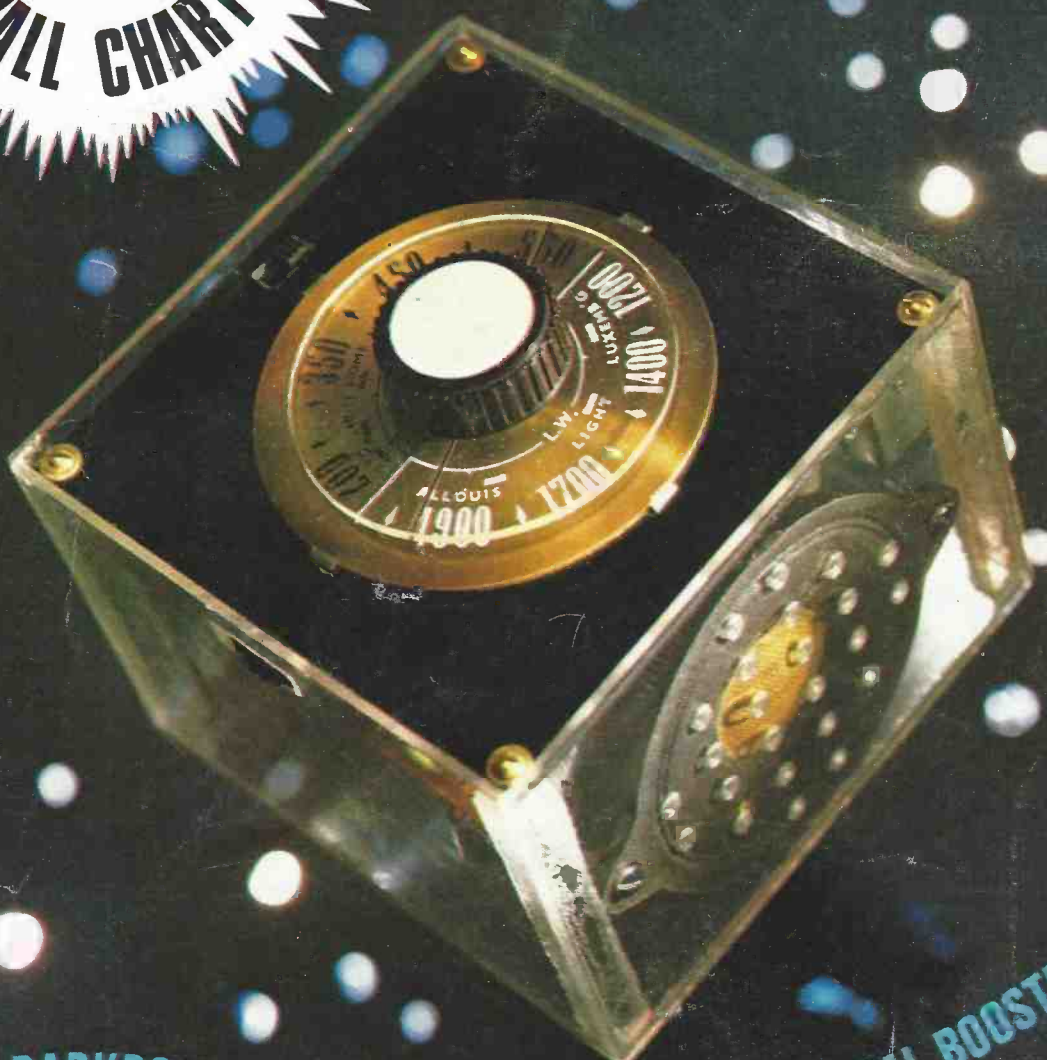
# PRACTICAL WIRELESS

MARCH 1972

20p

FREE INSIDE
DX DATA
WALL CHART

build the PW
CUBE RADIO
7 transistor superhet




ALSO: DARKROOM THERMOMETER · CAR RADIO SIGNAL BOOSTER

# RSC HIGH-FIDELITY STEREO PACKAGE OFFERS

Four fully wired units ready to 'plug in'.
★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
★ GARRARD SP25 MK III Turntable on Plinth with cover
★ GOLDRING CS90 Ceramic Pick-up Cartridge with diamond stylus
★ PAIR OF STANWAY II Speaker Units

Special Total Price **£79·80** Carr. £1·50

Terms: Deposit £12 and 9 monthly payments £8·55 (Total £88·95).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing
★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
★ Goldring Magnetic P.U. Cartridge.
★ Pair of Stanway II speaker units.

Special Total Price **£97·75** Carr. £1·50

Terms: Deposit £15 and 9 monthly payments £10·53 (Total £114·55).

**ATTRACTIVE TEAK OR AFRORMOSIA VENEERED CABINETS AND PLINTHS**

**Send S.A.E. for coloured brochure showing other money saving offers.**

Matching as recommended for optimum performance. Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.

★ TA12 AMPLIFIER 6·5 + 6·5 watt in veneered housing
★ GARRARD SP25 MK III Player unit on Plinth
★ GOLDRING CS90 Ceramic P.U Cartridge with diamond stylus
★ PAIR OF DORCHESTER Loudspeaker Units

Special Total Price **£58**

Or Deposit £7·15 and 9 monthly payments £6·35 (Total £64·30). Carr. £1·25

Trans. Plastic Cover £3·15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1·25 **£51·75**

Or Deposit £6 and 9 monthly payments £5·70 (Total £57·30)

Trans. Plastic cover £3·15 extra.

## 'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

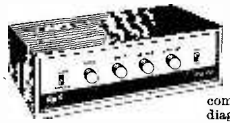
★ Moderate size only 25×14×10in. COMPLETE KIT **£23**
★ Response 30-20,000 c.p.s. Impedance 15 ohms Carr. 65p
★ Performance comparable with units costing considerably more.

Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8×5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4·60 and 9 monthly payments £2·47 (Total £26·83).

**DEMONSTRATIONS AT ALL BRANCHES**

## RSC G66 Mk II 6+6 WATT high quality STEREO AMPLIFIER

Individual Ganged Controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Frequency range 20–20,000 c.p.s. Bass Control ± 12db. Treble Control ± 13db. Selector switch for P.U. or Tape/Radio. For loudspeaker output impedances of 3 to 15 ohms. For standard 200–250v. A.C. mains operation. Attractive Black and Silver finished metal facia plate and matching control knobs.



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11·50** Carr. 40p

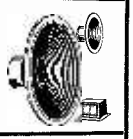
Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £15·99 or dep. £3·20 and 9 monthly payments £1·70 (Total £18·50).

## AUDIOTRINE HI-FI SPEAKER SYSTEMS

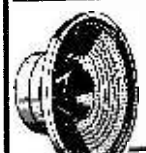
**Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction.**

**£5·75** Carr. 30p

OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6·75** Carr. 35p



## AUDIOTRINE HIGH FIDELITY SPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. **PLEASE STATE CHOICE. Exceptional performance at low cost.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HF80ST | 8″ | 10W | £2·88 | HF120D | 12″ | 15W | £4·75 |
| HF102D | 10″ | 10W | £3·40 | HF126 | 12″ | 15W | £5·50 |
| HF120 | 12″ | 15W | £4·25 | HF126D | 12″ | 15W | £5·90 |

## FANE 807 HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω. STATE WHEN ORDERING **£3·50**

## HIGH FIDELITY LOUDSPEAKER UNITS

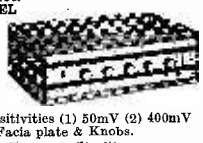
**Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.**

**DORCHESTER** (Illustrated) Size 16×11×9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13×8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9·45** Carr. 40p.

**STANWAY II** Size 20×10¾×9¾in. approx. Rating 10 watts, Inc. 13×8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. **See 'package offers' for illustration** **£17·85**

## R.S.C. TA12 MKIII 6·5+6·5 WATT STEREO AMPLIFIER

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



Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder 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 20-20,000 c.p.s. −2dB ★ Harmonic Distortion 0·3% at 1,000 c.p.s. Hum and Noise −70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.

**COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS.** **£15·50** Carr. 40p. **Factory built with 12 mths. guarantee** **£19·50**

Deposit £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet. **£23**

## HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. All sizes approx. Carr. 30p. per enclosure.

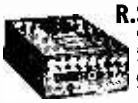
**JES** Size 16×11×9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

**SE8** For optimum performance with any 8in. Hi-Fi speaker. Size 22×15×9in Ported. **£6·47**

**SE10** For outstanding results with 10in. Hi-Fi spkr. Size 24×15×10in. P'td. **£6·74**

**SE12** For exclnt prfmcne with 12in Hi-Fi speaker and Tweeter. Size 25×16×10¾in. **£7·87**

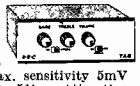
## R.S.C. BATTERY/MAINS CONVERSION UNITS



**TYPE BM1.** An all-dry battery eliminator. Size 5½×4¼×2in. approx. Completely replaces batteries supplying 1·5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available.

COMPACT KIT WITH DIAGRAM **£3·25** ASSEMBLED READY FOR USE **£3·75**

## R.S.C. TA6 6 Watt HI-FI AMPLIFIER



**200-250v. AC mains operated.** Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9¾×2¾×5¾in. Attractive brushed silver finish facia plate 10¼×3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7·50** Carr. 40p.

**OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £9·75**

# R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

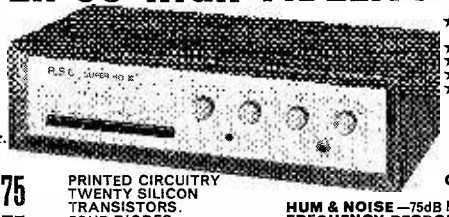
**A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE. REPRESENTING VALUE FAR HIGHER THAN THE PRICES SUGGEST.**

Only high grade components by leading manufacturers. **£25** Carr. 65p

**COMPLETE KIT OF PARTS** Or **FACTORY BUILT** with 12 months guarantee. Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25.) **£33·75**

Or **FACTORY BUILT** in cabinet as illustrated. Dep. £6 and 9 monthly payments £3·86 (Total £40·74) **£37·75**

PRINTED CIRCUITRY
TWENTY SILICON TRANSISTORS.
FOUR DIODES,
FOUR RECTIFIERS



★ **SATIN SILVER METAL FACIA** with black lettering. Black edged knobs with bright silver centres.
★ **PUSH-BUTTON SELECTOR SWITCHING**
★ **NEON INDICATOR**
★ **JACK SOCKET FOR HEADPHONES**
★ **CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC, REGARDLESS OF PRICE. WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.**

**OUTPUT:** 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.
**HUM & NOISE** —75dB Min. Vol. —65dB Full Vol. **HARMONIC DISTORTION** 0·1% at 1000 Hz 10 Watts
**FREQUENCY RESPONSE:** —3dB 7Hz to 70kHz
**TREBLE CONTROL:** +16dB to —12dB at 14kHz
**BASS CONTROL:** +17dB to —16dB at 40Hz **CROSS TALK** —58dB
**SENSITIVITIES:** Disc Mag. 2·5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
**REAR PANEL SOCKETS** ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

TECHNICAL DETAILS (Applying to each channel where appropriate)
**CONTROLS:** PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble and Balance. Plus Ceramic Mag P.U. Switch.


SEND S.A.E. FOR LEAFLET

# RSC DISCOTHEQUE EQUIPMENT

**SAVINGS ON PACKAGE OFFER**

(1) FAL FG1/2 Console
(2) 100W Power Amplifier
(3) Pair High Quality Headphones
(4) Matching Microphone fitted to Headphones
(5) Pair 50W Speakers black rexine covered Size approx. 16"×18"×8"

TOTAL COST OF ALL ILLUSTRATED UNITS Carr. £2·50 **£136**

Terms: Deposit £30 and 9 monthly payments of £13·25 (Total £149·25

## FAL

**F.G. 1/2 DISCO CONSOLE**

Incorporating twin Garrard SP25 Mk.III turntables and Goldring C890 Ceramic Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. **£69**

Carr. £1·25

Terms: Deposit £15 and 9 monthly payments of £6·75 (Total £75·75

## R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair

TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

**TYPE C48S 25-30 WATTS** Fitted four 8" high flux 8 watt speakers Overall size approx. 48×10×5in. **£17·75** Terms: Dep £3 and 9 monthly payments £2 (Total £21) Carr. 50p.

**TYPE C412S 50 WATTS** Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56×14×9in Terms: Dep. £4 and 9 monthly payments £3 (Total £31) Carr. 75p **£27·50**

**TYPE C4100 100 WATTS** inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58×16×10" Acoustically filled and pressurised. Terms: Dep. £7·50 and 9 mthly. pyts. £5·45 (Total £56.55). Carr. £1 **£50·50**

## FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE

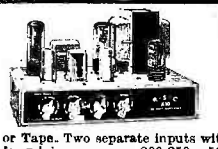
High flux ceramic magnets. All carr. free.

**'POP' 100** 18" 100 Watt 14,000 gauss 8/15Ω **£22·50** Dep: £6 and 9 mthly payments £2·15 (Total £25·35)

**'POP' 60** 15" 60 Watt 14,000 gauss 8/15Ω **£12·90** Dep. £3·30 and 9 monthly payments £1·30 (Total £15).

**'POP' 50** 12" 50 Watt 13,000 gauss 15Ω **£10·50** Dep £2 and 9 monthly payments £1.15 (Total £12.35) Pair suitable all purposes

FOR BASS GUITAR, ELECT. ORGAN, ETC.



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

Highly sensitive. Push-Pull high output, Hum level—70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes. 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £1·90. Or factory built with EL34 output valves and 12 months' guarantee for £19·75 Carr. 65p **£15·75**

TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

## FANE LOUDSPEAKERS 'POP' 25/2 12· 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). **£6·75** Carr. free or Dep. £1 and 9 mthly payments 75p (Total £7·75).

