. LAP/HAND MIKE—1 1/2in. dia. Lapel Clip, ideal for tape recording. With leat. Very sensitive. 7/6. P. & P. 1/-. CRYSTAL HAND MIKE. Robust and sensitive. Cream plastic case. Just the thing for tape recorders, 8/6. P. & P. 1/6.

STUDIO CRYSTAL MIKE. Professional, Omni-directional, providing features usually only available at many times the price. Sensitivity—50dB. Response—50-12,000 c.p.s. Black Plastic with punched chromum case, 50 ft. cable, stand holder and shielded cable. Only 48/-, P. & P. 2/-. The stand below fits this mike as well as many others).

ACOS MIC 40—World famous Desk Mike. 1 3/8 plus P. & P. 1/3. ACOS MIC 45—Splendid Curved Hand Grip Crystal Mike. 14/6 plus P. & P. 1/6. ACOS MIC 60—"Stick" Type Crystal Mike. 18/6 plus P. & P. 1/6.

ACOS ROUND Crystal Mike Insert. 1 1/2in. dia. 7/6. P. & P. 6d. TELESCOPIC FLOOR STAND, HEAVY BASE. Standard thread, ext. to 4ft. 7in. 49/6. Carriage and Extension 4/6.

TELEPHONE PICK-UP COIL. For recording or amplifying both sides of telephone conversation. Suction cup fitting to telephone, with lead, 7/6. P. & P. 1/-. INTER-COMM. DE-LUXE 2-WAY. Highly efficient, safe BABY ALARM. Works off P13 battery. Buzzer call system, complete with lead, plugs, battery, 55/-, P. & P. 2/6.

STEREO AMPLIFIER in handsome black padded leatherette case with spun aluminium front panel, inputs for tape, radio, crystal and ceramic p.u.'s and tape output. Over 5W per channel. Size 12 1/2 x 6 x 4 1/2 in. Controls for Gram, radio, tape, bass, treble, balance and vol. with mono/stereo switch and indicator bulb. Price 19 1/2 plus P. & P. 6/-.

AMPLIFIER. Compact for use in mains portable frames 6 1/2 x 2 1/2 x 5 1/2 in., printed circuit, vol. and tone controls attached by fly leads, over 2 watts output, 55/-, P. & P. 4/6.

4 TRANSISTOR 3W AMPLIFIER. Size 2 1/2 x 2 1/2 x 1 1/2 in., 3, 8 or 15Ω output. 9 volt battery operated. Highly sensitive. Price (less battery) 5/6. P. & P. 1/6.

RECORD PLAYER DECKS. GARRARD. Autochangers 4 speed MODEL 1000 £6.6.0 MODEL 2000 £8.16.6 MODEL 3000 £8.19.6 AT6 MK. IIA £10.19.6 AT70 MK. II auto transcription unit £17.17.0

Single Players SP25 4 speed Light T/Table 29.19.6 (less cartridge) SP25 4 speed Heavy T/Table £10.19.6 (less cartridge) SRP22 3 speed £4.19.6

All latest models complete with mono cartridge (except SP25). Stereo 10/- extra. P. & P. all models 7/6. Price includes free gift.

B.S.R. AUTOMATIC RECORD-CHANGER DECKS. LATEST MODELS. UA25—Very popular—4 speed. Cap. six 7in., 10in., 12in. records. 25 19 6 UA155S—Slim design—first class 7 in. speed, two-tone grey. 26 2 6 P. & P. on either of the above 7/6. Price includes Free Gift.

MAGNAVOX "363" TAPE DECKS. LATEST MODELS. WORLD FAMOUS. 13 1/2 x 11 x 5 1/2 in. below board. For 200/250V 50 cycles A.C. 3 speed, digit control, piano key controls, 7in. reels. Every modern feature. Speeds 1 1/2, 3 1/2 and 7 1/2 i.p.s. With 1 track Brantmatic heads, £10.10.0. With 1/2 track Marriot heads, £13.9.6. P. & P. 10/-. Price includes Free Gift.

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POCKET MULTI-TEST METER. 1000Ω per volt. Volts 0.10/50/250/500/1000 A.C. and D.C. Current: 0.1-100-500mA. Resistance: 0-100kΩ. Complete with test probes, instructions. 37/6. P. & P. 1/6.

MULTI-TEST METER. Pocket size: 4 1/2 x 3 1/2 x 1 1/2 in. 20,000Ω per volt. D.C. Volts (20,000Ω P.V.) 0.5/25/250/500/2500 D.C. Current: 0-50 milli amp/2.5 mA/250 Am A.C. volts (10,000Ω P.V.) 0.10/50/100/500/1000. Resistance: 0-6kΩ-0.6 megΩ. Capacity: 10μF to 0.01μF. 0.01μF to 1μF. Decibels: -20 to +22dB. Complete with battery, instructions, leads 7/6. P. & P. 1/6.

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NEW HIGH FREQUENCY TRANSISTORS. Sincilar ST140 4/-; ST141 6/-, both capable of operating up to 700 Mc/s. ALSO MAT110 7/8. MAT101 8/6. MAT120 7/9. MAT121 8/6. ADT140 15/-. High speed switching transistors: BSY26, BSY28, BSY65, 5/- each.

TRISTORS. 100P1V 5A, 12/6. 200 PIV 5A, 15/-. All Transistors postage 6d. up to 3. Over 12 sent P. & P. paid.

R.F. FIELD INDICATOR. For use with radio controlled models. Checks radiation from existing antenna. Tunes 1 to 250Mc in 5 bands. Sensitive 200mA meter movement. 5 section plug-in aerial. Phone jack and crystal earpiece for monitoring. No battery required. Powerful magnet for attaching to metal surfaces. Complete with instructions. 47/6. P. & P. 2/6.

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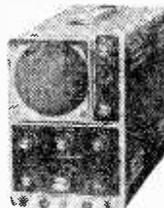
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OS-2



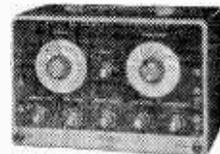
VVM, 1M-13U



V-7A



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HFW-1

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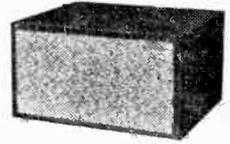
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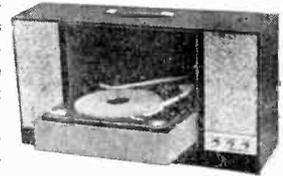
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A High Fidelity unit providing excellent results at modest output levels.

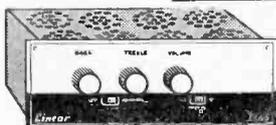
Frequency Response 30-20,000 cps—2dB

Sensitivity 5 mv (max)

Harmonic Distortion 0.5% at 1,000 cps.

Output for 3-8-15 ohm Loudspeakers.

Input Sockets for "Mike," Gram and Radio Tuner/Tape Recorder.



Recommended Retail price **8 gns**

Size 9½ × 2½ × 5½ in.

Controls (5) Volume, Bass, Treble, Mains Switch, Input Selector Switch.

LTA15 15 WATT AMPLIFIER

High Fidelity Output switched inputs for Gram, "Mike," Tape, and Radio.

Frequency Response 10-40,000 cps—3dB

Bass Control

+18dB to -16dB at 40 cps

Treble Control

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Recommended Retail price **16 gns**

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(2) Radio Tuner (3) Ceramic PU

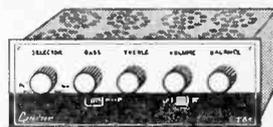
Microphone

Controls (6) Volume, Bass, Treble,

Balance, Mains Switch, Input

Selector Switch. Stereo/Mono Switch.

Facia Plate Rigid Perspex with black/silver background and matching black edged knobs with spun silver centres.



Recommended Retail price **15 gns**

Size 12 × 3½ × 6 in.

PTA30 HI-FI PUBLIC ADDRESS AMPLIFIER

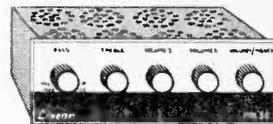
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Input Sensitivity 2 mv (max)

★ Output 30 watts.

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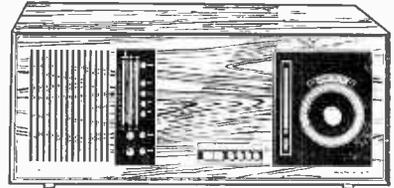


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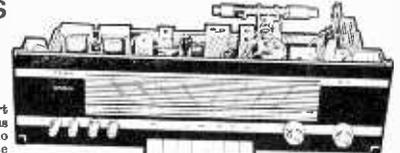
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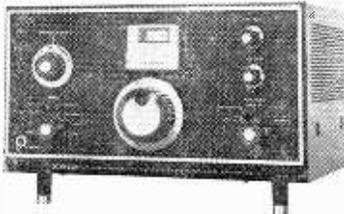
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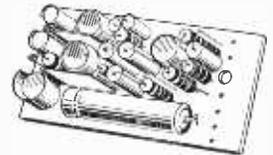
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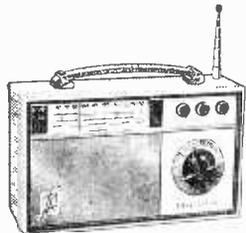
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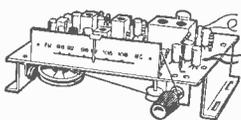
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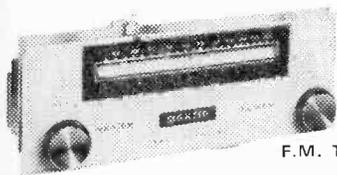
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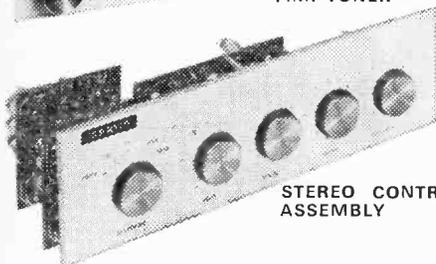
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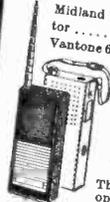
Model 3000 with Bonotone
9TAHO Stereo cartridge
AT60 Mk. I less cart. ... £8.19.6
AT60 Mk. II less cart. ... £12.19.6
SP25 Mk. I less cart. ... £12.19.6
SP25 Mk. II less cart. ... £12.19.6
LAB80 Mk. II less cart. ... £24.19.6
P. & P. 7/8 extra.
Mono Cart. 12/6. Stereo cart. 19/6
Plinths with perspex cover 6 gns.
(for LAB80 6 gns.). P. & P. 6/-
Agents for Thorens Dual, Goldring
—Prices on request.

SELECTOR DRIVE



Numerous applications. Electro magnet and brass yooth wheel. A switch wafer and contacts are coupled to this and arranged to be on for 10 pulses and off for 15. An auxiliary contact is normally on but off 1 in every 25. Complete with suppressor, resistors, plus series contact for continuous operation. Ideal window displays, switching lamps, models, etc. 12v. or 24v. D.C. Brand new and boxed 12/6. P. & P. 2/6. Many more similar items available.

2-WAY RADIOS



Midland (as illus.) 10 Transistor £18.18.0
Vantone 6 Transistor. £8.15.0
Vantone 5 Transistor £6.15.0
Lafayette 2 channel long range 65 gns.
P. & P. 5/- each.
These cannot be operated in U.K.

FANTASTIC OFFER! AIRCRAFT BAND RADIO



Sanyo Aircraft Medium Wave portable radio, 9 transistors, 2 diodes, 1 thermister, 4 x 24in. oval speaker, 107 to 135 metres. Twin outlets for private earphone. 6 penlight batteries. Telescopic aerial. Leather carrying case and straps. O.U.B. PRICE £16.19.6 P.P. 5/-
Many other radios from 39/6.



The World's Smallest Radio!!

SINCLAIR MICROMATIC

The set that plays anywhere. Fantastically efficient 6 stage transistor set size only 1 1/4 x 1 3/8 x 1/2 in. (Illustrated actual size). Complete with earpiece. Fully guaranteed. An ideal Christmas present!

NOW ONLY 49'6

(or ready built 59/6)

In Kit Form P. & P. 2/6

ALL OTHER SINCLAIR PRODUCTS AVAILABLE
MICRO FM KIT £5.19.6 Complete. P. & P. 2/6.
Z12 HI-FI AMP and PRE-AMP £4.19.6, P. & P. 2/6.
STEREO 25 CONTROL UNIT £9.19.6, P. & P. 2/6.
PZ3 MAINS POWER SUPPLY UNIT £3.19.6, P. & P. 2/6.

1000's OF SPECIAL BARGAINS AVAILABLE.
HI-FI EQUIPMENT. TRANSISTOR RADIOS.
TAPE RECORDERS. COMPONENTS. MIKES, etc.

MULTIMETERS



TTC1001 (as illus.) 20,000 opv £3.12.6
C1000, 1,000 opv £2.2.0
Caby NH 200 20,000 opv £6.10.0
Caby 140 4000 opv £6.10.0
TMK500 30,000 opv £9.19.6
TTC Model 1030 50,000 opv £9.19.6
TTC Model 1031 100,000 opv £12.19.6
Also stockists of Avo, Nombrex, Eagle etc. Test equipment. P.P. 3/6

STEREO HEAD- PHONES



Selection from stock:
TTC 11100 16 ohms £3.19.6
AKAI ABES8 8 ohms £5.19.6
CORAL E102 16 ohms £4.19.6
Eagle SE1 16 ohms £3.19.6
TTC Stethoscope 8 ohms £2.8.6
P.P. 4/8 each. Also stockists of Koss, Beyer, etc.

SPECIAL OFFER

This coupon entitles you to receive 10% special discount off any purchase over £10.

10% OFF



CUT OUT AND TAKE ALONG TO ONE OF OUR SHOPS OR ENCLOSE WITH YOUR MAIL ORDER.

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FOR PROMPT DESPATCH SEND YOUR ORDER TO DEPT. PW168, 53 TOTTENHAM COURT ROAD, LONDON W.1.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

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

HF121 12in. 15 watt	69/9
HF126 12in. 15 watt	79/9
HF126 12in. 15 watt	89/9
HF126 12in. 15 watt	5 gns.
HF127D 12in. 30 watt	9 gns.
HF510 5in. 8 watt	49/9
HF800D 8in. 8 watt	59/9
HF111D 8in. 10 watt	£4.19.9
HF101D 10in. 15 watt	£5.19.9

RECORD PLAYING UNITS All types available on Credit Terms. Ready for plugging into Amplifier or Tape Recorder.

RP2 Consisting of Garrard SP25 (with heavy cast turntable) fitted Goldring C590 high compliance ceramic Stereo/Mono cartridge with diamond stylus, plinth and cover. Normally **£25 22 Gns.** Carr. 15/.

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge **26 1/2 Gns.** Normally over £33. Carr. 15/- ONLY

HIGH FIDELITY LOUDSPEAKER UNITS

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

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

The DORCHESTER Size 24 x 15 x 10in. Fitted Audiotrine HF101D Speaker. Rating 15 watts. Impedance 3 or 15 ohms. Response 30-20,000 c.p.s. Carr. 15/- **12 1/2 Gns.**

The GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Smooth response 40-20,000 c.p.s. Impedance 15 ohms. Carr. 15/- **12 1/2 Gns.**

The BRONTE Size 22 x 15 x 9in. Fitted Wharfedale Super 8 RSDD or Audiotrine HF815D Speaker, with Roll surround and dual gap. Rating 6/10 watts. Impedance 3 or 15 ohms. Carr. 16/6 **12 1/2 Gns.**

LINEAR TAPE PRE-AMPLIFIER. Type LP1

Switched Equalisation. Positions for Recording at 11in, 3 1/2in, 7in, per sec., and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Magnavox Tape Deck and Hi-Fi amplifier suitable most **10 1/2 Gns.** Tape Decks. Terms available.

LINEAR SOLID STATE AMPLIFIERS IN STOCK

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

200-250v. A.C. mains operated. Frequency Response 30-20,000 cps. -2dB. Harmonic Distortion 0.3% at 1000 cps. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input Selector Switch. Output for 3-15 ohm speakers. Max. Sensitivity 5mV. Fully enclosed enamelled case. 9 1/2 x 2 1/2 x 5 1/2ins. Attractive brushed silver finish facia plate 10 1/2 x 3 1/2ins. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6. Or factory built with 12 months guarantee **£7.19.11.**

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

FULLY TRANSISTORISED 200/250V. A.C. Mains. OUTPUT 10 WATTS R.M.S. cont. into 15 ohms. 15 WATTS R.M.S. cont. into 3-4 ohms. LATEST MULLARD TRANSISTORS. AD149, AD149, OC127Z, OC81Z, OC44, OC44, OC81Z, OC44, AC107. 5 POSITION INPUT SELECTOR SWITCH. EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads. FULL TAPE MONITORING FACILITIES. SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2.5 mV. Radio/Aux or Ceramic P.U. 110 mV. FREQUENCY RESPONSE: +2dB 20-20,000 c.p.s. FREQUENCY CONTROL: +15dB to -14dB at 10Kc/s. NEG FEEDBACK: +52dB. BASS CONTROL: +12dB to -15dB at 50 c/s. HUM LEVEL: -75dB. HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0.25%. Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6. Supplied factory built 15 1/2 Gns. Carr. 12/6. Terms: Deposit 49/- and 9 monthly payments 35/- (Total £184.00). Or fitted in beautiful walnut or Teak veneered cabinet as illustrated. 4 1/2ins. extra. **11 1/2 Gns.** ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING BRITISH MANUFACTURERS.

AUDIOTRINE PLINTHS for Record Playing units

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

Or deeper type cut for TAI2, Super 15 or 30 13/6 extra.

HI-FI LOUDSPEAKER ENCLOSURES

All types of pleasing modern design acoustically lined and ported and beautifully finished in light Teak or Walnut veneer. Credit terms available

JES. Size 20 x 11 x 8in. Gives pleasing results with any 8in. speaker. Carr. 7/6 **£4.19.9**

SES. For optimum performance with any Hi-Fi 8in. speaker. Size 22 x 15 x 9in. Carr. 7/6 **£5.19.9**

SHF. For outstanding results with 10in. Hi-Fi Speaker. Size 24 x 15 x 10in. Carr. 10/- **6 Gns.**

SE12. For outstanding performance with any 12in. Hi-Fi speaker. Cut for tweeter. Size 25 x 16 x 10in. Carr. 10/- **7 Gns.**

AUDIOTRINE HI-FI TAPE RECORDER KIT

REALISM AT INCREDIBLY LOW COST: CAN BE ASSEMBLED IN AN HOUR. ONLY 4 PAIRS OF SOLDERED JOINTS PLUS MAINS. Incorporating latest Magnavox Tapedeck. High quality Tape Amp. Speaker, empty Tape Spool, Reel of Best Quality Tape and handsome Portable Cabinet of latest styling, finished dark grey leather-cloth. Size 14 1/2 x 17 x 8 1/2in. and circuit. Purchased separately would total approx. £34. Performance equal to units in the £30-£60 class. Deposit 4 gns. and 9 monthly payments 59/6 (Total 29 1/2 gns.) 4 Track Model 3 gns. extra. Carr. 10/6

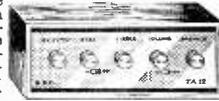
R.S.C. TF MI TRANSISTORISED VHF/FM RADIO TUNER

★ High-sensitivity ★ 200-250V. A.C. Mains operation. ★ Sharp. A.M. Rejection ★ Drift-free reception. ★ Output ample for any amplifier (approx. 500 m.v.). ★ Simple alignment instructions. ★ Output available for feeding tuning meter. ★ Tuner head using silicone Planar Transistors. ★ Designed for standard 80 ohm co-axial input. Made to visually match our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of constant. Printed circuitry. Only first grade transistors and compon'ts used. A quality product at half the cost of comparable units. Stereo version. All parts 19 1/2 gns. Assembled 25 1/2 gns. Carr. 10/6

R-S-C-TAI2 13 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 13 WATTS PER CHANNEL

Designed for optimum performance with any crystal or ceramic Gram P.U. cartridge. Radio tuner. Tape recorder, 'Mike' etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output—3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 30-20,000 c.p.s. —2dB ★ Harmonic Distortion 0.3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 100mV (3) 100mV (4) 2mV ★ Handy case brushed silver finish Facia and Knobs. Complete Kit of parts with full wiring diagrams and Carr. instructions. Factory built with 12 month gtee 14 gns. 11/0/6. Or Deposit 55/- and 9 mthly. pymts. 31/- (Total £16.14.0) GNS. Teak finished cabinet as above 73/6 or as below 86/6 extra.



SENSATIONAL STEREO OFFER!

R-S-C-13 WATT HI-FI STEREO SYSTEM

Inc. Garrard SP25 Player Unit (with heavy cast turntable) on plinth, ready wired, with plugs and fitted Goldring CS90 high compliance ceramic cartridge with diamond stylus. Assembled TA 12 Stereo Amp. in cabinet and Pair of Dorset Speaker Units. Total **£56.** Special Price or Deposit **£5.3.2** and 9 mthly. pymts. **£5.3.2** (Total **£51.11.8**). Carr. 25/- **44 Gns.** Perspex cover 50/- extra with above.

Consisting of matched 12in. 12,000 line, 10 watt 15 ohm high quality speaker; cross-over unit & Tweeter. Smooth response extended frequency range ensure surprisingly realistic reproduction. Carr. 6/9 Or Senior 15 watt inc. HF126 Speaker 6 gns. Carr. 8/9.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 12,000 line, 10 watt 15 ohm high quality speaker; cross-over unit & Tweeter. Smooth response extended frequency range ensure surprisingly realistic reproduction. Carr. 6/9 Or Senior 15 watt inc. HF126 Speaker 6 gns. Carr. 8/9.

Consisting of matched 12in. 12,000 line, 10 watt 15 ohm high quality speaker; cross-over unit & Tweeter. Smooth response extended frequency range ensure surprisingly realistic reproduction. Carr. 6/9 Or Senior 15 watt inc. HF126 Speaker 6 gns. Carr. 8/9.

R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. Cross-tolerance Ganged Pots. Matched Components. (GROSS TALK: 32dB at 1,000 c.p.s.)

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

etc. except for Ganging and Balance Control, apply also to Super 15.

THIS UNIT IS ESPECIALLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPER SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- Unit factory built 26 1/2 Gns. or deposit 83/9 and 9 monthly payments 59/3. (Total £30.17.0). Fitted cabinet as Super 15 30 Gns. Carr. 15/- or Deposit £4.15.6 and 9 monthly pymts 67/- (Total £34.18.6). Send S.A.E. for leaflet

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349

BRISTOL 14 Lower Castle St. (Half-day Wed.) Tel. 22904

BIRMINGHAM 30/31 Gt. Western Arcade opp. Snow Hill! Station 021-236-1279 No half-day

DERBY 26 Osaston Rd. The Spot (Half-day Wed.) Tel. 41361

DARLINGTON 13 Post House Wynd (Half-day Wed.)

EDINBURGH 133 Leith St. (Half-day Wed.) Tel. Waverley 5766

GLASGOW 326 Argyle St. (No half-day) Tel. City 4158
403 Sauchiehall St. (Opp. Locarno) Tel. 332-1572

HULL 91 Paragon Street. (Half-day Thursday) Tel. 20505

R-S-C

HI-FI CENTRES LTD.

32 High Street. (Half-day Thurs.) Tel. 56420 **LEICESTER**

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Open all day Sats, except High Holborn

HI-FI LOUDSPEAKER UNITS Consisting of 8in. Hi-Fi Speaker in Bass Reflex Cabinet size approx. 17 1/2 x 9 1/2 in. Walnut finish. Limited number only. Impedance 3 or 15 ohms. Peak rating 10 watts. ONLY 7 Carr. 7/9. GNS.

STEREO/TEN HIGH QUALITY AMPLIFIER

5 watts high quality output on each channel. Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo heads. Ganged Bass and Treble Controls. Valves ECC83, (2) EL84, (2) E281. For 2-3 ohm speakers. Complete kit with full wiring diagrams and instructions. Or supplied factory assembled £8.15.0 Carr. 11/6
 Terms: Dep. 36/- and 9 monthly payments 25/- (Total £13.4.0)



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

PROVIDING 10/4 WATT ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM, RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) E281. Frequency Response: +2dB 30-20,000 c.p.s. Hum Level: 65dB down. Sensitivity: 20 millivolts max. Harmonic Distortion: 0.2%
 ★Four-position tone compensation and Input Selector Switch. ★Stereo/Mono switch. ★Neon panel indicator.
 ★Handsome Perspex Frontplate. ★Separate Bass "Lift" and "Cut" controls. Output transformers are high-quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts, point-to-point wiring diagrams and instructions. 14 Gns. Carr. 12/6
 Or factory assembled with our usual 12 months' guarantee 19 Gns. Or Deposit £3 and 9 monthly payments 43/7 (Total £22.8.6). Send S.A.E. for Leaflet.



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

A highly sensitive 4-valve quality amplifier for the home. Small club etc. Suitable for all crystal or ceramic P.U. heads and practically all "mikes". Separate Bass and Treble controls. Hum level 71dB down. Negative Feedback 15dB. Reserve power supply 300v. 25 m.a. 6.3v. 1.5a for Radio Tuner etc. For A.C. mains 200-250v. Speaker output 3 ohms. Complete kit with point-to-point wiring diagrams and instructions. Or assembled ready for use 6 gns. plus 5/9 carr. £4.17.9



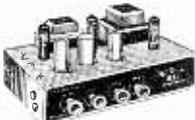
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

Highly sensitive. Push-Pull high output. with Pre-amp./Tone Control Stages. Performance figures equal to most expensive amplifiers. Hum level 70dB. Frequency response +3dB 30-20,000c/s. Sectionally wound output transformer. All first grade components. Valves EF86, EF86, ECC83 807, 807, G234. Separate Bass and Treble Controls. Sensitivity 12 millivolts so that any kind of Microphone or Pick-up is suitable. Designed for Clubs, Schools, Theatres, Dance Halls or Outdoor Functions, etc. For use with Electronic Organ, Guitar, Stereo Bass, etc. Gram. Radio or Tape. Reserve L.T. and H.T. for Radio Tuner. Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Metal cover with 2 handles available for 25/-. TERMS ON ASSEMBLED UNITS. Deposit 36/6 and 9 monthly payments of 33/7 (Total £17.10.3). Send S.A.E. for leaflet.



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

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with associated controls allowing mixing of "mike" and gram, etc., etc. High sensitivity. Valves ECC83, ECC83, EL84, EL84, E281. High quality sectionally wound output transformer and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE. Frequency response +3dB 30-20,000c/s. Six negative feedback loops Hum level -60dB. SENSITIVITY 23 millivolts. Suitable for Crystal or Ceramic P.U.s. all types "mikes". Comparable with the very best designs. For Musical Instruments such as String Bass, Electric Guitars, etc. Reserve Power 300v. 30mA. and 6.3v. 1.5a. for Radio Tuner or Tape Pre-Amp. Size approx. 12x9x7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohm speakers. Full instructions and point-to-point wiring diagrams £8.15.0. Carr. 11/6 (or factory built £11.15.0). Metal cover with 2 handles available for 25/-. TERMS ON ASSEMBLED UNITS. Deposit 36/6 and 9 monthly payments of 25/9 (Total £13.8.3). Send S.A.E. for leaflet.



R.S.C. A11 TRANSISTORISED VERSION of above complete kit 9 gns. Carriage 9/6.

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

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT For lead, rhythm, bass guitar and all other musical instruments. For vocalists, gram, radio, tape, and general public address.
 ★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 12in. 30 watt unit PLUS a 12 inch 20 watt unit with extended frequency response.
 ★ 4 Jack inputs and two Volume Controls for simultaneous use of up to 4 pick-ups or "mikes". ★ Cabinets covered in two-tone Rexine/Vynair with gold trimming. Fitted carrying handles.
 ★ Separate Bass and Treble Controls giving "lift" and "cut".
 49 1/2 Gns. Carr. 30/- Or dep. £7.17.6 and 9 monthly pymts of 25.10.10. (Total 55 gns.) Send S.A.E. for leaflet.



B20 MULTI-PURPOSE AMPLIFIER

especially suitable for Bass Guitar
 Incorporating massive 15in. high flux loudspeaker. Rating 25 watts. Individual bass and treble controls. Two jack inputs separately controlled. Substantial cabinet attractively finished in Rexine and Vynair. Size approx. 24 x 21 x 11in. Send S.A.E. for leaflet. 29 1/2 Gns. Or Deposit £4.14.6 and 9 monthly payments of 66/- (Total £34.8.6). Carr. 17/6.



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

High-fidelity output. Separate bass and treble controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Heavy Duty 12in. 20 watt Speaker. Cabinet covered in attractive Rexine/Vynair. Size 18 x 18 x 8in. Deposit 3 gns. 19 1/2 Gns. Carr. and 9 monthly payments of 43/7 (Total £15.15.3). S.A.E. for leaflet.

G80 80 WATT AMPLIFIER

2 Channels, 6 inputs, Tremolo, 2 Columns and 1 Bass Speaker unit with two 15in. Extra Heavy Duty Speakers.

99 Gns. £3

R.S.C. BATTERY/MAINS CONVERSION UNITS

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

POWER PACK KIT

Consisting of Mains transformer. Metal Rectifier. Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. 22/11 mains. Output 250v. 60mA 6.3v. 2a. Supplied with case in lieu of chassis 26/11. Or assembled 39/11.

SELENIUM RECTIFIERS F.W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 3/11. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9. 10a. 25/8.



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

Kits consist of Enamelled steel case. Ammeter, Rectifier, Transformer. Fuses, Panels, Plugs and Leads.
 2 amp 39/9, 4 amp. with variable charge rate sel. 49/9
 6 amp heavy with variable charge rate sel. 69/9
 All types 200-250 A.C. mains. Ready built 10/- extra.

LONDON-GLASGOW New branches now open—see addresses

R.S.C. COLUMN SPEAKERS Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address. 15 ohm matching. Type C48, 25-30 watts. Fitted four 8in. high flux 7 watt speakers. Overall size 15 Gns. approx. 42 x 10 x 5in. Or deposit 44/- and 9 monthly pmts 34/9 (Total £15.1.6 Carr. 10/- Type C412, 40 watts. Fitted four 12in. 10,000 line 10 watt speakers. Overall size 22 Gns. 56 x 14 x 9in. approx. Carr. 15/- Or Deposit £3.13.0 and 9 monthly payments of 50/- (Total £26.3.0).

30 WATT HI-FI AMPLIFIER

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



12in. HIGH QUALITY L'SPEAKERS

In teak veneered cabinets. Size 15 x 15 x 7in. 10 Watt Model, Gauss 12,000 5 Gns. Lines. 3 or 15 ohms. Carr. 7/6
 20 Watt Model, 15 ohm. Size 8 Gns. Carr. 15 x 10 x 10in. Gauss 12,000 lines. 10/6
 Rexine covered extra. Terms available.
 30 Watt Model, Rexine covered 10 Gns.



LOUDSPEAKERS Limited number at fraction of list price 15 ohms impedance.

Brand new, guaranteed. Terms available over 48.
 12in. 10 watt HIGH FLUX 59/11.
 12in. 20 watt DUAL CONE Heavy Duty £51.1.9. Carr. 6/9.
 12in HEAVY DUTY 30 watts. 7 Gns. Carr. 10/- Normally £13 approx.
 15in. EXTRA HEAVY DUTY 40 watts. 12 Gns. Carr. 15/- Massive units. Usually 18 Gns.

FANE 'POP' 100 L'SPEAKER

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

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

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

TWO-WAY TELEPHONE AMPLIFIERS

Speak and Listen with both hands free. Comp. £3.19.9 pact transistorised Dry Battery operated.

R.S.C. MAINS TRANSFORMERS

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

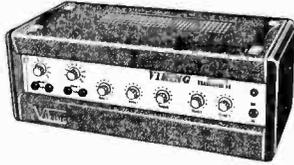
EDGET TYPE 2 1/2 x 2 1/2 in.	14/11
250v, 60mA, 6.3v. 2a.	14/11
250-0-250v., 60mA, 6.3v. 2a.	15/11
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250v. 60mA, 6.3v. 2a., 0-5-6.3v. 2a.	19/9
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	33/9
300-0-300v. 130mA, 6.3v. 4a., c.t., 6.3v. 1a.	
For Mullard 510 Amplifier, etc.	
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	41/9
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	42/9
425-0-425v. 200mA, 6.3v. 4a., c.t., 5v. 3a.	67/9
425-0-425v. 200mA, 6.3v. 4a., c.t., 5v. 3a.	69/9
450-0-450v. 250mA, 6.3v. 4a., c.t., 6.3v. 3a.	78/9
TOP SHROUDED DROP-THROUGH TYPE	
250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a.	19/9
250-0-250v. 100mA, 6.3v. 3.5a.	21/9
250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a.	22/9
300-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a.	23/9
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	32/9
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a.	
Suitable for Mullard 510 Amplifier, etc.	
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a.	39/9
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a.	39/11
FILAMENT OR TRANSISTOR POWER PACK TYPES	
6.3v. 1.5a. 6/9; 6.3v. 2a. 7/9; 6.3v. 3a. 9/9; 6.3v. 6a. 19/9; 12v. 1a. 8/9; 12v. 3a. or 24v. 1.5a. 19/9; 0-9-18v. 1 1/2a. 15/9; 0-12-24-42v. 2a. 27/9.	
CHARGER TRANSFORMERS 0.9-15v. 11a. 13/11; 2 1/2a. 16/11; 3a. 18/11; 5a. 21/11; 6a. 25/11; 8a. 31/11	
AUTO (Step Up/Step Down) TRANSFORMERS	
0-110/120v. -200-250-250v. 50-80 watts	14/9
50-120 watts, 29/11; 250 watts 49/9; 500 watts 99/9	
OUTPUT TRANSFORMERS	
Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	7/9
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	11/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15 Ω	21/9
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	19/9
Push-Pull Ultra Linear for Mullard 510, etc.	35/9
Push-Pull 15-18 watts sectionally wound 6L6, KT66, etc. for 3 or 15 Ω	29/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	55/9
SMOOTHING CHOKES	
150mA, 7.10H, 250 Ω 4/9	
100mA, 10H, 200 Ω 9/11	
80mA, 10H, 350 Ω 7/9	
60mA, 10H, 400 Ω 4/11	



VIKING TRANSISTOR

40-50 WATT AMPLIFIER

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



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

POCKET MULTI-METER



Size 3 1/2 x 2 1/2 x 1 1/2 in. Meter size 2 1/2 x 1 1/2 in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0-15, 0-150, 0-1000. D.C. current 0-150mA. Resistance 0-100kΩ. Complete with test leads, battery and full instructions, 42/6. P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value 15/- to every purchaser of the Pocket Multi-Meter.

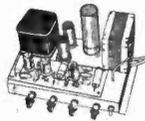
600 mW SOLID STATE 4-TRANSISTOR AMPLIFIER

Features NPN and PNP Complementary Symmetrical Output Stage. The elimination of transformers ensures maximum efficiency and frequency response. Automatic heat compensation. Combined AC/DC feed back. Class B output stage. i.e. output power is proportional to total current consumption, this ensures long battery life. Under no signal condition (1Q) current drain is approx. 12mA at 9 volts (4mA in the output pair). Printed circuit construction, size 2 1/2" x 3 1/2" x 3 1/2". Speaker output impedance 12 ohms. Output power 600mW at 5% distortion, 400mW at 2.5% distortion, 750mW at 10% distortion. Supply 9 volts. Total current consumption at a reasonable listening level approx. 35-40mA at full power (speech and music), average 65mA. Sensitivity for 50mW output is 10mV. Frequency response—3dB points 90c/s and 12Kc/s. Price 15/-, plus 1/- P. & P. 7" x 4" speaker to suit, 13/6 plus 2/- P. & P.

Features NPN and PNP Complementary Symmetrical Output Stage. The elimination of transformers ensures maximum efficiency and frequency response. Automatic heat compensation. Combined AC/DC feed back. Class B output stage. i.e. output power is proportional to total current consumption, this ensures long battery life. Under no signal condition (1Q) current drain is approx. 12mA at 9 volts (4mA in the output pair). Printed circuit construction, size 2 1/2" x 3 1/2" x 3 1/2". Speaker output impedance 12 ohms. Output power 600mW at 5% distortion, 400mW at 2.5% distortion, 750mW at 10% distortion. Supply 9 volts. Total current consumption at a reasonable listening level approx. 35-40mA at full power (speech and music), average 65mA. Sensitivity for 50mW output is 10mV. Frequency response—3dB points 90c/s and 12Kc/s. Price 15/-, plus 1/- P. & P. 7" x 4" speaker to suit, 13/6 plus 2/- P. & P.

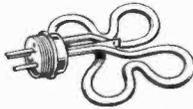
8-watt 4-valve PUSH-PULL AMPLIFIER & METAL RECTIFIER

Size: 9" x 6" x 1 1/2". A.C. Mains, 200-250V, 4 valves. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Output 8 watts at 5 per cent of total distortion. Separate bass and treble lift control. Two inputs with controls for gram. and mike. Output transformer tapped for 3 and 15 ohm speech coils. Built and tested. £44.0. P. & P. 11/-, 8" x 5" speaker to suit price 14/6 plus 1/8 P. & P. Crystal mike to suit 12/6 plus 1/6 P. & P.



GEC KETTLE ELEMENT

3,000W WITH AUTOMATIC EJECTION 200/240 v. Size of hole required 1 1/8". List Price 32/-, Our PRICE 15/-, P. & P. 1/6.



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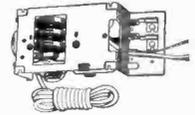
STAR SR 150 COMMUNICATION RECEIVER

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



TRANSISTORISED 1 1/2 WATT AMPLIFIER

Incorporating Mullard transistors type: 2, AC128's, 2, OC75's, and 2, AA129's. Separate bass and treble volume controls. Complete with Power Supply AC mains, 240V. Size 7 1/2" x 3 3/4" x 2". Price 50/- plus 2/6 P. & P.



ANTI-THIEF CAR BURGLAR ALARM

The Melguard Safermatic consists of an electrical device housed in small metal box 4" x 2" x 1 1/2", which has been designed and developed to provide protection required by the average motorist at an economic cost. Using this system, an alarm and the immobilised condition is set automatically as soon as you park the car. Should you leave the key in the ignition, no one but you can drive the car away. Upon entering the vehicle the method of starting the car is by switching on the ignition, depressing two hidden switches, and simultaneously operating the starter. Location of the switches is known only to you. Should the alarm be set off it can be stopped by following the normal starting procedure. For 12V operation. List price 79/6, our price 29/6 plus 2/6 P. & P. Full easy-to-follow instructions supplied.

3 to 4 Watt AMPLIFIER

3-4 watt Amplifier built and tested. Chassis size 7 x 3 1/2 x 1in. Separate bass, treble and volume control. Double wound mains transformer, metal rectifier and output transformer for 3 ohm speaker. Valves ECC81 and 6V6. £2.5.0 plus 5/6 p. & p.



"MUSETTE" 6-Transistor Superhet Portable Radio

★ 2 1/2" Speaker. ★ 6 Transistor Superhet Output 200mW. ★ Plastic Cabinet in red, size 4 1/2" x 3" x 1 1/2" and gold speaker louvre. ★ Horizontal Tuning Scale. ★ Ferrite Rod Internal Aerial. ★ IF 460 kc/s. ★ All components Ferrite Rod and Tuning Assembly mount on printed board. ★ Operated from PP3 Battery. ★ Fully comprehensive instructions and point-to-point wiring diagram. ★ Printed Circuit Board. ★ Tunable over medium and low waveband. ★ Car aerial and earpiece socket.



Price 39/8. inc. carrying strap. Circuit Diagram 2/6 free with parts. P. & P. 3/6.

NEW TRANSISTORISED SIGNAL GENERATOR

Size 5 1/2 x 3 1/2 x 1 1/2 in. For IF and HF alignment and AF output 700 c/s frequency coverage 460 kc/s to 2 mc/s in switched frequencies. Ideal for alignment to our Elegant Seven and Musette. Built and tested. 39/6 P. & P. 3/6.



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

Type TD2 Tape speed 3 1/2 twin track, £6.19.6. Type TD10 2-track, 3 speed, plus rev. counter—£7.19.6. Type TD10 4-track, 3 speed, plus rev. counter—£9.5.0. P. & P. on each 7/6.



FIRST QUALITY P.V.C. TAPE

5 1/2" Std.	850ft.	9/-	5" L.P.	850ft.	10/6
7 1/2" Std.	1200ft.	11/6	3" T.P.	600ft.	10/6
3" L.P.	240ft.	4/-	5" T.P.	1800ft.	25/6
5 1/2" L.P.	1200ft.	11/6	5 1/2" T.P.	2400ft.	32/6
7 1/2" L.P.	1800ft.	18/6	7" T.P.	3600ft.	42/6
5 1/2" D.P.	1800ft.	18/6	4" T.P.	900ft.	15/-

P. & P. on each 1/8, 4 or more post free.

EXTRACTOR FAN



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

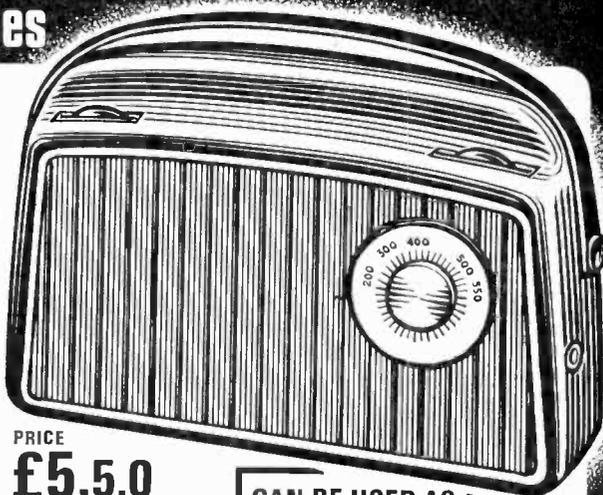
GEC DOORBELL

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



NEW! The Dorset Transistor Portable Radio with BABY ALARM facilities

600 milli-watt solid state 7 transistor plus diode and thermistor. Completely modulated high quality portable radio featuring complementary N.P.N. and P.N.P. output stage. The comprehensive easy-to-follow drawings supplied make this the easiest-ever transistor radio set of parts, with the following features: ● Simple connections to only 6 tags on the R.F./I.F. module, 3 I.F. stages, osc. coil and 3 transistors which with their associated components are completely wired. ● Only 4 connections on the A.F. module to complete the 4 transistor 600 milli-watt solid state amplifier. ● Pre-aligned R.F./I.F. module built and tested. ● A.F. module built and tested. ● Fully tunable over M.W. and L.W. bands. M.W. 540-1640 Kc/s (557-183 metres). L.W. 150-275 Kc/s (2000-1100 metres). ● Intermediate Frequency 470 Kc/s. ● Sensitivity: M.W. at 1 Mc/s 10 microvolts plus or minus 3db. L.W. at 200 Kc/s 40 microvolt plus or minus 4db. ● High Q internal ferrite rod aerial on both wavebands. ● Class "B" modulated output stage with thermistor controlled heat stabilisation. Class "B" output stage ensures long battery life. Current drain is proportional to the output level. Total current drain of the receiver under no signal conditions is 10-12 mA. At reasonable listening level 20-30 mA. ● Extension sockets for car aerial input, tape recorder output (Independent of volume control) and Ext. Speaker. ● All components (except speaker) mount on the printed circuit board. Easy-to-follow instructions. Size of cabinet 12in. long, 8in. high and 3in. deep. ● Finger-tip controls.



PRICE
£5.50

plus 7/6 postage & packing

**CAN BE USED AS
BABY ALARM**

Circuit and parts list 2/6 free with parts.

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Elegant Seven Mk III COMBINED PORTABLE and CAR RADIO

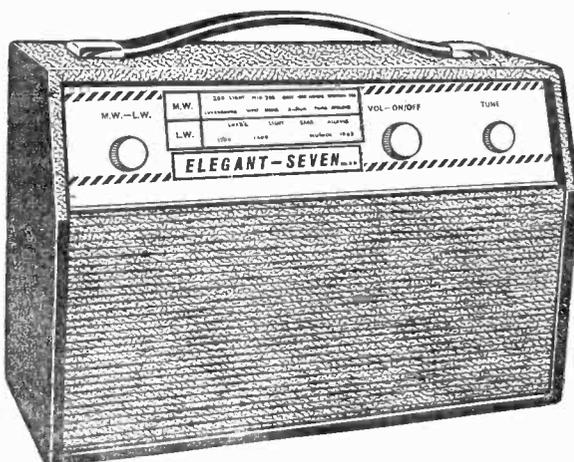
SPECIAL OFFER

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

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

ONLY **£4.4.0**

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



POWER SUPPLY KIT

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

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6B6 2/-	6K6 3/-	7C6 8/-	12R7 3/9	37 5/-	DF33 6/-	EC98 3/9	EFP98 9/-	N78 15/6	PL84 6/6	UBP89 6/6	3E11 50/-
6B4G 15/-	6J7M 7/6	7D5 8/-	14H7 9/-	50B5 6/6	DF91 3/-	EC98 3/9	EFP98 9/-	N78 15/6	PL84 6/6	UBP89 6/6	3E11 50/-
6BA6 6/6	6J7G 4/9	7H7 6/-	19AQ5 5/-	50C5 5/9	DF92 2/6	EC98 3/9	EFP98 9/-	N78 15/6	PL84 6/6	UBP89 6/6	3E11 50/-
6BE6 4/6	6J7GT 6/6	7R7 17/6	20D1 10/-	50CD6G 31/-	DF96 6/3	EC98 3/9	EFP98 9/-	N78 15/6	PL84 6/6	UBP89 6/6	3E11 50/-

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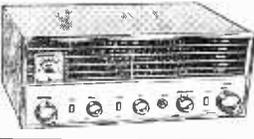
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1mA	750mA	22/6	500V D.C.	22/6
2mA	1A D.C.	22/6	750V D.C.	22/6
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10mA	5A D.C.	22/6	50V A.C.	22/6
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50mA	10V D.C.	22/6	300V A.C.	22/6
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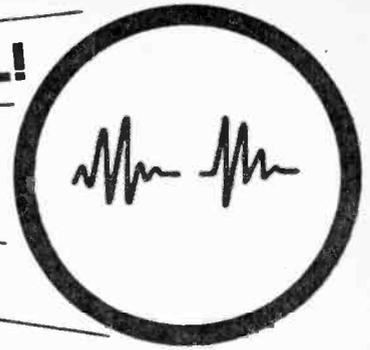
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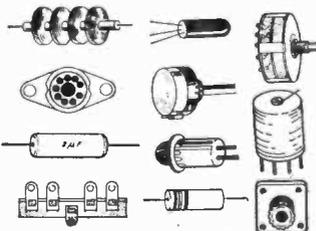
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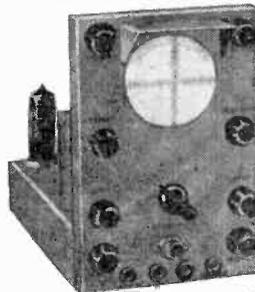
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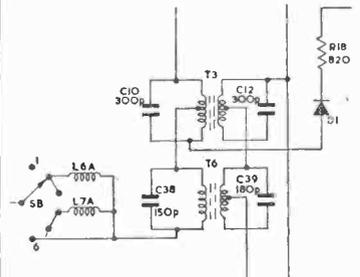
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PRACTICAL WIRELESS

VOL 43 No 9

issue 731

JANUARY 1968

TOPIC OF THE MONTH

Dear Santa

AND what, dear reader, would you like Santa Claus to bring you this Christmas—assuming that the old gentleman can negotiate your array of TV aerials, break out of your converted chimney-piece speaker enclosure, avoid falling over your junk box and, if he does, choke back the cries of anguish to avert operating your audio switch and turning on the telly? Apart, that is, from a gadget to stop editors committing sentences like the above to print.

We made a few enquiries. Messrs. Guttridge and Gibson plumped for sockfuls of exotic DX, Henry and Pax wanted an exclusive interview with the man (no doubt as an excuse to work in a Santa Claus and reindeer sketch) and although many readers would ask for the secret of 100% success in constructional projects Messrs. King and Hellyer wanted more and better failures, obviously to justify some more fault finding articles.

The P.W. staff, when pressed, came up with a number of startling (though somewhat predictable) requests which we are glad to forget. But every individual reader would find no trouble in drawing up a splendid list of gifts.

Well, fasten your safety belts, for we have bad news. We learn, on the best authority, that there just ain't no Santa Claus! You will just have to carry on without his help and make the best of it under your own steam. Maybe it's just as well, really. You'll get much more fun and satisfaction working things out on your own. The only sure way to success is in learning by mistakes, building up experience gradually and trying things out.

But if you're still not convinced about Santa Claus, why not ask him for an annual subscription to Practical Wireless? You never know your luck! Or, better still, play Santa yourself and solve that difficult Christmas problem with a subscription to your friend — or, if you have no friends, to yourself!

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FEBRUARY ISSUE WILL BE PUBLISHED ON
JANUARY 5th

Merry Christmas and a Happy New Year

from the staff of Practical Wireless

W. N. STEVENS

L. E. Howes, G3AYA

D. L. Gibson, G3JDG

J. A. Reddihough

C. R. Riches, BRS28358

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., 1968. 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.

NEWS AND COMMENT...

"SATELLITE JOURNALISM"

The Post Office made journalism history on October 17th when it provided facilities for the inter-continental transmission of a newspaper page over a 48kc/s satellite circuit.

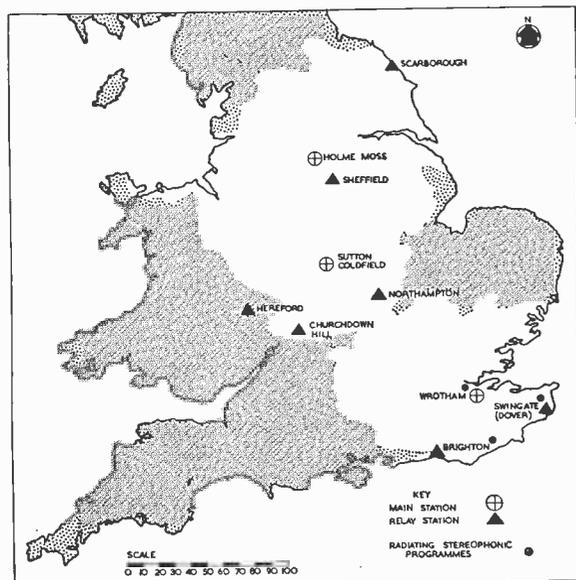
A Muirheads Page Facsimile Transmitter in the London office of the "Daily Express" was connected with a Muirheads Page Facsimile Receiver installed in the plant of the "El Mundo" newspaper in San Juan, Puerto Rico.

The 48kc/s circuit, involving the use of cable and micro-wave systems connecting the "Daily Express" with the GPO's Goonhilly Earth Station, was extended to Mill Village, Canada, through the COMSAT Organisation's "Early Bird" satellite. The link from Mill Village to San Juan was afforded over the facilities of the AT & T and IT & T companies.

This demonstration was undertaken on behalf of the Inter-American Press Association whose annual general conference took place in San Juan during the middle of October.

V.H.F. STEREOPHONIC TRANSMISSIONS

(Extension to the Midlands and North)



Reproduced by courtesy of the BBC Engineering Information Department.

Work is in hand to extend the stereophonic transmissions, at present radiated from Wrotham, Swingate and Brighton, to Sutton Coldfield and Holme Moss and certain relay stations fed from them, early in 1968. The unshaded part of the map above indicates the areas in which satisfactory stereophonic reception should normally be obtained. In places where the field strength is low, increased background noise may be heard on stereophonic programmes; improvements to the receiving aerial should enable the noise level to be reduced.

"KNIGHT

KITS"

FROM

MESSRS.

ELECTRONIQUES



KG-275 Exposure Meter

Messrs. Electroniques have entered the "Kit" market with a vengeance. Their latest catalogue lists a host of units to suit all tastes. Signal generators, Hi-Fi, Oscilloscopes, Power Units and Receivers to mention just a few.

Readers will be pleased to hear that Electroniques claim a near foolproof system of guaranteed satisfaction with all their "Knight-Kits". They run a postal service for any advice needed. They will service the unit if required, and if, after building the Kit, difficulty is encountered, they will get it working too. There is also a money-back guarantee.

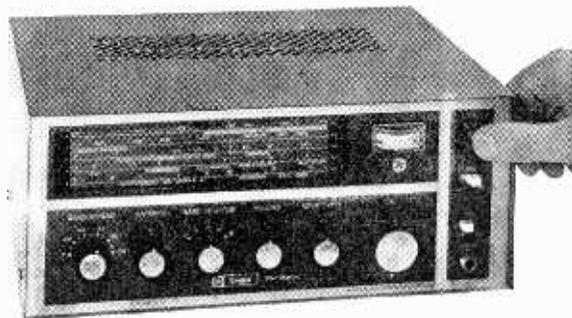
The above photograph illustrates the KG-275 Exposure Meter. It is possible to construct this in an evening and it is claimed that "It responds to light so weak—you can't see to read the meter".

The photograph below is their "Star Roamer" all band receiver which covers from 200 to 400kc/s and from 550kc/s to 30Mc/s continuous thus covering long, medium and short waves both commercial and amateur.

The instruction manuals are laid out in such a manner that Electroniques are able to claim that anyone—regardless of their knowledge of radio and electronics, can build any of these kits. The wiring is taken a step at a time and each manual is generously illustrated. Even the wires are colour-coded and cut to length too. They even tell the constructor when to take a break for coffee!

It is pleasing to note in the catalogue, that against most of the kits is a recommended book to assist the constructor gain the fullest advantage of the unit he has constructed.

A catalogue of the new "Knight-Kits" is available free from Messrs. Electroniques (Prop. STC Ltd.), Edinburgh Way, Harlow, Essex.



Star Roamer receiver

NEWS AND COMMENT...

NON-STOP POP BATTLE

The BBC may face a big clash with the pop record companies if it increases the broadcasting time for playing records. The companies fear that continuous radio pop will stop people buying records.

The BBC chiefs are under pressure from Mr. Robin Scott, controller of Radio 1, who wants record time increased from the present 82-hours-a-week limit.

His plea is backed by young people who have been writing to the BBC complaining about the broadcasting of quiz shows and plays instead of continuous pop "like the pirate stations".

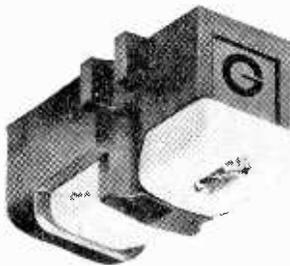
Opposition to an increase of needle time (the broadcasting term for the playing of records) comes from the Musicians' Union and Phonographic Performances, a consortium of record firms.

They claim an increase would mean less work for musicians and "over-exposure" of records, with transistor radios being used as "portable juke boxes".

LONG-RANGE COMMUNICATIONS IN AUSTRALIA

The building of a long-range cable connection is to be commenced in Western Australia early in 1968, involving a cable almost 600 miles long with four co-axial conductors which will connect the towns of Perth and Carnarvon. A 12Mc/s system will simultaneously transmit 1,200 long-distance calls and a TV programme along two conductors; the other two lines are being equipped with a 4Mc/s system comprising 960 telephone circuits. Siemens will be supplying and installing the line amplifiers for both systems. The transistorised wideband amplifiers conform with the latest state of the art, require no maintenance whatever and can be fed with d.c. via the inner conductors of the associated coaxial conductors. These wideband amplifiers are accommodated in more than 200 intermediate repeater points mainly in underground containers.

FREE FIELD STEREO CARTRIDGE



Goldring Manufacturing Co. (GB) Ltd., 486-488 High Road, Leytonstone, London, E.11, announce their new stereo magnetic cartridge, No. 800. In this unit, a very light-weight tube of magnetic material lies in a "free field" generated by a fixed source and is made to follow the record groove modulation by its

coupling to a low mass diamond point. Due to the low mass, the mechanical impedance of the moving system has been reduced, pushing the resonance up to a frequency of over 20kc/s.

A significant by-product of this "free field" system is that the cross-talk separation is maintained at a very high level, never falling below 15dB even at the highest frequencies and averaging over 20dB at the mid-frequencies.

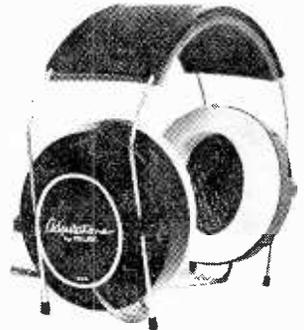
Sensitivity is 1mV per cm/sec.; separation is 25dB at 1kc/s; load is 100k Ω -47k Ω ; effective point mass is 1mg and stylus point, 0.0005in. diamond. Tracking weight is 8 grams. The price is £12 7s. 6d. which includes P.T.

HEADPHONES WITH TONE CONTROL

A new headphone, from the USA claims to reproduce full bass sound to surpass any headphone made, plus the special "Adjustatone" feature which allows response up to the limits of human hearing yet provides for scratch and hiss elimination.

Frequency response is from 10 to 15,000 c/s. Weight 12 oz. Operation is on outputs from 3 to 16 Ω and requires less than 1W. Distortion is less than 1% at levels below the threshold of pain (130dB SPL). Sensitivity is 100dB SPL/mW at 400c/s.

Price is 9½ gns. Transatlantic Music Tapes (Distributors) Limited, Bristol & West House, High Street, Salisbury, Wiltshire.



BBC RADIO LEICESTER

The first of the BBC's local radio stations was brought into service at Leicester on November 8. Transmission is on 95.05Mc/s in the v.h.f. band, with horizontal polarisation, from a transmitter at Anstey Lane. Regular trade test transmissions are radiated daily from 09.30 to 18.00 and started on Friday, October 27.

The local programmes are originated from the headquarters of BBC Radio Leicester at Epic House, Charles Street.

Radio Leicester serves Leicester and its immediate surroundings including Arnesby, Cosby, Desford, Woodhouse Eaves, Burton-on-the-Wolds, Hungerton and Gaulby. The transmissions are on v.h.f. only. Listeners who may not have a v.h.f. receiver should consult their radio dealers who will be able to advise about reception.

Receivers for Radio Leicester are also suitable for reception on v.h.f. of Radio 2 (Light Programme), Radio 3 (Third Network) and Radio 4 (Home Service). The BBC's v.h.f. sound services provide improved reception which is much less susceptible to noise and interference than is reception on medium and long waves.

L. W. Roche

It is with deep regret that we have to announce the death of L. W. ROCHE. "Lew", as he was known to all his many friends and acquaintances, did a great deal of pioneer work in the field of electronic music. Many of his electronic organ designs in "kit form" currently enjoy wide popularity. He was associated at various times with a number of companies who specialised in this field, and at the time of his death was chief design engineer for Henry's Radio Ltd. "Lew" had been failing in health for a number of years. To his family we express our sympathies in their great loss.

SIMPLE CRYSTAL TUNER



W.E. DODD

THE simple crystal receiver has many advantages to offer. It is cheap to construct, easy to build and doesn't require any form of power either from the mains or batteries. It can be left switched on without waste, and requires only an aerial and an earth lead to provide hours of inexpensive entertainment. This is an ideal project for the beginner and also provides a very acceptable present for the Christmas stocking for a youngster.

LAYOUT

The layout of the receiver is very uncritical and the components can be laid out in almost any style to suit the container or case. The prototype was built in a two-ounce tobacco tin merely because this

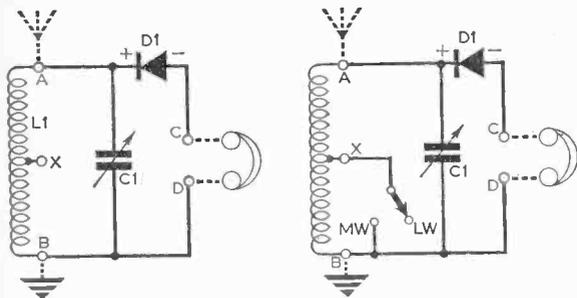


Fig. 1 (left): Simple longwave crystal set.
Fig. 2 (right): Adding a switch for m.w. and l.w.

was to hand and a wooden container would be just as good.

CIRCUIT

The complete circuit diagram is shown in Fig. 1. Only three components are used: a coil, a capacitor, and a crystal diode. An aerial is connected to point A, the earth to point B, and a pair of headphones to points C and D. If a mistake is made in the wiring no damage will be done, the set just will not work until the fault is rectified.