## GROUP/DISCO EQUIPMENT PACKAGE OFFERS

**F.A.L. PHASE 50 MK.III AMPLIFIER** £34.75
**PR. FANE POP 25/2 25W L/SPEAKERS** £13.50
Terms: Deposit £6.50 and 9 monthly payments of £4.72 (Total £48.98) £48.25
PACKAGE PRICE **£45** carr. £1·25

**F.A.L. PHASE 50 MK.III AMPLIFIER** £34.75
**PR. FANE POP 50 L/SPEAKERS** £21
Terms: Deposit £12 and 9 monthly payments of £5 (Total £57.00) £55.75
PACKAGE PRICE **£51** carr. £1

**F.A.L. PHASE 100 AMPLIFIER** £61.95
**PR. L125 50W L/S in cabinets** £59.80
Terms: Deposit £22 and 9 monthly payments of £11.62 (Total £129.58) £121.75
PACKAGE PRICE **£118** carr. £2·50

**F.A.L. PHASE 100 AMPLIFIER** £61.95
**4 FANE POP 50 L/SPEAKERS** £42
Terms: Deposit £15 and 9 monthly payments of £10.52 (Total £109.50) £103.95
PACKAGE PRICE **£99** carr. £2

## R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS

**FULLY GUARANTEED. Impregnated and Interleaved where necessary.**

Primaries 200-250v. 50c/s. Screened

**MIDGET CLAMPED TYPE 2½×2½×2¼in.**
250v., 60mA, 6·3v. 2a ..... 99p
250-0-250v., 60mA 6·3v 2a ..... £1·05

**FULLY SHROUDED UPRIGHT MOUNTING**
250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a. £1·40
250-0-250v. 100mA. 6·3v. 4a., 0-5-6·3v. 3a. £2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·20
300-0-300v. 130mA, 6·3v. 4a. c.t., 6·3v. 1a. For Mullard 510 Amplifier ..... £2·45
350-0-350v. 100mA, 6·3v. 4a., 0 5-6·3v. 3a. £2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·65
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a. £4·95
425-0-425v. 200mA, 6·3v. 4a., 6 3v. 3a., 5v. 3a ..... £5·10
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a. £5·50

**TOP SHROUDED DROP-THRO' TYPE**
250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a. £1·35
250-0-250v. 100mA, 6·3v. 3·5a. ..... £1·55
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a. .. £1·60
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a. £1·65
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·20
300-0-300v. 130mA, 6·3v. 4a., c.t. 6·3v. 1a. Suitable for Mullard 510 Amplifier ..... £2·60
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a. £2·60

**FILAMENT or TRANSISTOR POWER PACK**
Types 6·3v. 1·5a. 49p; 6·3v. 2a. 54p; 6·3v. 3a. 76p; 6·3v. 6a. £1 30; 12v. 1a. 55p; 12v. 3a. or 24v. 1·5a £1·35;0-9-18v 1½a £1·10; 0-12-25-42v 2a£1·76.

**CHARGER TRANSFORMERS** 0-9-15v. 1½a. 99p; 2½a. £1·10; 3a.£1·25; 5a.£1 45; 6a.£1·65; 8a.£2·00

**AUTO (Step UP/step DOWN) TRANSFORMERS** 0-110/120v. 200-230-250v. 50-80 watts £1·10, 150 watts, £1·90 250 watts £2·75; 500 watts £5·75

**OUTPUT TRANSFORMERS**
Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω. . 83p
Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω ..... £1·37
Push-Pull EL84 to 3 or 15 Ω 10-12 watts. . £1·35
Push-Pull Ultra Linear for Mullard 510, etc. £2·20
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω ..... £1·99
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω £2·30

**SMOOTHING CHOKES** 150mA, 7-10H. 250 Ω 70p; 100mA. 10H, 200 Ω 60p; 80mA, 10H, 350 Ω 50p; 60mA, 10H, 400 Ω 25p.

**SELENIUM RECTIFIERS F. W. (Bridged)**
All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 25p. 2a. 35p. 3a. 50p. 4a. 65p. 6a. 80p.

## HIGH QUALITY LOUDSPEAKER UNITS

**TWO TONE REXINE AND VYNAIR FINISH**

**L125 50 WATT** Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms.

Or deposit £4 and 9 monthly payts. of £3·85. Total £34·15 **£31** Carr 75p

**L12 12" 25 WATT** 10,000 lines 15 ohms. Also supplied Rexine covered Carr 45p **£10·50**

**L13 13"×8" 10 Watt** 10,000 lines 3 or 15 ohms. State impedance required. **£5·25** carr. 40p

## FAL PHASE 50 MkIII AMPLIFIER 50W

Solid state 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for 8speaker/s 3-30 ohms. Size 17"×7"×7¼" 200-250v. A.C. mains.Output 50 watts music rating. Or deposit £7.25 & 9 monthly payments £3·50. Total £38.75. **£34·75** Carr. 75p.

**LOW DEPOSIT CREDIT TERMS**
**INTEREST CHARGES REFUNDED**

Available on purchases over £8 (Kits of parts excepted) on credit sales settled in 3 months.

**R.S.C. Branches listed below open all day Sats.**

**BRADFORD** 10 North Parade (Half-day Wed.). Tel. 25349
**BLACKPOOL** (Agent) O & C Electronics 227 Church Street
**BIRMINGHAM** 30/31 Great Western Arcade. Tel. 021-236 1279 (Half-day Wed)
**DERBY** 26 Osmaston Rd. The Spot (Half-day Wed.). Tel. 41361
**DARLINGTON** 18 Priestgate (Half-day Wed.). Tel. 68043
**EDINBURGH** 133 Leith St. (Half-day Wed.). Tel. 556 5766
**GLASGOW** 326 Argyle St. (Half-day Tues.). Tel. 248 4158
**HULL** 91 Paragon Street (Half-day Thurs.). Tel. 20505
**LEICESTER** 32 High Street (Half-day Thurs.). Tel. 56420
**LEEDS** 5-7 County (Mecca) Arcade, Briggate (Half-day Wed.). Tel. 28252
**LIVERPOOL** 73 Dale Street (Half-day Wed.). Tel. 236 3573
**LONDON** 238 Edgware Road, W.2 (Half-day Thurs.). Tel. 723 1629
**MANCHESTER** 60A Oldham Street (Half-day Wed.). Tel. 236 2778
**MIDDLESBROUGH** 106 Newport Rd. (Half-day Wed.). Tel. 47096.
**NEWCASTLE** UPON TYNE 41 Blackett Street (opp. Fenwicks Store) (Half-day Wed.). Tel. 21469
**NOTTINGHAM** 19/19A Market Street (Half-day Thurs.) Tel: 48068
**SHEFFIELD** 13 Exchange Street (Castle Market Bldg.) (Half-day Thurs.), Tel. 20716

## Another New Branch!

**NOW OPEN AT—**
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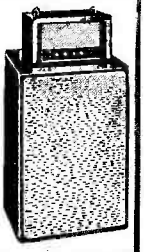
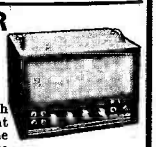
## R.S.C. BASS REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape, Peak Output rating Loudspeaker unit optional horizontal or vertical mounting.
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes".
Bass and Treble controls. Send S.A.E. for leaflet.
Credit Terms: Deposit £16 and 9 monthly payments of £5·75 (Total £67·75) **£60** Carr. £1·50

## 30 WATT HI-FI AMPLIFIER

*For Guitar, Vocal or Instrumental Group.*



A 4 input, 2 vol. control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers.
Send S.A.E. for leaflet. Terms: Deposit £3·70 and 9 monthly payments of £2·10 (Total £22·60). **£19·95** Carr. 65p

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Our miniature irons are used all over the world in that most exacting market—the modern electronics industry, the rapidly developing technology of which has made possible the enormous growth of activities available to the technical hobbyist.

He now also requires equipment to the highest commercial standards. Like our soldering irons, for example.

Look at the ADAMIN Model 15. If there is a smaller iron for mains use, we haven't seen it. It weighs a mere ½ oz (less flex) and is about 7 inches long.

But it has a big performance. Used with interchangeable bits from $\frac{3}{64}$" to $\frac{3}{16}$" it is suitable for all work, from Hearing Aids to Colour Television.

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|---|---|---|
| 1N4148 (=1N914) | Signal Diode | 18 for 50p |
| 1N5060 (=A14D) | 1 Amp Rectifier 400V avalanche protected | 7 for 50p |
| 2N2923 | NPN Silicon Transistor hfe 90 – 180 (25v) | 7 for 50p |
| 2N2926 (Red) | NPN Silicon Transistor hfe 55 – 110 | 8 for 50p |
| 2N3391A | Si NPN Hi Gain (250 – 500) low noise transistor | 3 for 50p |
| 2N3402 | Medium power (driver) 900mw 25v Hfe 75 – 225 | 6 for 50p |
| C6U | 1.6 amp general purpose 25v SCR in T05 case | 3 for 50p |

Post and packing 10p for 1 or 2 packs; 3 packs or more post free.
Order any quantity, till sold (but we regret packs cannot be subdivided).

Star Bargain
Sprague (Pirgo) Triacs
PT406S (6 amp 400v)
48p each

P.O. or Cheque payable
Jermyn Industries,
Vestry Estate,
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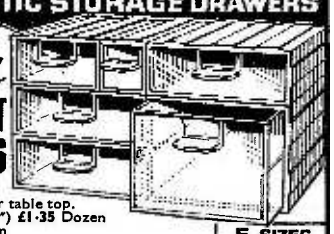

**SINGLE UNITS** (5"×2¼"×2¼") **£1·35** Dozen
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**TREBLE** (3D) **£2·35** for 8
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**5 SIZES ALL INTERLOCK**

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PW3/72

**MERLIN SUPPLY CO.**

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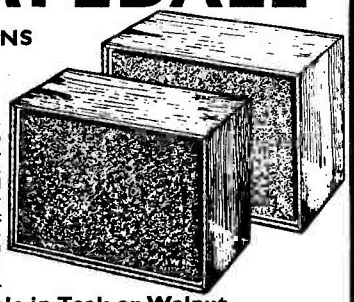
# FANTASTIC! WHARFEDALE

**SPEAKER BARGAINS**
**DENTON 2**
**SAVE £8·40**



Sold in matched pairs for a perfectly balanced stereo system. Each Denton contains an 8in. bass unit with 3in. pressure unit, coupled by a Wharfedale crossover network. Rated input: 18 watts maximum. Frequency response: 65-17,000 Hz. Impedance: 4/8 ohms. Cabinet 9¾in. x 14in. x 8¼in.

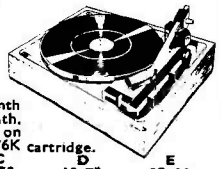
**All speakers available in Teak or Walnut**

List Price £39·90 **LASKY'S PRICE** Per Pair **£31·50** C & P £2.00

| | List Price | Lasky's Price | C &P | | List Price | Lasky's Price | C & P |
|---|---|---|---|---|---|---|---|
| LINTON 2 p. pr. | £49·90 | £39·95 | £2 | ROSEDALE ea. | £65·00 | £50·00 | £1 |
| TRITON 3 p. pr. | £65·00 | £53·50 | £2 | UNIT 3 each | £12·50 | £9·70 | 50p |
| MELTON 2 p. pr. | £35·00 | £25·50 | £1 | UNIT 4 each | £18·00 | £12·50 | 50p |
| DOVEDALE 3 ea. | £45·00 | £33·00 | £1 | UNIT 5 each | £26·00 | £18·50 | 50p |

# BSR McDONALD MP60

High precision low-mass counterbalanced pick-up arm, heavy balanced turntable, simple to operate controls, viscous cueing device, slide in cartridge carrier, 4 pole motor.



*LASKY'S PRICE* **£10·95** C & P 50p

**BSR McDONALD UNITS & PACKAGES**

**A.** Chassis only. **B.** Complete with Lasky's plinth and cover. **C.** Complete with Lasky's plinth, cover and AD76K cartridge. **D.** Comp. wired on BSR plinth with cover. **E.** As D plus AD76K cartridge.

| MODEL | A | B | C | D | E |
|---|---|---|---|---|---|
| MP.60 | 10·95 | 15·50 | 18·50 | 18·75 | 22·00 |
| HT.70 | 15·90 | 19·90 | 23·50 | 23·75 | 27·00 |
| 610 | 14·50 | 18·75 | 23·00 | 22·25 | 25·50 |
| 510 | 12·10 | 16·50 | 18·85 | 20·00 | 22·85 |
| 310 | 9·75 | 14·00 | 16·50 | 17·25 | 20·25 |
| 210 | | | | | 9·95 |
| MP.60 TPD2 Styrene base | | | | 17·50 | 21·00 |

# GARRARD UNITS AND PACKAGES

GARRARD SL 55B
Four speed autochanger
*LASKY'S PRICE* **£10·25** C & P 50p

**Now available ZERO 100S £43.50, C & P £1·50**

Garrard SP25 Mk. III ... **£11·50**

Garrard SL40B ... ... **£9·95**
Garrard AP76 without cart. **£20·95**
Garrard 3000 with 9TA cart. **£10·50**
Garrard 2025TC with KS40A cart. ... ... ... **£8·50**

## GARRARD PACKAGES

Post on packages 75p

Garrard AP76 with Micro M2100/e cart. and Lasky's plinth and cover **£31·50**
Garrard AP76 with Shure M44E cart. and Lasky's plinth and cover **£33·75**
Garrard SP25 Mk. III, AD76K cart. and Lasky's plinth and cover... **£18·50**
Garrard SP25 Mk. III with Shure M3 cart. and Lasky's plinth and cover **£22·95**

# LASKY'S NEW LOW NOISE CASSETTES FROM THE USA

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|---|---|---|---|---|
| C·60 | 32p | £1·52 | £2·96 | £5·60 |
| C·90 | 50p | £2·37 | £4·62 | £8·75 |
| C·120 | 69p | £3·28 | £6·38 | £10·85 |

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# INTERNATIONAL

MAGNETIC RECORDING TAPE FROM THE U.S.A. AT LASKY'S RECORD LOW PRICES

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|---|---|---|---|---|---|
| 3in. | RT.20 | Message Tape 225ft. | 19p | 5¼in. | RT.25 | Triple play, 2,400ft. | £1·31 |
| 3¼in. | RT.21 | Triple play, 600ft. Mylar | 50p | 7in. | RT.22 | Standard play, 1,200ft. Acetate | 63p |
| 5in. | RT.23 | Double play, 1,200ft. | 75p | 7in. | RT.10 | Standard play, 1,200ft. Mylar | 63p |
| 5in. | RT.18 | Long play, 900ft Acetate | 50p | 7in. | RT.12 | Long play, 1,800ft. Mylar | 95p |
| 5in. | RT.17 | Standard play 600ft. | 43p | 7in. | RT.13 | Double play, 2,400ft. Mylar | £1·25 |
| 5¼in. | RT.15 | Double play, 1,800ft. Mylar | £1·13 | 7in. | RT.11 | Long play, 1,800ft. Acetate | 75p |
| 5¼in. | RT.16 | Long play 1,200ft. Acetate | 75p | 7in. | RT.19 | Triple play, 3,600ft. Mylar | £2·50 |
| 5¼in. | RT.24 | Standard play 900ft. P.V.C. | 68p | 3¼in. | RT.22 | Quad play, 1,100ft. | £1·02 |
| 5¼in. | RT.14 | Long play 1,200ft. Mylar | 75p | | | | |

P. & P. 5p extra per reel, 4 reels & over Post Free. Special quotes for quantities

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The great new 1972 edition of Lasky's famous Audio-Tronics catalogue is now available—**FREE** on request. The 44 newspaper size pages—many in full colour—are packed with 1,000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast, Electronics hobbyist, Serviceman and Communications Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories and don't miss **LASKY'S AUDIO TRONICS CREDIT CARD SCHEME** offering holders one months interest free credit up to £50. Send your name and address and 15p for post and inclusion on our regular mailing list.