The prototype receives three programmes in Hertfordshire at headphone strength—Radio 1, Radio 4, and on long waves Radio 2. As it stands the circuit in Fig. 1 will receive only long waves and thus only one station, Radio 2. If a piece of wire is connected to points B and X this will short out the lower part

of the coil and the receiver will work only on medium waves. In this condition it receives two stations, Radio 1 and Radio 4. For simplicity this latter connection would be ideal, but if we were to wire-in a simple switch between points B and X we could have a two-band set for either medium or long waves dependent upon the position of the switch. This modification is shown in Fig. 2. Any on/off type of switch will do but in order to ensure that it will fit in the case, one of the small slide switches, mounted on the side of the case, would be best.

CONSTRUCTION

There are only four holes to drill. Three are 6BA—two for the coil and one for the small tag strip. The fourth hole is $\frac{3}{8}$ in. diameter for the tuning capacitor. Mount the tuning capacitor first, then the tag strip and finally the coil. The 6BA bolts will make their own thread in the coil former but these should be tightened gently otherwise the coil former might split.

The thick double tag on C1 is the tag to connect to earth, the other tag being the aerial connection. It must now be decided whether a switch is to be used. If not, then now is the time to decide whether long or medium wave is to be selected. Since the

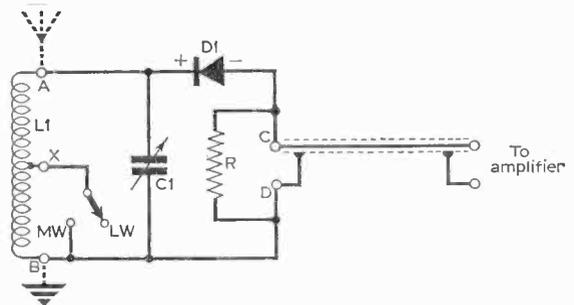


Fig. 3: Adding a 4.7k Ω resistor to make a tuner.

prototype was wired for medium wave only, this wiring will be described first.

Take a length of wire and connect it to the red and blue tags on the coil L1. From here the same wire is taken to the large double tags on the tuning capacitor C1 and from this point to tags 1 and 2 on the tag strip.

Next, a wire is connected from the remaining tag on C1 to tag 4 on the tag strip. Now solder another wire from the same point (tag 4 on the tag strip), to the black tag on the coil. The last step is to connect the diode between tags 3 and 4 on the tag strip. The diode should be connected with its positive end to tag 4 and the negative end to tag 3. This completes all the wiring for the medium wave only set.

To test the receiver, connect a pair of high resist-

ance headphones (4,000Ω) to tags 2 and 3 on the tag strip, the aerial to tag 4 and the earth lead to tag 1. By rotating the tuning capacitor it should be possible to hear a station, possibly two stations. The set should receive a station quite well if it is within 40 to 50 miles from the transmitter.

In some cases it might be difficult to separate the two stations and here it would pay to experiment with the length of the aerial. Alternatively, another variable capacitor, the same value as C1, could be connected between the aerial and point A on Fig. 1.

If long wave only is required it is only necessary to break the wire which shorts the red and blue tags on the coil together. In this case the red tag is left unconnected and only the blue tag is wired up.

DUAL WAVE

For the reception of both long and medium waves a switch is required as explained. The set is wired as for long waves only and two wires are taken to the switch. One wire from the blue tag, this is the wire which goes from the blue tag to the double tags on the tuning capacitor and tags 1 and 2 on the tag strip. This wire is continued to one terminal on the switch. Another wire is taken from the red tag on the coil to the other terminal of the switch. Note, this will be the only wire on the red tag of the coil.

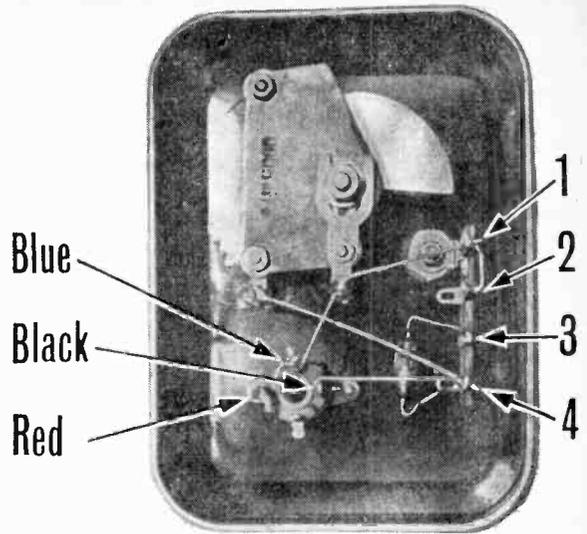
The aerial should be as long and as high as possible. A length of 70ft. of bell wire was used on the prototype with the earth taken to a length of copper pipe driven into the ground just outside the window. However, quite good results were obtained using only the bedsprings as an aerial and no earth, although this produced considerably less volume and no stations could be heard on long waves with this set-up. A length of wire around the picture rail should also produce results.

The front of the case was masked with adhesive tape and then sprayed with a paint aerosol, after which the tape was removed. The dial was made from

★ components list

- C1 500pF variable capacitor (Jackson Dilecon).
- L1 Dual range crystal set coil (Repanco type DRX1).
- D1 Diode. OA81 (or OA70, OA79). Almost any diode will do.

Four-tag tag strip, 6BA bolts and nut, scraper board, pointer knob, two-ounce tobacco tin, high resistance headphones (4,000Ω), aerial and earth wire, wire for wiring up, solder, 4.7kΩ ¼-watt fixed resistor if required.



View of the completed receiver wiring. Component positioning is not critical as there is plenty of room. Note the bottom tag of coil has no connections

black scraper board which is easily obtainable from most stationers and art shops. It costs 2s. 6d. for a small packet. This is a black-coated card which, when scratched or scraped, will produce a white image. The dial could easily be made from a piece of white card or paper and the marking made in ink.

The photograph shows the inside of the case and the wiring of the prototype wired for medium waves only. The inside of the tin is not normally black. It was painted this colour purposely, but only so that the wiring and components would show up better on the photograph.

The crystal set may be used as a tuner in conjunction with an amplifier. Good results were obtained using the prototype with a small commercial transistor amplifier. To use the set in this way one extra component is required—a 4.7kΩ fixed resistor. This component is wired across on tags 2 and 3 on the tag strip. A length of screened lead is then taken from these two tags to the amplifier. The braiding or screening of this lead goes to tag 2, and the other wire to tag 3. Similarly, at the amplifier end, the screening goes to the earth line and the other wire to the amplifier input. When the set is used in conjunction with an amplifier the phones are, of course, disconnected from the circuit. ■

CONSTRUCTION

THEORY

DISCUSSION

WIDE RANGE PULSE GENERATOR

A precision unit which, when used in conjunction with an oscilloscope, is extremely useful for television circuit and response testing. It also has important applications in the fields of CCTV and colour television.

CAPACITANCE DIODE TUNING

Junction diodes are becoming increasingly used for a wide range of applications, from a.f.c. to tuning by means of a potentiometer at v.h.f. and u.h.f. How and why they do this, and elementary basic principles of semiconductor diodes are examined in this article.

THE PROFESSIONAL SERVICE ENGINEER

What are the prospects, the opportunities and qualifications required in this field? Many amateurs plunge headlong into the trade without this knowledge and are at a disadvantage. These relevant points are discussed and general workshop procedure is also fully covered.

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SEMICONDUCTOR AUDIO

PART 3

R. LEYLAND

IN power amplifiers transistors are required to work at levels that leave only a small margin of safety against thermal runaway. The maximum temperature has to be kept within the limit permissible by the efficient removal of the heat being produced, which is concentrated mainly at the collector junction. Conduction of this heat into a larger area of metal enables it to be radiated and convected at a faster rate, and the power is increased for a given junction temperature.

Germanium transistors in Class B output stages require heat sinks at outputs above a fraction of a watt, and small silicon transistors similarly above a watt or two. In a high-power amplifier the driver stage transistors, when germanium, may also need to be mounted on a heat sink.

A number of transistors of TO-3 or similar construction make thermal contact with the heat sink through a thick copper mounting-plate with two-screw fixing. Small power transistors of TO-5 construction can be fixed on a heat sink by a method that presses the rim of the transistor casing on to the heat sink, so producing metallic contact over the flat area of the transistor. A washer with holes for screws can be used. For other small-output transistors it is necessary to fit a copper clip that is bolted to the heat sink, or which at low power can itself serve as a heat sink.

Any surface unevenness on the heat sink under the transistor should be avoided. Burrs at holes have to be removed, and a special silicone grease is applied to reduce the thermal contact resistance.

INSULATION

The collector in power transistors is connected internally to the metal case of the transistor. There are, however, small output transistors, e.g. of TO-1 construction, which are electrically isolated from their case, or in which it is the base that is connected to the container.

In general, therefore, both transistors of an output stage can only be mounted on the same heat sink if 0.002in. mica and insulating bushes are used to insulate one or both transistors. Instead of mica a $\frac{1}{8}$ in. thick anodised aluminium insulator can be used, and its very low thermal resistance is an asset when the transistor and heat sink also have very low thermal resistances. The heat sink itself can be anodised to insulate it and improve radiation from it, but the separate insulator provides a double insulating layer.

Heat sinks in direct contact with the transistor can be mounted on insulators inside an amplifier cabinet provided that effective cooling is maintained. The area of a heat sink creates a risk of capacitive feedback to earlier

stages, and the preamplifier may have to be screened from it.

There is no harm in merging a number of heat sinks into a single large one providing that the transistors are spaced out and electrically insulated. A metal cabinet or chassis can be used as the common heat sink, or two large heat sinks insulated from each other can serve as the sides of a cabinet. With these methods precautions may be necessary to avoid short-circuits from accidental contact with external metal objects.

HEAT SINKS

The surface of a heat sink, except at the point where the transistor is mounted, can be blackened to improve radiation. This reduces the thermal resistance by about 30% as compared with bright metal. Convection is assisted by mounting the heat sink vertically, and an improvement of possibly 20% can in this way be obtained. The thermal resistance of a rectangle of blackened 16 s.w.g. aluminium measuring 7in. x 4in. is approximately 3.5 deg. C/W.

In determining the thermal resistance necessary for a heat sink from the derating characteristic of the transistor it is usual to assume an ambient temperature of 45 deg. C.

Sometimes a heat sink is chosen that is adequate for music but not for continuous sinewave testing. The lower the thermal resistance of a heat sink the better, as there will be less variation in quiescent current with signal level, but there is little advantage in making it very much lower than the internal thermal resistance of the transistor. For example,

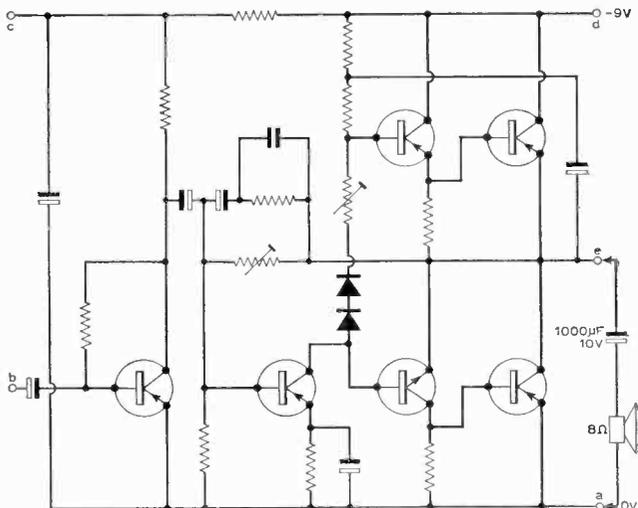


Fig. 10: Packaged 800mW a.f. amplifier type PC7+ (Newmarket Transistors). Dimensions: 3in × 1.75in.

a small transistor with a thermal resistance of 50 deg. C/W junction-to-case would probably not be fitted on a heat sink with a thermal resistance lower than 15 deg. C/W (possibly a 2in. square of metal) but if a power transistor of 1.5 deg. C/W thermal resistance was fitted on this heat sink there would be considerable room for improvement.

Heat sinks of finned design in extruded aluminium alloy are obtainable with specified values of thermal resistance. For example, one measuring 5in. x 4in. x 1in. deep (over the fins) has a thermal resistance of 2 deg. C/W.

NEGATIVE FEEDBACK

Unvarying amplification of varying signals is the ideal, and fidelity amplification implies an amplification that is linear up to the maximum output. It is the effectiveness of negative feedback in promoting linearity that makes fidelity amplifiers possible. Distortion occurs mainly at high signal levels in the driver and output stages and, subject to some reservations, can be reduced to any desired extent, relative to signal, by applying sufficient negative feedback.

A.C. negative feedback stabilises amplifier gain, according to the values of resistances in the feedback network, making it insensitive to changes within the amplifier, and less dependent on the characteristics of the transistors. Since distortion is reduced to the same extent as gain is reduced, the more amplification within the feedback loop the better, and high-gain transistors will result in a lower distortion figure. It is also more effective to apply the negative feedback over a number of stages. Modifications to stages within a negative feedback loop may appear to have no effect until the feedback is disconnected. For example, when negative feedback is in action, bootstrapping does not produce any very noticeable increase of gain.

It is only worthwhile reducing low basic distortion to a small fraction of 1% by negative feedback if the loudspeaker itself produces little distortion. In a portable radio the quality improvement resulting from the use of 10dB of negative feedback, reducing the gain about three times, could be considered adequate, while in a fidelity amplifier as much as 50dB of negative feedback, reducing the gain over 300 times, might be applied. More usual amounts are 20—40dB with gain reductions of 10 to 100 times. Some gain must be retained in the power amplifier however to avoid the need for a high-level output from the preamplifier, which would tend to reintroduce distortion.

D.C. negative feedback used to stabilise the quiescent midpoint voltage can be applied to a much greater extent than a.c. feedback. A single feedback path can be used for both with a decoupling capacitor included, e.g. at the emitter of the driver stage or at a point in the feedback path, to reduce the amount of a.c. feedback applied. It is preferable that the amount of feedback should not depend too much upon the value of the capacitor, as it can when a feedback voltage is developed across the capacitor in series with a low resistance.

Negative voltage feedback from the output reduces the output impedance. Values of output impedance of less than an ohm can be obtained for good loudspeaker damping.

FREQUENCY RESPONSE

Tone controls are usually incorporated in the pre-amplifier stages, a completely uniform response, obtained by means of a resistive negative feedback network, being aimed at in the power amplifier over the a.f. range. In some amplifiers, however, the negative feedback network is modified and made frequency-dependent to provide a bass or treble control.

Even with negative feedback the maximum power response is not usually maintained with germanium power transistors at a frequency of 10kc/s and above due to a decrease of efficiency. There is an increased risk of thermal runaway in testing with a continuous sine-wave signal at high frequency, but little effect on the reproduction of music. Silicon power transistors, made by the newer diffusion process, do not have this limitation of h.f. output. It is usually necessary, however, to limit the response beyond the a.f. range, i.e., above 15kc/s.

Although in a fidelity amplifier the response will extend down to -3dB at 20c/s, with a small loudspeaker a -3dB response at 200c/s is more suitable to avoid the distortion produced by a small loudspeaker at low frequencies. This allows a loudspeaker coupling capacitor much smaller than the 1,000 μ F or more used with a loudspeaker of low resonant frequency. A disadvantage of the smaller capacitor is its higher series resistance, which could put as much as an ohm in series with the loudspeaker.

When negative feedback is applied via a resistor as a current to the base of the driver stage it lowers the effective input impedance, and the amount of negative feedback depends on the collector load resistance of the predriver stage, being greater if the value of the load is high. If instead the negative feedback is applied as a voltage across a small resistor at the emitter of the predriver stage it raises the input resistance of the predriver stage, and the amount of negative feedback is then maximum when the predriver input comes from a low-impedance source.

H.F. STABILITY

Feedback is a stabilising factor when phased negatively to reduce the effective input. Instability is produced however when amplifier phase shift is sufficient at some frequency to transform negative into positive feedback. This phase shift accompanies the usual decrease in amplifier response outside the a.f. range, at low and high frequencies, and may cause a peak in the amplification. If the loop gain exceeds unity at this frequency, oscillation occurs.

With no transformers to restrict the performance phase shift in a transformerless amplifier is reduced, allowing more negative feedback to be applied without oscillation. Direct coupling of amplifier stages overcomes low-frequency phase shift, but there is still risk of oscillation above the a.f. range, especially with a reactive loudspeaker load. Even when continuous oscillation does not occur there may still be bursts of oscillation following any abrupt transition in the waveform. This shows up in tests with a square waveform, or when the signal is increased to the point where clipping occurs on peaks, or in the presence of some crossover distortion.

learning morse

T. SIMON

EVERY day, thousands of messages are transmitted in morse or c.w., from ships, aircraft or commercial stations. Many news broadcasts from all over the world are in morse and offer interesting listening for keeping up to date with the international situation. Again, amateur radio enthusiasts or Hams can be heard chatting across thousands of miles. If you can't read morse you are missing a lot of interesting fun.

Learning to send and receive c.w. is not difficult, though some will learn quicker than others. There are numerous methods of learning too, but whichever way you finally decide upon, one factor will be far more dominant than the actual method itself—your determination. If you are really determined to learn morse, then you will, no matter how you go about it.

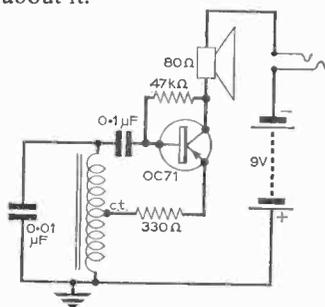


Fig. 1: Circuit for a simple oscillator.

One point is important and agreed by practically all c.w. men. **DO NOT** think of the code in terms of dots and dashes, if you do, and you are determined to learn then you will succeed, but it will be more difficult and will almost certainly take longer. For example, the letter U is

thought of as di-di-dah and not dot-dot-dash, while F would be di-di-dah-dit.

Memorising the code can be done in a number of ways. Some people learn the characters containing only dots—E, I, S and H, and then those with dashes—T, M and O. These are quite easy to remember and this takes care of seven characters. Some then proceed to learn all the remaining characters which begin with a dit, and finally those beginning with a dah. Others advocate memorising the five vowels first since these are in common usage.



Fig. 2: Correct spacing and character length.

Another method, which the writer can recommend, is to start by learning the first seven characters of the alphabet. When these are memorised, make up little groups using only these seven characters in different sequences. This is to ensure that they are thoroughly committed to memory. The next seven letters are then memorised and the

process repeated, after which, jumbled groups using the first fourteen letters are practised. This procedure divides the alphabet roughly into four easy bites and with just fifteen minutes practice every day it should not take longer than two weeks to completely memorise the code. The length of each practice session is a matter of individual preference. However, several short sessions are better than a few long ones.

ESSENTIALS

The first essential is a morse key and an audio oscillator. Failing this a buzzer will do but an oscillator is preferred. Circuitry for a suitable unit is shown in Fig. 1. It is very simple and easy to make up either on Veroboard, printed circuit or a tagstrip.

Hold the key lightly, resting the first and second fingers on the knob. The morse code is sent with the arm, the wrist acting as a pivot, and **NOT** by pecking at the key with the fingers. The fingers should not leave the key, and above all—relax. Send slowly and concentrate on accuracy, speed will come with practise. Remember that—one dah is equal in length to three dits, the spacing between two letters of the same word or group is three dits, the spacing between individual characters of the same letter is one dit, and finally the space between words or groups should be equal to five dits. (See Fig. 2.)

AMZFR	GOLMM	THEFP	QCMOA	IIFMZ
YOOVB	TFORQ	HXCEF	ENJNJ	LWUAF
REDER	TPEKQ	LAKSJ	MCUOI	AIOSH
QLWPS	ODKRU	THNVG	ALOUÉ	IEOUA
MZNXB	BVGFH	JDKSL	APQOW	IEURY

Fig. 3: Example of some five-letter groups.

Practise sending slowly and accurately, if you develop a sloppy style or a bad fault it will be almost impossible to correct after a time. Guard against clipped characters, incorrect length of characters and spacing. Most important, guard against tension in the hand, wrist and arm muscles. A good c.w. operator can send for a very long time without any apparent effort. If your hand, wrist or arm are tensed up in any way, you will find that you are unable to send for more than a few minutes, so relax, take your time and hold the key very lightly with the fingers just resting on the key.

A tape recorder is a great asset because you can send some morse at a very slow speed, concentrating on well-formed, properly spaced characters, and then play it back thus getting valuable practice at receiving, and at just the right speed too. Receiving

morse is always harder than sending. This is mainly because in sending you can think ahead, you know what's coming next, in receiving you must take it as it comes and while you're writing down one character you must already be listening and concentrating on reading the next.

PRACTISE

One excellent way of practising is to write out some mixed groups of characters as shown in Fig. 3. Using five figures to the group you can then count each group as a word. In this way you can time yourself and thus find out your speed in words per minute. In the case of the Ham licence you will need to be able to send *and* receive at 12 w.p.m. so it would be prudent to aim at 15 w.p.m. It might prove easier to write out the groups on graph paper, this makes division easier. Groups are excellent practise, particularly in receiving. With plain language there is a tendency for the brain to cunningly try to guess the next letter. Thus if the letters come out T-H- the brain might guess E making the word THE. However, the word might easily be THAT or THIS or THESE etc. In five-figure mixed groups this is eliminated and the brain can't cheat. It is very tempting to try and read sense into the code, i.e., make out the words, but this should be avoided at all costs in the early stages. When you can receive comfortably at 25 w.p.m. all well and good, but when you're just starting to learn morse remember, while you are trying to read the message, you are not concentrating on the next character and thus your concentration will be divided and you will lose characters and have to pick up again. This is also a bad thing as it is rather demoralising to keep missing characters.

MISTAKES

If you miss a character leave a blank space and carry on. Don't ponder on the character you missed or you'll miss others while you are thinking. If, on checking, you find that a particular character(s) is causing bother, make up some mixed letter groups using the difficult character(s) interspersed with some you know well. Half an hour's practice will soon sort things out, or better still, three or four ten-minute sessions.

Once you have learnt the code, a very good way of practising is to mentally send the code in your head. When you travel on a train or a bus look at the adverts and send these mentally. This exercise will help enormously in improving your speed, while in the early stages it affords a very good exercise in familiarity.

LISTENING

The amateur bands are an excellent hunting ground for practice. Even stations sending very fast will send their callsigns two or three times. If a country's list is obtained, then, by hearing the callsign, it is easy to determine the country where the particular amateur is located. To add to the interest, a world map might be purchased, and coloured pins pushed in when a particular country is heard. This is simple because amateurs in a particular country have their callsigns beginning with the same prefix, only the last few letters differ. Amateurs in Sweden all have callsigns beginning SM, those in Peru all

ALPHABET

A di dah	N dah dit
B dah di di dit	O dah dah dah
C dah di dah dit	P di dah dah dit
D dah di dit	Q dah dah di dah
E dit	R di dah dit
F di di dah dit	S di di dit
G dah dah dit	T dah
H di di di dit	U di di dah
I di dit	V di di di dah
J di dah dah dah	W di dah dah
K dah di dah	X dah di di dah
L di dah di dit	Y dah di dah dah
M dah dah	Z dah dah di dit

NUMERALS

1 di dah dah dah dah	6 dah di di di dit
2 di di dah dah dah	7 dah dah di di dit
3 di di di dah dah	8 dah dah dah di dit
4 di di di di dah	9 dah dah dah dah dit
5 di di di di dit	0 dah dah dah dah dah

MISCELLANEOUS

Question mark	di di dah dah di dit
Oblique stroke	dah di di dah dit
End of Message	di dah di dah dit
Error	di di di di di di dit
Invitation to transmit	dah di dah

start with OA. Thus if the callsign DU1FFZ was heard, the station would be in the Philippine Islands because DU is the amateur prefix for the Philippines. A list of prefixes for the different countries is obtainable from the R.S.G.B., 28 Little Russell St., London, W.C.1, and costs 9d.

The Radio Society of Great Britain has many members all over the country who send slow c.w. (morse) specially for the benefit of those starting to learn and who wish to improve their speed. The main band on which these transmissions take place is topband 1.8—2.0Mc/s or 160 metres. The Society publish a monthly bulletin (free to all members) and this gives details of the times, dates and frequencies of these transmissions together with the callsign and location of the station.

You can learn morse—anyone can. Get yourself a key and an oscillator or buzzer. If you have a tape recorder all the better, if not borrow one. A cheap one will do fine and you will be able to practise without an instructor. All you need now is determination and you're in business. ■

IMPORTANT

DON'T BUY PRACTICAL WIRELESS and then allow it to become torn and dirty. Don't search frantically through your back issues for that particular article either.

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 MT. 510/300-0-300. 120 mA. A.C., 6.3 v. 4 a. 29/6
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 Aligned calibrated. Chassis isolated from mains.
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 "BONDACOUST" Wadding for Cabinet lining 15/-sq. yd.

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WAVE-CHANGE SWITCHES WITH LONG SPINDLES. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 3/6 each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way, 3/6 each. Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 8 p. 2-way. Prices include click switches, adjustable stops, spacers, etc. 1 water, 10/6; 2 water, 15/-; 3 water, 19/6.
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REISTORS. Preferred values: 10 ohms to 10 meg. 1/4, 1/2, 1 w., 1 w., 20% 3d.; 1 1/2 w., 8d.; 2 w., 1/-; 1 w. 10% 6d.
HIGH STABILITY. 1 w. 1% 10 ohms to 10 meg., 2/-.
DITO 5%. Preferred values 10 ohms to 22 meg., 9d.
 5 watt } WIRE-WOUND RESISTORS { 1/6
 10 watt } 10 ohms to 6,800 ohms { 1/9
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MAINS DROPPERS. Midget. With sliders. 0.3 a., 1 K., 0.2 a., 1.2 K., 0.15 a., 1.5 K., 6/- each.
LIN CORE 100 ohm ft. twin link resistance. 1/- 1/2 in.

WIRE-WOUND 3-WATT Values **WIRE-WOUND 4-WATT** STANDARD SIZE POTS. 10 ohms to 30 K., 3/3. LONG SPINDLE VALUES Carbon 30 K. to 2 meg., 3/3. 50 OHMS to 100 K., 7/6.

VALVE HOLDERS. Int. Oct. 6d. Mazda Oct. 6d., B7G, B8A, B8G, B9A, Moulded 9d. Ceramic 1/-, B7G, B9A. Cans 1/- Valve base plugs B7G, B9A. Int. Oct. 2/3.

60 ONLY - SANGAMO 3 inch SCALE LABORATORY MOVING COIL METERS
 Various calibrations and movements. 100 Microamp 55/-; 1 Milliamp 50/-, etc. Post 6/- extra. Send S.A.E. for list.
BRAND NEW QUALITY EXTENSION LOUDSPEAKER
 Cream plastic cabinet, 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohm. POST Size: 7 1/2 x 5 1/2 x 3". **30/-**
 Post 1/6 unless otherwise stated. C.O.D. 5/- ex. List 1/-



practically wireless

commentary by **HENRY**

IT is Mr. Mendit, isn't it? The wireless man? You may not remember me, I'm Smith. Smith, that's it, with an "I", "but one eye, although popular prejudice runs in favour of two", as Charlie Dickens said. Yes, I know there are a lot of Smiths, biggest family in the phone book, eh? But I was in your shop the other day.

Sorry, didn't quite get that — it's a bit noisy—bit of a party going on here. Yes, you can hear it, can you? Can't pick you up loud and clear, as you wireless chaps say. . . Atmospherics, eh? that's a laugh. The atmosphere here you could cut with a chopper, man, ninety-five per cent proof, ha, ha,

No, I say, don't ring off. I know it's late. . . well, Christmas and all that. Yes, Merry Christmas to you, too, Mr. Mendit. I just wanted to ask you. . .

Important? Well, you judge, you just ask Mrs. Smith if it is important—see what she says. No, I know you don't want to talk to Mrs. Smith—tell the truth, I don't much, either, ha, ha. No, I'm the one who was in your shop the other day. Yes, we met. I was looking at that Super-Special Goldbrick Stereoplex Radiogram, remember?

I thought you would. Yes, the gentleman with the dog, that's right. Listen, I'm sorry about that



Bit of a party going on here

lamp standard. Yes, rather flimsy, wasn't it. And Rover is a big fellow. No, I didn't ring you up to talk about that. . .

The Goldbrick? Well, yes, I was very interested. Yes, I know it has—yes, and what-d'ye-call-it feedback, too. I know I heard you. Quite a bargain, I'm sure. Mrs. Smith was saying. . . yes, that's her you can hear in the background. Well, she always sings *Shenandoah* at family parties. She needs a bit of relaxation since that shock she had from the vacuum cleaner — no, no, I'm not complaining, honest. Not unless it is that the shock should have been a bit bigger!

No, really, I was joking, Mr. Mendit. Yes, I know you've got your code of ethics. Me too. . . what's that? Does it include ringing up in the middle. . . oh, come, friend, it is Christmas. Yes, I know you are opening the shop tomorrow—good luck. Me, I'll be dead—oh, if tonight goes on like this! No time to call around. I wondered if you would be coming out this way—you or one of your engineers? Always a drop of tiddley on hand.

No, I don't suppose you can afford to drink on duty, not with these breathalysers and things. It doesn't bother me, not since I was disqualified last Bank Holiday.

What's that? No, I don't suppose it is easy to fit in deliveries at holiday times—as the midwife said, ha, ha. Oh, really, would you? Make a special case of it. Well, I do declare, that's big of you, I mean, considering we only met the once. . . Previous customer? Well, you could say that. We have had a few bits and pieces. . . ha, ha. Perhaps I am being modest. You've got a sense of humour, Mr. Mendit. It is very good of you. I don't like to bother you really, not with the weather like it is. Look, perhaps I could get the boy to pop round, if I can tear him away from his train set.



Rover is a big fellow. . .

No, train set. . . electric? but of course, what else! Well, no, not actually from your shop—we got it wholesale. Yes, like the fridge, and the telly, yes.

Hallo, you there, Mr. Mendit? Bad line, this. All I could hear was a sort of heavy breathing. I said, I could send the nipper. . . Big van, what big van? Do you do all your rounds in a big van? that's not what I would call economic. . . oh, well, I suppose if you sell a lot of big stuff. No, not every day you sell a Super-Special Goldbrick I guess. Good luck to you. Nice bit of profit for the holiday.

What's that? Cash? Well, ha, ha, you're still joking—that's funnier than that noise Mrs. Smith is making behind here—I must say. Not much of a purchase to run up a contract for, Mr. Mendit. I reckon I can scrape up a couple of bob, even after what this party is setting me back. Enough for a dry battery anyway. . .

Goldbrick, what Goldbrick? I thought you said you'd sold it! ME? You're joking again. . . I was just asking if you could drop by with a battery for the kid's transistor radio.