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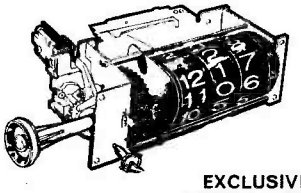
# DIGITAL CLOCK SCOOP



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- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
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- 12-HOUR ALARM
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- SHOCK AND VIBRATION PROOF
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*SPECIAL QUOTES FOR QUANTITES*

for you to mount into any housing. The clock measures 4¾ W x 1¾ H x 3¾ D (overall from front of drum to back of switch). SPEC.: 210/240V a.c., 50Hz operation; switch rating 250V, 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS.**

*LASKY'S PRICE* **£6·50** C & P 52p

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**PYE S.W. CAR RADIO CONVERTER MODEL 2649**

High quality transistorised and ultra compact Shortwave Converter for use with any suitable MW (AM) Car Radio. Self powered for use on 12V positive or negative earth systems. The model 2649 is simply connected to the radio via the aerial socket and provides shortwave covering in 9 push button selected band spread ranges (13, 16, 19, 25, 31, 41, 49, 60 & 90 M) combined with the normal radio tuning to give full cover from 3·2MHz–21·75MHz. On/off switch and by-pass switch for normal M.W. radio use. Complete with mounting bracket fitting and alignment instructions. Black hammer crackle finished case—size: 6(W) x 1¼(H) x 3¼(D) in. C & P 20p.

Made to sell approx. £20 **LASKY'S PRICE** **£8·75**

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DRIVE-IN CAR PARK

# COMET
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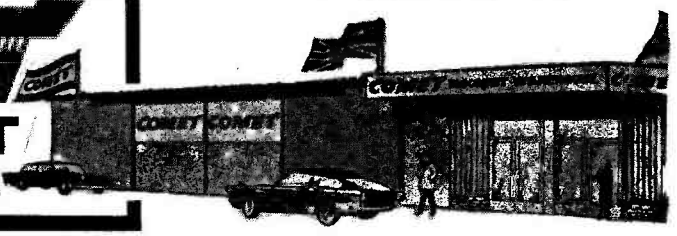

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| STEREO AMPLIFIERS | Rec. Retail Price | Comet Price |
|---|---|---|
| ALBA UA 700 | 34·50 | 24·95 |
| ALPHA 212 By Highgate | 36·75 | 27·95 |
| AMSTRAD Stereo 8000 Mk 2 | 27·95 | 17·95 |
| AMSTRAD I.C. 2000 | 42·95 | 27·95 |
| ARMSTRONG 521 | 59·00 | 44·95 |
| DULCI 207 | 26·00 | 16·95 |
| DULCI 207M | 32·00 | 19·95 |
| FERROGRAPH F307 Mk. II (cased) | 64·00 | 46·95 |
| FERROGRAPH F307 MII (Metalcase) | 60·00 | 43·95 |
| GOODMANS Maxamp | 54·00 | 37·95 |
| LEAK Delta 30 (cased) | 65·00 | 51·95 |
| LEAK Delta 70 (cased) | 79·50 | 63·95 |
| METROSOUND ST20E | 39·50 | 27·95 |
| METROSOUND ST60 | 70·00 | 49·95 |
| PHILIPS RH 591 | 79·00 | 54·95 |
| PHILIPS RH 590 | 52·00 | 36·95 |
| PHILIPS RH 580 | 29·00 | 19·95 |
| PIONEER SA500A | 53·62 | 38·95 |
| PIONEER SA600 | 83·75 | 59·95 |
| PIONEER SA700 | 97·97 | 66·95 |
| PIONEER SA800 | 109·21 | 75·95 |
| PIONEER SA900 | 133·83 | 93·95 |
| PIONEER SA1000 | 137·56 | 95·95 |
| PIONEER Reverberation 202W | 46·35 | 33·95 |
| RANK Rotel 310 | 47·50 | 35·95 |
| RANK Rotel 610 | 74·50 | 53·95 |
| RANK ROTEL 210 | 34·90 | 24·95 |
| ROGERS Ravensbourne | 59·50 | 42·95 |
| ROGERS Ravensbourne (cased) | 64·00 | 47·95 |
| ROGERS Ravensbrook Mk. II | 47·50 | 36·96 |
| ROGERS Ravensbrook (cased) Mk.II | 52·50 | 39·95 |
| SINCLAIR 2000 | 35·00 | 23·75 |
| SINCLAIR Project 60/2 x Z30/PZ5 | 23·90 | 15·95 |
| SINCLAIR PROJECT 60/2 x Z50/PZ8/trans | 34·86 | 23·25 |
| SINCLAIR PROJECT 605 | 29·95 | 21·95 |
| SINCLAIR AFU | 5·95 | 4·45 |
| SINCLAIR Neoteric | 61·95 | 43·95 |
| SINCLAIR 3000 | 45·00 | 31·50 |
| TELETON SAQ 206 | 32·50 | 18·25 |
| TELETON 307 | 30·00 | 19·95 |
| VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs | 185·00 | 139·00 |
| WHARFEDALE Linton Amplifier | 60·00 | 47·95 |

All take both ceramic and magnetic cartridges.

| TUNERS | | |
|---|---|---|
| *ARMSTRONG 523 AM/FM | 54·22 | 42·95 |
| *ARMSTRONG 524 FM | 42·17 | 33·95 |
| ARMSTRONG M8 Decoder | 9·50 | 7·70 |
| *DULCI FMT.7 FM | 25·10 | 17·95 |
| DULCI FMT.7S Stereo | 33·79 | 27·25 |
| GOODMANS Stereomax | 80·07 | 47·95 |
| LEAK Delta FM | 75·00 | 58·95 |
| LEAK Delta AM/FM | 89·50 | 69·50 |
| PHILIPS RH 690 | 45·30 | 36·50 |
| PHILIPS RH 691 | 85·80 | 69·95 |
| PIONEER TX500 AM/FM | 66·09 | 57·95 |
| PIONEER TX600 AM/FM | 147·15 | 118·00 |
| RANK ROTEL 320 | 54·94 | 43·95 |
| ROGERS Ravensbourne chassis | 59·63 | 46·95 |
| ROGERS Ravensbourne in teak case | 64·45 | 48·95 |
| ROGERS Ravensbrook chassis | 43·37 | 34·95 |
| ROGERS Ravensbrook (cased) | 49·39 | 38·95 |
| SINCLAIR 2000 | 45·00 | 34·95 |
| SINCLAIR project 60 tuner (stereo) | 25·00 | 19·95 |
| TELETON GT 101 | 43·93 | 30·95 |

All above Tuners are complete with MPX Stereo Decoder except where starred.

| TUNER/AMPLIFIERS | | |
|---|---|---|
| AKAI AA 8500 | 221·85 | 175·00 |
| AKAI 6600 | 137·34 | 108·00 |
| AKAI 6300 | 128·85 | 99·95 |
| AKAI 6200 | 91·56 | 79·95 |
| ARENA 2600 | 111·30 | 69·95 |
| ARENA T9000 | 303·45 | 285·00 |
| ARMSTRONG M8 Decoder | 9·50 | 7·70 |
| ARMSTRONG 525 | 92·77 | 71·95 |
| ARMSTRONG 526 | 105·72 | 84·95 |
| GOODMANS Module 80. 35w. RMS | 91·59 | 71·95 |
| GOODMANS Module 80 Compact | 165·00 | 129·00 |
| GOODMANS Model 110 FM/MW/LW/SW 100W RMS | 135·00 | 108·00 |
| LEAK Delta 75 | 165·00 | 139·95 |
| MIDLAND 19/542 | 49·56 | 37·50 |
| PHILIPS RH 790 | 134·00 | 79·95 |
| PIONEER SX770 AM/FM | 139·23 | 109·95 |
| PIONEER SX990 AM/FM | 167·83 | 129·95 |
| PIONEER 440 | 104·18 | 82·95 |
| ROGERS Ravensbrook Chassis | 99·39 | 81·95 |
| ROGERS Ravensbrook (cased) | 108·43 | 89·95 |
| ROTEL RX150 | 69·90 | 54·95 |
| TANDBERG 1171 | 110·00 | 91·95 |
| TANDBERG TR200 | 99·00 | 82·95 |
| TELETON F2000 | 51·50 | 28·95 |
| TELETON 10AT1 150w. RMS | 160·00 | 94·00 |
| TELETON TFS50 | 79·65 | 52·95 |
| TELETON TFS50 LA MW/LW/FM | 86·64 | 60·95 |
| TELETON CR55 | 125·26 | 67·95 |
| WHARFEDALE 100-1 | 139·00 | 89·95 |

All the above Tuners and Tuner/Amplifiers take both ceramic and magnetic cartridges except Teleton F2000 which takes ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

| CARTRIDGES | Rec. Retail Price | Comet Price |
|---|---|---|
| AUDIO TECHNICA LT66 | 6·47 | 4·50 |
| GOLDRING G800 | 12·55 | 6·75 |
| GOLDRING G800E | 18·16 | 10·50 |
| GOLDRING G800 Super E | 25·10 | 19·95 |
| *GOLDRING CS90 Stereo | 5·02 | 4·10 |
| *GOLDRING CS91/E | 7·53 | 6·00 |
| GOLDRING G850 | 6·27 | 3·95 |
| EMPIRE 1000ZE/X | 60·34 | 51·25 |
| EMPIRE 999VE/X | 43·00 | 34·95 |
| EMPIRE 999TE/X | 25·09 | 21·00 |
| EMPIRE 999SE/X | 20·31 | 16·95 |
| EMPIRE 999E/X | 15·89 | 12·50 |
| EMPIRE 999/X | 12·55 | 10·25 |
| EMPIRE 909E/X | 12·37 | 9·95 |
| EMPIRE 909/X | 9·26 | 7·75 |
| EMPIRE 90EE/X | 9·56 | 7·95 |
| ORBIT Magnetic NM 22 | Special Price | 2·95 |
| ORTOFON SL15E | 28·62 | 22·95 |
| ORTOFON 2 X 15K Transformer | 7·00 | 4·95 |
| ORTOFON M15E | 29·08 | 23·50 |
| SHURE M3DM | 7·16 | 4·75 |
| SHURE M31E | 11·63 | 8·70 |
| SHURE M32E | 10·73 | 8·05 |
| SHURE M32-3 | 9·84 | 7·80 |
| SHURE M44-5 | 10·73 | 7·19 |
| SHURE M44-7 | 9·84 | 7·15 |
| SHURE M-44C | 9·84 | 7·15 |
| SHURE M44E | 11·63 | 7·95 |
| SHURE M55E | 12·52 | 8·95 |
| SHURE M75G | 16·99 | 13·75 |
| SHURE M75-6 | 16·10 | 12·45 |
| SHURE M75EJ | 18·78 | 14·95 |
| SHURE M75E | 20·57 | 13·50 |
| SHURE V15-11 | 39·35 | 27·95 |

Starred cartridges above are ceramic. All others are magnetic.

| PICKUP ARMS | | |
|---|---|---|
| GOLDRING Lenco 75 | 13·98 | 9·50 |
| GOLDRING Lenco L69 | 10·04 | 6·50 |
| SME 3009 with S2 Shell | 33·26 | 24·95 |
| SME 3012 with S2 Shell | 35·42 | 26·45 |

**TURNTABLES**

**The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.**

**GARRARD SP25 Mk III with Goldring G.800 Special Price £19·95**

**GARRARD SP25 Mk III with Shure M.44/7 Special Price £22·95**

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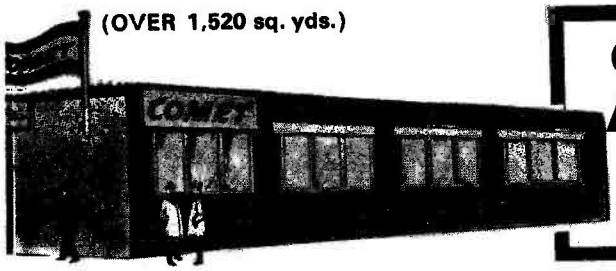


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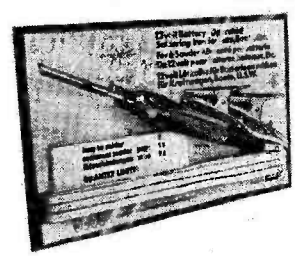

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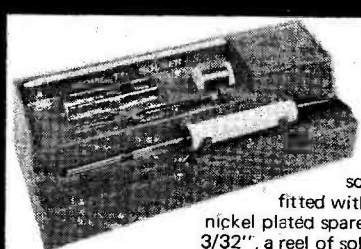

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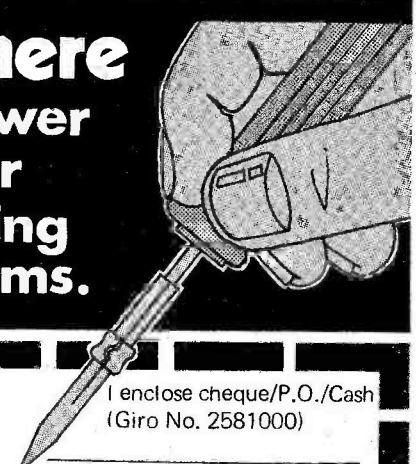

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**Special Offer. Aircraft Sighting Head.** Comprising flexible drive, lens prism unit, Giro. Useful for model constructors, schools, etc. Condition fair. **75p.** Carr. 75p.