What's that, I don't hear you very well. I know it's late, yes, I know, but it is Christmas. I say, Mr. Mendit, hallo—hallo—this is a bad line. I thought I heard you say. . .

Funny, the line's gone dead.

ADAPTABLE LOW COST hi-fi SYSTEM

W. CAMERON

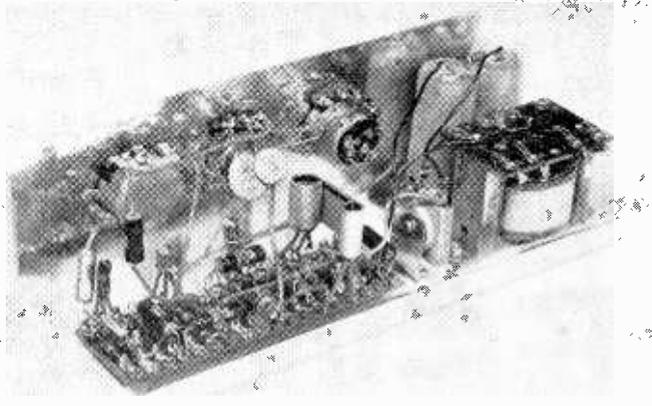
PART 2

IN THIS PART A PRE-AMPLIFIER STAGE IS ADDED TO THE BASIC AMPLIFIER DESCRIBED LAST MONTH, TO ENABLE A COMPREHENSIVE TONE CONTROL CIRCUIT TO BE INCORPORATED.

AN OC45 is used in the pre-amplifier stage and is shown as Tr1a in the pre-amplifier circuit diagram (Fig. 4). It will be seen that it replaces R2 (4.7k Ω) in the basic circuit, as a bias element for Tr1. Thus these two transistors are directly coupled.

The bias for the first stage is a.c. bootstrapped to the emitter via C2a; this virtually eliminates the shunting effect of the bias elements and gives a relatively high input impedance, about 30k Ω in this case.

An h.t. decoupling resistor and capacitor R4a and C3a have been added to reduce mains hum to negligible proportions when used with a mains power unit. R1 now goes to the other side of the collector load R3. Feedback is provided by the treble control VR1a. C4a serves to increase the negative feedback and hence reduce the gain at higher frequencies, by an amount determined by the setting of VR1a.



Bass boost and cut is provided by VR2a and its associated network.

The frequency response characteristics of the tone control circuits plotted against that of the basic amplifier is shown in Fig. 5.

INPUT IMPEDANCE & SENSITIVITY

Due to the higher input impedance, the sensitivity into the base direct (via C1a) is less than previously at 30mV, but whereas the basic amplifier required a series resistor of 100k Ω to give a sensitivity of 1V, in this case the series resistor must be 1M Ω .

To make this clearer it will be remembered that the input impedance of the basic amplifier was about 300 Ω with a sensitivity of 3mV. It can be said therefore that the sensitivity is 3mV/300 Ω or 30mV/3k Ω if a series resistor of 2.7k Ω is inserted, or 1V/100k Ω with a series resistor of 99,700 (100k Ω in practice). In other words 1mV/100 Ω above 3mV.

Compare this with the base sensitivity/impedance now of 30mV/30k Ω , or 100mV/100k Ω with a series resistor of 70k Ω (68k Ω in practice) or 1V/1M Ω with a series resistor of 970k Ω (1M Ω) i.e. 1mV/1k Ω above 30mV, or 10 times better than previously at an input impedance of 30k Ω or more.

Matching the source impedance to the input impedance is not difficult, as it is not particularly

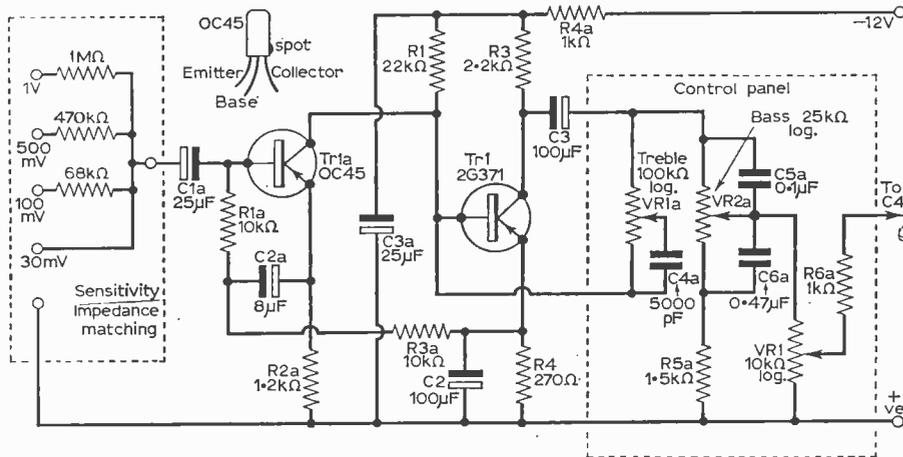
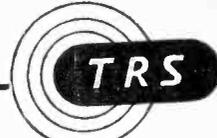


Fig. 4: Pre-amplifier and tone control circuits: additional components are suffixed a.

critical provided the source impedance is equal to or less than the input impedance. For example a tuner might have an output of 100mV and output impedance of 10k Ω , this would then be fed into the 100mV input even though the impedance at this input is 100k Ω .

The only difficulty might be when it is desired to use a device with a very low source impedance, with an output of less than 30mV and an impedance of considerably less than 30k Ω , such as a dyn-

BARGAIN OPPORTUNITIES FROM



Amplifiers KITS AND READY BUILT

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10-10
BY
TRS**



Built or
in kit form

Valve amplifier to exact Mullard spec. With pre-amp tapped off transformer, 3 and 10 $\frac{1}{2}$ g, all controls, H.F. and L.F. outlets, mono stereo and speaker phase switching. Complete with escutcheon, £20.00 knobs, plugs, etc. Ready built. (p. & p. 12/6) Kit for building above, with instructions. £17.10.0 (p. & p. 12/6)

MULLARD 5-10 MONO

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

MULLARD 3-3 MONO

3 valve 3W amplifier with controls, absolutely complete kit including panel knobs, etc. (p. & p. 7/6). £7.10.0

MULLARD MONO PRE-AMP

Complete kit with 2 valves, front panel controls, etc. for use with 5-10 or other good power amp. Built and tested. Carriage on either, 5/6. £6.10.0 £8.10.0

STEREO 2+2 PRE-AMP

Double 2 valve integrated pre-amp (4 valves in all) for use with TRS MULLARD 10-10. In kit form, with valves, front panel etc. Price to be announced. S.A.E. brings details.

7 VALVE AM/FM RG CHASSIS

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

SINCLAIR Z.12 SYSTEM

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

STEREO 25 PRE-AMP/CONTROL UNIT

Input selector, tone and volume controls. Ready built with elegant front panel as £19.19.6 advertised.

1 $\frac{1}{2}$ Z.3 Mains power unit to drive two Z.12's and Stereo 25. 79/6

PEAK SOUND SA 88

14 Transistor Kit builds into superb hi-fi amp. 8W per channel (16W Mono) with integrated pre-amp to take high quality ceramic p.p. Unusually easy to build by following the instructions (1/6d. purchased separately and refunded when kit is bought). This makes one of the best and most economical stereo transistor amps. We have ever offered. All purchases backed by T.R.S. service facilities. When built and fitted in its special cabinet, the SA 88 equals the best in modern styling.

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

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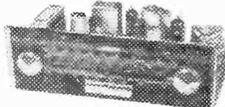
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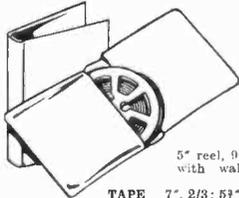
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IC6 10/8	6F18 8/8	12E1 17/8	303 16/-	E1148 1/8	EL41 8/-	P41 3/8	TP22 5/-	VR150 5/-	BCY40 5/-	OA97 1/8
LD5 6/-	6F23 11/8	12J5GT 2/8	305 16/8	EA50 1/8	EL42 7/8	P61 2/8	TP25 5/-	VR150 5/-	BCY41 5/-	OA98 1/8
LD6 9/8	6F24 10/-	12J7GT 6/8	306 13/-	EA76 1/3	EL43 8/8	PABCS0 7/8	TP25 5/-	VR150 5/-	BCY42 5/-	OA99 1/8
LD7 5/-	6F25 10/-	12K7GT 3/8	307 11/8	EABCS0 5/8	EL44 4/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY43 5/-	OA100 1/8
LD8 5/-	6F26 10/8	12K8GT 7/8	1821 10/8	EA42 7/8	EL45 7/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY44 5/-	OA101 1/8
LD9 5/-	6F27 10/8	12K9GT 3/8	5768 10/-	EA42 7/8	EL46 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY45 5/-	OA102 1/8
LD10 5/-	6F28 10/8	12L2GT 3/8	7475 2/8	EA42 7/8	EL47 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY46 5/-	OA103 1/8
LD11 5/-	6F29 10/8	12L2GT 3/8	18324 20/-	EA42 7/8	EL48 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY47 5/-	OA104 1/8
LD12 5/-	6F30 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL49 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY48 5/-	OA105 1/8
LD13 5/-	6F31 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL50 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY49 5/-	OA106 1/8
LD14 5/-	6F32 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL51 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY50 5/-	OA107 1/8
LD15 5/-	6F33 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL52 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY51 5/-	OA108 1/8
LD16 5/-	6F34 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL53 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY52 5/-	OA109 1/8
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LD18 5/-	6F36 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL55 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY54 5/-	OA111 1/8
LD19 5/-	6F37 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL56 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY55 5/-	OA112 1/8
LD20 5/-	6F38 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL57 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY56 5/-	OA113 1/8
LD21 5/-	6F39 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL58 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY57 5/-	OA114 1/8
LD22 5/-	6F40 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL59 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY58 5/-	OA115 1/8
LD23 5/-	6F41 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL60 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY59 5/-	OA116 1/8
LD24 5/-	6F42 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL61 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY60 5/-	OA117 1/8
LD25 5/-	6F43 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL62 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY61 5/-	OA118 1/8
LD26 5/-	6F44 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL63 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY62 5/-	OA119 1/8
LD27 5/-	6F45 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL64 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY63 5/-	OA120 1/8
LD28 5/-	6F46 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL65 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY64 5/-	OA121 1/8
LD29 5/-	6F47 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL66 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY65 5/-	OA122 1/8
LD30 5/-	6F48 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL67 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY66 5/-	OA123 1/8
LD31 5/-	6F49 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL68 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY67 5/-	OA124 1/8
LD32 5/-	6F50 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL69 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY68 5/-	OA125 1/8
LD33 5/-	6F51 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL70 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY69 5/-	OA126 1/8
LD34 5/-	6F52 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL71 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY70 5/-	OA127 1/8
LD35 5/-	6F53 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL72 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY71 5/-	OA128 1/8
LD36 5/-	6F54 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL73 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY72 5/-	OA129 1/8
LD37 5/-	6F55 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL74 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY73 5/-	OA130 1/8
LD38 5/-	6F56 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL75 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY74 5/-	OA131 1/8
LD39 5/-	6F57 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL76 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY75 5/-	OA132 1/8
LD40 5/-	6F58 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL77 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY76 5/-	OA133 1/8
LD41 5/-	6F59 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL78 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY77 5/-	OA134 1/8
LD42 5/-	6F60 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL79 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY78 5/-	OA135 1/8
LD43 5/-	6F61 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL80 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY79 5/-	OA136 1/8
LD44 5/-	6F62 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL81 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY80 5/-	OA137 1/8
LD45 5/-	6F63 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL82 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY81 5/-	OA138 1/8
LD46 5/-	6F64 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL83 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY82 5/-	OA139 1/8
LD47 5/-	6F65 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL84 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY83 5/-	OA140 1/8
LD48 5/-	6F66 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL85 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY84 5/-	OA141 1/8
LD49 5/-	6F67 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL86 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY85 5/-	OA142 1/8
LD50 5/-	6F68 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL87 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY86 5/-	OA143 1/8
LD51 5/-	6F69 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL88 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY87 5/-	OA144 1/8
LD52 5/-	6F70 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL89 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY88 5/-	OA145 1/8
LD53 5/-	6F71 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL90 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY89 5/-	OA146 1/8
LD54 5/-	6F72 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL91 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY90 5/-	OA147 1/8
LD55 5/-	6F73 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL92 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY91 5/-	OA148 1/8
LD56 5/-	6F74 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL93 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY92 5/-	OA149 1/8
LD57 5/-	6F75 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL94 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY93 5/-	OA150 1/8
LD58 5/-	6F76 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL95 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY94 5/-	OA151 1/8
LD59 5/-	6F77 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL96 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY95 5/-	OA152 1/8
LD60 5/-	6F78 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL97 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY96 5/-	OA153 1/8
LD61 5/-	6F79 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL98 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY97 5/-	OA154 1/8
LD62 5/-	6F80 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL99 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY98 5/-	OA155 1/8
LD63 5/-	6F81 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL100 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY99 5/-	OA156 1/8
LD64 5/-	6F82 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL101 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY100 5/-	OA157 1/8
LD65 5/-	6F83 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL102 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY101 5/-	OA158 1/8
LD66 5/-	6F84 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL103 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY102 5/-	OA159 1/8
LD67 5/-	6F85 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL104 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY103 5/-	OA160 1/8
LD68 5/-	6F86 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL105 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY104 5/-	OA161 1/8
LD69 5/-	6F87 10/8	12L2GT 3/8	AC204 14/-	EA42 7/8	EL106 8/8	PC88 8/8	TY86F 11/10	VR150 5/-	BCY105 5/-	OA162 1/8

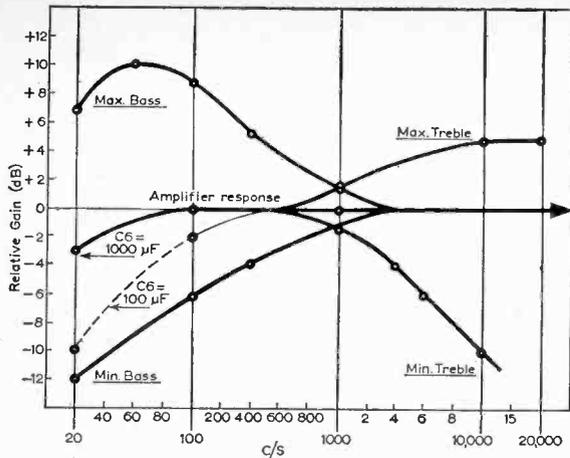


Fig. 5: Frequency response characteristics of the complete amplifier and tone control system.

amic microphone. This difficulty could be overcome by using a pre-set in place of R2a, with the slider taken to earth via a 100µF capacitor. This would then give an input impedance range of 300Ω to 30kΩ, being 300Ω at better than 1.5mV with the capacitor at the emitter end of R2a. Adjusting the slider will optimise the sensitivity for any value of source impedance up to 30kΩ, above which it has no advantage whatsoever, and robs the circuit of its very low noise properties.

OVERLOAD CAPABILITY

The foregoing remarks concerning sensitivity for maximum output assume the volume control at maximum, but the overload capability of the stages preceding the volume control is about four times, so the maximum input into the 30mV terminal can be 120mV, and into the 100mV terminal 400mV and so on.

Even so, some crystal pick-ups will overload the first stage and result in distortion unless the series resistor is increased in value. An example is the TC8H cartridge which on loud passages has an output of about 6V r.m.s., so in this case the series resistor could well be 2 to 4MΩ to prevent overload distortion. However, with this type of input, with the load resistor in series, there is a noticeable loss of top response when the resistor exceeds 1MΩ, due to the capacitive nature of crystal pick-ups, and it is necessary to compensate for this by shunting the whole or part of the series resistor(s) with a small capacitor of 50 to 100pF, the most suitable value being a matter of individual taste, found by trial.

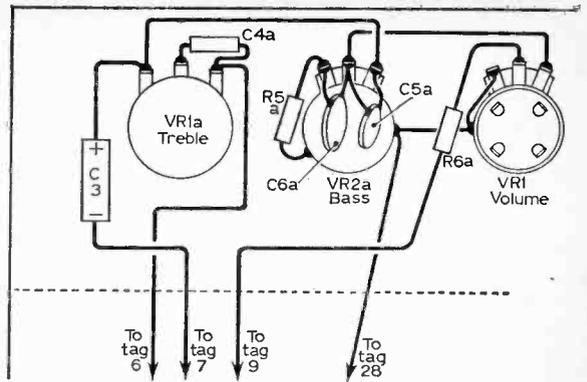


Fig. 6: Wiring to the bass, treble and volume controls. Tags referred to are those in Fig. 8.

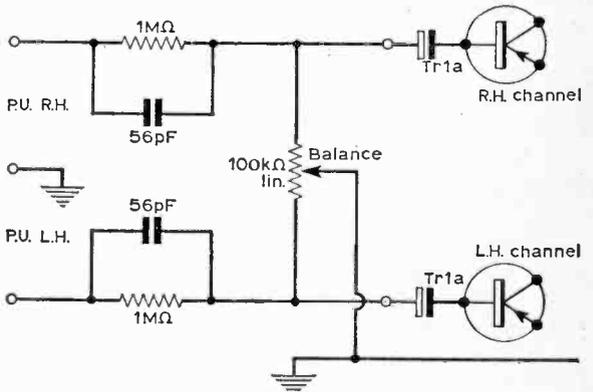
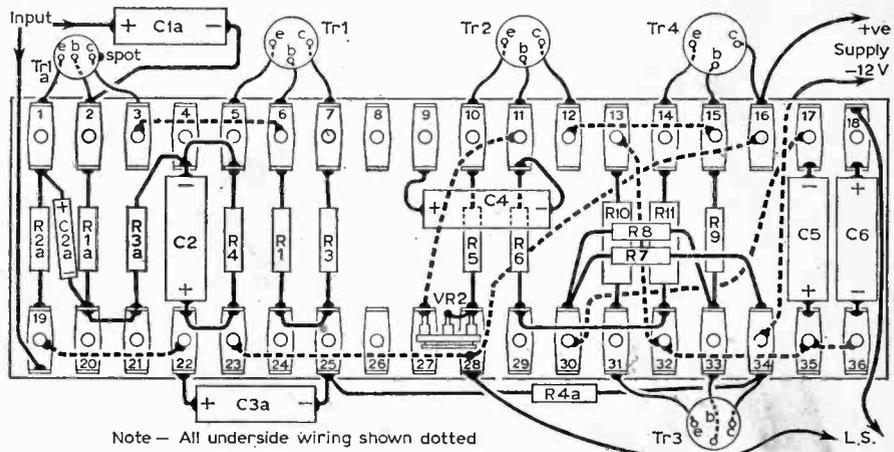


Fig. 7: Input and balance control arrangement for stereo operation. Suitable for use with a crystal or ceramic pickup.

Alternatively, an attenuator could be used in the input and its simplest form could be a 1MΩ pre-set across the input, with the slider taken via C1a to the base of Tr1a. The slider should at all times be near the earthy end of the control.

STEREO OPERATION

Two of these amplifier units can be used to pro-



Note — All underside wiring shown dotted

Fig. 8: Modified tagboard layout. The sensitivity/impedance matching network is not shown: this consists of a group of sockets mounted at the rear of the chassis.

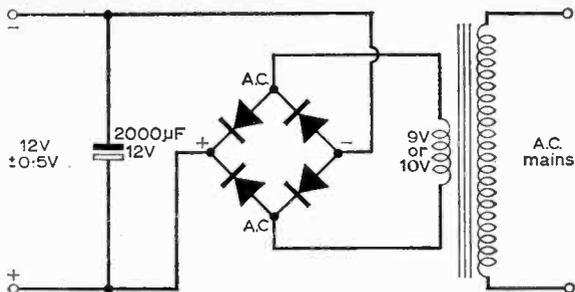


Fig. 9: Simple mains power supply unit for the basic 1-watt amplifier

★ components list

Resistors:

R1a 10kΩ
R2a 1.2kΩ
R3a 10kΩ
R4a 1kΩ
R5a 1.5kΩ
R6a 1kΩ

Capacitors:

C1a 25µF electrolytic 6V
C2a 8µF electrolytic 6V
C3a 25µF electrolytic 12V
C4a 5,000pF paper or polyester
C5a 0.1µF paper or polyester
C6a 0.47µF paper or polyester

Potentiometers:

VR1a 100kΩ log
VR2a 25kΩ log

Transistors:

Tr1a OC45
Tr1 2G371

vide stereophonic reproduction, simply by utilising dual controls for volume and tone control functions, and adding a balance control.

This is shown in Fig. 7. The 56pF capacitors shunting the series resistors are optional and are to compensate for some loss of top due to the high series resistors.

A tweeter may be incorporated in the speaker system, provided the main speaker is not less than 15Ω impedance, and the tweeter, also 15Ω, is fed via a reversible or non-polarised capacitor of not more than 4µF.

OPERATION FROM THE MAINS

The power requirements are modest and a mains transformer rated at 9 or 10V at 0.5 amp and a 0.5 amp 12V selenium bridge rectifier are more than adequate to supply either a single amplifier or two amplifiers of a stereo pair.

A suitable power supply circuit is shown in Fig. 9, but constructors intending at some future time to proceed with the power amplifier described next will do well to obtain the larger mains transformer and rectifier specified with this, using one-half of the centre tapped secondary to obtain the 12V required for the 1 watt unit.

To be continued

ADAPTABLE LOW COST HI-FI SYSTEM

(Part 1, December issue)

The text giving Chassis Details on page 614 should have appeared instead at the end of the article on page 572. The author has drawn our attention to the fact that the Texas range of transistors (i.e. 2G371 etc.) were used in the prototype. He recommends their use if the performance figures given are to be expected. If constructors experience difficulty in obtaining these semiconductors, and other components, they may be obtained from Messrs. C. & D. Electronics, 17 St. Luke's Road, Pallion, Sunderland. They can supply the recommended transistor package (matched set of driver and output pair) at 12s. 6d. per set.

LETTERS...

Letter of thanks

I feel very flattered to think that fellow readers have responded to my appeal for help as they have. I am also grateful to you for publishing my letter.

Readers and yourself will therefore be pleased to know that I succeeded in getting results, after replacing the electrolytics, and repairing a broken joint on the L.S. mains windings.—**W. M. Mackenzie** (*Gosport, Hants.*).

Not only button pushing!

I would like to comment on the letter by R. T. Brown in the September issue of P.W. As a part-time commercial operator, I object to the statement that the only qualification to operate is the ability to push a button and speak into the microphone. The

ability to rig aerials and to maintain the equipment is essential in most cases.

I would like to see some of the "competent amateurs" working directed net with ten outstations under difficult conditions.

I personally do not want a licence because I could not stand the few poor amateurs to be found on the bands in this district. I am no anti-RAE or anti-Morse man, but I do consider myself a competent operator in my own field and would like to be treated as such and not as just a "button pusher".—**M. Fisher** (*Huddersfield, Yorkshire.*).

19 Set Mods "Mods"

I have, with the assistance of Mr. S. Simpson's extremely good articles on 19 Set Mods, modified my own 19 Set. I found it

beneficial to earth the centre pin on the set's tone control pot, but I have gone one step further. I by-passed a 4,800Ω resistor fixed to the b.f.o. triode anode tag. I now find that s.s.b. signals are not saturated as was the case before. A further modification I attempted was for Top Band. Four 100pF capacitors (1% silver mica) which were to hand, were fitted across the four ganged tuning capacitors and earthed through a four-pole two-way wafer switch when necessary.

I am pleased to say that this modification is successful and by moving the wavechange switch to the 4.5 to 8Mc/s position, I find that Top Band appears between 2 and 2.5Mc/s. This is very convenient as it is on the same scale as 80 metres.—**J. Scott** (*Newquay, Cornwall.*).

P.W. DATA RULE

by I.J.KAMPEL

PART 3

THE PRACTICAL WIRELESS Data-Rule was originally presented free with the November issue of this magazine, together with complete summary of instructions. This is the second of a short series of articles explaining the use of the rule, especially aimed at the beginner. The rule is now available from the PRACTICAL WIRELESS Blueprint Department, price 5/-.

Last month's article dealt with the more general uses of the L and M scales, the component tolerance scale, the reciprocal scale, the decibel scale and the log scale. This article will now complete the instructions concerning the same side of the rule.

DIRECT CONVERSION

The rule provides a means of ready conversion between many of the more common electrical units, or units closely associated with electrical engineering or electronics.

Conversion between two given units is straightforward given suitable log scales, such as the L and M scales on the rule. It is only necessary to place the significant figures of two equivalent units adjacent to each other, for the rest of the rule to then give direct conversion. Take, for example, conversion between metres and yards. Now it is known that 1m. = 1.09 yds., therefore, if the 1 of scale L is placed adjacent to the 1.09 of scale M, direct conversion between the two units is now possible. Thus, if we wished to know the metric equivalent of 6 yards, this is found to be 5.5 metres, for 5.5 in scale L is adjacent to 6 in scale M, i.e., scale L reads in metres, scale M in yards.

The decimal point may be placed easily if a note is made of relative magnitude at the initial setting. In the previous example, with the rule set as indicated, since scales read 1—10, direct conversion between scales is possible, and thus if one scale was multiplied by some factor of 10, the other scale must be multiplied by a similar factor. Thus had we wished to know the metric equivalent of 600 yards, we would call this 6.0×10^2 in scale M, giving the reading in scale L, as indicated, but also $\times 10^2$, i.e., $5.5 \times 10^2 = 550$ metres.

Take the point where the conversion falls off the scale, for example, find the distance in yards corresponding to 9.5m. The rule must be reset, placing the 10 of scale L opposite the 1.09 of scale M. The significant figures of

the answer are then seen to be 1036, but this is known to represent the end of rule, in scale M, just above the 10. Thus we can correct this to read the true answer, 10.36 yds.

It is thus possible to mark on the slider, marks indicating the conversion factors between various units, and this is done on the Data Rule in windows combining I and J. When the slider is set so that the correct conversion factor is set on scales L and M, the appropriate units are displayed in the window. Note that there are two windows, and any units conversion may only appear in one window at once.

It has been shown that when the 1 of scale L has been set against the correct conversion factor in scale M, direct reading conversion is available, where the bottom scale is multiplied by the same factor as is required to be multiplied by the indicated value in scale L. A further conversion factor may be required to allow for differences in magnitudes. Now when the scale is reset to 10 in scale L, it is necessary to multiply by 10 on top of any other conversion factors. This factor consideration is taken into account automatically by the calculator, by means of the two small circular Conversion Factor windows in the two bottom corners of the rule. When the slider is pulled out to the left of the rule, units to be converted will only appear in the left-hand IJ window, and the conversion factor will appear in the left-hand small circular window, both right-hand windows remaining blank. The converse applies, i.e., with the slider pulled out to the right, the appropriate conversion factor appears in the right-hand small circular window, the units to be converted being in the right-hand IJ window, the left-hand windows being blank. Thus a different conversion factor will appear for the same units conversion, according to the choice of two slider settings.

The procedure to convert between the units given on the rule is thus as follows. Expose the desired units conversion in one or other of the two units conversion windows. When this is done, as the black arrows indicate, the I portion of the window indicates the units described by the L scale, and the J portion of the window indicates the units described by the M scale. The conversion factor in the appropriate small circular window then indicates the multiplication factor of scale M for this to read correct conversion from scale L,

where the units in scale L refer to magnitudes of between 1 and 10. Thus, if the indicated conversion factor is 10^n , and if it is necessary to multiply a quantity in scale L by 10^x to give it in the form $N \times 10^x$, where N is between 1 and 10, then multiply the read-off value in scale M by $\times 10^{n+x}$. Due to the space available in the conversion factor windows, a minus index could not be shown in the usual form $\times 10^{-n}$, and has instead been shown with

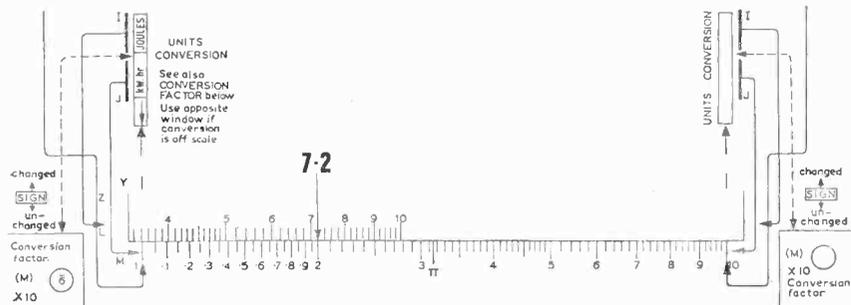


Fig. 9: Conversion to kW. hours of 72×10^6 joules.

a bar above the index, thus: $\times 10^7$.

Example: Convert 72×10^6 joules into kW.hrs. (see Fig. 9). This must firstly be mentally converted to the form 7.2×10^7 joules, and a wise precaution is to jot down the factor $\times 10^7$. Now adjust the slider until JOULES appears in window I, and kW.hrs. in window J. The left-hand window is required for this example. Ensure that the positioning arrow in the window is correctly aligned. Now scale L reads directly in joules, and scale M directly in kW.hrs., times the appropriate factor, and thus we see that 7.2 joules (scale L) is equivalent to 2 (on scale M) $\times 10^{-6}$ (left small conversion window) kW.hrs. But we wish to convert 7.2×10^7 joules, not 7.2 joules, therefore the answer is times the same factor, i.e., $2 \times 10^{-6} \times 10^7 = 2 \times 10^1 = 20$ kW.hrs.

To convert from the units in the lower scale to those in the upper scale, the procedure is reversed, and the same example, 20 kW.hrs. would be approached thus:—

Convert to the form 2×10^1 , and keep a note of the factor $\times 10^1$. Now with reference to the upper scale, the lower scale is times the factor 10^{-6} . Thus the upper scale, relative to the lower, is $\times 10^6$. Thus, opposite 2 in the lower scale, we see 7.2 in the upper scale, and thus the answer is $7.2 \times 10^{6+1} = 7.2 \times 10^7$, or, in the original form, 72×10^6 joules.

As an example of this, let us say that it was desired to add on the yards-metres conversion. We know that $1\text{m.} = 1.09$ yds., thus set the 1 of scale L against the 1.09 of scale M. If this is done, it is seen to be too near the LUX-ft. can. conversion, and it is not possible to mark the yards-metres conversion at this point.

The other point is the reciprocal of one of the units however, or more simply, set the 1.09 of scale L against the 1 of scale M, and now we have the conversion, and also a blank window on the left, where we may fill in yards in the upper section of the window, and metres in the lower section of the window. Now 10 yards is equivalent to 9.17 metres, therefore no multiplication factor is required for the M scale to be correct, thus put the index 0 in the left-hand window ($\times 10^0 = 1$), and by resetting the rule to place the newly-created units conversion in the right-hand window, insert the index 1 in the right-hand conversion factor window. This is so since 1 yard must correspond to the indicated 9.17 , but $\times 10^{-1}$ metres. Thus the right-hand window conversion factor will always be one factor of ten lower than the corresponding left-hand window factor.

RESONANCE

Resonance for an inductance and capacitance in a parallel circuit may be computed from the ABAC provided on the rule. The full formula for parallel circuit

resonance is given as: $f_{\text{res}} = \frac{\sqrt{L/C - R^2}}{2\pi L}$ In radio circuits, however, "R" may nearly always be taken as negligible in comparison with $2\pi fL$, and therefore:—

$C \approx \frac{1}{(2\pi f)^2 L}$ and the frequency expression may be

simplified to read:— $f_{\text{res}} = \frac{1}{2\pi\sqrt{LC}}$ as in fact shown on

the rule. The ABAC scales are based on this expression, and by relating the log scales by a straight-edge, given two of the three variables, the third may be fixed directly.

Let us consider the following example by calculation, and by evaluation by the rule. A capacitor is measured at 3.76pF . What inductance is required for the circuit to resonate at 150Mc/s ? Also, deduce the capacitor range required, if the above capacitor is a variable, to give the tuning range $100\text{--}200\text{Mc/s}$ assuming a fixed inductance.

We shall evaluate the first part of this question mathematically, check on the rule, and then complete the question by the rule only. Now, $150 \times 10^6 =$

$$\frac{1}{2\pi\sqrt{3.76 \times 10^{-12}L}} \therefore (150)^2 \times 10^{12} = \frac{1}{4\pi^2 \times 3.76 \times 10^{-12}L}$$

$$\therefore L = \frac{1}{4\pi^2 \times 3.76 \times 10^{-12} \times (150)^2 \times 10^{12}}$$

$$L = \frac{1}{4\pi^2 \times 3.76 \times 22,500}$$

$$L = 0.3\mu\text{H}$$

To check this on the rule, adjust the slider to expose V.H.F. in the frequency window (A), thus making the resonance panel correspond to Fig. 10. If a ruler is placed to cut the C scale at 3.76pF , and the f scale at 150Mc/s , it is also seen to pass through $0.3\mu\text{H}$ on the L scale, agreeing with the far more complicated method of evaluation shown above. Note that the coloured scale markings on the ABAC represent significant figures only, and the decimal point, or rather the magnitude of the points, is defined by the windows above and below the scales, the windows defining the upper and lower limits of the scales.

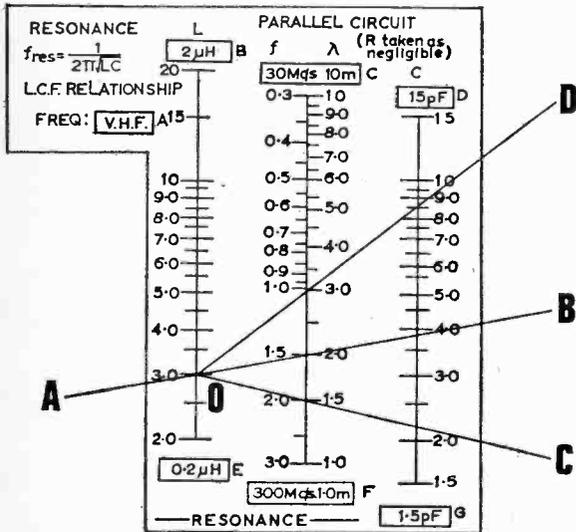


Fig. 10: Resonance example taken from the rule.

A method of simplifying this even further has been devised, eliminating thought about the sign of the conversion factor according to the direction of conversion, in the form of the "SIGN" symbols above the conversion factor windows. This indicates that when changing down, that is from the upper units in the window to the lower units, the units are unchanged, i.e. the units being converted to are times the indicated factor. If changing up, however, from the lower window units to the upper, the sign changes, i.e. scale L is $\times 10^{-z}$, where z is the indicated factor. From this it will be seen that 7.2 joules corresponds to 2×10^{-6} kW.hrs., and 2 kW.hrs. corresponds to $7.2 \times 10^{-(6)} = 7.2 \times 10^6$ joules.

If the reader wishes to add any other units conversions to the rule to suit individual needs this is easily achieved, provided that at least one equivalent is known. If the rule is set up to give the required conversion, provided that this particular conversion does not overlap one already shown on the rule, the new position arrow may be marked in the window, and the appropriate units entered together with the conversion factors.

To complete the question, refer to Fig. 10. In the figure, the line AB indicates the straight line evaluation in the first part of the question, where point O is the answer to the first part of the question. Since inductance is constant, all other lines drawn on the scales in this question must also pass through point O. The frequency range 100–200Mc/s is asked for, thus line OC through the red 2 in the f scale, representing 200Mc/s, and the line OD through the red 1 in the f scale, representing 100Mc/s, define the limits of capacitance required on the C scale, and this is seen to be, approximately, 2·1pF to 8·2pF.

PARALLEL RESISTOR CHART

The red numbers and lines on the chart represent preferred values of resistance which are normally obtainable. The right-hand numbers in black are specific values from 0 to 100. A problem often encountered is when a particular value of resistor is required which is not a preferred value. One way to overcome this problem is to use two other resistors of the appropriate value wired in parallel. The chart works out the required values at a glance without recourse to mathematical problems.

Let us assume that 490Ω is the required value (see Fig. 11). Firstly locate 49 on the right-hand black scale. On the chart, decimal points are placed by inspection, hence look at 49 for 490. Now look across the chart, in line with the 49, until the nearest intersection of coloured lines is seen to the 49 line. Reference to the chart on the rule will confirm that this is the intersection of the lines marked 120 and 82 in the left-hand column, and as shown in the figure. These two values represent the significant figures of the parallel resistors.

From the rule of thumb that when two resistors are in parallel, the combined resistance must be lower than the lowest of these resistors, and also remembering that two resistors of equal value in parallel will give a combined resistance of half their individual value, we can easily estimate the correct values. The reader will also realise that if one resistor is very much larger than the other, it will have little effect, and the combined resistance will be just slightly lower than the lower resistor value. Since we are evaluating for 490Ω, common sense tells us that the two values must be 1·2kΩ and 820Ω. As

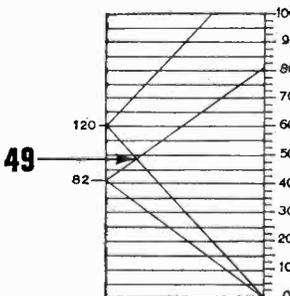


Fig. 11: Parallel resistors determined for a non-standard resistance.

$$R_{\text{tot}} = \frac{820 \times 1,200}{820 + 1,200} = 488\Omega.$$

As described last month, we could then rapidly evaluate the percentage difference this is with the tolerance scale, by setting the central line to the required 490, and thus seeing that the chart has given a value better than $\pm 1\%$.

In the practical case, do not overlook the actual resistor tolerances that will be used. Thus the chart

rapidly evaluates the resistance values, and the L and M scales provide the means of evaluating the check shown above accurately, having worked out that $820 + 1,200 = 2,020$. To do this, divide 820 by 2,020, then multiply the answer by 1,200, to get the answer 488.

As indicated, the chart can also be used for series capacitors, however it is really designed for parallel resistors, therefore the preferred resistor values are not really suitable for capacitors.

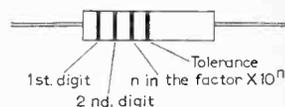


Fig. 12: Interpreting the resistor colour code.

For capacitors it will serve as an approximate guide, but since capacitor tolerance is usually exceedingly wide, particularly in electrolytics, it can serve a purpose for capacitors as well.

RESISTOR SELECTION

The two upper tables on the rule are designed to ease selection of resistors, the left-hand table gives the resistor colour code, and the right-hand table gives the preferred resistance values. Fig. 12 indicates how the coloured bands on the resistor should be interpreted. It should be noted that the bands start from one end of the resistor, leaving the far end of the resistor blank, and when reading the colour code, always start with the colour next to the nearest end of the resistor, and then work along taking colours in turn. The first colour indicates the first digit, and the second colour the second digit of the resistance value. The third colour indicates the number of noughts which should be placed after the previous two digits, or the factor "n" if the previous two digits are multiplied by 10^n . The last band, if there is one, indicates the resistance tolerance allowed. If there is no fourth band a tolerance of $\pm 20\%$ is assumed.

As an example, take the following four colours, reading in from the end:—red, violet, orange, gold. Obtain the first digit by looking for red in the top left-hand table. This is seen to be 2. The second digit, from the same table, is seen to be 7, the code number for violet. We must then add on to this three noughts, due to the orange band, and the gold band at the end tells us the resistor's $\pm 5\%$ tolerance. Thus the resistance value is nominally 27kΩ, and it is read as 27×10^3 from the code, or 27 with 3 zeros after this giving 27,000Ω.

Another example:—green, blue, black. This represents 56×10^0 i.e. 56Ω.

A final example, the resistance 3Ω would be coded 03Ω, i.e., black, orange, black.

The top right-hand table indicates the first two digits of resistance values that are usually obtainable. Thus, if a calculation calls for a resistance of say 5·9kΩ, reference to this table tells us that the nearest preferred value to this will be 5·6kΩ.

Next month's issue will deal with the scales on the other side of the rule.

To be continued

A SUGGESTION

One year's subscription to PRACTICAL WIRELESS makes a very useful and acceptable gift, and it lasts all the year too. Just send name, address, and 36s. to our Subscription Department, George Newnes Limited, Tower House, Southampton Street, London W.C.2 and leave the rest to us. Make it a Practical Merry Christmas this year.

THE 'CLUBMAN'

J. THORNTON-LAWRENCE GW3JGA



FOLLOWING the formation of a local Amateur Radio Club, many junior members expressed the desire to purchase or build a receiver but either lacked the finances or felt that building a receiver was beyond their capabilities. With these and other requirements in mind, the Clubman MK I receiver was designed to provide:

- 1 Satisfactory reception of a.m. signals on Top Band (160m), Trawler Band and the 80 metre amateur band.
- 2 Easy construction from readily available parts.
- 3 Minimum cost.
- 4 Pleasing appearance.
- 5 Facility for adding extra stages and refinements at a later date.

Basic Circuit

The basic circuit is that of a 5-stage superhet receiver, as shown in Fig. 1. In order to economise on transistors and components, a reflex circuit is employed as shown in Fig. 2. In this circuit the i.f. amplifier transistor is also used as an a.f. amplifier. Only one double-tuned i.f. transformer is used providing a reasonable degree of selectivity which is in keeping with the general performance of the receiver. The complete circuit is shown in Fig. 3.

Frequency Changer Stage

Incoming signals pass through the r.f. gain control VR1 to the coupling coil L1. VR1 is connected so as to provide to L1 an impedance which varies as little as possible with the setting of the control. L2 is the tuning coil which, with VC1 and TC1, is tuned to incoming signal. L3 is the coupling coil to Tr1 base. Tr1 and its associated components comprise a self-oscillating mixer stage which follows standard practice. The local oscillator frequency is determined primarily by L6 and VC2. TC2 is the oscillator trimmer and C4 is the padding capacitor. The feedback required for oscillation is provided by the collector coupling winding L4 and the emitter coupling winding L5. D.C. biasing for Tr1 base is provided by the potential divider R1 and R2, while R4 is the emitter stabilising resistor. Decoupling of the various circuits is provided by C1, C2, and C3. The purpose and value of R3 is discussed later.

The I.F. and Detector Stages

Signal, local oscillator and resultant sum and difference (i.f.) frequencies appear at the collector of Tr1. The i.f. frequency only is accepted by the i.f. transformer i.f.t.1., the primary and secondary of which are tuned to 470 kc/s. I.F. signals at this frequency are passed to the base of Tr2. Amplified i.f. signals at Tr2 collector are developed across the choke L7 and passed by C7 to the demodulator.

The demodulator consists of a voltage doubling rectifier circuit comprising D1 and D2, the signal load resistor is R7 and decoupling is provided by C6. The audio frequency signal is developed across R7 and is returned to the base of Tr2 by the coupling capacitor C8.

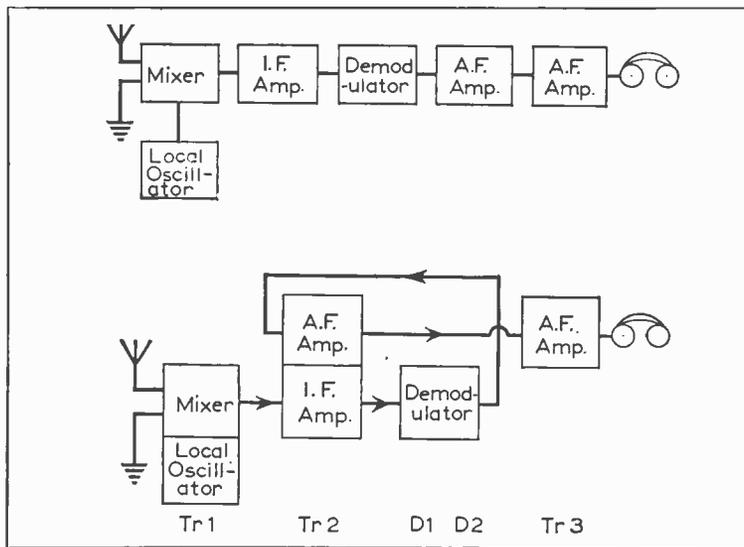
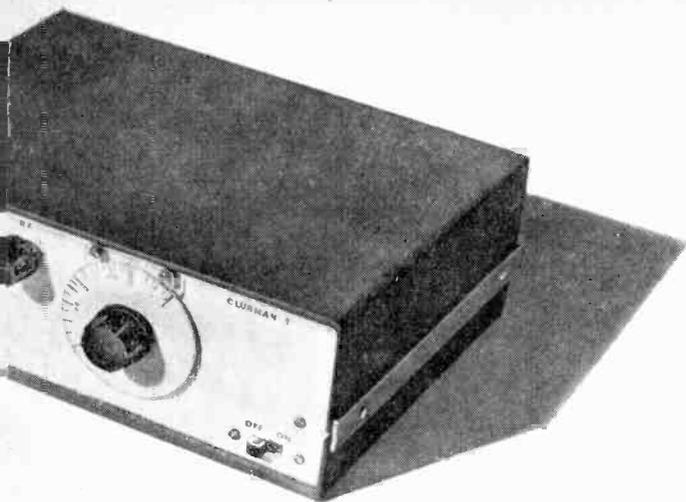


Fig. 1 (above): Block diagram of a conventional 5 stage superhet.

Fig. 2 (below): Basic block diagram of the "CLUBMAN".



* STEP BY STEP GENERAL PURPOSE RECEIVER

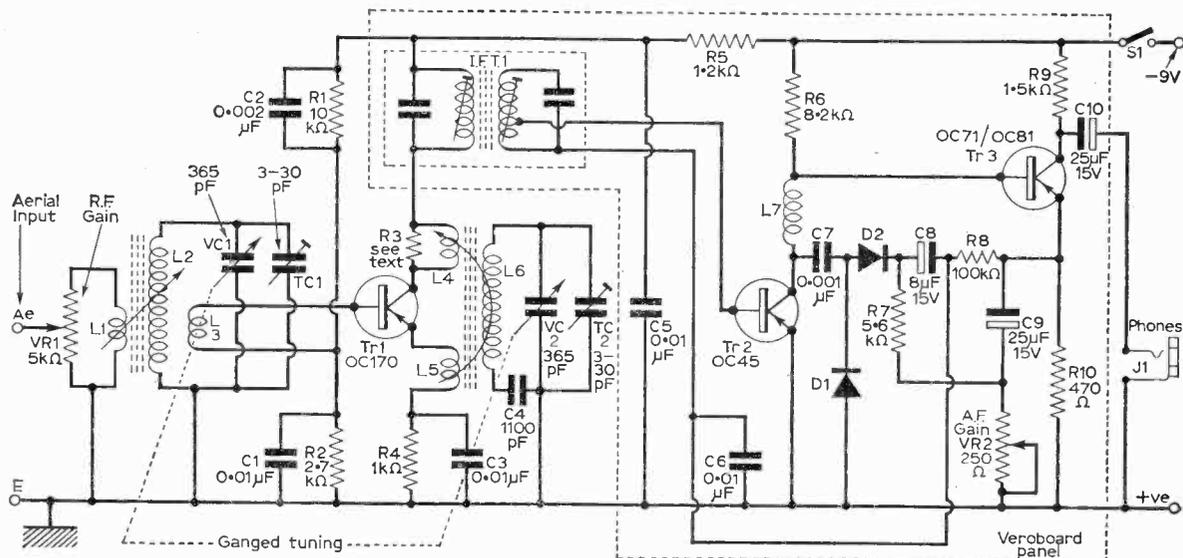


Fig 3: Circuit diagram of the "CLUBMAN" Mk I receiver.

★ components list

Resistors:

All 10% watt Carbon.

R1 10kΩ	R5 1.2kΩ	R9 1.5kΩ
R2 2.7kΩ	R6 8.2kΩ	R10 470Ω
R3 see text	R7 5.6kΩ	VR1 5kΩ
R4 1kΩ	R8 100kΩ	VR2 250Ω

Capacitors:

C1 0.01μF 20V disc ceramic
C2 0.002μF Hi-K ceramic
C3 0.01μF 20V disc ceramic
C4 1100pF (1000pF and 100pF in parallel) Mica
C5 0.01μF 20V disc ceramic
C6 0.01μF 20V disc ceramic
C7 0.001μF Hi-K
C8 8μF 15V electrolytic
C9 25μF 15V electrolytic
C10 25μF 15V electrolytic
TC1 3-30pF concentric trimmers

TC2 3-30pF concentric trimmers

VC1/VC2 365pF 2 gang Jackson type 02

Semiconductors:

TR1 OC170 Mullard
TR2 OC45 Mullard
TR3 OC71 or OC81 Mullard
D1 OA81 Mullard
D2 OA81 Mullard

Inductors:

L1/L2/L3 3T blue	} Denco
L4/L5/L6 3T red	
L7 2.5mH RFC type CH1 Repanco	
IFT1 470kc/s type T41/IE Weymouth	

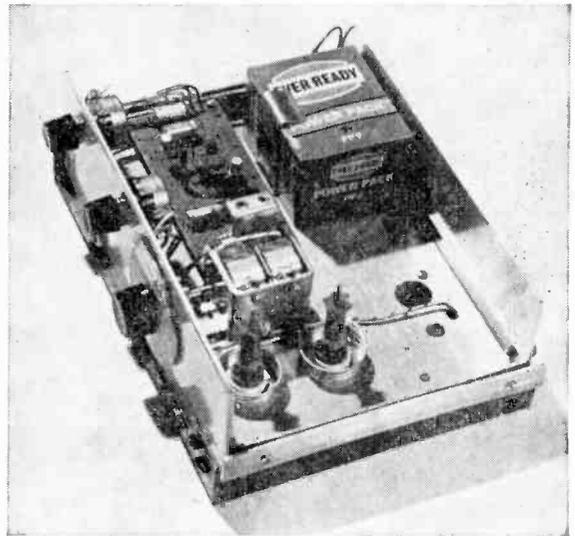
Miscellaneous:

Open jack socket, miniature slide switch, slow motion drive, knobs, terminals, 2 B9A valveholders, solder tags, battery clips, nuts, bolts and screws, materials for cabinet.

A.F. Amplifier and Output Stage

Tr2 now performs as an a.f. amplifier, the amplified signal appears across the collector load R6 and is passed directly to the base of Tr3. Tr3 is the a.f. output stage and the collector and load resistor R9 are coupled to the headphone jack by C10. D.C. biasing of Tr2 and Tr3 is rather unusual and is shown in Fig. 4. The coupling between Tr2 and Tr3 is seen to be direct. The bias current for the base of Tr2 is obtained from Tr3 emitter. This means that there is a complete d.c. feedback loop. Starting at the base of Tr2, signals and d.c. level changes appear amplified and of opposite polarity at the collector and pass on to the base of Tr3. Corresponding d.c. changes appear at Tr3 emitter and this is fed back to Tr2 base. As the changes fed back to Tr2 base are opposite to those originating there, the circuit is kept stable. A.F. signals existing at Tr3 emitter find an easy path to earth via the decoupling capacitor C9, and are not fed back to the base of Tr2. Strongly amplified a.f. signals appear at Tr3 collector.

For simplicity the a.f. gain control was omitted from the circuit in Fig. 4 and is now shown in its correct position in Fig. 5. As the a.f. gain control VR2 is increased in resistance (anticlockwise rotation) the a.f. currents flowing through C9 produce an a.f. voltage across VR2 and R10. This a.f. voltage provides negative series current feedback to Tr3 and



Photograph shows internal view of the basic receiver.

General Construction

The receiver is built on a simple aluminium chassis with front and rear panels, giving excellent accessibility for construction and adjustment. A two-part wrap-around cover provides neat appearance with easy fixing. Drawings of the chassis, covers and other items are given in Fig. 6.

If you have the usual metalworking tools and have some experience of metalwork, the chassis and panels should present no problems. If you are new to metalwork the following hints may help you.

1—The aluminium for the panels, chassis and brackets should be cut by a guillotine or metal saw, tin shears or snips leave a poor edge to the metal which is difficult to correct. A supplier of sheet metal will probably cut the metal to the required size for you. If you have to cut the metal with a saw, be sure to file the edges level and smooth afterwards.

2—Mark out centre lines on the chassis and panels as all dimensions are given from these lines. Mark out all the other dimensions from the centre lines, double check dimensions and use a small centre punch to mark the centres of all holes. Mark out the brackets etc., as shown in Fig. 6. The holes in the chassis, panels and brackets may now be drilled. It is advisable to run a pilot drill of $\frac{1}{8}$ in. diameter through the large holes first before drilling to the correct size. Holes over $\frac{1}{4}$ in. diameter should be made using a chassis cutter, the Q-Max type is ideal. The rectangular holes for the slide switches may be made by drilling a couple of holes within the marked-out area and then opening up to size with a small flat or three-cornered file.

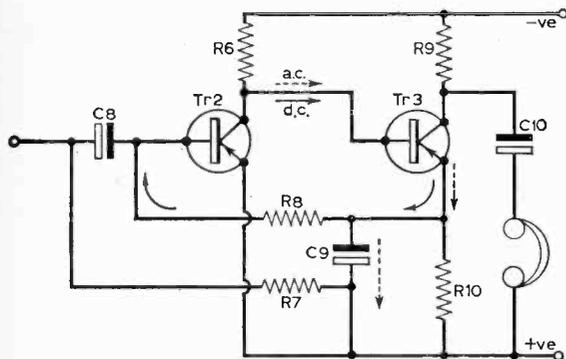


Fig. 4 (upper): Biasing circuit Tr2, Tr3.

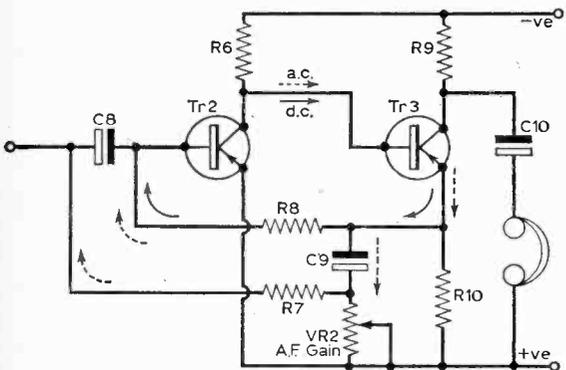


Fig. 5 (lower): Biasing circuit Tr2, Tr3, with a.f. gain control.

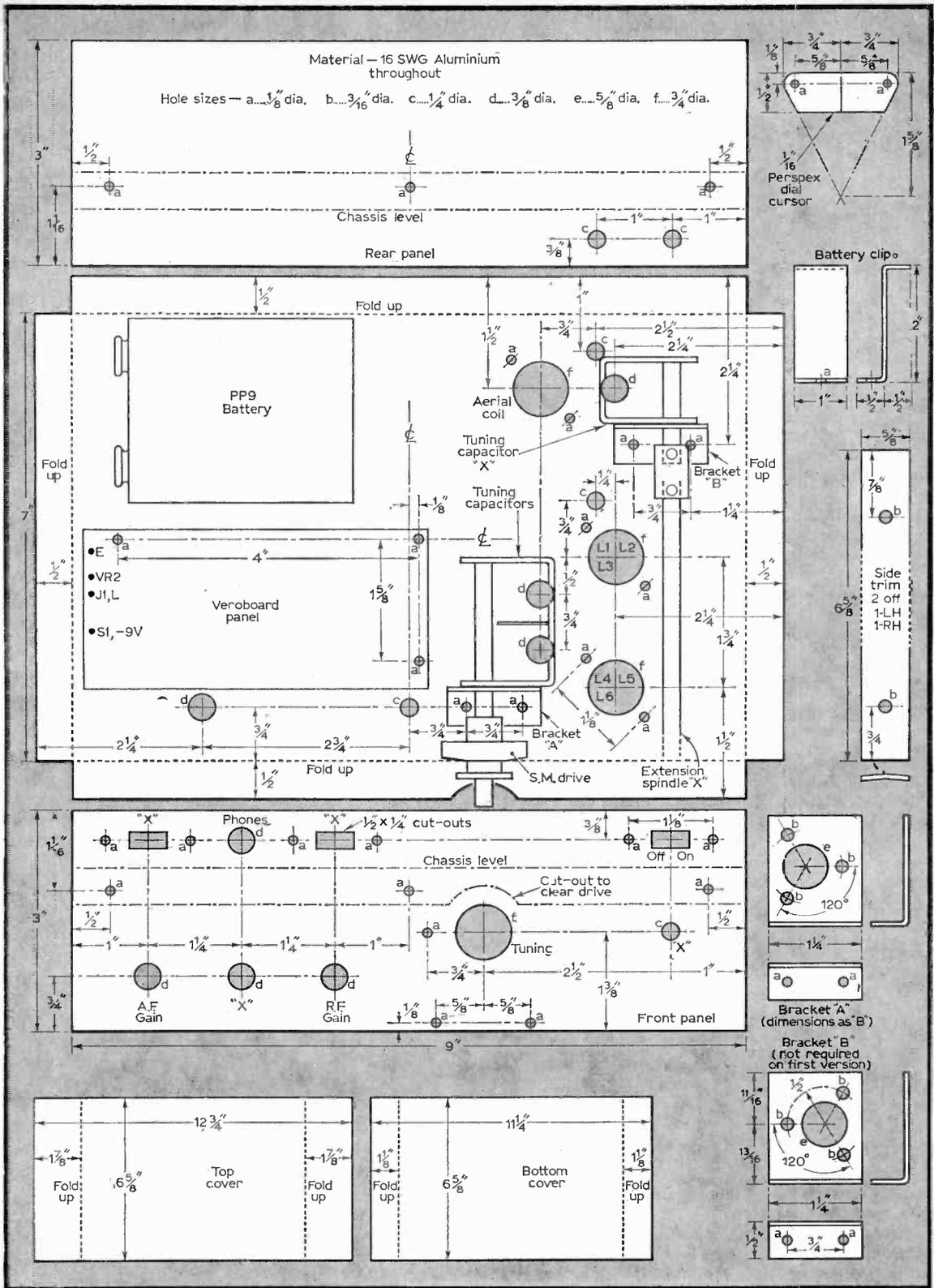


Fig. 6: Details of the main chassis drilling, front and rear panels, top and bottom covers, capacitor brackets, side trims and battery clip.

THE MW COLUMN

ONCE again we bring you some notes on the Medium Wave DX situation. The most interesting items to report are of West Coast North American reception. It must be pointed out that with the approach of the sunspot maximum these are liable to be more difficult to log.

On August 28th KOMO (1000) was heard in Southport at 0430 GMT and in Bristol KOMO again plus KING (1090) (both in Seattle, Washington) on October 22nd—KOMO at 0520 and KING over WBAL, Baltimore, Maryland.

Another interesting catch from Charles Molloy in Southport, who with Pat Dobbs in Bristol are the only ones who have reported West Coast reception recently, is CBW (990) in Winnipeg on September 11th at 0515 with close down announcements followed by their all night programme. Of course the regular East Coast stations in Canada and the USA continue to be logged widely.

Looking to South America we have a report of a real rarity in the UK—CP4 (1020) *Emisora del Estado*, La Paz, Bolivia, which was heard in June and July by Al Slater in Southwick, Sussex. This was verified—sign off at 0400. Other South Americans that you can look for are YVQQ (770) *R. Puerto la Cruz*, this is regular—also YVLH (660) *R. Giradot*, Maracay, HJED (820) *La Voz de Cauca*, Cali, and HJCT (1190) *La Voz de la Costa*, Baranquilla and there are Brazilians to be heard when conditions permit from midnight onwards. PRE8 (980) *R. Nacional*, Rio, PRB9 (1000) *R. Pan-Americana*, Sao Paulo, PRG9 (1100) *R. Nacional*, Sao Paulo, PRE3 (1180) *R. Globo*, Rio and PRG3 (1208) *R. Tupi*, Rio. Also we must not forget our old friend L.R1 (1070) *R. El Mundo*, Buenos Aires.

Now to Asia—under favourable conditions around 0030 to 0310 one may log All India Radio. We have reports of Ahmadabad (850), Delhi (1070), and you may look for Sangli (1250). Afternoon reception of the latter was known, but we feel it to be very difficult now. Others are Hopei (770) around 2220, Urumchi (1525) in Russian from around 1800 and Taiwan (750) from about 2100.

On the African continent there are some excellent potential catches. Fairly often heard is Sao Tome (759) around 2000, also the high power *R. Biafra*, Enugu (620) at 0430 and *R. Lourenco Marques* (917) at 0100. A good source of DX is South Africa and over the past year we have had reports of the S.A.B.C. Springbok Commercial Service, which is an All Night Service. As far as we know the earliest hour for this is about 0130 and the following channels should be carefully watched: 1286—in Johannesburg, East Rand, 1268 in Pretoria and 782 in Bloemfontein—if Deutschlandsender is off the air.