**Reclaimed T.V. Tubes. All with 12 months guarantee.**
AW43/88. **£2.** AW43/80. **£1·50.** MW43/69 **£1.** Special offer Brand New Brimar Tubes C17P.M. **£1.** Many older types in stock. Carriage and insurance on any tube £1·10.

**Breaking-up. Ferguson Model 506T.** Tested L.O.P.T. **£1·45.** Post paid. Fireball Tuner Unit with Valves less Knobs. **75p.** Post paid. S.A.E. for Price List of other spares for this set and other types.

Valve List Ex Equipment All Valves Tested on a Mullard Valve Tester before despatched. 3 Months Guarantee on all Valves *Single Valves P/P 3p. Over three Valves P/P Paid.*

| | | | | | |
|---|---|---|---|---|---|
| ARP12 | 5p | PCC84 | 5p | U191 | 20p |
| EB91 | 4p | PCF80 | 5p | U251 | 12½p |
| EF85 | 12½p | PCL82 | 12½p | 6BW7 | 10p |
| EBF80 | 12½p | PCL83 | 12½p | 6U4 | 10p |
| EBF89 | 12½p | PCF82 | 12½p | 6F23 | 20p |
| ECC81 | 10p | PL36 | 20p | 20P1 | 20p |
| ECC82 | 12½p | PL81 | 17½p | 20P3 | 10p |
| ECL80 | 7½p | PY81 | 7½p | 20D1 | 10p |
| EF80 | 7½p | PY33 | 17½p | 30P4 | 20p |
| EF91 | 4p | PY82 | 7½p | 30P12 | 20p |
| EY86 | 20p | PL82 | 7½p | 30FL1 | 20p |
| EF50 | 60p per dozen | PL83 | 7½p | 6/30L2 | 20p |
| | | PCL84 | 12½p | 30F5 | 10p |

## DISTRIBUTION PANELS

Just what you need for work bench or lab.
4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2** less plug; **£2·25** with fitted 13 amp plug; **£2·40** with fitted 15 amp plug, plus 23p P. & I.

## MULTI-SPEED MOTOR

Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000; 12,000 & 15,500 r.p.m. shaft is ¼ in. diameter 230/240v Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long. Price **88p** plus 23p postage and insurance.

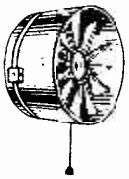
## RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1 each or £11 per dozen, specify 5, 10 or 15 amp—*simply fit in place of switch.*

## SPARTAN Portable RADIO

Long and medium wave, 7 transistor, size 6in. × 4in. × 1¾in. with larger than usual speaker giving very good tone. Built-in ferrite aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carrying sling, earplug and case **£3·75** plus 25p post and ins.

## EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5½" casing with 5½" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, **£2** plus 36p post and ins.

## MAINS MOTOR

Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **50p.** Postage 15p for first one then 5p for each one ordered.

## TELEPHONE DIAL

Ex-G.P.O. Perfect working order. **50p** each.

## TELEPHONE HAND SET

Ex-G.P.O. Perfect order. **50p** each + 20p p&p.

## G.P.O. DESK TELEPHONES

Complete with dial and hand set. Believed in good order **£1·50** plus 25p p. & p.

## SELECTOR SWITCHES

Ex-G.P.P. All in good working order.
3 pole **£1·25** 4 pole **£1·50** 5 pole **£1·75**
6 pole **£2·00** Plus 20p p&p.

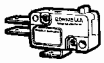
## QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **£1·25,** post and insurance 14p. 12v. car model also available same price. Jug heater **£1·50** plus p. & p. 14p.

## MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **83p,** plus 20p postage.

## MICRO SWITCH

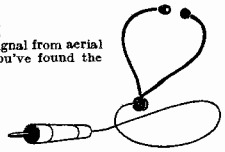


5 amp. changeover contacts, **9p** each, **£1** doz. 15 amp. Model **10p** each or **£1·05** doz.

## CAPACITOR DISCHARGE CAR IGNITION


This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version (*Practical Wireless,* June). Price **£4·95** plus 20p post. When ordering please state whether for positive or negative systems. Also available, ready made ignition systems for 6v. vehicles, **£5·25** plus 20p.

## RADIO STETHOSCOPE



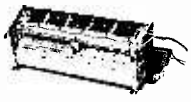
**Easiest way to fault find**—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **£2**—twin stethoset instead of earpiece **75p** extra—post and ins. 20p.

## STANDARD WAFER SWITCHES

Standard size 1½ wafer—silver-plated 5-amp contact standard ¼" spindle 2" long—with locking washer and nut.

| No. of Poles | 2 way | 3 way | 4 way | 5 way | 6 way | 8 way | 9 way | 10 way | 12 way |
|---|---|---|---|---|---|---|---|---|---|
| 1 pole | 40p | 40p | 40p | 40p | 40p | 40p | 40p | 40p | 40p |
| 2 poles | 40p | 40p | 40p | 40p | 40p | 40p | 40p | 70p | 70p |
| 3 poles | 40p | 40p | 40p | 40p | 70p | 70p | 70p | 95p | 95p |
| 4 poles | 40p | 40p | 40p | 70p | 70p | 70p | 70p | £1·20 | £1·20 |
| 5 poles | 40p | 40p | 70p | 70p | 95p | 95p | 95p | £1·45 | £1·45 |
| 6 poles | 40p | 70p | 70p | 70p | 95p | 95p | 95p | £1·70 | £1·70 |
| 7 poles | 70p | 70p | 70p | 95p | £1·20 | £1·20 | £1·20 | £1·95 | £1·95 |
| 8 poles | 70p | 70p | 70p | 95p | £1·20 | £1·20 | £1·20 | £2·20 | £2·20 |
| 9 poles | 70p | 70p | 95p | 95p | £1·45 | £1·45 | £1·45 | £2·45 | £2·45 |
| 10 poles | 70p | 70p | 95p | £1·20 | £1·45 | £1·45 | £1·45 | £2·70 | £2·70 |
| 11 poles | 70p | 95p | 95p | £1·20 | £1·70 | £1·70 | £1·70 | £2·95 | £2·95 |
| 12 poles | 70p | 95p | 95p | £1·20 | £1·70 | £1·70 | £1·70 | £3·20 | £3·20 |

## TANGENTIAL HEATER UNITS



This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. **£3·50.** 2kW Model as above except 2 kilowatts **£2·50.** Don't miss this. Control Switch **35p.** P. & P. 40p.

## THIS MONTH'S SNIP

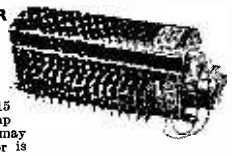
### MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into ohms speakers. Input suitable for crystal mic. or pick-up. 9 volt battery operated. Size 2" long × 1½" wide × 1" high. SPECIAL SNIP PRICE **60p** each. 10 for **£5.**

## POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), **30p** or 2 for **50p.** Post paid.

## HONEYWELL PROGRAMMER

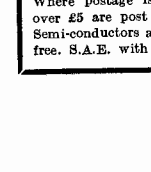


This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price **£5.75** plus 25p post and insurance. Don't miss this terrific bargain.

## INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over **£5.** Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 5/- upwards with circuits and technical data of each. Complete parcel only **£1** post paid. *DON'T MISS THIS TERRIFIC BARGAIN.*

## BATTERY CONDITION TESTER

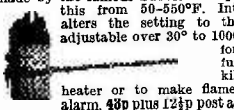


Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3¾" x 6¼" x 2" with leads and prods. Price **£1·75** plus 20p postage.

## THERMOSTATS

**Type "A"** 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F. **40p.** Calibrated dial **20p** extra. Suitable box for wall mounting **25p.**

**Type "B"** 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting to this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flame-stat or fire alarm. **48p** plus 12½p post and insurance.



**Type "D"** We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing. If a length of our blanket wire (16 yd **50p**) is wound round the pipes. **40p.**

**Type "E".** This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. **50p**

**Type "F".** Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types Adjustable over range 50° to 150° F. Price **80**

## TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. **£2·95** plus 20p post and insurance.

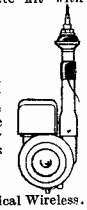
## DRILL CONTROLLER *NEW 1KW MODEL*


Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·50** plus 13p post and insurance. Made up model also available, **£2·25** plus 13p post & p.

## HIGH ACCURACY THERMO STAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack **£5·50.**

## AUTO—ELECTRIC CAR AERIAL



with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12v positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£5·75** plus 25p post and ins.

## AUTO-LITE

as Circuit in this month's issue Practical Wireless. Kit of parts **£1·20** post paid

## TOGGLE SWITCH

3 amp. 250v. with fixing ring **7½p** each, **75p** doz.

## CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. **38p** each or 10 for **£3·42.**

## ROCKER SWITCH

13 amp self-fixing into an oblong hole, size approximately 1" × ¾" **6p** each, 10 for **54p.**

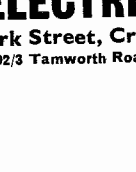
## MAINS RELAY BARGAIN

Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Ex-unused equipment. Size approx. 1½" × 1".
Open construction
Single pole **25p** each 10 for **£2·25**
Treble pole **40p** each 10 for **£3·06**

## BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits, **33p** each, **£3·50** doz.

## 2½kW FAN HEATER



Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling —adjustable thermostat acts as auto control and safety cut-out. Complete kit **£3·95.** Post and ins. 38p.

Where postage is not stated then orders over **£5** are post free. Below **£5** add **20p.** Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

# J. BULL (ELECTRICAL) LTD.

**(Dept. P.W.), 7 Park Street, Croydon CRO 1YD**

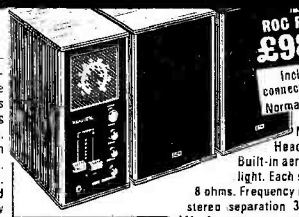
**Callers to: 102/3 Tamworth Road, Croydon.**

# "Where can I get exclusive ROC ELECTRONICS!

**ACADEMY STEREO CASSETTE TAPE DECK, MODEL CS-2000D**

No hi-fi system is complete without one – hook it up to any ROC or other good quality amplifier, and the results are fantastic! The CS-2000D records and plays back. A big feature is its easy-to-use piano-key controls. Easy-to-get-at mic inputs are on top; line inputs and outputs at the rear. Dual-channel recording level meter. Pop-up cassette ejection. Stereo/Mono button. Tape counter. Pause control. Tape speed 1⅞ ips (4·75 cms). Frequency response 100–10,000 Hz. Wow and flutter better than 0·3%. Rewind time better than 60 sec with C60 cassette. Engineered throughout to the highest electrical and mechanical standards. Size 16" wide, 4¾" high and 8" deep. Walnut cabinet with satin aluminium trims.

**ROC PRICE £54.95**
Including two pencil microphones and all connecting leads
Normal Price £65·00



**ROC PRICE £98.50**
Including connecting leads
Normal Price £115·00

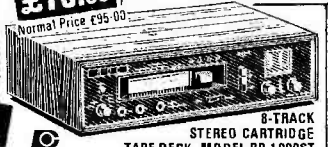
**REALISTIC HI-FI 36-WATT STEREO CONCERTMASTER FM-AM RECEIVER SYSTEM, MODEL 12-694**

Brilliantly designed tuner/amplifier with two matching speakers. All three units in beautifully finished walnut cabinets with smart aluminium vertical trims. The tuning dial is fronted by unique black glass. Figures light up behind it in green when the unit is on. Separate easy-to-operate Left and Right volume controls. Microswitch for on/off. Programme selector. Separate bass and treble controls. Headphone socket on front panel for easy access. Single tuning knob for FM and AM. Built-in aerials, facilities for external FM aerial. Illuminated dial. Stereo broadcast indicator light. Each speaker has 6½" bass and 3" treble units. Output: 9 watts r.m.s. per channel into 8 ohms. Frequency response: 30 to 20,000 Hz. FM: frequency range 80-108 MHz, sensitivity 2·5µV, stereo separation 30dB, image rejection 40db. AM: frequency range 530-1605 kHz, sensitivity 100µV. Sizes: speakers 8" wide, 12" high and 9¾" deep; receiver 6" wide, 12" high and 9¾" deep. And their sophisticated appearance matches the excellence of the specification.

**REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500**

A superb hi-fi amplifier with all the features you've ever wanted – for under £46·00. Saving over £10·00 on the normal retail value. Up-to-the-minute slider controls for bass and treble. Separate volume and balance controls. Headphone socket on front panel. Push-button input controls – magnetic phono (high/low) tuner, aux, mono, monitor. Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers. Noise filtering and tape monitoring facilities. Two auxiliary AC outlets. Frequency response 20-20,000 Hz ± 1 db at full power. 15 watts rms per channel. Walnut cabinet with satin aluminium trims. Inputs: phono 2·5mV and 5mV RIAA; tuner/aux 250mV. Hum and noise: phono – 50db; tuner/aux – 65db. How's that for a specification! Size 14¼" wide, 3¾" high, 10½" deep.

**ROC PRICE £43.75**
Normal Price £55·50



**ROC PRICE £76.50**
Normal Price £95·00

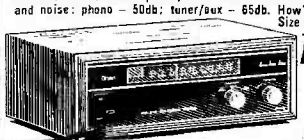
**8-TRACK STEREO CARTRIDGE TAPE DECK MODEL RP-1000ST**

The popular Lear-Jet type recording unit is the heart of the fantastic RP-1000ST, which has full record and playback facilities. Automatic track change with manual override. Press to start button. Stereo headphone and Left and Right Mic sockets on front panel. Dual recording level meter, and Left and Right volume controls. Built-in pre-amp. Tape speed 3¾ ips (9·5 cms). Frequency response: playback 30-10,000 Hz; recording/playback 30-8,000 Hz. Line output: fully variable 0-500mV. The RP-1000ST incorporates all the features you'd expect in a top quality Cartridge Tape Deck. Size 16" wide, 4" high, 9" deep. Cabinet in walnut. Including connecting leads

**25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-5b**

This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units an 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10½" × 7½" × 8¾". Exactly right for matching the most modern decor.

**ROC PRICE £27.25**
Normal Price £39·95 each.



**OLSON RA-310 AM/FM/MPX STEREO TUNER**

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10·00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz; AM: 525-1605 kHz. FM Sensitivities: FM, 3µV; AM, 250µV. Stereo separation 30dB at 1kHz. Image rejection 60dB. Size: 11⅞" wide, 4" high, 7½" deep.

**ROC PRICE £39.95**
Normal Price £50·00

**ROC PRICE £33.20**
Normal Price £42·00

**PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16**

This is one of the lowest priced stereo tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received – that's the time to switch to 'Stereo'! The SSA-16 has all the facilities you'd expect to find on tuners costing twice as much – separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz. AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4¾" high, 8" deep.

**ROC PRICE £39.95**
Normal Price £49·00

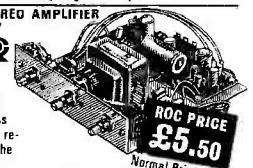
**8-TRACK HOME STEREO CARTRIDGE PLAYER MODEL E1**

With this unit, you can play any standard 8-track cartridge on the market – at a fraction of the normal retail value! It gives you a total of 5 watts of power, to feed into two 8-ohm speakers. The frequency response is 50 to 10,000 Hz, giving you a fine tonal quality that can't be bettered at anything near this price. The E1 has separate tone, balance and volume controls, giving you complete freedom to select the sound you want to hear. Tape speed is 3¾ ips, and wow and flutter are both less than 0·3%. Size: 11¾" wide, 5" high, 11" deep.

**REALISTIC SA-100B 6-WATT STEREO AMPLIFIER**

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide × 3" high × 5⅜" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/tuner and power on/off slide switches. The ends are oiled Walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

**ROC PRICE £14.50**
Normal Price £21·00



**ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317**

This excusive ROC Stereo Chassis is completely self-contained, and it costs £2·25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5½" wide, 1¾" high and 6¾" deep. It contains its own mains power supply, and has a ganged volume control and separate treble controls for each channel. Specification: frequency response 40-17,000 Hz ± 3dB; output 3·5 watts music power per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45dB.

**ROC PRICE £5.50**
Normal Price £7·75

**REALISTIC TM-100 AM/FM/MPX STEREO TUNER**

Here's another unit that gives you fabulous value in miniature! Designed specifically to match the Realistic SA-100B in both appearance, size and performance, the TM-100 is superb value-for-money. It gives you the full FM and AM ranges – FM, 88-108 MHz; AM, 535-1605 kHz. Sensitivities: FM 5µV; AM 250µV. Image rejection 50dB.

**ROC PRICE £23.25**
Normal Price £28·80

**ROC PRICE £16.40**
Normal Price £22·50 per pair.

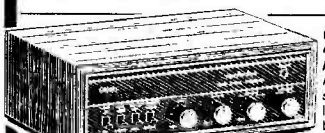
**R.446 3-WAY MATCHED SPEAKERS**

These will do justice to your amplifier – and to your pocket. At only £16·40 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 18 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range: 40 to 18,000 Hz. Size 14" high, 9" wide, 6½" deep.

**ROC PRICE £18.25**
Normal Price £25·20

**OLSON AM-372 16-WATT STEREO AMPLIFIER**

Here's a really good amplifier at a really down-to-earth price – nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you – reproduce signals from ceramic or crystal cartridges. AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r.m.s per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12½" wide, 3½" high, 7½" deep.



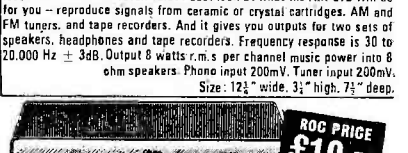
**ROC PRICE £29.00**
Normal Price £39·60

**OLSON AM-395 40-WATT STEREO AMPLIFIER**

An ideal unit for your new stereo separate system. It is more than £10·00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3·0mV RIAA, crystal phono 100mV; tape 160mV; tuner 160mV. Size 11⅞" wide, 4" high, 7½" deep. The specification reads well – sounds even better!

**OLSON AM-357 4-WATT STEREO AMPLIFIER**

Here's marvellous value for someone just starting to set themselves up in audio! At only £10·50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz ± 3dB. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tuner/aux 80mV. Size 8" wide, 2¾" high, 4¾" wide.



**ROC PRICE £10.50**
Normal Price £14·70

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**R.328 STEREO HEADPHONE**
If you're starting in hi-fi, and you discover the need for a pair of really good stereo headphones. The R.328 is ideal, at a price you can afford. They have padded ear cushions, a 6-foot cord and jack plug. Frequency range 30-15,000 Hz. Impedance 8 ohms per channel.
**ROC PRICE £2·95**

**EAGLE SE-30 STEREO HEADPHONE**
This model is for the more discriminating listener. For a start the frequency range extends from 30 to 16,000 Hz. And you can adjust the volume of each earpiece independently. There's also a mono/stereo switch. For maximum comfort, the ear cushions are covered in soft leathers. **ROC PRICE £7·05**

**EAGLE SE-80 STUDIO STEREO HEADPHONE**
Here's the ultimate in headphone design! Apart from its fantastic ability to reproduce all the frequencies from 20 to 20,000 Hz, the SE-80 has eliminated the discomfort and strain associated with traditional headphone design. Eagle have designed and produced a pair of headphones which breaks with all previous concepts. You hear all the sounds crisp and clear. In fact, the reproduction is so good, that it compares favourably with the most expensive hi-fi speaker systems. Separate slider volume control on each earpiece. Impedance: 8 ohm per channel.
**ROC PRICE £14·90**

**TEC HR-007 HEADPHONE RADIO**
When you want to listen to the radio all by yourself. Then this will solve the problem. Separate volume and tuning controls with easy-to-use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW. Normal Price £9·45 **ROC PRICE £7·65**

**THORENS TD150AB/II**
Transcription Turntable. Complete with pick up arm, plinth and cover. **£52·31**

**R.186 STEREO HEADPHONE JUNCTION BOX**
If you want easy, fingertip control of headphones *and* loudspeakers, here's the ideal solution to the problem. All you do is connect it to your speakers and amplifier, plug in your headphones – and you're ready to take over! At the flick of a slide switch, you can have headphones alone, or speakers alone, or both together. Input: suitable for use with amplifiers rated up to 20 watts. Size: 2⅔" × 3⅜" × 1 7/16". **ROC PRICE £1·50**

**R.151 STEREO CAR SPEAKERS**
Smart black, tough, plastic cases, each containing a high flux 110mm diameter speaker unit. Just what you need to go with the CS.8 Cartridge Player or any other car stereo system. Fitted with over three yards of connecting cable. Dimenstons: 6¼" × 5 11/16" × 3⅜". Impedance: 8 ohms per speaker. Rating: 5 watts max per speaker. **ROC PRICE £3·72**

**EAGLE 8-TRACK CAR STEREO PLAYER. CS.8**
Drive to the sound of music – with this fabulous 8-Track Cartridge Player. It gives you superb tone and power to fill the car with stereo sound. Ideal for use with R.151 or R.152 speakers. Complete with all mounting accessories. For negative earth electrical systems only. Output: 2·5 watts per channel. Frequency range: 70-10,000 Hz. Wow and flutter: less than 0·3%. Tape speed: 3·5 cm/sec. Channel selector: automatic with manual over-ride. Mounting dimensions: 5 3/32" × 5½" × 2 11/16". **ROC PRICE £27·20**

**R.152 STEREO CAR SPEAKERS**
These sloping front speakers match the CS.8 Cartridge Player or any other car stereo system. Fitted with high flux 110mm diameter speaker unit, and over three yards of connecting cable. Dimensions: 6 11/16" × 6 11/16" × 3⅜". Impedance: 8 ohms per speaker. Rating: 5 watts max. per speaker.
**ROC PRICE £4·96**

**EAGLE LC.05 STEREO MAGNETIC CARTRIDGE**
For fabulous reproduction at a very low price, you'll find it hard to beat. 0·7 mil diamond stylus. Output: 6mV per channel. Frequency range: 30-18,000 Hz. Channel balance: ±1·5dB. Channel separation: 20dB. Recommended stylus pressure: 2-4 grams. Compliance: 9 × 10-6 cm/dyne. **ROC PRICE £4·75**

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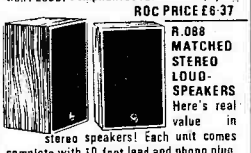
**R.307 TRANSISTORIZED STEREO PRE-AMPLIFIER**
Now your amplifier that could only reproduce ceramic or crystal pick-up cartridges, can accept signals from moving-magnet cartridges! The R.307 steps up signals from between 5-20mV to 200-800 mV. Input: 5-20mV. Equalisation: RIAA. Output: 200-800mV flat. Frequency range: 20-22,000 Hz. Dimensions: 3½" × 1¾" × 2 3/16". Supply: 240 VAC. **ROC PRICE £4·92**

**15-FOOT STEREO HEADPHONE EXTENSION CORD R.362**
Fitted with heavy duty 3-circuit stereo plug at one end and a matching stereo socket at the other. **ROC PRICE £1·30**

**STEREO HEADPHONE "Y" ADAPTOR R.361** Enables you to use two sets of stereo headphones from a single socket. Fitted with male plug and two female sockets. **ROC PRICE £1·30**

**EAGLE LC.07 STEREO MOVING-MAGNET CARTRIDGE**
Here's your opportunity to own a transcription cartridge for the price of a ceramic! Is specially designed to match top quality tone arms, and to get the very best from your hi-fi amplifier. 0·7 mil diamond stylus. Output: 7mV per channel. Frequency range: 20-21,000 Hz. Channel balance: +1dB. Channel separation: 28dB. Compliance: 12 · 10-6 cm/dyne. **ROC PRICE £6·37**



**R.088 MATCHED STEREO LOUDSPEAKERS**
Here's real value in stereo speakers! Each unit comes complete with 10-foot lead and phono plug, and look really smart. Power handling per speaker: 4 watts rms, 8 watts peak. Frequency range: 40-16,000 Hz. Flux density: 8,500 gauss. Impedance: 8 ohms. Dimensions: 9" high, 5½" wide, 4¾" deep. Finish: oiled walnut.
**ROC PRICE £9·50 pair**

**EAGLE DL.67 HIGH COMPLIANCE 3- WAY TEAK SPEAKER SYSTEM**
From a rich, deep, 35 Hz bass to above the limit of human hearing – this fantastic response comes from such a small size – only 10" × 6" × 6½"! The DL.67 is the end product of several years effort into the problems of full frequency response from small cabinets. The DL.67 has a dual cone high compliance bass mid range unit, and a horn tweeter. The speaker has a variable brilliance control to suit individual rooms – a feature normally only found on very expensive speaker systems. Power handling capacity: 10 watts rms, 20 watts peak. Frequency range: 35-20,000 Hz. Flux density: 11,000 gauss. Impedance: 8 ohms. Dimensions: 11¾" high × 8" wide × 6¾" deep. Finish: oiled teak. **ROC PRICE £18·80 each**

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**REALISTIC SA-100B SYSTEM**
Realistic SA-100B Stereo Amplifier, Garrard 2025TC Autochanger with Stereo ceramic cartridge, plinth and cover and a pair of ROC R.446 Speakers. Matching TM-100 Stereo Tuner £23·25 extra if required.
Normal Price £63·98
**ROC PRICE £47·60**

**OLSON AM-395 SYSTEM**
Olson AM-395 Stereo Amplifier, Garrard SP25 Mk III Record Player with Eagle LC07 Stereo Magnetic Cartridge, plinth and cover and a pair of Eagle DL.67 Speakers. Matching RA.310 Stereo Tuner £39·95 extra if required.
Normal Price £106·65
**ROC PRICE £92·60**

**OLSON AM-357 SYSTEM**
Olson AM-357 Stereo Amplifier, Garrard 2025 T/C Autochanger with Stereo ceramic cartridge, plinth and cover and a pair of ROC R.088 4 watt Speakers.
Normal Price £45·28
**ROC PRICE £36·70**

**PALACE SYSTEM**
Palace SSA-16 Stereo Tuner Amplifier, Garrard 2025 T/C autochanger with stereo ceramic cartridge, plinth and cover and a pair of ROC R.446 Speakers.
Normal Price £84·98
**ROC PRICE £66·30**

**REALISTIC SA-500 SYSTEM**
Realistic SA-500 Stereo Amplifier, Garrard SP25 Mk III Single Record Player with Eagle LC.07 Stereo Magnetic Cartridge, plinth and cover and a pair of Crysler CE-5b Speakers. Normal Price £157·95
**ROC PRICE £124·00**

**OLSON AM-372 SYSTEM**
Olson AM-372 Stereo Amplifier, Garrard 2025 T/C Autochanger with Stereo ceramic cartridge, plinth and cover and a pair of ROC R.446 Speakers.
Normal Price £68·18
**ROC PRICE £51·53**

**REALISTIC 12-694 SYSTEM**
Realistic 12-694 Stereo Tuner Amplifier with matching speakers and Garrard SP25 Mk III with Eagle LC.07 Stereo Magnetic Cartridge and plinth and cover.
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**ROC PRICE £124·50**