We hope that these notes are of interest. They have been compiled at very short notice upon an urgent request to help out due to the indisposition of Al Woodland.

KEN BROWNLESS

3—The bending of the chassis and covers is tackled next. If you do not have access to a bending machine, or suitable pieces of angle iron which may be clamped in a vice, an easy way of bending the chassis is as follows. Cut two pieces of $\frac{3}{4}$ in. thick blockboard, size $8\frac{7}{8}$ x 6in., make sure all the corners are square and the edges parallel. Sandwich the chassis between them so that the blockboard fits the $8\frac{7}{8}$ x 6in. area which will be the inside dimensions of the chassis. Screw the two pieces of blockboard together through two or more of the holes already drilled in the chassis. The whole assembly is now clamped in a vice and each edge of the chassis is gently tapped over, using a block of hardwood and a light hammer. Do not rush this operation as it is difficult to straighten any irregularities that may appear in the edge. Make sure the edges are folded in the correct direction. The covers and brackets may be made in the same manner as the chassis but without drilling holes.

4—The panels now require fixing to the chassis, and it will be seen that no holes exist on the edges of the chassis for this purpose, this is intentional. Cut four small blocks of wood having a distance of exactly $\frac{1}{2}$ in. between two opposite faces, for use as jig blocks. Turn the chassis folded-edge upwards and stand this on the four blocks so that the chassis is raised exactly $\frac{1}{2}$ in. Take the front panel and rear panel and stand these against the respective edges of the chassis as shown in Fig. 6. Make sure everything is square and mark through the panel fixing hole on to the chassis edge. Centre punch the centre of the markings and drill $\frac{1}{8}$ in. diameter holes. The panels may now be bolted to the chassis using 6BA bolts and nuts. The jig blocks should again be used to ensure the complete unit is tightened up squarely.

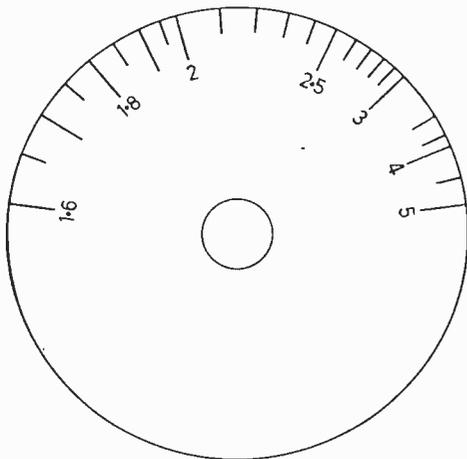


Fig. 7: The receiver dial—shown to scale.

5—The top and bottom covers are now placed in position. The rear panel should be set in about $\frac{1}{4}$ in. and the front panel about $\frac{1}{2}$ in.

6—To present a good appearance, the front and rear panels are covered with white Fablon or Contact plastic material.

7—The dial is made of an aluminium disc cut to shape and a calibrated paper disc attached. (See Fig. 7.)

To be continued



replacement RECTIFIERS

by J. LAW



THE growing popularity of transistor portable receivers in recent years has resulted in large numbers of mains table receivers being discarded long before their useful life was over. Many of these sets have excellent short wave bands, others have push pull output and good quality speakers. Many dealers, having taken this type of receiver in part exchange against sales, are glad to get rid of them for a nominal payment.

Many of these receivers have only rectifier and smoothing faults but it is surprising how many different types of bases there are. The amateur has only a limited selection of valve rectifiers in his junk box. An attempt to find an interchangeable rectifier which could be used with base adaptors to test any set resulted in this universal rectifier.

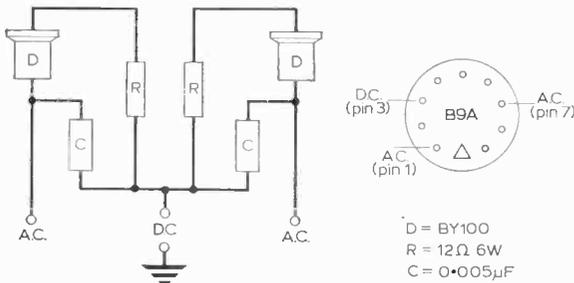


Fig. 1: Full wave rectifier using two silicon diodes.

The problem of catering for different heater voltages has been overcome by the use of silicon diodes. Wiring the diodes and limiting components to a B9A base enables direct replacement of EZ80 and other current rectifiers. Base adaptors, as in Fig. 5 enable the basic unit to be adapted to International and Mazda octal, B7G, B8A and other

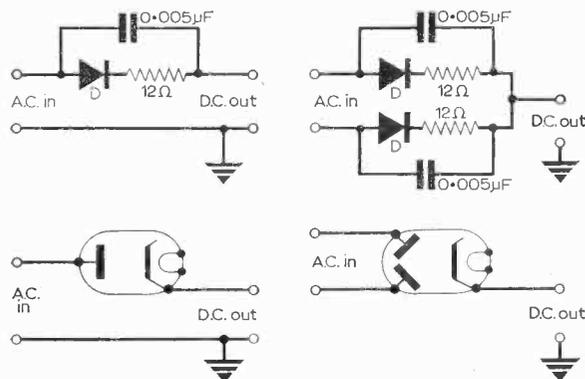


Fig. 2: Half wave rectifier circuits (left) and (right) full wave circuits. The 0.005 μF capacitors should be 1000 V wkg.

type bases. Most a.c. receivers using full wave rectifiers have heater supplies of 5 or 6 volts. Removal of the rectifier does not interfere with the heater supplies of the other valves in the receiver. A defective rectifier can, therefore, be removed and a diode replacement unit substituted.

Figure 1 shows the component parts of a full wave universal rectifier, namely two B100 silicon diodes, two 12Ω 6 watt resistors, two 0.005μF 1kV wkg., capacitors wired to a B9A pin base. Fig. 2 shows the comparative valve and diode circuits for both full wave and half wave rectifiers.

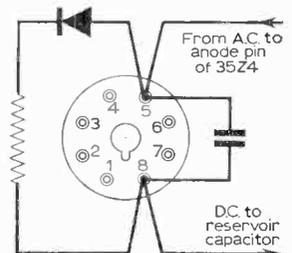
Many a.c./d.c. receivers are still in use despite the ever-growing popularity of the transistor home radio. Using high voltage filaments for output and rectifier valves they make use of half wave rectification for h.t. supplies. Typical of this design are the Ultra U930 with UL41 output valve and UY41 rectifier, the Philco Model 104 with UL84 and UY85 rectifier and the Pilot Maestro with 35L6 and 35Z4 valves.

A common fault in a.c./d.c. rectifiers is a break in the cathode lead leaving the heater intact. Since half wave rectification is used only one silicon diode and associated components is required to replace the rectifier valve. In such a case the parts can be wired across the valve holder base as shown in Fig. 3.

Where, however, the heater is open circuit, it is necessary to bridge the gap in the heater circuit, in order to restore the current to the remaining valves in the set. The resistance value of the "bridge" must be chosen so that approximately the same voltage will be dropped across it as was developed across the rectifier valve filament.

Reference to a valve data booklet will give details of rectifier heater voltages and currents. The Ultra radio, Model U390, referred to above makes use of a UY41 rectifier. This is a valve with a 31V 0.1A heater and a B8A base. The value of the resistor required to replace the filament can be obtained from Ohm's Law—Resistor $R = E/I$. The nearest resistor value would be 300Ω (5 watt rating) and this would be wired across pins 1 and 8 of the rectifier base and the diode, resistor and capacitor connected as shown in Fig. 4(a).

Fig. 3: Replacement silicon rectifier (on international octal base) for 35Z4 where filament is still intact.



The Philco radio uses a UY85 rectifier valve with a 38 volt heater at 0.1A. Again from Ohm's Law the heater "bridge" resistor can be ascertained. The nearest commercial value would be 400Ω 5W. The valve has a B9A base and the resistor would be joined across pins 4 and 5. Fig. 4(b) shows the diode wiring.

For the Pilot Maestro which has a 35 volt rectifier a bridge resistor of 200Ω 6W will suffice (see Fig. 4(c)).

When a valve rectifier has been proved to be defective, the glass envelope and valve structure may

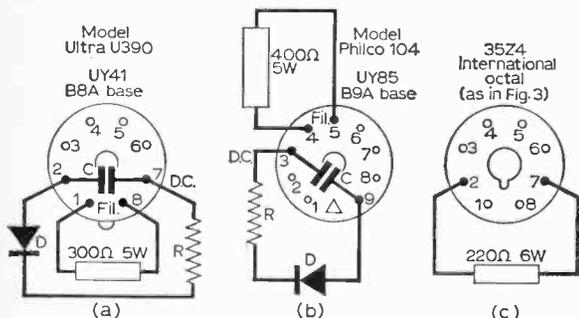
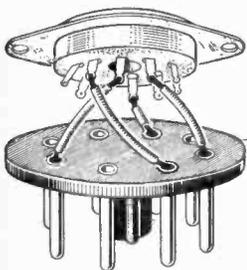


Fig. 4: (a) Complete rewire to replace UY41 with o/c filament; (b) ditto for UY85; (c) used where 35Z4 filament is o/c (also add Fig 3 details).

be removed, and the components wired on top of the base if it is thought undesirable to wire them under the chassis. This allows ventilation of the bridge resistor which will run warm. When wiring up diodes the full length of the wires should be used. Sleeve them and sheath the outer case of the diodes in plastic tape. If the case should contact the chassis the output will be short circuited.

Before fitting a replacement rectifier, the cause of failure must be ascertained; otherwise the diodes may in their turn be damaged. A short circuit in the reservoir capacitor is a typical cause of rectifier failure.

Referring back to Fig. 2 silicon diodes have a lower forward resistance than valve rectifiers. Replacement of a valve with a diode would result in a higher voltage across the reservoir capacitor.



B9A valveholder joined to International octal or Mazda octal valve pin base by stiff wires. Base cut from old valve

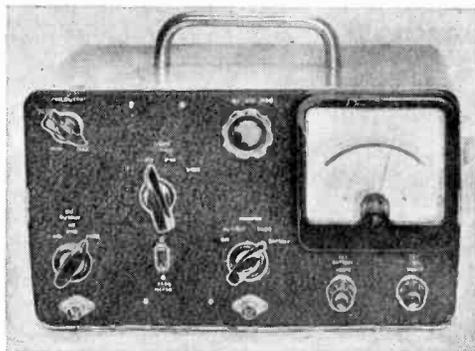
Fig. 5: Simple base adaptor.

Since there is no heater warm and smoothing up period the full voltage appears across the reservoir capacitors immediately the receiver is switched on. This could cause damage. To reduce these dangers a series resistor of 12Ω 6W is connected to each diode. The 0.005μF capacitors are connected across the diodes to protect them from voltage surges.

Universal silicon diode rectifiers have given a new

—continued on page 698

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Full constructional details are given of this design, which uses 8 transistors and 5 diodes, together with helpful notes on calibration.

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Faulty transistors are usually thrown away. But are they always really useless? Only one junction can be damaged and many such components can be reclaimed for use as diodes or zeners. This article shows how to build a simple test unit to check whether damaged transistors can be utilised for other purposes.

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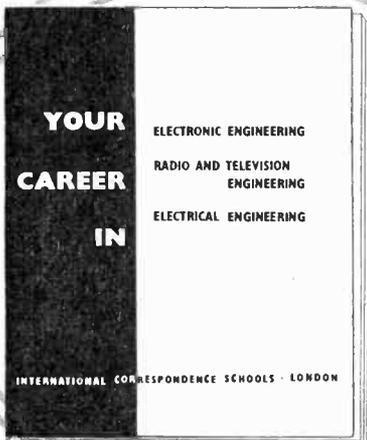
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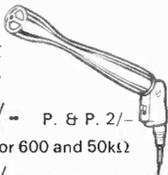
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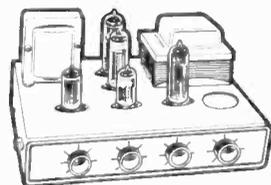
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500µF/50, 330v	2/7	100/100, 50v	250µF, 50v	10d.	
1,000µF, 70v	3/2	12,500µF, 12v	12,500µF, 30v	18/-	
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0.25µF	3 volt	5µF	50 volt	30µF	10 volt
1µF	6 volt	1µF	70 volt	32µF	1.5 volt
1µF	10 volt	6µF	3 volt	40µF	3 volt
1µF	15 volt	6µF	12 volt	40µF	6-4 volt
1µF	50 volt	6µF	15 volt	50µF	50 volt
1.5µF	16 volt	6µF	150 volt	50µF	9 volt
2µF	3 volt	8µF	3 volt	50µF	12 volt
2µF	9 volt	8µF	6 volt	64µF	2.5 volt
2µF	70 volt	8µF	25 volt	64µF	9 volt
2µF	150 volt	8µF	350 volt	100µF	3 volt
2µF	350 volt	8µF	50 volt	100µF	6 volt
2µF	350 volt	8µF	275 volt	100µF	9 volt
3.5µF	16 volt	10µF	6 volt	150µF	12 volt
2.5µF	25 volt	10µF	10 volt	150µF	25 volt
3µF	3 volt	10µF	12 volt	200µF	3 volt
3µF	12 volt	10µF	25 volt	200µF	4 volt
3µF	25 volt	12µF	3 volt	200µF	16 volt
3µF	450 volt	12µF	20 volt	250µF	2.5 volt
3.2µF	6 volt	16µF	30 volt	250µF	12 volt
3.2µF	6-4 volt	20µF	150 volt	250µF	9 volt
3.2µF	64 volt	20µF	3 volt	320µF	2.5 volt
4µF	4 volt	20µF	6 volt	350µF	9 volt
4µF	12 volt	20µF	15 volt	400µF	2.5 volt
4µF	25 volt	25µF	6 volt	400µF	15 volt
4µF	64 volt	25µF	12 volt	500µF	4 volt
4µF	100 volt	25µF	15 volt	500µF	6 volt
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0.001µF	1000 volt	0.02µF	350 volt	0.5µF	150 volt
0.002µF	500 volt	0.1µF	350 volt	0.5µF	350 volt
0.002µF	750 volt	0.1µF	750 volt	0.5µF	500 volt
All at 15/- per 100, 3/- per dozen.					

MULLARD POLYESTER CAPACITORS ALL HALF PRICE

0.0022µF	400 volts	4d.	0.15µF	400 volts	7d.
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0.0015µF	400 volts	4d.	0.37µF	150 volts	8d.
0.001µF	400 volts	4d.	0.056µF	125 volts	7d
0.01µF	400 volts	4d.	1µF	125 volts	1/6
68pF	Tubular pulse ceramic	6d. each.			
120pF	Disc pulse ceramic	6d. each.			

VERY SPECIAL VALUE! Silver Mica, Ceramic, Polystyrene Condensers. Well assorted. Mixed types and values. 10/- per 100.

RESISTORS. Give-away offer! Mixed types and values. 1/2 to 1/2 watt. 8/6 per 100 or 55/- per 1,000. Also 1 to 3 watt, close tolerance. Mixed values. 7/6 per 100, 55/- per 1,000. WIRE-WOUND RESISTORS. 1 watt, 3 watt, 6 watt. 6d. each. 7 watt and 10 watt 9d. each.

CONNECTING WIRE. THIN P.V.C. INSULATED

10v/15 1/-; 100yds 7/6; 500yds 25/- (post 4/6); 1,000yds 40/- (post 6/3-).

VALVES. BRAND-NEW AND BOXED. ROCK-BOTTOM PRICES!

DY47	5/10	EY86	5/10	PCL56	7/4
6AC80	6/1	EY87	5/10	PF1200	10/2
ECC82	6/5	PABC80	6/2	PL36	8/9
ECC83	6/5	PC97	5/10	PL81	7/4
ECL80	6/2	PC84	8/5	PL83	7/4
ECL86	7/4	PCP80	7/4	PL84	5/0
EP80	6/2	PCP86	8/9	PL500	10/10
EP85	6/2	PC182	7/4	PV32	7/10
EP183	8/2	PCL83	8/6	PV81	5/10
EP184	8/2	PCL84	7/4	PV82	4/1
EV31	5/10	PCL85	7/4	PV800	5/10

A further 10% discount will be given on lots of 50 of any one type

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Sonytone Mono 10/-; Acos Mono 15/-; Acos Stereo 20/-; Stereo Diamond 25/-, All with needles.

Signal Injector Kit—10/-, Signal Tracer Kit—10/-.

Vero Board. All sizes in stock. Cutter and 5 boards 2 1/2 in. x 1 in. only 9/0.

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G. F. MILWARD, 17 PEEL CLOSE, DRAYTON BASSETT, Staffs.

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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

ASIA

Afghanistan: *Radio Afghanistan* (Ansari Watt, Kabul) using the new outlet of 15,435 from 1100-1200 for a combined Pushta/Dari programme.

China: *Radio Peking* (Fu Hsin Men, Peking) has English to Europe at 2030-2125 and 2130-2225 on approximately 9,890 and also in the 25 and 42 metre bands. English for Africa is at 1930-2025 and 2030-2125 on 9,450.

Indonesia: *Radio Republik Indonesia* (P.O. Box 157, Djakarta) has left 9,865 for its Arabic, French, Indonesian and English programmes at 1615-2000 to Europe. Listed new frequency, on which the station has not so far been reported is 15,200. However part of the Arabic programme at 1615 was heard on 9,588 before being blotted out by interference.

Japan: *N.H.K. (Tokyo)* latest schedule for the general service is: on 15,105/15,195/15,300 0100-0130, 0200-0230, 0300-0330, 0400-0430, 0500-0530; on 9,505/15,195/15,300 0600-0630, 0700-0730, 0800-0830, 0900-0930; on 9,505/11,815 15,300 1000-1130; on 9,505/9,560/11,815, 1200-1230, 1300-1330, 1400-1530, 1600-1630, 1700-1730, 1800-1830; on 9,560/11,815/15,105 1900-1930, 2000-2030, 2100-2130; on 9,700/15,195/17,785 2200-2230, 2300-0030.

Lebanon: *R. Lebanon* (Ministry of Information, Beirut) now using 15,180 at 1830-2030 in English, Arabic and French to Africa.

AUSTRALASIA

Australia: *Radio Australia* (P.O. Box 428G, G.P.O. Melbourne) now uses 11,810 from 1800-2115 in English. The 2230-0030 Indonesia programme now goes out over 21,680/15,330. The UK English transmission is now at 0815-0915 on 9,560/11,710.

NORTH AMERICA

U.S.A.: *Radio New York Worldwide* (485 Madison Avenue, New York, NY, 10022) now reported to have the following frequency usage to Europe. On 17,730 1600-1945; 21,530 1600-1700; 11,970 2000-2200; 21,520 1700-1945; 17,760 1945-2200; 15,440 1600-2200. A press release from the station says however that at 1700 it is using 17,760/17,845/21,465/21,530.

CENTRAL AMERICA

Cuba: *Radio Habana Cuba* (Apartado Postal 7026, Habana) has made the following changes: Spanish to Mediterranean: 1630-1730, 0830-0930 11,735; 1855-2030 17,855/17,885. Arabic to Mediterranean 0800-0830, 1000-1030 11,735; 1810-1855, 2030-2110 17,855/17,885; English for the Americas 2050-2150 15,230. French to Mediterranean 0730-0800, 0930-1000 11,735; 1700-1810, 2110-2140 17,855/17,885.

Netherlands Antilles: *Trans World Radio* (Bonaire) reported on 15,255 to Europe at 2000-2130.

Windward Islands: *Windward Islands Broadcasting Service* (St. George's, Grenada) noted at 2015-2130 on 21,690.

SOUTH AMERICA

Chile: *Radio Nuevo Mundo* (Casilla 9255, Santiago) reported on the new outlet of 17,865 at 2400-0200.

EUROPE

Albania: *Radio Tirana* (Rue Ismail Quemal, Tirana) reported using new outlets 6,200/9,510 for the 2200-2230 English transmission to Europe.

Belgium: *Radiodiffusion—Television Belge* (18 Place Eugene Flajey, Brussels 5) transmits as follows at 1830-2100 over 6,010/11,615/17,860; 2115-2200 6,010/9,615 15,335; 2315-0100 6,010/9,615/11,895.

Denmark: *Radio Denmark* (Radio House, Rosenorasalle 22, Copenhagen 5) has retimed its South American service. New times are Danish 2000-2045 and Spanish 2045-2115 over 15,165.

German Federal Republic: *Deutsche Welle* (5 Koln 1, Postfach 344) has made the following frequency changes: Indonesian 1210-1320 15,300/17,830/21,650; English 0300-0340 9,640/11,945; 1550-1620 15,275/17,875. Spanish 0555-0635 9,545/11,945; 2240-2350 and Portuguese 2140-2240 9,545/11,795/15,435. Turkish 0610-0640 9,610/11,795.

German Democratic Republic: *Radio Berlin International* (116 Berlin Nalepastrasse 18-50) now transmits in English as follows at 1730, 2015*, 2200**, 2300** on 6,080/6,115/7,185/7,300/9,730 (also on *1,511; **1,430); 0100, 0230 on 9,730/11,890; 0345, 0445 9,560/9,650; 0345, 11,795; 1215, 1600 21,600; 0615 11,795; 1315 21,655; 1915 17,785; 1600 17,805; 0645 17,700; 1200, 1315 21,610; 1415, 15,125.

Great Britain: *BBC* (C EXB, Bush House, London, WC2) noted on 25,720 with Hindu 1500-1545; Urdu 1415-1500; Chinese 1200-1300; Indonesian 1030-1100; Japanese 1100-1130; Vietnamese 1130-1200.

Manx Radio (*Loch Promenade, Douglas, Isle of Man*) transmits as follows: 0600-0630 and 1730-1900, 1,594; 0630-1730 1,295. There is also a religious programme at 1015-1100 on 1,594.

Greece: *Radio Athens* (Mourouzi Street 16, Athens 138) noted with English and French during the 2200-2230 Greek transmission on 11,720/15,345.

Hungary: *Radio Budapest* (Brody Sandor-S.U. 5-7, Budapest VIII) has English as follows: To Europe 2130-2230 on 11,910/9,833/7,220/6,234 and 2330-2400 on 6,234/3,995/539. To Far East 0800-0815 Wednesday and 1015-1030 Friday 11,910/15,160/17,890. To North America 0030-0130 6,234/7,220/9,833/11,910/15,160; 0300-0400 and 0430 and 0500 6,234/7,220/9,833/11,910.

Thanks for help go this month to D. O. French, Roy Patrick, A. E. Roxburgh, M. A. Golics, Swiss Shortwave Service, Radio New York Worldwide and the International Short Wave Club.

THINGS are really hotting up now and if they get any hotter the shack at 3JDG will be growing orchids. Ten metres has burst its banks at times although still rather up and down. Twenty and fifteen have really been wide open and even noisy seven megs has reared its DX head. **David Smith** (Lancs.), has sent in a log for 1.8 Mc/s which shows that it is far from being just a "G only" band. Incidentally **W1BB** has now worked 97 different countries on 160 metres, anyone beat that?

Best times to listen on the bands is always a good thing to know. At the time of writing topband is interesting after 10 p.m., while twenty and fifteen seem to be at their best from 10 a.m. to 4 p.m. Ten is a daytime band too from 10 a.m. to 4 p.m. but has stayed open till 9 p.m. on occasions.

Many thanks to all those who sent in logs this month. Some were really fine business so let's take a peep at the postbag and see.

L.F.

Brave men still shake at the knees and keen types hide in dark corners, that is if you happen to mention a listen on the l.f. bands. Only two souls came through unscathed this month each with a bag of goodies.

D. Smith (Lancs.), RX60N, 35ft. end fed scooped this lot on topband c.w.—OK2BOB, OK2BKH, OK2AKU, OL2AIO, OK3KAS, and from the Channel Islands—GC3ODE.

P. Baker (S. Wales), HE30, 150ft. end fed listened on 80 s.s.b. and got—CN8AW, FP8CA, VE1UA, VO1AW, VS6FS, VS9MB, W3BMS, ZC4MO, then a good opening to the Pacific—ZL2FQ, ZL2KT, ZL2BCG, ZL2RJ, ZL4KE, ZL4LM. On 40 (I'm shaking already), Paul raised—CN8AW, CN8BV, EA6BC, K1DRI, K8AWS, OA8NAM, PZ1CF, SVØWV, UJ8GW, VK2AVA, W3BMS, ZB2AP, ZC4AK, ZL2BDA.

TEN METRES

The r.f. coming in on this band is quite devastating at times. Really worth a listen these days too so spin the dial round to 28Mc/s and leave it there ready for the next session.

G. Coomber (Essex), HRO-MX, 15 metre dipole at 16ft. hooked these on s.s.b.—W1HRN, W2QCR, W3GHE, W4MMD, W5TBH, W8OCT, W9LKY, WØAXE, 5N2AAF, 9HIK.

P. Knowles (Cheshire), CR45 plus PR30, heard these, which is pretty good for a t.r.f.—DJ9HI, EA6BJ, 1IKTS, K1FWK, UB5GTW, UB5SLF, VE3CTI, W1TAT, W2EIR, W3TUA, W4CNN, W8YCI, W9HLY, YO2QCA, ZE8JM, ZS1JH all on a.m. too.

L. Rowland (Cheshire), lurked with intent on 28Mc/s. Using a Trio 9R-59 and a 150ft. long wire as bait he captured—CE3TS, CN8PR, CR6IV, CR7FM, CX9PP, EA6BJ, EL2AI, EL2S, EP2BQ, IS1IUA, IT1BXX, JA1AG, JA1FGE, JA2GDF, K1YZW, K2QIL, K4KJN, K5DFZ, K6CCY, K6HAD, K8EQH, KØRCH, KG6ALY, KP4BJD, KR6TAB, KV4AD, KV4BW, KZ5MB, OD5BZ,

OX3BS, PY2DSE, PZ1BX, SVØWM, UA3AVV, UF6ACR, VE3PWA, VE4GC, VE5LL, VK6BE, VK6CF, VK6XX, VK9DR, VK9DJ, VS6DO, VU2MWP, W2BZ, W3AEC, W4YYY, W5IOU, W6EPZ, W6V10, WA6HXW, WB6RJG, W7PEY, W8AUE, W9RYX, WØQDW, XE2IW, YV1LA, YV5ANE, ZC4MO, ZE1AA, ZS1FH, ZS5DG (No relation), ZS6AOW, 3V8BZ, 4X4BL, 5N2AAF, 5R8AS, 9J2WR, 9L1GQ, 9L1JJ. All on s.s.b. (My kingdom for a b.f.o.).

I. Davies (Essex), homebrew double superhet transistorised (well done, Sir), 10 metre dipole, logged—OD5BZ, OX3BX, PJ2CQK, VE3BRC, YV6BV, 5N2AAF, 9HIAG, 9HIK, 9G2OK.

TWENTY/FIFTEEN

D. Henbry (Sussex), HA500, 20 metre dipole, shows what's about on 21 Mc/s s.s.b.—CE3PY, CR6II, CR7DS, EL8H, HK3BLD, HK5ASA, HL9KB, HR1KAS, KV4CF/M, KZ5SF, LU8DB, LU8DKA, OA4JR, OA8V, TG7AV, VP2GBC, VP8JD, VS6BE, VS6FZ, VU2BK, W7MX, WA7CDM, WA7EVO, YN4WD, ZL1ABO, ZL1JN, ZP5JB, 6O1GB, 9X5GC.

S. Herod (Suffolk), Two commercial sets, one as a b.f.o. On 21 Mc/s s.s.b.—CEØAE, CN8FV, CR6IA, CR7FG, FL8HM, H18XBA, HR1KAS, JA1BZ, JA2JAA, JA3FSN, JA4COS, JA5CEU, JAØBQF, K7NEQ, K3USL/AM (23,000ft. up off Sardinia), KG6AAY, OD5CN, VS9MB, W7LVI, ZE6JL, ZL2JSC, ZL1PZ, 5Z4IW, 7Q7EC, 9Q5AF, 9U5CM.

R. Dinning (Scotland), HA350, Joystick, logged—CR4CB, DU1FC, DU1FB, H11MN, KL7SAY, KZ5WL, LU1DAB, JAØPE, VK1GD, VK2AGW, VK3AMK, VK6ALY, VQ9CT, YA1HD, YS1JSL, ZL1IH, ZS6BFY, 9H1R. All 21 Mc/s s.s.b.

L. Bousher (Wales), R1155, 50ft. end fed raised these on phone on twenty—CE6EQ, EL3C, H18LAL, HC6GM, HK3AUE, HK4AZX, JA1PIB, KP4AKB, KZ5NH, KZ5RJ, OA3CL, OX4AA, OY1WP, PX1NV, PY1CLI, PY7GV, PZ1BW, TG9AD, UP2NV, VE3BZU, VK4PU, VO1HQ, VP8JB, YS1RCP, YV5BE, ZE1CGF, ZS9H, 3A2DW, 5Z4IW, 6Y5GG, 8R1S, 9G1BS, 9Y4VT.

J. Edwards (S.E.20), SX24, 80ft. long wire switched in the b.f.o. for these on s.s.b.—CR4BC, EP2BQ, ET3USA, H18XMY, HK3AUE, JT1BB, KP4AKB, LU8DDI, PY1TX, TI2ALG, UG6AW, VK2AVG, VK7RX, VP8HZ, VP8IU.

P. Leybourne (Glos.), HRO, 60ft. end fed listened from 0500 to 0700 and heard—EP9EP, HB9AA, HP1JC, KP4AST, PY2SO, VE3EWY, VK2WD, VO1FB, WB2RRR, W6ZKM, W9TFU, YV1EL, ZL1AIX, ZL2AAG, ZL2ANR, ZL2AZZ, ZL4GH, ZL4KL, ZL5KL, ZM7WMM.

CONTESTS

Many a tear will be shed in the Christmas pud this month. Only one contest in my diary—3rd December 70Mc/s c.w. contest.

Very best wishes for Christmas and the New Year to all r.f. lovers. Don't forget all those wonderful nets that go on on Christmas Day morning. CUAGN in 1968.

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THE MAGNIFICENT ROAMER 7 MK.IV

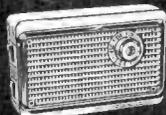
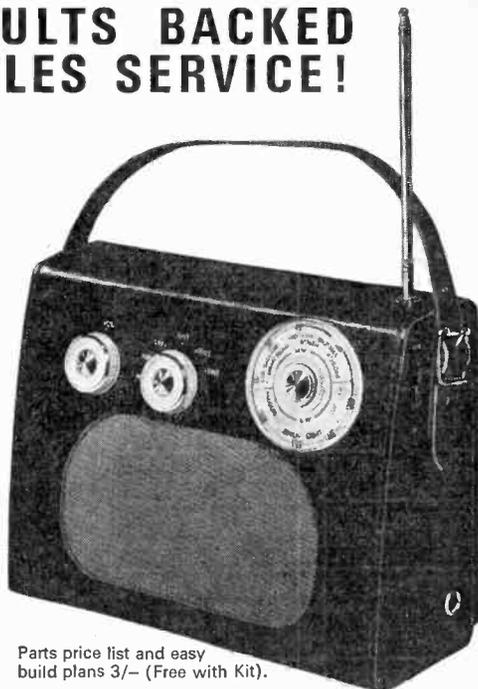
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- Separate on/off switch, volume control, wave change switches and tuning control.
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- First grade components.
- Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build with guaranteed results.

Total building costs
£5.19.6

P. & P.
5/6

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



TRANSONA FIVE

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive case with red speaker grille. Size 6½ x 4½ x 1½in. Fully tunable. 5 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone super dynamic 3in. speaker, all first grade components. Easy build plans and parts price list 1/6. (FREE with kit).

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



MELODY SIX

TWO WAVEBAND PORTABLE WITH 3in. SPEAKER

Randsome leather-look case size 6½ x 3½ x 1½in. with gilt trim and hand and shoulder straps. Fully tunable over both Medium and Long waves. Incorporates pre-tagged circuit board, 8 stages—6 transistors and 2 diodes, ferrite rod aerial, push-pull output, wave change slide switch, tuning condenser, volume control, 3in. moving coil speaker etc. Easy build plans and parts price list 2/-. (FREE with kit).

Total building costs
59/6 P. & P.
3/6

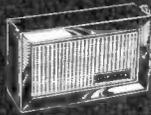


ROAMER SIX

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings, size 7½ x 5½ x 1½in. World wide reception. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for short waves. All top grade components, 8 stages—6 transistors and 2 diodes including Philco Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra.) Easy build plans and parts price list 2/- (FREE with kit).

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



POCKET FIVE

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE

Attractive black and gold case. Size 5½ x 1½ x 3½in. Fully tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone 2½in. moving coil speaker etc. Easy build plans and parts price list, 1/6 (FREE with kit).
POCKET FIVE Medium and Long Wave version with miniature speaker **ONLY 29/6**. P. & P. 3/6.

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



MELODY MAKER 6

THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Smart pocket size case, 6½ x 3½ x 1½in. with gilt fittings. Fully tunable over both Medium and Long Waves with extra M.W. band for easier tuning of Luxembourg, etc. 8 stages—6 transistors and 2 diodes, top grade 3in. speaker, 2 R.F. stages for extra boost, high "Q" ferrite rod aerial. Easy build plans and parts price list 2/- (FREE with kit).

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



SUPER SEVEN

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

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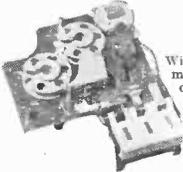
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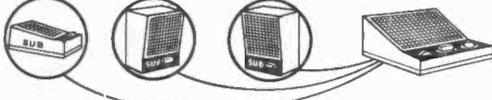
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With Capstan control. This unit is extremely well made and measures approx. 6 x 5 x 2in. deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4 1/2 volts. Supplied complete with 2 spools ready to install. Record, Replay head is the sensitive M4 type intended for use with transistor amplifier. Price £4.15.0. Post and insurance 4/6.



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4 speed, gram. motor with light weight pick up, motor electronically balanced and free from wow and flutter. Speed change by push button—16, 33, 45, 78 r.p.m. Price 39/6. Cartridge extra mono 10/6, stereo 15/- plus 4/6 post and insurance. DONT MISS THIS TERRIFIC BARGAIN.

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Capstan Driven, 4 Transistors SPECIFICATION: 200/7,000 c.p.s.—400 mW. output—double track—twin speed (31 and 71) fast rewind time—5in. spool gives one hour playing with standard tape. Complete with batteries, microphone—tape spool and instruction manual. Nothing to go wrong if you use a good tape and keep heads clean. Demonstration gladly given at our Croydon shop. Special Snip Price This Month £9.18.6 post and insurance 6/6.



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TRANS/CEIVERS

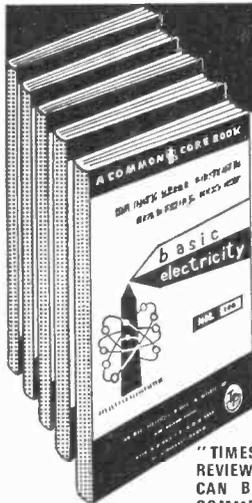
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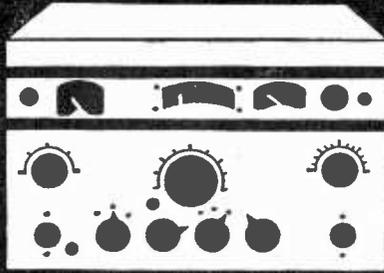
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GUIDE TO SURPLUS COMMUNICATIONS RECEIVERS

K.ADKINS

PART 6

The R1155

The R1155 has always been popular. It was first manufactured for the R.A.F. in large numbers during the last war, and was used by Bomber Command. There are several versions but as the differences are minor they will all be dealt with in this section. The frequency range of the R1155 and R1155B (the most common versions) is as follows:—
18.15—7.5Mc/s; 7.5—3.0Mc/s; 1,500—600kc/s; 500—200kc/s; 200—75kc/s.

The R1155L and the R1155N versions have the following frequency range:—

18.0—7.5Mc/s; 7.5—3.0Mc/s; 3.0—1.5Mc/s; 1,500—600kc/s; 500—200kc/s.

The i.f. is 560kc/s.

The circuitry includes an r.f. stage, two i.f. stages, a b.f.o., noise limiter, and a visual tuning indicator of the magic eye type. In its unmodified form, output is for headphones. The R1155 has a very large and distinctive tuning dial. In addition, the R1155B version has a superb high reduction tuning drive. This tuning drive is available separately, and can be fitted to the other versions.

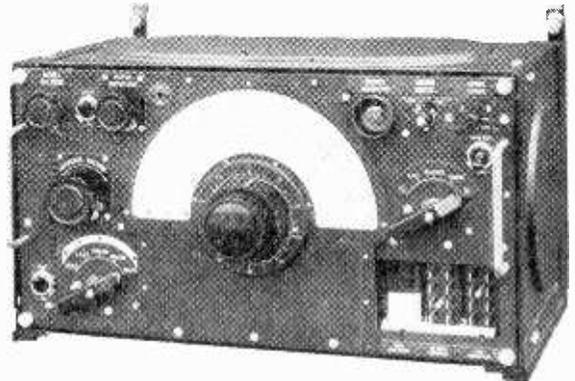
The b.f.o. control is pre-set. This arrangement is quite suitable for c.w., but not quite so convenient for s.s.b.

The R1155 requires an external power unit. Output for headphones, and power input, are all provided for by one Jones socket, located on the front panel. A commercially manufactured power unit/output stage, inclusive of speaker, has been available. This unit will connect with the Jones socket thus enabling the R1155 to be used without modification.

In its original form, the R1155 was fitted with a direction finding device. This is of no use to the amateur, however.

Modifications: Although the magic eye tuning indicator is quite suitable for the accurate tuning in of signals, an "S" meter would be required for the accurate comparison of signals. In spite of the availability of a commercial power unit/output stage unit, many users prefer to modify the R1155 itself, and build a power supply and output stage into the set. There is room for this, if the unwanted D/F components are removed. For s.s.b. use, a fully tunable b.f.o. would be required, and this can be achieved simply by replacing the pre-set component by one with a longer spindle. Another possible modification is the stabilisation of the oscillator supply.

Availability: Quite a large number of R1155's were available before the period covered in this



Photograph by courtesy of The Marconi Company

report. A large number of the R1155B version were available in grade 2 condition between mid-1960 and mid-1961, and sold for prices ranging between £8 and £10. The commercial mains power supply/output stage unit, mentioned earlier, was available for £6 10s. Handbooks were not available, but a booklet of technical information was supplied.

Following the R1155B's, a number of R1155L's, or R1155N's (with the 1.5 to 3Mc/s band) in grade 2 condition were available in mid-1961. They were only on sale for a month or two, at £12 19s. 6d., power/output units extra.

No R1155's were released during 1962, 1963 and 1964. In mid-1965, however, a very small number of R1155B's in grade 2 condition were sold for £12 19s. 6d. They are no longer available.

During 1960/61/62, the high reduction tuning drive, (fitted to the "B" version), was in plentiful supply for fitting to the other versions.

Although at the present time the R1155 is not available on the surplus market, and is unlikely to be in the future, they can be quite easily obtained on the secondhand market. Prices are from £10 downwards, and most of them have been modified in various ways.

R1155 manuals are believed to be unobtainable, although a commercially produced booklet, containing technical information is available.

The R1475

Designed by Marconi for the R.A.F., this is generally considered to be the receiver that replaced the R1155, although the authenticity cannot be

established. The R1475 certainly has a very fine performance, and is highly stable.

The receiver covers from 2 to 20Mc/s in four bands. The i.f. is 600kc/s. The R1475 has 11 valves as follows:—3 6K7, 1 6K8, 1 6J5, 3 6Q7, 1 6H6, 1 Y63 tuning indicator and a VR150-30 voltage regulator. The circuit includes one r.f. stage and two i.f. stages, a 600kc/s crystal reference oscillator and a crystal controlled b.f.o. A voltage stabiliser is also incorporated. Other features include four-position selectivity with audio filters for c.w. reception; fast and slow a.g.c., and high and low noise suppression. Receiver sensitivity is of the order of 1 microvolt.

The tuning dial, which is of rather unusual design, is accurately calibrated and provides very adequate mechanical bandspread. The dial can be reset against the 600kc/s oscillator by means of a special panel trimmer control.

A unique feature is that it is able to receive on two entirely independent frequencies simultaneously. This feature is provided by means of a plug-in unit with an additional mixer, allowing the R1475 to receive on a guard channel in the range of 2 to 4Mc/s or 4 to 7.5Mc/s.

The R1475 requires an external power supply, and the unit which is normally associated with this

receiver is the power pack type 360, which will operate from 200 to 250V a.c. or 12V d.c. The size is 16½in. x 9in. x 11in. and the power pack is 8in. x 9in. x 11in.

Modifications: Modification is hardly necessary, but for the serious user, an "S" meter might be considered more convenient than the tuning indicator that is fitted. It would be possible to replace the front-end valves with miniatures, but this is rather a drastic measure, and might not effect a great improvement.

Availability: A very few of these receivers came on the market in 1961. They were in grade 2 condition and were priced at £12 to £14, with power unit. A few grade 3 specimens were also available at a much lower price.

However, last year another batch arrived on the market, in varying conditions, the price ranging from £10 to £15. Some of these were in grade 3 condition. Power supplies were not available. The receivers were available over a reasonable period of time, and so it should not be too difficult to obtain one secondhand if they are no longer available from surplus dealers.

Information on the R1475 is very difficult to obtain, as it is a relatively scarce receiver. Manuals are not available.

The TCS

This was made by Collins of the USA and it is deservedly popular. It is an exceptionally stable receiver, covering from 1.5 to 12Mc/s. It has seven valves, as follows:—1 12SA7, 1 12SQ7, 2 12A6, and 3 12SK7. The circuit includes one r.f. stage and a separate local oscillator. The i.f. is 460kc/s.

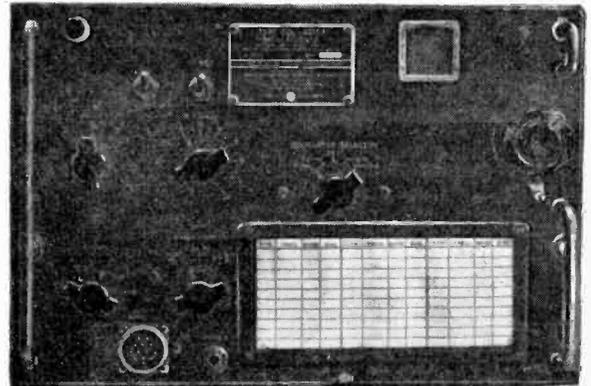
The TCS was originally designed for operation with a matching transmitter, but will operate entirely satisfactorily as an independent unit.

It has a vernier tuning system, fitted with anti-backlash gears. Other panel controls are r.f. gain, a.f. gain, b.f.o. control, bandswitch, power switch, and a crystal local oscillator switch. The last control provides for reception on a crystal controlled frequency. In addition an output jack for 600-ohm phones is provided. It does not have an internal power supply, and requires 250V d.c. at 80mA and 12V a.c. at 1.25 amps.

Modifications: Although the TCS is exceptionally stable, making it eminently suitable for s.s.b. reception, the two main criticisms are the wide bandwidth and inadequate bandspread. The tuning drive can easily be modified by fitting an epicyclic drive; this will provide good mechanical bandspread. A Q-multiplier will improve the selectivity.

The r.f. gain controls both the r.f. and the i.f. stages. The provision of a separate r.f. gain control would doubtless improve the performance. Also, it is considered desirable to replace the 12A6 output and the 12A6 local oscillator with 12J5 valves. (These are a direct replacement.) This will give a more comfortable output for headphones and will reduce the output to the mixer which is considered to be excessive. By carrying out this modification, the h.t. current will be reduced by as much as 25mA.

Availability: Unfortunately, the TCS has not been widely available in this country. It is almost certain that some were released prior to 1960, however. The one and only release in the period covered by



Photograph by courtesy of R.T & I Electronics Ltd.

this report occurred in the summer of 1960. A number were released in grade 2 condition, at prices between £8 and £11. Power units were also available for about £4. It is believed that the sale of receivers from this release continued until late 1961 or early 1962. A few grade 3 specimens were available for a correspondingly lower price.

As this receiver is rather popular, and was probably released in larger numbers in the United States, it should be easy to obtain a manual.

The No 52 Set

The 52 set is a Canadian receiver, and was manufactured by Marconi in large quantities. It was intended for operation in conjunction with a matching transmitter, but it is completely self-contained as a receiver. The frequency range is from 1.75 to 16Mc/s in three bands, as follows:—

1.75—4Mc/s; 3.5—8Mc/s; 7—16Mc/s.

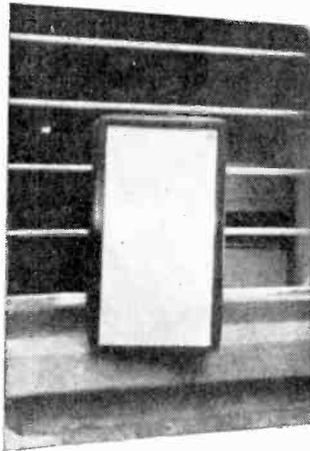
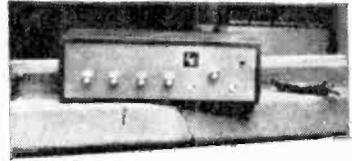
The receiver contains 10 valves, and has the following stages:—r.f., mixer, separate oscillator, two

ESV

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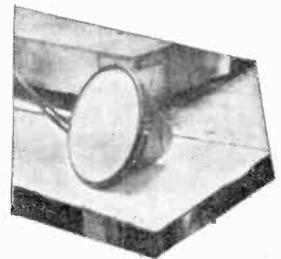
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i.f.'s, detector/a.g.c., first audio. output and b.f.o. There is also a three-valve crystal calibrator to provide marker check points at 10/100/1,000kc/s intervals. The set contains a valve check voltmeter which can also be used as an "S" meter.

Panel controls are r.f. gain, a.f. gain, noise limiter, b.f.o. switch, heterodyne pitch control and wide or narrow bandwidth switch. Also, fast and slow tuning controls with additional oscillator control for fine adjustment. Other features include manual or automatic volume control on both c.w. and r.t., and there is also a c.w. filter. The set contains an internal 3in. loudspeaker, and the whole receiver is housed in a steel carrying case, size 15in. x 12in. x 15in.

An external power unit is required for the 52 set, and must supply 12V and 160V h.t. Suitable power units are available which operate from 115/230V a.c. or 12V d.c.

Modifications: The 52 set does not require modification for satisfactory operation. One drawback to this receiver is the lack of bandspread on the 14Mc/s amateur band, and modification details have appeared for this in the amateur radio press.

Availability: It first became available in small quantities in 1960 in grade 2 condition, for £12, power unit £3 extra. Early in 1961, they became more widely available, and the price was reduced

to £9, plus £3 for the power unit. They had all been sold, however, by the end of 1961.

In late 1962, more of them were released in grade 2 condition, and sold for prices between £5 and £8, or for £9 10s. with power unit. These were quickly sold. Also, at this time, a few in grade 3 condition were available, and sold for £2 10s.

In late 1963, grade 2 receivers were available for £7, without case or power unit; and then a quantity of grade 1 52 sets, self-contained with power units, were available at £13 to £14. These latter were quickly sold out by the end of 1963. Some receivers in grade 2 condition were also sold for various prices at the same time. None were available in 1964.

During 1965, a quantity of the complete 52 set installation, comprising receiver, transmitter and power unit, came on the surplus market, and a few receivers were available separately for £10 without the power unit. There should be no difficulty in obtaining a 52 set on the secondhand market, owing to the large number released over the last five or six years.

The 52 set receiver handbook is difficult to obtain, although circuit diagrams were supplied with the receiver in some cases.

END OF SERIES

? YOUR QUESTIONS ANSWERED ?

SCRATCH FILTER

Could you give me any information about a scratch-filter for a record player? I believe there was a simple one published a few years ago in *Practical Wireless* but I have been unable to trace it.—E. Robins (Newport, Monmouthshire).

It is not easy to add scratch-filters to existing record-playing equipment. However, you could try connecting a 50pF or 100pF mica capacitor from each grid to chassis, and from each anode to chassis. The combined effect of these capacitors should reduce the high-frequency response.

If you want comprehensive control of tone, rumble, and hiss, you need a full-scale pre-amp. One such is described in the Mullard publication *Mullard Circuits for Audio Amplifiers*.

LOG OR LINEAR?

Can you please tell me how and why we use log and linear potentiometers in circuits? I cannot find a rule which tells when and where to use these components.—F. Hardy (Hull, E. Yorkshire).

The type of potentiometer used in a circuit depends largely on whether or not the circuit handles audio frequencies. The human ear has what is termed a logarithmic response to sound volume. This means that, for instance, if an amplifier rated at 5W were fully driven, and then compared with a 10W amplifier fully driven with the same signal, then the second volume level would not sound anywhere near twice as loud as the first, even though the output power had been doubled. Thus, in audio gain-control circuits, log pots. are employed so that equal increments of rotation of the pots. result in equal increases in loudness.

If linear pots. were used, then to double a given

volume level, and then double it again, the two increments in rotation of the control would be far different. You will find more on this subject in books in your local library.

I WANT TO LEARN

At the moment I know nothing about TV, radio, signs, terms, etc. and would like to learn, especially how to read wiring diagrams. Can you suggest any books which may help me?—M. Sabre (Wellington, Somerset).

Our book entitled *Beginner's Guide to Radio* would be of interest to you. We also publish a Keybook entitled *More Simple Radio Circuits* which contains a number of designs suitable for the beginner. We recommend that you start constructing units as soon as possible in order to gain experience. If you look through recent issues of P.W. you will find a number of simple designs and we suggest you select one which interests you and which you feel capable of constructing.

REPLACEMENT AUTO-TRANSFORMER

I have been using an auto-transformer to drop the local voltage down from 220 volts to 110 volts in order to use a soldering iron of 110 volts 75 Watts. Unfortunately the auto-transformer has burned out so I am writing to inquire if some other means can be employed to do this, such as a resistor to drop voltage, before purchasing another auto-transformer.—J. Macfarlane (Sunderland, Co. Durham).

It would not really be a good idea to use a dropping-resistor instead of your auto-transformer to power your 75W soldering iron. If you were to use a resistor, then it would have to dissipate 75W in order to drop the voltage to the correct amount. We recommend that you obtain another auto-transformer for your iron. Such transformers are available from a number of our advertisers.

LETTERS...

Radio One v Radio Caroline

In a recent poll on the merits of "Radio 1" in our class, the results were as follows:

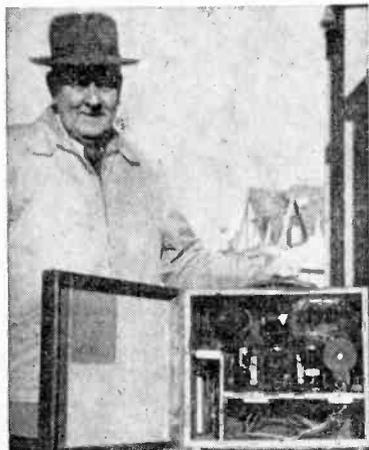
Two pupils admitted they didn't like either station. Another two pupils said they liked Radio Caroline and Radio One, but Radio One lacked something. And twenty-five pupils said Radio Caroline was great and Radio One was a flop.—**K. Howes, 3T** (*The Latymer School, Edmonton, N.9.*)

An early portable

As a reader of P.W. since No. 1 and having read and gained very much valuable information and advice from it over the years, I thought perhaps the construction for Christmas 1925 of a portable radio, may be of interest to readers.

This early set was of the I.H.F. Detector, and two L.F. Stages with 2V P.M. class valves. The frame aerial was mounted in the lid of the case and could be swung over 180 deg. for the best reception. Provision was also made for the connection of external aerial and earth. A two-pin non-reversible plug for extension speaker (2kΩ) was fitted on the front control panel.

The weight of the l.t. grid and h.t. batteries was approximately 28 lb. This just goes to show the progress of radio in 40 years.—**F. F. Towndraw** (*Newquay, Cornwall*).



Mr. Towndraw with his early portable receiver.

Radio alarm

I was interested to read in the August issue of P.W. re Patrick Highams "Radio Alarm".

It is some 30 years ago when I used to experiment with clocks for switching on and off of radios etc. You may be interested to know of my first one which was a chain driven clock and by fixing an ordinary switch to the wall in direct line with the trailing end of the chain and soldering a small hook to the knob it acted very effectively as an automatic switch. It was noted the speed of the chain was exactly 8 links per hour, therefore it was possible to divide the time by 8 and measure off the number of links for any given time; to my surprise the chain was always thrown clear and never prevented the clock from still carrying on.

Later on I progressed further and made one which would put the radio on and off 8 times in the 12 hours, and in addition to this it could be pre-selected to also change from one station to another. One could go to bed listening to dance music on the "Light" until a set time and be awakened at 7 a.m. by the "Home News". It of course needed some planning when setting up for a full day's programme but once set it did the job and amused many of my visitors and friends.

Today I have a surplus to requirements cooker electric clock which switches my f.m. set on and off at pre-set times, and in addition the outlet socket can also be used for other purposes, electric fire, tape recorder, etc.

Still on the subject of clocks, some years ago I had what I thought was a good idea but it was turned down by a British firm as costing too much to make. When an electric clock fails due to a power failure, my idea was to bring into operation an ordinary movement automatically, to keep the clock on time, and when the power of the mains was again restored the spring-driven clock mechanism was automatically stopped until another failure presented itself.

Some of my Swiss friends

inform me a similar clock was tried out in Switzerland about 1938 but never came to anything due to the extra costs.

However, all our little ideas and whims seem very much outdated in this modern World of Electronics.

Anyhow, I was pleased to hear of Mr. Higham's idea, and seems he was thinking on the same lines as myself.—**H. S. Barker** (*Lancashire*).

How's this for a shack?



Mr. Rowlinson's wireless cabin on board the S.S. City of Winchester.

I felt that you might like to publish this photograph of my wireless cabin on S.S. City of Winchester during the time I served on the ship, 1923-4, in the frozen meat trade on the New Zealand—UK run.

The transmitter was a ½kW job made by Marconi. In the picture, the old Jigger transformer and ATI with plugs to tap windings can be seen.

Also, one can see the Emergency Transmitting Set comprising a 10in. induction coil, and the rotary converter starter and field regulator.

Of chief interest perhaps, is the 31A crystal receiver and the then brand-new one valve amplifier for use with crystal receiver. Also the old sliding ATI for reception of Poldhu, Eiffel Tower and long waves around 2,000 metres.—**L. Rowlinson** (*Farnham Common, Buckinghamshire*).

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DIODES and RECTIFIERS: OA 91, 2/-; OA 95, 2/-; OA 200, 3/-; OA 202, 4/-; BYZ 11, 14/3; BYZ 12, 11/3; BYZ 13, 7/3; BZY 88/C6V2, 6/-, etc.

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TRANSFILTERS: Ceramic filters for use in transistor I.F. stages. (INFORMATION ON REQUEST) TF-01D (470KHz), (Emitter Bypass), 7/-; TO-01D (470KHz) (Interstage Coupling), 8/9.

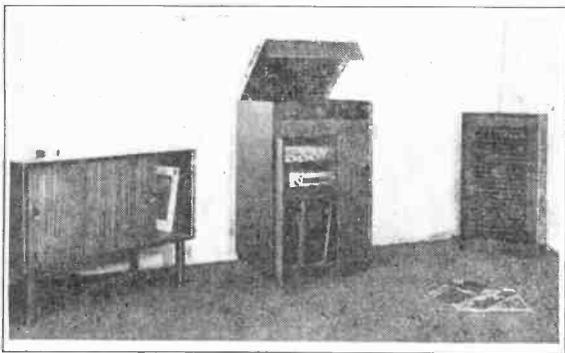
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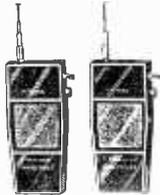
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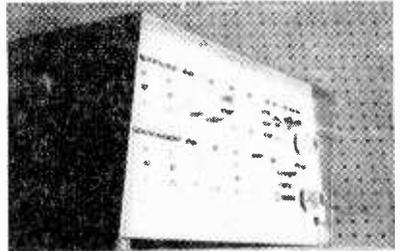
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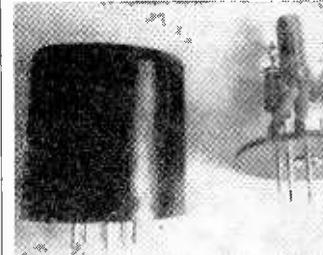
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intermittent fault locator

IT has been said that necessity is the mother of invention. It was certainly necessity which caused the writer to build the following instrument.

To explain how this came about is quite simple. The writer was engaged in repairing and servicing car radios, and, as a result of the vibration to which car radios are subjected a number of intermittent faults were encountered which to say the least were extremely irritating. The next question after deciding that such an instrument was necessary was the manner in which this was to be achieved?

The ideal instrument would be one in which the fault showed itself to be in some particular stage of the receiver. So far so good, but it was also necessary to decide which fault to locate on the instrument.

If one were to consider a voltage fault, then a number of voltmeters would be needed, each connected (a) to the anode or screen of the valves—in the case of valve car radios, or (b) to the collectors of each transistor—when servicing transistor car radios. However, such an arrangement would not locate an open inter-stage capacitor either r.f. or a.f., since such faults would hardly cause any indication on the voltmeters.

An oscilloscope is most useful in receiver servicing, but like other such instruments, may only be connected to one spot at a time. Hence, with such and instrument, luck would play an important part in having it connected to the faulty stage when the fault developed, and in servicing one does not have stores of luck in the same way as parts.

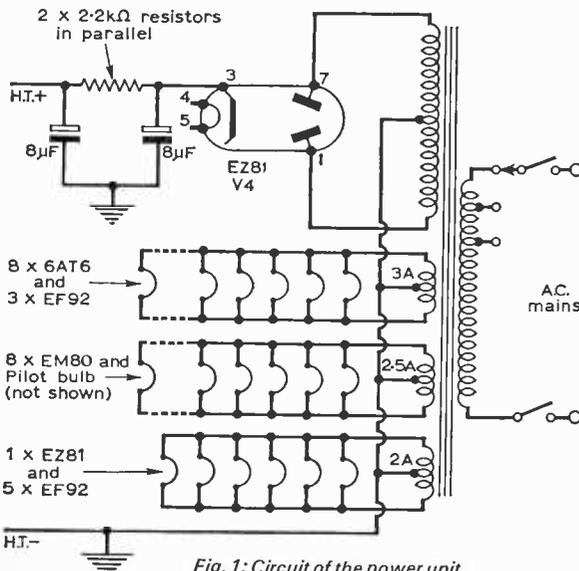


Fig. 1: Circuit of the power unit.



F. C. PALMER

What was left? The answer to that was the actual signal passing through the various stages of the receiver, could something be carried out on those lines? It certainly could, and what was more, the advantage of the oscilloscope and the voltmeter was employed to give further assistance. Therefore, it was reasoned that a signal indication was of far greater value when considering intermittent faults, however such faults occurred.

It was decided to employ eight magic eyes to provide the means of visual indication of the presence, or absence of a signal, eight r.f. amplifier valves, and eight diode detectors together with a rectifier valve meant 25 valves. This, of course, resulted in another problem, that of providing sufficient h.t. and most important, heater voltage and current.

The valves employed were, eight magic eyes EM80; eight r.f. valves EF92; eight detectors 6AT6; rectifier valve EZ81.

A mains transformer was obtained with the following secondaries, H.T. 350—0—350 at 150mA; L.T.1 6.3 volts 2.5 amps c.t.; L.T.2 6.3 volts 3 amps c.t.; Rec. 6.3 volts 2 amps; Primary, 200—250 volts.

The heaters of the valves were connected in the manner shown in Fig. 1. Despite the advantage of transistors in the reduction of size when such an instrument is considered, the writer was of the opinion that, since most of the intermittent faults were on transistor receivers, he did not require the instrument to suffer in the same way with intermittent faults! Thus the plan to employ valves for those reasons was firmly decided at the start. Hence we have an instrument which has eight inputs, each having an EF92, a 6AT6, and an EM80 indicator, and may therefore be connected to eight points of a receiver providing visual indication of, or the absence of, signal at various parts in a receiver. The next step is to work a circuit around these valves and to incorporate such features as voltage readings, and also oscilloscope graphs at the eight points of connection.

The Circuit

The circuit is shown in Fig. 2, with the exception that only one single stage is given, this being for clearness, and will be quite sufficient for the general function of the instrument to be seen. The other seven stages are exactly the same in all respects.