**ROC E1 SYSTEM**
ROC E1 8 track Stereo Cartridge Player complete with a pair of ROC R.088 4 watt Speakers.
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| 2N2160 | 57½p | 2N4060 | 12½p | AF116 | 25p | BF195 | 15p | GET880 | 30p | OC28 | 62½p |
| 2N2193 | 40p | 2N4061 | 12½p | AF117 | 25p | BF196 | 42½p | GET887 | 20p | OC29 | 62½p |
| 2N2193A | 42½p | 2N4062 | 12½p | AF118 | 62½p | BF197 | 42½p | GET889 | 22½p | OC35 | 50p |
| 2N2194A | 30p | 2N4244 | 47½p | AF119 | 20p | BF198 | 42½p | GET890 | 22½p | OC36 | 62½p |
| 2N2217 | 27½p | 2N4285 | 17½p | AF124 | 22½p | BF200 | 52½p | GET896 | 22½p | OC41 | 22½p |
| 2N2218 | 23p | 2N4286 | 17½p | AF125 | 20p | BF224 | 14p | GET897 | 22½p | OC42 | 25p |
| 2N2219 | 23p | 2N4287 | 17½p | AF126 | 20p | BF225 | 19p | GET898 | 22½p | OC44 | 20p |
| 2N2220 | 25p | 2N4288 | 17½p | AF127 | 17½p | BF237 | 23p | MJ400 | £1·07½ | OC45 | 12½p |
| 2N2221 | 25p | 2N4289 | 17½p | AF139 | 37½p | BF238 | 23p | MJ420 | £1·12½ | OC46 | 15p |
| 2N2222 | 30p | 2N4290 | 17½p | AF178 | 42½p | BF244 | 23p | MJ421 | £1.12½ | OC70 | 15p |
| 2N2270 | 47½p | 2N4291 | 17½p | AF179 | 72½p | BFW61 | 47½p | MJ430 | £1·02½ | OC71 | 12½p |
| 2N2297 | 30p | 2N4292 | 12½p | AF180 | 52½p | BFX12 | 22½p | MJ440 | 95p | OC72 | 12½p |
| 2N2368 | 17½p | 2N4303 | 47½p | AF181 | 42½p | BFX13 | 22½p | MJ480 | 97½p | OC74 | 32½p |
| 2N2369 | 17½p | 2N5027 | 52½p | AF239 | 42½p | BFX29 | 30p | MJ481 | £1·25 | OC75 | 22½p |
| 2N2369A | 17½p | 2N5028 | 57½p | AF279 | 47½p | BFX30 | 30p | MJ490 | £1·00 | OC76 | 22½p |
| 2N2410 | 42½p | 2N5029 | 47½p | AF280 | 62½p | BFX42 | 37½p | MJ491 | £1·37½ | OC77 | 30p |
| 2N2483 | 27½p | 2N5030 | 42½p | AF211 | 32½p | BFX44 | 37½p | MJ1800 | £2·17½ | OC81 | 20p |
| 2N2484 | 32½p | 2N5172 | 12½p | ASY26 | 25p | BFX68 | 67½p | MJE340 | 62½p | OC81D | 22½p |
| 2N2539 | 22½p | 2N5174 | 52½p | ASY27 | 37½p | BFX84 | 25p | MJE520 | 60p | OC83 | 25p |
| 2N2540 | 22½p | 2N5175 | 52½p | ASY28 | 27½p | BFX85 | 32½p | MJE521 | 73p | OC84 | 25p |
| 2N2613 | 35p | 2N5176 | 45p | ASY29 | 27½p | BFX86 | 25p | MPF102 | 42½p | OC139 | 32½p |
| 2N2614 | 30p | 2N5232A | 30p | ASY36 | 25p | BFX87 | 27½p | MPF103 | 37½p | OC140 | 32½p |
| 2N2646 | 52½p | 2N5245 | 45p | ASY50 | 25p | BFX88 | 25p | MPF104 | 37½p | OC170 | 30p |
| 2N2696 | 32½p | 2N5246 | 42½p | ASY51 | 32½p | BFX89 | 62½p | MPF105 | 37½p | OC171 | 30p |
| 2N2711 | 25p | 2N5249 | 67½p | ASY54 | 25p | BFX93A | 70p | MPS3638 | 32½p | OC200 | 40p |
| 2N2712 | 25p | 2N5265 | £3·25 | ASY86 | 32½p | BFY10 | 32½p | NKT0013 | 47½p | OC201 | 60p |
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| 2N2906 | 25p | 2N5310 | 42½p | BC116A | 15p | BFY25 | 25p | NKT211 | 30p | ORP61 | 50p |
| 2N2906A | 27½p | 2N5354 | 27½p | BC118 | 10p | BFY26 | 20p | NKT212 | 30p | P346A | 22½p |
| 2N2907 | 30p | 2N5355 | 27½p | BC121 | 20p | BFY29 | 50p | NKT213 | 30p | TIS34 | 62½p |
| 2N2923 | 15p | 2N5356 | 32½p | BC122 | 20p | BFY30 | 50p | NKT214 | 22½p | TIS43 | 27p |
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| 2N2926 | | 2N5367 | 57½p | BC140 | 37½p | BFY50 | 23p | NKT217 | 42½p | TIS46 | 11p |
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| 2N3134 | 30p | 3N83 | 40p | BC168B | 10p | BFW59 | 25p | NKT242 | 20p | TIS62 | 27½p |
| 2N3135 | 25p | 3N128 | 70p | BC168C | 11p | BFW60 | 25p | NKT243 | 62½p | TIP29A | 50p |
| 2N3136 | 25p | 3N140 | 77½p | BC169B | 11p | BPX25 | £1·85 | NKT244 | 17½p | TIP30A | 60p |
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| SN7405 | 0·20 | 0·18 | SN7441AN | 0·87 | 0·83 | SN7476 | 0·45 | 0·44 |
| SN7406 | 0·80 | 0·75 | SN7442 | 0·85 | 0·81 | SN7480 | 0·70 | 0·65 |
| SN7407 | 0·80 | 0·75 | SN7443 | 2·86 | 2·70 | SN7481 | 1·40 | 1·38 |
| SN7408 | 0·20 | 0·18 | SN7444 | 2·86 | 2·70 | SN7482 | 0·87 | 0·82 |
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| SN7413 | 0·40 | 0·38 | SN7449 | 1·00 | 0·95 | SN7490 | 0·87 | 0·84 |
| SN7420 | 0·20 | 0·18 | SN7450 | 0·20 | 0·18 | SN7491AN | 1·21 | 1·10 |
| SN7423 | 0·51 | 0·47 | SN7451 | 0·20 | 0·18 | SN7492 | 0·87 | 0·84 |
| SN7427 | 0·48 | 0·45 | SN7453 | 0·20 | 0·18 | SN7493 | 0·87 | 0·84 |
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## SILICON RECTIFIERS

| PIV | 50 | 100 | 200 | 400 | 600 | 800 | 1000 | 1200 |
|---|---|---|---|---|---|---|---|---|
| 1A | 8p | 9p | 10p | 11p | 12p | 15p | 20p | — |
| 3A | 15p | — | — | 22½p | — | 30p | — | — |
| 6A | — | — | 25p | 30p | 32½p | 35p | — | — |
| 10A | — | 52½p | 57½p | 65p | 77½p | 86½p | 97½p | £1·25 |
| 15A | — | 57½p | 62½p | 77½p | 90p | 97½p | £1·20 | £1·57½ |
| 35A | — | 80p | 90p | £1·00 | £1·25 | £1·50 | £2·50 | — |

1 amp and 3 amp are plastic encapsulation.

## DIODES & RECTIFIERS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| IN34A | 10p | AA119 | 7p | BAX16 | 12½p | FST3/4 | 22½p |
| IN914 | 7p | AA129 | 15p | BAY18 | 17½p | OA5 | 17p |
| IN916 | 7p | AAZ13 | 12p | BAY31 | 7p | OA10 | 20p |
| IN4007 | 20p | AAZ15 | 12p | BAY38 | 25p | OA9 | 10p |
| IS44 | 7p | AAZ17 | 10p | BY100 | 15p | OA47 | 8p |
| IS113 | 15p | BA100 | 15p | BY103 | 22p | OA70 | 7p |
| IS120 | 12p | BA102 | 25p | BY122 | 47½p | OA73 | 10p |
| IS121 | 14p | BA110 | 25p | BY124 | 15p | OA79 | 7p |
| IS130 | 8p | BA114 | 15p | BY126 | 15p | OA81 | 8p |
| IS131 | 10p | BA115 | 7p | BY127 | 17p | OA85 | 10p |
| IS132 | 12p | BA141 | 17p | BY164 | 57p | OA90 | 7p |
| IS920 | 7p | BA142 | 17p | BYX10 | 22p | OA91 | 7p |
| IS922 | 8p | BA144 | 12p | BYZ10 | 35p | OA95 | 7p |
| IS923 | 12p | BA145 | 17p | BYZ11 | 32p | OA200 | 7p |
| IS940 | 5p | BA154 | 12p | BYZ12 | 30p | OA202 | 10p |
| | | BAX13 | 5p | BYZ13 | 25p | TIV307 | 50p |

## TRIACS

| | | | |
|---|---|---|---|
| SC35D | £1·12½ | SC51D | £1·95 |
| SC36D | £1·00 | 40430 | 97½p |
| SC40D | £1·50 | 40486 | 95p |
| SC41D | £1·20 | 40528 | 72½p |
| SC45D | £1·62½ | 40430 | £1·30 |
| SC46D | £1·42½ | 40432 | £1·37 |
| SC50D | £2·05 | 40512 | £1·45 |

## BRIDGE RECTIFIERS

| A. PIV | | A. PIV | |
|---|---|---|---|
| 1 100 | 37p | 4 50 | 60p |
| 1·4 140 | 57p | 4 100 | 70p |
| 2 50 | 32p | 4 400 | 80p |
| 2 200 | 41p | 6 50 | 82p |
| 2 400 | 46p | 6 200 | 80p |
| | | 6 400 | £1·10 |

## THYRISTORS (SCR)

| PIV | 50 | 100 | 200 | 300 | 400 |
|---|---|---|---|---|---|
| 1A | 25p | 27½p | 37½p | 40p | 47½p |
| 4A | 47½p | 55p | 57½p | — | 77½p |
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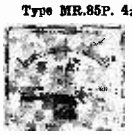

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| 1mA ..... | £2·80 | 5 amp. A.C.* | £2·80 |
| 1-0-1mA .. | £2·80 | 10 amp. A.C.* | £2·80 |
| 5mA ..... | £2·80 | 20 amp. A.C.* | £2·80 |
| 10mA .... | £2·80 | 30 amp. A.C.* | £2·80 |

**Type MR.52P. 2½in. square fronts.**

| | | | |
|---|---|---|---|
| 50μA ..... | £3·10 | 10V. D.C... | £2·00 |
| 50-0-50μA | £2·60 | 20V. D.C... | £2·00 |
| 100μA .... | £2·60 | 50V. D.C... | £2·00 |
| 100-0-100μA | £2·50 | 300V. D.C. | £2·00 |
| 500μA .... | £2·30 | 15V. A.C... | £2·10 |
| 1mA ..... | £2·00 | 300V. A.C. | £2·10 |
| 5mA ..... | £2·00 | S Meter 1mA | £2·10 |
| 10mA .... | £2·00 | VU Meter .. | £2·20 |
| 50mA .... | £2·00 | 1 amp. A.C.* | £2·00 |
| 100mA .... | £2·00 | 5 amp. A.C.* | £2·00 |
| 500mA .... | £2·00 | 10 amp. A.C.* | £2·00 |
| 1 amp. .... | £2·00 | 20 amp. A.C.* | £2·00 |
| 5 amp. .... | £2·00 | 30 amp. A.C.* | £2·00 |

**Type MR.65P. 3½in. × 3½in. fronts.**

| | | | |
|---|---|---|---|
| 50μA .... | £3·37 | 10V. D.C... | £2·20 |
| 50-0-50μA | £2·75 | 20V. D.C... | £2·20 |
| 100μA .... | £2·75 | 50V. D.C... | £2·20 |
| 100-0-100μA | £2·65 | 150V.D.C.. | £2·20 |
| 200μA .... | £2·65 | 300V. D.C. | £2·20 |
| 500μA .... | £2·40 | 15V. A.C... | £2·30 |
| 500-0-500μA | £2·20 | 50V. A.C... | £2·30 |
| 1mA ..... | £2·20 | 150V. A.C | £2·30 |
| 5mA ..... | £2·20 | 300V. A.C | £2·30 |
| 10mA .... | £2·20 | 500V. A.C | £2·30 |
| 50mA .... | £2·20 | S Meter 1mA | £2·37 |
| 100mA .... | £2·20 | VU Meter.. | £3·37 |
| 500mA .... | £2·20 | 50mA A.C. * | £2·20 |
| 1 amp. .... | £2·20 | 100mA A.C.* | £2·20 |
| 5 amp. .... | £2·20 | 200mA A.C.* | £2·20 |
| 10 amp..... | £2·20 | 500mA A.C.* | £2·20 |
| 15 amp. .. | £2·20 | 1 amp. A.C.* | £2·20 |
| 20 amp. .. | £2·20 | 5 amp. A.C.* | £2·20 |
| 30 amp. .. | £2·30 | 10 amp. A.C.* | £2·20 |
| 50 amp. .. | £2·50 | 20 amp. A.C.* | £2·20 |
| 5V. D.C. .. | £2·20 | 30 amp. A.C.* | £2·20 |

**Type MR.33P. 1 21/32in. square fronts.**

| | | | |
|---|---|---|---|
| | | 200mA .... | £1·60 |
| | | 300mA .... | £1·60 |
| | | 500mA .... | £1·60 |
| | | 750mA .... | £1·60 |
| | | 1 amp. .... | £1·60 |
| | | 2 amp. .... | £1·60 |
| | | 5 amp. .... | £1·60 |
| | | 10 amp. .. | £1·60 |
| 50μA ..... | £2·10 | 3V. D.C. .. | £1·60 |
| 50-0-50μA | £1·90 | 10V. D.C... | £1·60 |
| 100μA .... | £1·90 | 15V. D.C... | £1·60 |
| 100-0-100μA | £1·75 | 20V. D.C... | £1·60 |
| 200μA .... | £1·75 | 100V. D.C. | £1·60 |
| 500μA .... | £1·65 | 150V. D.C. | £1·60 |
| 500-0-500μA | £1·60 | 300V. D.C. | £1·60 |
| 1mA ..... | £1·60 | 500V. D.C. | £1·60 |
| 1-0-1mA .. | £1·60 | 750V. D.C. | £1·60 |
| 2mA ..... | £1·60 | 15V. A.C... | £1·70 |
| 5mA ..... | £1·60 | 50V. A.C... | £1·70 |
| 10mA .... | £1·60 | 150V. A.C. | £1·70 |
| 20mA .... | £1·60 | 300V. A.C. | £1·70 |
| 50mA .... | £1·60 | 500V. A.C. | £1·70 |
| 100mA .... | £1·60 | S Meter 1mA | £1·70 |
| 150mA .... | £1·60 | VU Meter.. | £2·10 |

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

| | | | |
|---|---|---|---|
| 50μA ..... | £2·25 | 5 amp. .... | £1·70 |
| 50-0-50μA | £2·10 | 10V. D.C... | £1·50 |
| 100μA .... | £2·10 | 20V. D.C... | £1·50 |
| 100-0-100μA | £1·87 | 50V. D.C... | £1·50 |
| 200μA .... | £1·87 | 300V. D.C. | £1·50 |
| 500μA .... | £1·75 | 15V. A.C... | £1·80 |
| 500-0-500μA | £1·70 | 300V. A.C. | £1·80 |
| 1mA ..... | £1·70 | S Meter 1mA | £1·85 |
| 5mA ..... | £1·70 | VU Meter.. | £2·25 |
| 10mA .... | £1·70 | 1 amp. A.C.* | £1·70 |
| 50mA .... | £1·70 | 5 amp. A.C.* | £1·70 |
| 100mA .... | £1·70 | 10 amp. A.C.* | £1·70 |
| 500mA .... | £1·70 | 20 amp. A.C.* | £1·70 |
| 1 amp .... | £1·70 | 30 amp. A.C.* | £1·70 |