It will be seen from examination of Fig. 2, that

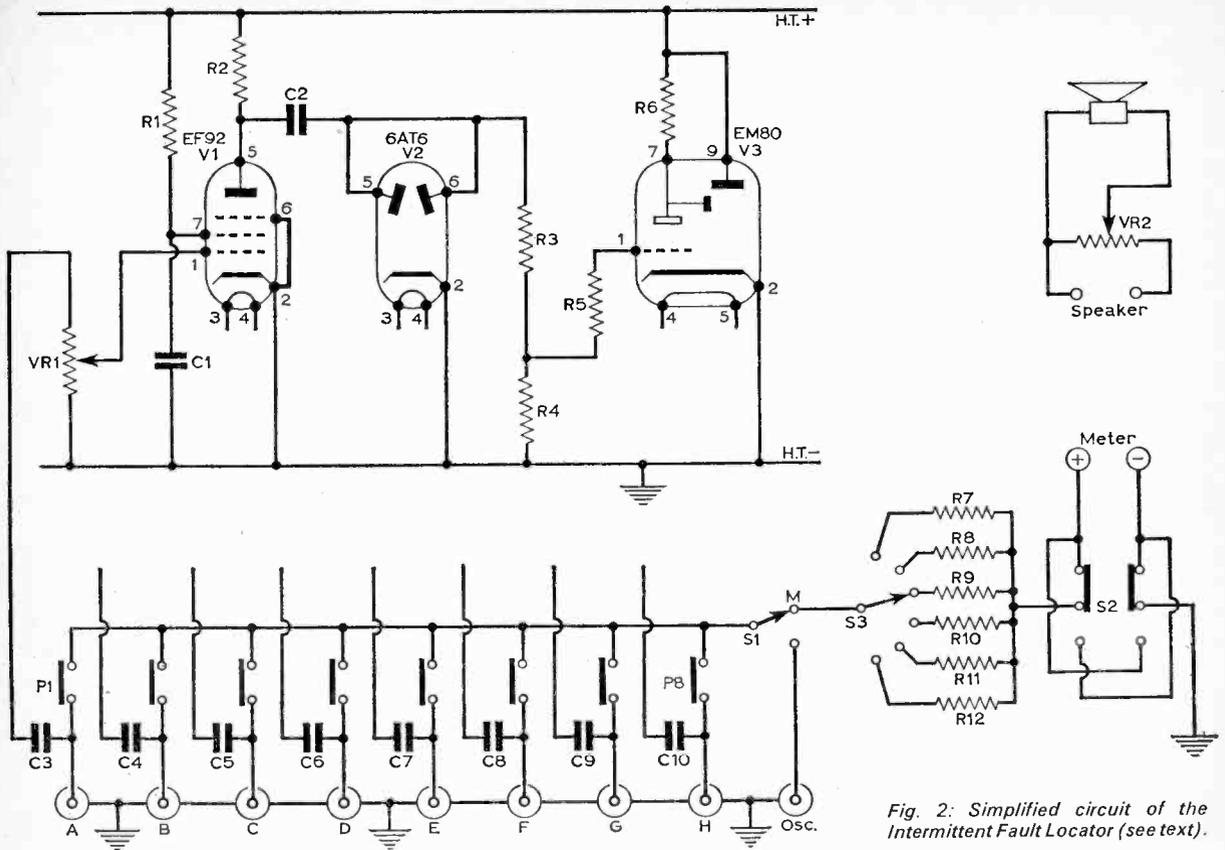


Fig. 2: Simplified circuit of the Intermittent Fault Locator (see text).

the input to the instrument is via the coaxial sockets, and in our own particular case to socket A. It is then fed to the volume control VR1 via the isolating capacitor C3, this capacitor being most necessary when connecting to the anode of valve receivers.

The control VR1 also plays an important part, since as the instrument is connected to the various stages of the receiver, the gain or signal strength is much greater. This would result in overloading of the target, thus making visual indication of the signal difficult, if not impossible. Hence the purpose of VR1 is to limit the signal fed to V1, and in consequence, to V3.

As the signal reaches the grid of V3, the area of the target fluorescent portion increases—in this instance green—and in the absence of a signal, a shadow results. This action is, of course, different to some indicators, where the reverse takes place, i.e., the signal causes the shadow on the target to become small.

The values of the components will be given at the end of this article, in particular, it is important to note that R3 and R4, must be equal in value, in order for maximum signal gain to the grid section of V3.

Voltage Test

So that voltage checks may be carried out, eight "press to test" switches are provided, contact being made when the switches are pressed, and contact is automatically broken when the hand or finger is removed from the button. A d.p.d.t. S1 switch is also provided to enable oscillograph readings to be obtained. This switch is actually a d.p.d.t. connected

to act as a s.p.d.t. as shown in the diagram.

This provision will be found very useful in the early stages of transistor receivers, where the signal gain is not very great. However, with the system of the press button, the oscilloscope, or the voltmeter may be quickly connected to eight points in the receiver, and in particular, to the stage where the magic eye has indicated that a fault exists.

With reference to the voltage test which may be carried out on the instrument, it is most essential that the meter used should be of good quality. Therefore, anything less than 20,000 ohms/volt should not be used, this requirement being for transistor receivers where the total voltage supply is extremely low, and from which the meter must draw its own supply to operate its movement, all of which can lead to errors in measurement.

Voltmeter Range

With reference to Fig. 2, it will be seen that S3 is the voltage range switch, this allows voltage checks from 3 to 600 volts to be carried out.

With regard to transistor receivers it is essential that the low voltage ranges have accurate resistance values, to avoid serious errors in measurement. This means that the resistance of the meter *must* be at all times taken into account, even on the low range of 3 volts, a meter movement of 2,500 ohms can introduce an error of 4% at f.s.d. if its resistance is left out of the calculations.

The voltage ranges considered useful by the writer are, 0-3V, 0-15V, 0-30V, 0-100V, 0-300V, and 0-600V. The first three voltage ranges must be considered to be for transistor receivers, this of

3-PUSH SWITCH

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2μF ..	12v	1"	1"	50μF ..	50v	1"	1"
2μF ..	150v	1"	1"	50μF ..	275v	1"	1"
2μF ..	275v	1"	1"	50μF ..	350v	2"	1"
2μF ..	350v	1"	1"	64μF ..	450v	2"	1"
2μF ..	500v	1"	1"	100μF ..	15v	1"	1"
4μF ..	25v	1"	1"	100μF ..	25v	1"	1"
4μF ..	150v	1"	1"	100μF ..	50v	1"	1"
4μF ..	275v	1"	1"	100μF ..	100v	1"	1"
4μF ..	350v	1"	1"	100μF ..	250v	3"	1"
4μF ..	500v	1"	1"	100μF ..	350v	3"	1"
5μF Rev	20v	1"	1"	100μF ..	450v	3"	1"
5μF ..	50v	1"	1"	125μF ..	500v	4"	1"
5μF ..	70v	1"	1"	200μF ..	275v	2"	1"
6μF Rev	50v	1"	1"	200μF ..	350v	3"	1"
8μF Rev	20v	1"	1"	250μF ..	12v	1"	1"
8μF ..	150v	1"	1"	250μF ..	18v	1"	1"
8μF ..	275v	1"	1"	250μF ..	25v	1"	1"
8μF ..	350v	1"	1"	250μF ..	50v	1"	1"
8μF ..	500v	1"	1"	350μF ..	12v	1"	1"
10μF ..	6v	1"	1"	350μF ..	25v	1"	1"
10μF ..	50v	1"	1"	400μF ..	15v	1"	1"
10μF ..	150v	1"	1"	400μF ..	30v	1"	1"
10μF ..	300v	1"	1"	400μF ..	50v	1"	1"
16μF ..	250v	1"	1"	400μF ..	275v	4"	1"
16μF ..	350v	1"	1"	500μF ..	6v	1"	1"
16μF ..	500v	1"	1"	500μF ..	15v	1"	1"
25μF ..	12v	1"	1"	500μF ..	25v	1"	1"
25μF ..	25v	1"	1"	1,000μF ..	15v	2"	1"
25μF ..	50v	1"	1"	1,000μF ..	18v	1"	1"
30μF ..	6v	1"	1"	1,000μF ..	25v	1"	1"
30μF ..	10v	1"	1"	1,000μF ..	50v	2"	1"
32μF ..	150v	1"	1"	1,500μF ..	25v	1"	1"
32μF ..	350v	2"	1"	1,500μF ..	50v	3"	1"
32μF ..	450v	1"	1"	2,000μF ..	25v	3"	1"
32μF ..	500v	2"	1"	2,000μF ..	50v	2"	1"

TERMINATION CODING

		s.	d.
2,500μF ..	30v	3"	1"
2,500μF ..	50v	4"	1"
4,000μF ..	25v	3"	1"
5,000μF ..	25v	3"	1"
10,000μF ..	25v	4"	1"
30,000μF ..	30v	4"	1"
32 x 32μF ..	350v	2"	1"
50 x 50μF ..	350v	2"	1"
60 x 100μF ..	275v	2"	1"
60 x 250μF ..	350v	4"	1"
100 x 100μF ..	150v	3"	1"
100 x 200μF ..	275v	4"	1"
150 x 200μF ..	350v	4"	1"
250 x 250μF ..	325v	4"	1"

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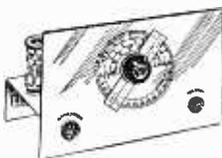
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course taking into consideration coach radio which require 24 volts. After the 30 volt range has been worked out, the meter resistance may be neglected, since an error of 4% means only an error of 4 volts in 100 volts.

The switch S2, allows the meter movement to have its leads reversed, this for transistor car radios, which may have the chassis either negative or positive polarity. It will also be seen that a speaker is provided with a balance control, so that the output stage is always loaded to avoid damage to the output transistor, and to reduce the signal should the phone ring. The receiver's volume control must always be at maximum in order that the magic eyes show the presence of the signal, any change in the volume control would give false indication not only to the magic eye display, but also to the oscilloscope, where perhaps, reference voltages have been used to set the Y amplifier to a certain gain which will prove of no use of the gain of the receiver is changed, or the input to the receiver from the signal generator.

Instrument Front Panel

Figure 3 shows the front panel of the instrument with all its main control positions cut out. The measurements here are very approximate, the volume controls and switches etc. should be of the midget type, or else difficulties will be met when it is desired to fix the front panel to the chassis.

The top row of holes are for the magic eye display, and it is essential that these coincide with the "windows" of the EM80, close working between the top chassis and the front instrument panel clearly being necessary.

The lower rows of holes must also "coincide" when drilling of the panel and chassis are undertaken.

These holes include those for the pilot lamp,

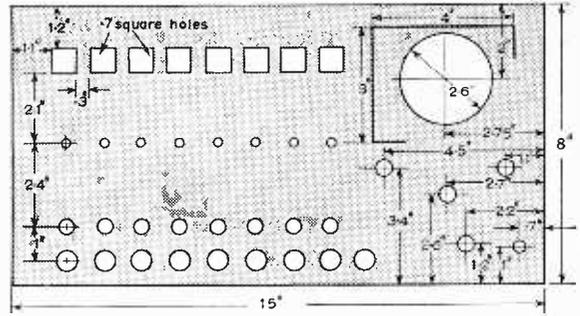


Fig. 3: Front panel of the instrument showing cut outs for the main controls etc.

on/off switch (d.p.s.t.), the polarity switch for the meter, the voltage range selector, and the switch for bringing in either the voltmeter or the oscilloscope.

Wiring Points

The leads to the valves such as V1 in Fig. 2, must be kept apart from each other, in no circumstances must they be made into a neat 8-core cable, for to do so would introduce capacity between them. This would result in a signal input to say point "A" Fig. 2, causing the other magic eyes to indicate the *same* signal, even if there is no other input to the coaxial sockets.

It has been previously stated that the press buttons were mounted very close to the coaxial sockets, the reason for this being again one of capacity effect. It will be seen that the lead from the centre of the coaxial socket up to the press button switch, is constantly present. That is to say, its capacity—with the other leads—are added to the receiver under test. It is, of course, necessary to reduce excess capacity, hence these connections must be kept very short. The press buttons are indicated in Fig. 2 by P1/P8.

In the general construction of the instrument, the heaters were wired first, different colour wiring being used for each section of valves, it is vital that these do not get mixed up!

The next stage is to wire the resistors to the magic eye display, completing one step at a time for instance, one would complete the anode connections of *all* the EM80 valves before they went on to the grid connections. In this way nothing is left to chance and so on with the other valves.

Perhaps the next step will be to describe the manner in which the instrument is employed to locate either (a) an intermittent fault, or (b) a fault which makes the receiver output low after it has been switched on for some time.

Take a typical five transistor car radio, including a germanium diode detector (D1).

We shall assume that we have

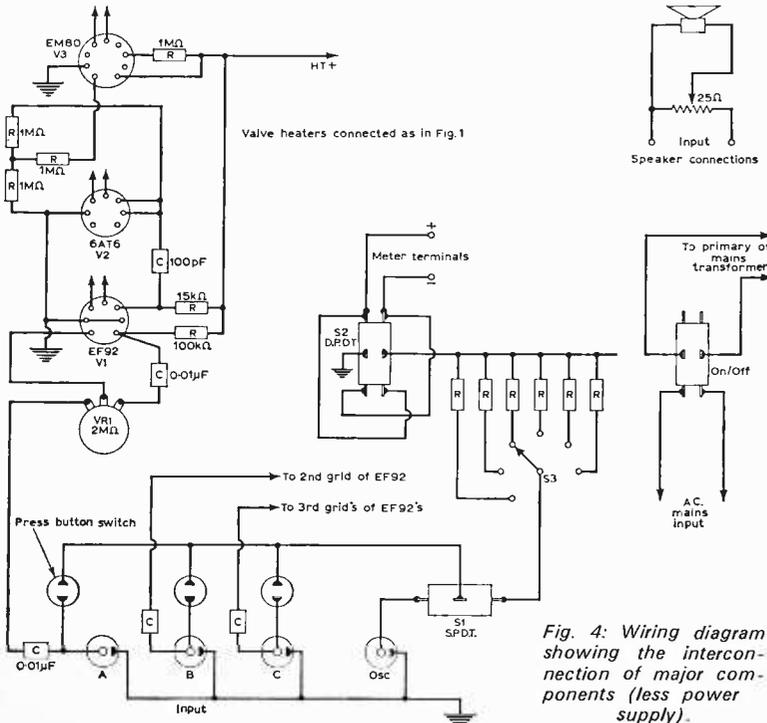


Fig. 4: Wiring diagram showing the interconnection of major components (less power supply).

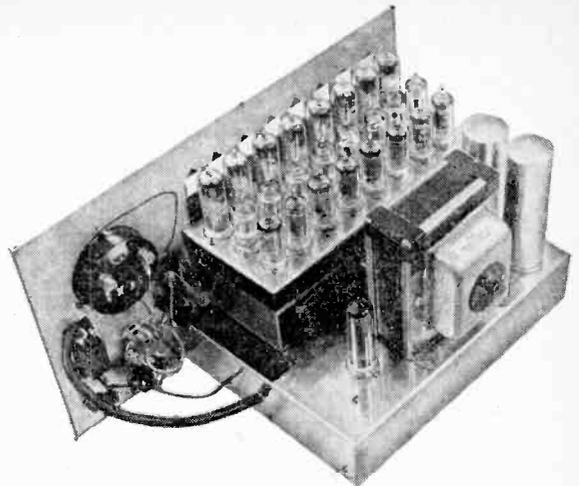
an intermittent fault, and to employ the instrument in its location, the socket "A" would be connected to the collector of Tr1 (frequency changer), socket "B" to the collector of Tr2 (st i.f. stage), socket "C" to the collector of Tr3 (2nd i.f. stage), socket "D" to the secondary of the 2nd i.f. transformer, socket "E" to the a.f. side of D1, socket "F" to the collector of Tr4 (1st audio stage), socket "G" to the base of Tr5 (output transistor—single ended), and socket "H" to Tr5 collector.

We may also obtain voltage readings at the various points so that we can check them, when the receiver cuts out, against those reading when the receiver was working, this would show up on the meter when the press buttons were operated.

In a like manner the oscilloscope, but before we may do this we shall require a signal input to the aerial socket, this being supplied from a signal generator. The car radio is tuned to this signal, and the aerial trimmer adjusted for maximum gain. It will, of course, be necessary to reduce the input to the coaxial sockets so as to prevent overloading of the "magic eye display", this being achieved by the volume controls under each of the windows. The gain of the receiver will become greater as we progress towards the output stage as expected.

As soon as we have a good indication of the signal on each of the magic eyes, the oscilloscope can be connected to each of the points and the various gains noted. This may be recorded, reference voltages from the front of the oscilloscope being used to measure the gain of the "Y" amplifier at any point. For instance, at the a.f. side of D1 the gain of the scope may be set to show 10 divisions on the graticule, for a reference voltage of 1 volt.

If the signal at this point is 0.3 volts, this would be equal to 3 divisions on the graticule; at other points in the circuit, the gain of the "Y" amplifier will be changed, but, if it is necessary to return to the a.f. side of D1, we only need to bring the trace up to



Internal view of the complete instrument.

10 divisions for a reference voltage of 1 volt switch in the scope to D1, where the gain should show 0.3 volt if all is in order.

Let us assume that the magic eye "D" reduced to a shadow instead of producing an area of green. If "C" shows that a signal is reaching the magic eye, then the secondary is o/c, or a capacitor o/c or even s/c.

On the other hand, if no signal is heard from the speaker, but the magic eyes up to "D" show that a signal is reaching those points, the scope should be connected to either "C" or "D", to see if the waveform is modulated, if not, this will point to the frequency changer stage being at fault.

Thus it is possible to locate the stage at fault, however, some faults cause the output to reduce after the receiver has been on for some time, this will be shown by the magic eyes after the stage at fault, to indicate a reduction in area of fluorescence. The fault being between the last good magic eye indication, and the first poor magic eye display.

It is also possible to use a probe for signal tracing, one amplifier stage of the instrument being used. The writer has used the instrument with good results in locating sources of intermittent faults, or the reduction of gain after the receiver has been on for some time.

It will be obvious to some readers that a single germanium diode could perform the function of V2. This is true, but the author had the valves and components to hand and to avoid extra expense these were used instead. ■

★ components list

R1	100kΩ	R4	1MΩ
R2	15kΩ	R5	1MΩ
R3	1MΩ	R6	1MΩ
VR1	2MΩ		

Meter resistances vary according to meter resistance. All capacitors in Fig. 2 with the exception of C2 which is 100pF are 0.01μF. The balance control resistance for the speaker is 25 ohms.

The smoothing capacitors are 8μF at 600 volts working, the smoothing resistance two 2.2kΩ wirewound resistors in parallel.

REPLACEMENT RECTIFIERS

—continued from page 678

lease of life to a number of old sets for which replacement valve rectifiers have long since disappeared. Perhaps the oddest was replacement of the

rectifier section of a 117L7 valve. This was a combined output valve and rectifier with 117V 0.09A heater from a pre-war American receiver. The heater was still intact but the rectifier cathode had collapsed. Substituting a diode unit left the output section functioning and restored the radio to a new lease of life. ■



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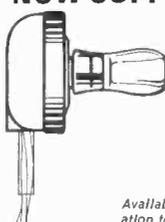
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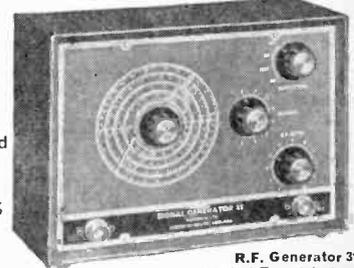
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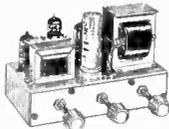
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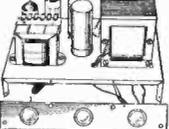
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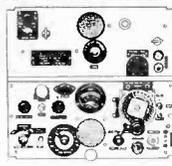
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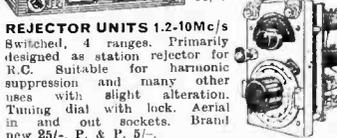
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14 1/2"	9 1/2"	1	0	8	1	5	0
14 1/2"	8 1/2"	1	15	0	2	4	9
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Price: £15.0.0. plus 20/- carr.

Rx. Unit Type 12

These are a small airborne Rx tuning the band 234 to 258 Mc/s and are intended to receive A.M. modulated sub carrier transmissions and in their present form are unsuitable for normal use. These Rx can, however, be modified to work on 2 meters, i.e. they can be made to tune the band 125 to 150 Mc/s, modification details and circ diagrams are supplied with Rx. The following valves are used: 6AK5X3, 9001X7, 12A6. The O/P is for low res h/phones. The small size of these, i.e. 5½ x 4½in. front, 11in. deep, makes them well suited to mobile use. To carry out successfully the mods to these a Sig Gen or Test Osc is required. Supplied in new condition.
Price: £3.10.0. plus 6/- post.

Test Set Type 253

These are a test set covering 20 to 88 Mc/s in 4 bands and are for 230v mains supply. A large variable dial is fitted, 2 Mc/s xtal is fitted for checking calibration, Noise diode with 50 Ma meter is also fitted for noise checks. R.F. signal is modulated with low freq xtals. Supplied with cal charts, used condition. These units were used for checking the R.F. 24/27 units.
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Type 88 Walkie-Talkies

These are a 4-channel unit operating in the freq range 38 to 42 Mc/s. They req 90/1.5v carbon mike and low res phones. They use 14 miniature valves, weight 1½lbs., size 5½ x 3½ x 9½in. Good condition with circ.
Price: £4.10.0. each plus 6/- post. Or 2 for £8.0.0. post paid.

Comparator Unit AN/GRD

I/P 115v contains valves: 6SN7x5, 6BA6, 6AU6, 6BX2, 6Y3, H.T. from unit is 350v at 100 Ma also 105/210v stabilised also contains U.H.F. coax relay, L.F. trans, 30v/s filter, block paper conds, panel nuts, etc. These units are for 19in. rack mounting and have slide on top cover. Size 19 x 8in. front, 10in. deep. New condition with circ.
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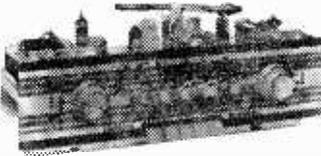
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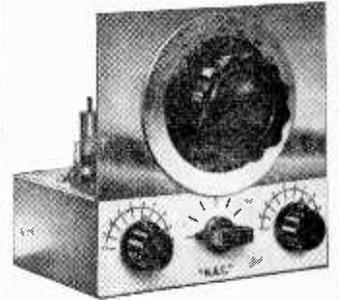
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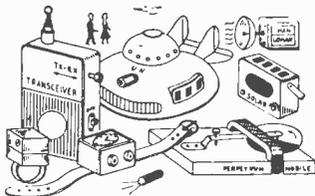
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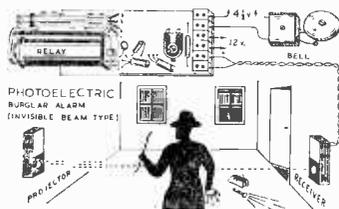
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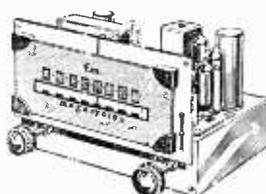


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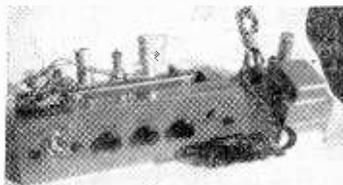
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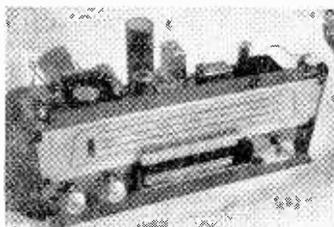
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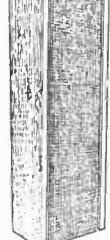
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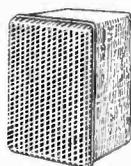
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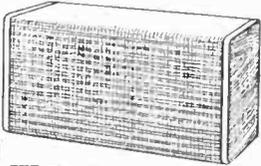


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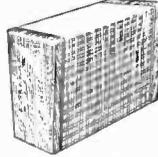


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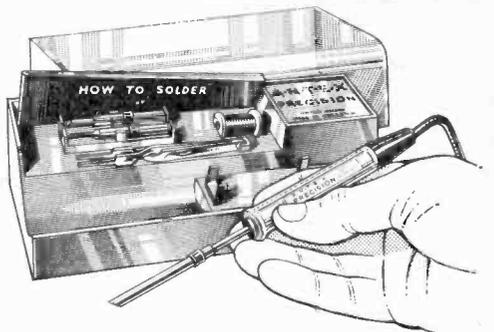
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30FL13	8/7	6146	27/8	DY87	6/8	ECC90	10/-
30FL14	14/-	6360	25/-	DY87	6/8	ECC91	10/-
30L1	5/8	6833	40/-	E550	9/7	ECC92	10/-
30L15	15/-	7199	15/-	E88C	17/8	ECC93	10/-
30L17	15/-	7360	30/-	EAB30	6/8	ECC94	10/-
30P16	7/8	7586	22/8	EAF42	8/8	ECC95	10/-
30P18	6/-	7895	22/8	EB91	3/-	ECC96	10/-
30P19	14/-	9002	5/8	EB33	7/-	ECC97	10/-
30PL1	16/-	9223	18/-	EB34	8/7	ECC98	10/-
35D	12/-	ARP12	4/8	EB39	5/-	ECC99	10/-
35L6GT	8/7	AT295	9/7	EB90	4/8	ECC100	10/-
35W4	4/8	AZ11	7/8	EB91	5/-	ECC101	10/-
3Z23	10/-	AZ31	9/7	EB92	5/-	ECC102	10/-
3Z24GT	8/8	CB11	15/-	EB93	5/-	ECC103	10/-
3Z25GT	6/8	CB13	15/-	EB94	5/-	ECC104	10/-
3Z26	6/8	CH35	9/7	EB95	5/-	ECC105	10/-
50C5	6/8	CY1	8/-	EB96	5/-	ECC106	10/-
50CDBG	6/8	CY31	7/8	ECC33	8/-	ECC107	10/-
50L6GT	7/8	DAC32	8/-	ECC34	8/-	ECC108	10/-

EP89	5/8	GS10H	40/-	PCL88	16/-	U95	14/-
EP92	4/-	GTE175M	12/-	PCL800	16/-	U96	14/-
EP93	4/-	GZ30	7/-	PCL801	16/-	U76	4/-
EP94	5/-	GZ31	7/-	PEN4DD8	8/-	U81	10/-
EP95	5/-	GZ32	10/-	GZ33	12/8	U81	14/-
EP96	2/8	GZ33	12/8	GZ34	10/-	PEN45D1	8/-
EP98	10/-	GZ34	10/-	GZ37	12/8	PEN46	6/8
EP183	6/8	GZ37	12/8	HABC80	7/-	PEN220A	U404
EP804	20/-	HABC80	7/-	PEN383	9/-	U401	17/-
EP811	14/-	HBC90	4/8	PEN384	7/-	UABC80	5/8
EP812	14/-	HBC91	5/8	PEN453D1	10/-	UAF42	9/-
E190	7/8	HBC92	5/8	PEN453D2	10/-	UB41	10/-
E134	4/8	HBC93	5/8	PEN453D3	10/-	UB41	10/-
E135	6/8	HBC94	5/8	PEN453D4	10/-	UB41	10/-
E138	25/8	HBC95	5/8	PEN453D5	10/-	UB41	10/-
E141	8/8	HL92	6/8	PF86	10/-	UBF80	8/8
E142	9/8	HL94	7/8	PF87	14/-	UBF99	7/-
E181	9/-	KT88	27/8	PL200	10/-	UB21	10/-
E182	8/8	PABC80	7/8	PL36	9/-	UC24	9/-
E183	6/8	PC86	10/8	PL82	7/8	UC24	9/-
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E185	7/8	PC89	7/8	PL84	6/8	UC24	9/-
E186	8/8	PC92	7/8	PL85	6/8	UC24	9/-
E190	5/8	PC93	7/8	PL86	6/8	UC24	9/-
E191	5/8	PC94	7/8	PL87	6/8	UC24	9/-
E192	5/8	PC95	7/8	PL88	6/8	UC24	9/-
E193	5/8	PC96	7/8	PL89	6/8	UC24	9/-
E194	5/8	PC97	7/8	PL90	6/8	UC24	9/-
E195	5/8	PC98	7/8	PL91	6/8	UC24	9/-
E196	5/8	PC99	7/8	PL92	6/8	UC24	9/-
E197	5/8	PC100	7/8	PL93	6/8	UC24	9/-
E198	5/8	PC101	7/8	PL94	6/8	UC24	9/-
E199	5/8	PC102	7/8	PL95	6/8	UC24	9/-
E200	5/8	PC103	7/8	PL96	6/8	UC24	9/-
E201	5/8	PC104	7/8	PL97	6/8	UC24	9/-
E202	5/8	PC105	7/8	PL98	6/8	UC24	9/-
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E205	5/8	PC108	7/8	PL101	6/8	UC24	9/-
E206	5/8	PC109	7/8	PL102	6/8	UC24	9/-
E207	5/8	PC110	7/8	PL103	6/8	UC24	9/-
E208	5/8	PC111	7/8	PL104	6/8	UC24	9/-
E209	5/8	PC112	7/8	PL105	6/8	UC24	9/-
E210	5/8	PC113	7/8	PL106	6/8	UC24	9/-
E211	5/8	PC114	7/8	PL107	6/8	UC24	9/-
E212	5/8	PC115	7/8	PL108	6/8	UC24	9/-
E213	5/8	PC116	7/8	PL109	6/8	UC24	9/-
E214	5/8	PC117	7/8	PL110	6/8	UC24	9/-
E215	5/8	PC118	7/8	PL111	6/8	UC24	9/-
E216	5/8	PC119	7/8	PL112	6/8	UC24	9/-
E217	5/8	PC120	7/8	PL113	6/8	UC24	9/-
E218	5/8	PC121	7/8	PL114	6/8	UC24	9/-
E219	5/8	PC122	7/8	PL115	6/8	UC24	9/-
E220	5/8	PC123	7/8	PL116	6/8	UC24	9/-
E221	5/8	PC124	7/8	PL117	6/8	UC24	9/-
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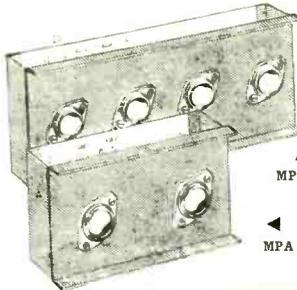
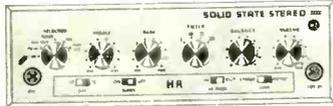
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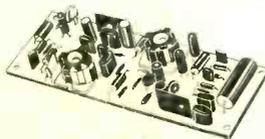
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