## "SEW" BAKELITE PANEL METERS

**Type MR.65. 3½in. square fronts.**

| | | | |
|---|---|---|---|
| | | 500mA .... | £1·90 |
| | | 1 amp. .... | £1·90 |
| | | 5 amp. .... | £1·90 |
| | | 15 amp.... | £1·90 |
| | | 30 amp.... | £1·90 |
| | | 50 amp.... | £1·90 |
| | | 5V. D.C. .. | £1·90 |
| | | 10V. D.C. .. | £1·90 |
| | | 20V. D.C. .. | £1·90 |
| | | 50V. D.C. .. | £1·90 |
| | | 150V. D.C. | £1·90 |
| | | 300V. D.C. | £1·90 |
| 25μA ..... | £2·50 | 30V. A.C.* | £1·95 |
| 50μA ..... | £2·75 | 50V. A.C.* | £1·95 |
| 50-0-50μA | £2·35 | 150V. A.C.* | £1·95 |
| 100μA .... | £2·35 | 300V. A.C.* | £1·95 |
| 100-0-100μA | £2·25 | 500mA A.C.* | £1·95 |
| 500μA .... | £2·20 | 1 amp. A.C.* | £1·95 |
| 1mA ..... | £1·90 | 5 amp. A.C.* | £1·95 |
| 1-0-1mA .. | £1·90 | 10 amp. A.C.* | £1·95 |
| 5mA ..... | £1·90 | 20 amp. A.C.* | £1·95 |
| 10mA .... | £1·90 | 30 amp. A.C.* | £1·95 |
| 50mA .... | £1·90 | 50 amp. A.C.* | £1·95 |
| 100mA .... | £1·90 | VU Meter .. | £3·10 |

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| | | | |
|---|---|---|---|
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| 100μA ..... | £4·65 | 50V d.c. .... | £4·40 |
| 1mA ..... | £4·40 | 300V d.c. ... | £4·40 |
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| 1-0-1mA..... | £4·40 | Dual range | |
| 1A d.c. ..... | £4·40 | 500mA/5A d.c. | £4·65 |
| 5A d.c. ..... | £4·40 | 5V/50V d.c... | £4·65 |
| 10V d.c. .... | £4·40 | | |

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**Type PE.70. 3 17/32in. × 1 15/32in. × 2½ in. deep.**

| | | | |
|---|---|---|---|
| 50μA ..... | £3·10 | 500μA .... | £2·75 |
| 50-0-50μA | £3·00 | 1mA ..... | £2·45 |
| 100μA .... | £3·00 | 300V. A.C. | £2·45 |
| 100-0-100μA | £2·90 | VU Meter.. | £3·40 |
| 200μA .... | £2·90 | | |

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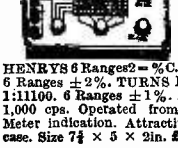

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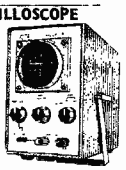

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| 2G309 | 30p | 2N3566 | 22p | 28303 | 60p | BC125 | 15p | BFX44 | 37p | NKT240 | 27p |
| 2G371 | 15p | 2N3568 | 25p | 28304 | 75p | BC126 | 25p | BFX68 | 67p | NKT241 | 27p |
| 2G374 | 20p | 2N3569 | 25p | 28501 | 32p | BC134 | 12p | BFX84 | 25p | NKT242 | 30p |
| 2G381 | 22p | 2N3570 | 125p | 28502 | 35p | BC135 | 12p | BFX85 | 30p | NKT243 | 62p |
| 2N388A | 49p | 2N3572 | 97p | 28503 | 27p | BC136 | 15p | BFX86 | 25p | NKT244 | 17p |
| 2N404 | 20p | 2N3605 | 27p | 3N83 | 40p | BC137 | 15p | BFX87 | 25p | NKT245 | 20p |
| 2N696 | 15p | 2N3606 | 27p | 3N128 | 70p | BC138 | 20p | BFX88 | 20p | NKT261 | 20p |
| 2N697 | 15p | 2N3607 | 22p | 3N140 | 77p | BC140 | 35p | BFX89 | 62p | NKT262 | 30p |
| 2N698 | 25p | 2N3638 | 18p | 3N141 | 72p | BC141 | 35p | BFX93A | 70p | NKT264 | 20p |
| 2N699 | 30p | 2N3638A | 20p | 3N142 | 55p | BC147 | 10p | BFY11 | 42p | NKT271 | 20p |
| 2N706 | 10p | 2N3641 | 18p | 3N143 | 67p | BC148 | 10p | BFY18 | 25p | NKT262 | 20p |
| 2N706A | 12p | 2N3642 | 18p | 3N152 | 87p | BC149 | 12p | BFY19 | 25p | NKT274 | 20p |
| 2N708 | 12p | 2N3643 | 20p | 40050 | 55p | BC152 | 17p | BFY21 | 42p | NKT275 | 20p |
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| 2N937 | 52p | 2N3706 | 10p | 40319 | 35p | BC159C | 15p | BFY77 | 43p | NKT453 | 47p |
| 2N1090 | 22p | 2N3707 | 12p | 40320 | 47p | BC170 | 12p | BFY77 | 57p | NKT713 | 20p |
| 2N1091 | 22p | 2N3708 | 10p | 40323 | 33p | BC171 | 15p | BFY90 | 65p | NKT717 | 42p |
| 2N1131 | 25p | 2N3709 | 10p | 40324 | 47p | BC172 | 15p | BSX19 | 17p | NKT734 | 27p |
| 2N1132 | 25p | 2N3710 | 10p | 40326 | 37p | BC175 | 22p | BSX20 | 15p | NKT736 | 35p |
| 2N1302 | 17p | 2N3711 | 10p | 40329 | 30p | BC177 | 20p | BSX21 | 20p | NKT773 | 25p |
| 2N1303 | 17p | 2N3713 | 187p | 40344 | 27p | BC178 | 20p | BSX26 | 45p | NKT781 | 30p |
| 2N1304 | 22p | 2N3714 | 200p | 40347 | 57p | BC179 | 20p | BSX27 | 47p | OC16 | 50p |
| 2N1305 | 22p | 2N3715 | 220p | 40348 | 52p | BC182 | 12p | BSX28 | 32p | OC19 | 37p |
| 2N1306 | 25p | 2N3716 | 285p | 40360 | 40p | BC182L | 10p | BSX60 | 82p | OC20 | 85p |
| 2N1307 | 25p | 2N3773 | 240p | 40361 | 40p | BC183 | 9p | BSX61 | 62p | OC22 | 50p |
| 2N1308 | 25p | 2N3791 | 275p | 40362 | 50p | BC183L | 9p | BSX76 | 15p | OC23 | 60p |
| 2N1309 | 25p | 2N3819 | 34p | 40370 | 32p | BC184 | 11p | BSX77 | 20p | OC24 | 60p |
| 2N1507 | 17p | 2N3820 | 55p | 40406 | 57p | BC184L | 11p | BSX78 | 25p | OC25 | 40p |
| 2N1613 | 20p | 2N3823 | 50p | 40407 | 40p | BC186 | 25p | BSY24 | 15p | OC26 | 25p |
| 2N1631 | 35p | 2N3854 | 27p | 40408 | 52p | BC187 | 27p | BSY25 | 15p | OC28 | 60p |
| 2N1632 | 30p | 2N3854A | 27p | 40409 | 55p | BC212L | 12p | BSY26 | 17p | OC29 | 60p |
| 2N1637 | 30p | 2N3855 | 27p | 40410 | 62p | BC213L | 12p | BSY27 | 15p | OC35 | 50p |
| 2N1638 | 27p | 2N3855A | 30p | 40412 | 50p | BC214L | 15p | BSY28 | 17p | OC36 | 60p |
| 2N1639 | 27p | 2N3856 | 30p | 40467A | 57p | BCY10 | 27p | BSY39 | 17p | OC41 | 22p |
| 2N1701 | 16p | 2N3856A | 35p | 40468A | 30p | BCY30 | 30p | BSY52 | 25p | OC42 | 40p |
| 2N1711 | 24p | 2N3858 | 25p | 40528 | 72p | BCY31 | 40p | BSY36 | 25p | OC44 | 15p |
| 2N1889 | 32p | 2N3858A | 30p | 40600 | 57p | BCY32 | 60p | BSY37 | 25p | OC45 | 12p |
| 2N1893 | 37p | 2N3859 | 27p | 40603 | 50p | BCY33 | 30p | BSY38 | 20p | OC46 | 15p |
| 2N2147 | 72p | 2N3859A | 32p | AC107 | 30p | BCY34 | 35p | BSY39 | 22p | OC70 | 15p |
| 2N2160 | 57p | 2N3860 | 30p | AC126 | 20p | BCY38 | 45p | BSY43 | 50p | OC71 | 12p |
| 2N2193 | 40p | 2N3866 | 150p | AC127 | 24p | BCY39 | 60p | BSY51 | 32p | OC72 | 12p |
| 2N2193A | 42p | 2N3877 | 40p | AC128 | 20p | BCY40 | 50p | BSY52 | 32p | OC73 | 30p |
| 2N2194 | 27p | 2N3877A | 40p | AC151 | 18p | BCY41 | 15p | BSY53 | 37p | OC74 | 30p |
| 2N2194A | 30p | 2N3900 | 37p | AC152 | 22p | BCY42 | 15p | BSY54 | 40p | OC75 | 25p |
| 2N2217 | 25p | 2N3900A | 40p | AC154 | 22p | BCY43 | 15p | BSY56 | 90p | OC76 | 25p |
| 2N2218 | 20p | 2N3901 | 97p | AC176 | 20p | BCY54 | 32p | BSY79 | 45p | OC77 | 40p |
| 2N2219 | 20p | 2N3903 | 20p | AC187 | 25p | BCY58 | 22p | BSY90 | 57p | OC78 | 20p |
| 2N2220 | 25p | 2N3904 | 25p | AC188 | 25p | BCY59 | 22p | BSY95A | 12p | OC81 | 20p |
| 2N2221 | 25p | 2N3905 | 30p | ACY17 | 27p | BCY60 | 97p | C424 | 15p | OC81D | 20p |
| 2N2222 | 20p | 2N3906 | 25p | ACY18 | 24p | BCY70 | 15p | C450 | 15p | OC82 | 25p |
| 2N2222A | 25p | 2N4058 | 12p | ACY19 | 24p | BCY71 | 20p | GET102 | 35p | OC82D | 15p |
| 2N2297 | 30p | 2N4059 | 10p | ACY20 | 20p | BCY72 | 15p | GET113 | 25p | OC83 | 25p |
| 2N2368 | 15p | 2N4060 | 12p | ACY21 | 20p | BCY78 | 30p | GET114 | 20p | OC84 | 25p |
| 2N2369 | 15p | 2N4061 | 12p | ACY22 | 10p | BCY79 | 30p | GET116 | 25p | OC139 | 25p |
| 2N2369A | 15p | 2N4062 | 12p | ACY28 | 17p | BCZ10 | 27p | GET120 | 20p | OC140 | 40p |
| 2N2410 | 42p | 2N4244 | 47p | ACY39 | 47p | BCZ11 | 40p | GET873 | 12p | OC170 | 25p |
| 2N2483 | 27p | 2N4248 | 15p | ACY40 | 14p | BD112 | 50p | GET880 | 45p | OC171 | 30p |
| 2N2484 | 32p | 2N4249 | 15p | ACY41 | 15p | BD116 | £1 2p | GET887 | 15p | OC200 | 40p |
| 2N2539 | 22p | 2N4250 | 18p | ACY44 | 25p | BD121 | 65p | GET889 | 22p | OC201 | 75p |
| 2N2540 | 22p | 2N4254 | 42p | AD140 | 47p | BD123 | 80p | GET890 | 22p | OC202 | 80p |
| 2N2613 | 35p | 2N4255 | 42p | AD149 | 47p | BD124 | 75p | GET896 | 22p | OC203 | 40p |
| 2N2614 | 30p | 2M4284 | 17p | AD150 | 62p | BD131 | 75p | GET897 | 22p | OC204 | 40p |
| 2N2646 | 47p | 2N4285 | 17p | AD161 | 35p | BD132 | 80p | GET898 | 22p | OC205 | 75p |
| 2N2711 | 25p | 2N4286 | 17p | AD162 | 35p | BDY10 | 125p | MAT100 | 25p | OC206 | 95p |
| 2N2712 | 25p | 2N4287 | 17p | AF109 | 45p | BDY20 | 105p | MAT101 | 25p | OC207 | 75p |
| 2N2713 | 27p | 2N4288 | 15p | AF114 | 25p | BDY61 | 125p | MAT120 | 25p | OCP71 | 42p |
| 2N2714 | 30p | 2N4289 | 12p | AF115 | 25p | BDY62 | 100p | MAT121 | 25p | ORP12 | 50p |
| 2N2904 | 20p | 2N4290 | 12p | AF116 | 25p | BF115 | 25p | MJ400 | 107p | ORP60 | 40p |
| 2N2904A | 25p | 2N4291 | 15p | AF117 | 20p | BF117 | 47p | MJ420 | 80p | ORP61 | 42p |
| 2N2905 | 25p | 2N4292 | 15p | AF118 | 44p | BF152 | 28p | MJ421 | 80p | P346A | 22p |
| 2N2905A | 20p | 2N4294 | 17p | AF121 | 30p | BF154 | 20p | MJ430 | 102p | ST140 | 15p |
| 2N2906 | 20p | 2N4303 | 47p | AF124 | 22p | BF158 | 15p | MJ440 | 95p | ST141 | 20p |
| 2N2906A | 25p | 2N4964 | 15p | AF125 | 19p | BF159 | 35p | MJ480 | 97p | TIS34 | 62p |
| 2N2907 | 25p | 2N4965 | 18p | AF126 | 16p | BF163 | 35p | MJ481 | 125p | TIS43 | 40p |
| 2N2923 | 15p | 2N5027 | 52p | AF127 | 16p | BF167 | 25p | MJ490 | 190p | TIS44 | 12p |
| 2N2924 | 15p | 2N5028 | 57p | AF139 | 28p | BF170 | 32p | MJ491 | 187p | TIS45 | 12p |
| 2N2925 | 15p | 2N5029 | 47p | AF178 | 42p | BF173 | 30p | MJE340 | 50p | TIS46 | 12p |
| 2N2926G | 12p | 2N5030 | 42p | AF179 | 45p | BF177 | 30p | MJE370 | 80p | TIS47 | 12p |
| 2N2926O | 12p | 2N5172 | 12p | AF180 | 50p | BF178 | 25p | MJE371 | 80p | TIS48 | 12p |
| 2N2926Y | 12p | 2N5174 | 52p | AF181 | 40p | BF179 | 30p | MJE520 | 75p | TIS49 | 12p |
| 2N3011 | 20p | 2N5175 | 52p | AF186 | 39p | BF180 | 35p | MJE521 | 70p | TIS50 | 12p |
| 2N3014 | 25p | 2N5176 | 45p | AF239 | 30p | BF181 | 35p | MPF102 | 42p | TIS51 | 10p |
| 2N3053 | 20p | 2N5232A | 30p | AF279 | 47p | BF182 | 30p | MPF103 | 35p | TIS52 | 11p |
| 2N3054 | 49p | 2N5245 | 45p | AF280 | 47p | BF184 | 20p | MPF104 | 37p | TIS53 | 22p |
| 2N3055 | 72p | 2N5246 | 42p | AFZ11 | 32p | BF185 | 20p | MPF105 | 37p | XB112 | 12p |
| 2N3133 | 25p | 2N5249 | 67p | ASY26 | 25p | BF194 | 15p | MPS3638 | 32p | XC141 | 35p |
| 2N3134 | 30p | 2N5265 | 325p | ASY27 | 30p | BF195 | 15p | NKT124 | 42p | ZTX107 | 15p |
| 2N3135 | 25p | 2N5305 | 37p | ASY28 | 24p | BF196 | 15p | NKT125 | 27p | ZTX108 | 12p |
| 2N3136 | 25p | 2N5306 | 40p | ASY29 | 27p | BF197 | 15p | NKT126 | 27p | ZTX109 | 15p |
| 2N3390 | 25p | 2N5307 | 37p | ASY50 | 25p | BF198 | 15p | NKT128 | 27p | ZTX300 | 12p |
| 2N3391 | 20p | 2N5308 | 37p | ASY51 | 32p | BF200 | 35p | NKT135 | 27p | ZTX301 | 15p |
| 2N3391A | 30p | 2N5309 | 62p | ASY54 | 25p | BF224 | 14p | NKT137 | 32p | ZTX302 | 20p |
| 2N3392 | 17p | 2N5310 | 42p | ASY67 | 45p | BF225 | 19p | NKT210 | 30p | ZTX303 | 20p |
| 2N3393 | 15p | 2N5354 | 27p | ASY86 | 32p | BF237 | 22p | NKT211 | 30p | ZTX304 | 25p |
| 2N3394 | 15p | 2N5355 | 27p | ASZ21 | 51p | BF238 | 22p | NKT212 | 30p | ZTX500 | 15p |
| 2N3402 | 22p | 2N5356 | 32p | AUY10 | 150p | BF244 | 32p | NKT213 | 30p | ZTX501 | 15p |
| 2N3403 | 22p | 2N5365 | 47p | BC107 | 10p | BFW61 | 47p | NKT214 | 20p | ZTX502 | 20p |
| 2N3404 | 32p | 2N5366 | 32p | BC108 | 10p | BFW87 | 25p | NKT215 | 22p | ZTX503 | 17p |
| 2N3405 | 45p | 2N5367 | 57p | BC109 | 10p | BFW88 | 23p | NKT216 | 25p | ZTX504 | 40p |
| 2N3414 | 22p | 2N5457 | 30p | BC113 | 10p | BFW89 | 20p | NKT217 | 40p | ZTX531 | 25p |

### Integrated Circuits

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FJH101 | 25p | SN7430 | 20p | | | | | |
| | FJH111 | 70p | SN7440 | 20p | | | | | |
| | FJH121 | 25p | SN7441AN | | | | | | |
| CA3000 | 180p | FJH131 | 25p | | 75p | | | | |
| CA3005 | 117p | FJH141 | 25p | SN7442 | 75p | | | | |
| CA3007 | 265p | FJH151 | 25p | SN7446 | 100p | | | | |
| CA3011 | 75p | FJH161 | 70p | SN7447 | 135p | | | | |
| CA3012 | 88p | FJH171 | 25p | SN7448 | 125p | | | | |
| CA3013 | 105p | FJH181 | 25p | SN7450 | 20p | | | | |
| CA3014 | 124p | FJH221 | 25p | SN7451 | 20p | | | | |
| CA3018 | 84p | FJH231 | 25p | SN7453 | 20p | | | | |
| CA3018A | | FJH241 | 25p | SN7454 | 20p | | | | |
| | 110p | FJH251 | 25p | SN7460 | 20p | | | | |
| CA3019 | 84p | FJJ101 | 50p | SN7472 | 30p | | | | |
| CA3020 | 126p | FJJ111 | 50p | SN7473 | 40p | | | | |
| CA3020A | | FJJ121 | 60p | SN7474 | 40p | | | | |
| | 160p | FJJ131 | 60p | SN7475 | 45p | | | | |
| CA3021 | 156p | FJJ141 | 125p | SN7476 | 45p | | | | |
| CA3022 | 130p | FJJ181 | 75p | SN7483 | 87p | | | | |
| CA3023 | 126p | FJJ191 | 65p | SN7486 | 33p | | | | |
| CA3026 | 100p | FJJ211 | 125p | SN7490 | 87p | | | | |
| CA3028A | 74p | FJJ251 | 125p | SN7492 | 87p | | | | |
| CA3028B | | FJL101 | 125p | SN7493 | 87p | | | | |
| | 105p | FJY101 | 25p | SN7495 | 87p | | | | |
| CA3029 | 87p | IC10 | 250p | SN7496 | 87p | | | | |
| CA3029A | | IC12 | 250p | SN74107 | 52p | | | | |
| | 165p | L900 | 40p | SN74153 | | | | | |
| CA3030 | 137p | L914 | 40p | | 140p | | | | |
| CA3035 | 122p | L923 | 40p | SN74154 | | | | | |
| CA3036 | 72p | MC724P | 60p | | 220p | | | | |
| CA3039 | 82p | MC780P | 247p | SN74160 | | | | | |
| CA3041 | 109p | MC788P | 146p | | 180p | | | | |
| CA3042 | 109p | MC790P | 124p | SN74161 | | | | | |
| CA3043 | 137p | MC792P | 66p | | 260p | | | | |
| CA3044 | 120p | MC799P | 66p | SN74164 | | | | | |
| CA3045 | 122p | MC1303L | | | 220p | | | | |
| CA3046 | 81p | | 100p | SN74165 | | | | | |
| CA3047 | 137p | MC1304P | | | 225p | | | | |
| CA3048 | 204p | | 225p | SN74192 | | | | | |
| CA3049 | 160p | MC1305P | | | 175p | | | | |
| CA3050 | 185p | | 386p | SN74193 | | | | | |
| CA3051 | 134p | MC8388P | | | 175p | | | | |
| CA3052 | 165p | | 549p | TAA241 | | | | | |
| CA3053 | 46p | MC1435P | | | 162p | | | | |
| CA3054 | 109p | | 345p | TAA242 | | | | | |
| CA3055 | 240p | MC1552G | | | 425p | | | | |
| CA3059 | 165p | | 461p | TAA243 | 150p | | | | |
| CA3064 | 120p | MC1709CG | | TAA263 | 75p | | | | |
| FCH101 | 85p | | 94p | TAA293 | 97p | | | | |
| FCH111 | 105p | MFC4000P | | TAA300 | 175p | | | | |
| FCH121 | 105p | | 75p | TAA310 | 125p | | | | |
| FCH131 | 50p | PA222 | 260p | TAA320 | 72p | | | | |
| FCH141 | 105p | PA230 | 140p | TAA350 | 175p | | | | |
| FCH151 | 105p | PA234 | 92p | TAA435 | 147p | | | | |
| FCH161 | 50p | PA237 | 210p | TAA521 | 132p | | | | |
| FCH171 | 105p | PA246 | 160p | TAA522 | 360p | | | | |
| FCH181 | 105p | PA424 | 235p | TAA530 | 495p | | | | |
| FCH191 | 105p | PA264 | 190p | TAA811 | 445p | | | | |
| FCH201 | 130p | PA265 | 200p | TAB101 | 97p | | | | |
| FCH211 | 130p | SN7400 | 20p | TAD100 | 150p | | | | |
| FCH221 | 130p | SN7401 | 20p | TAD110 | 150p | | | | |
| FCH231 | 150p | SN7402 | 20p | SL403D | 150p | | | | |
| FCJ101 | 160p | SN7403 | 20p | SL702C | 147p | | | | |
| FCJ111 | 150p | SN7404 | 20p | UA702A | 280p | | | | |
| FCJ121 | 275p | SN7405 | 20p | UA702C | 77p | | | | |
| FCJ131 | 275p | SN7406 | 80p | UA703C | 137p | | | | |
| FCJ141 | 525p | SN7408 | 20p | UA709C | 125p | | | | |
| FCJ201 | 100p | SN7409 | 20p | UA710C | 125p | | | | |
| FCJ211 | 275p | SN7410 | 20p | UA716 | 187p | | | | |
| FCK101 | 430p | SN7411 | 23p | UA723C | 162p | | | | |
| FCL101 | 230p | SN7413 | 30p | UA730C | 160p | | | | |
| FCY101 | 102p | SN7420 | 20p | UA741C | 87p | | | | |

**BRIDGE RECTIFIERS PLASTIC ENCAPSULATED**

| | | | |
|---|---|---|---|
| 50 PIV 4A | 60p | 600 PIV 1A | 50p |
| 100 PIV 4A | 70p | 50 PIV 2A | 55p |
| 200 PIV 4A | 70p | 100 PIV 2A | 60p |
| 400 PIV 4A | 75p | 200 PIV 2A | 65p |
| 200 PIV 6A | 62p | 400 PIV 2A | 75p |
| 400 PIV 6A | 75p | | |
| 600 PIV 6A | 100p | | |

**SILICON RECTIFIERS**
**MINIATURE WIRE ENDED PLASTIC**

| | IN SERIES 1 AMP | PL SERIES 1·5 AMP | CL SERIES 3 AMP |
|---|---|---|---|
| 4001 50PIV | 7p | 8p | 19p |
| 4002 100PIV | 7p | 9p | 20p |
| 4003 200PIV | 8p | 10p | 22p |
| 4004 400PIV | 8p | 10p | 25p |
| 4005 600PIV | 10p | 12p | 26p |
| 4006 800PIV | 12p | 15p | 27p |
| 4007 1000PIV | 15p | 16p | 30p |

50+ less 15% 100+ less 20%

**SILICON RECTIFIERS**
**STUD MOUNTING**

| | 6A | 10A | 17·5A | 35A |
|---|---|---|---|---|
| 100PIV | — | 45p | 50p | £1·22 |
| 200PIV | 25p | 50p | 55p | £1·42 |
| 400PIV | 30p | 55p | 62p | £1·77 |
| 600PIV | 32p | 60p | 72p | £2·12 |
| 800PIV | 35p | 75p | 87p | £2·47 |
| 1000PIV | 40p | 85p | £1·05 | £2·77 |

50+ less 15% 100+ less 20%

**ZENER DIODES**

| 400MW | 1·5 WATT | 10 WATT |
|---|---|---|
| 3·3-33 V | 2·4—100 | 3·9—100V |
| 10p each | 25p each | 40p each |

25+ less 15% 100+ less 20%

**TRANSISTOR DISCOUNTS:-** 12 + 10%; 25 + 15%; 100 + 20% any one type. Postage on all Semi Conductors 7p extra.
**S.A.E. FOR FULL LISTS.**

### VALVES

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| OA2 | 38p | 25Z4 | 30p | EL95 | 35p | | |
| OB2 | 45p | 25Z5 | 42p | EM80 | 45p | | |
| OZ4 | 30p | 25Z6 | 65p | EM81 | 60p | | |
| IL4 | 20p | 30C15 | 80p | EM84 | 35p | | |
| IR5 | 40p | 30C17 | 90p | EM85 | £1·00 | | |
| IS5 | 30p | 30C18 | 80p | EM87 | 70p | | |
| IT4 | 25p | 30F5 | 85p | EY51 | 40p | | |
| IU4 | 30p | 30FL1 | 75p | EY86 | 40p | | |
| IU5 | 60p | 30FL12 | 120p | EY87 | 42p | | |
| 2D21 | 35p | 30FL14 | 95p | EZ40 | 55p | | |
| 3Q4 | 50p | 30L15 | 85p | EZ41 | 50p | | |
| 3S4 | 35p | 30L17 | 80p | EZ80 | 27p | | |
| 3V4 | 48p | 30P12 | 80p | EZ81 | 29p | | |
| 5R4 | 75p | 30P19 | 85p | GZ32 | 48p | | |
| 5U4 | 35p | 30PL1 | 75p | GZ34 | 60p | | |
| 5V4 | 45p | 30PL13 | 93p | KT66 | £2·05 | | |
| 5Y3 | 40p | 30PL14 | 90p | KT88 | £2·00 | | |
| 5Z4G | 40p | 35L6 | 50p | MU14 | 75p | | |
| 6/30L2 | 80p | 35W4 | 35p | PABC80 | 40p | | |
| 6AC7 | 40p | 35Z4 | 35p | PC86 | 60p | | |
| 6AG7 | 40p | 35Z5 | 50p | PC88 | 60p | | |
| 6AK5 | 35p | 50B5 | 50p | PC97 | 45p | | |
| 6AK6 | 60p | 50C5 | 50p | PC900 | 48p | | |
| 6AL5 | 20p | 80 | 55p | PCC84 | 40p | | |
| 6AM6 | 30p | 85A2 | 50p | PCC85 | 40p | | |
| 6AQ5 | 38p | 807 | 50p | PCC88 | 55p | | |
| 6AS6 | 40p | 1625 | 50p | PCC89 | 50p | | |
| 6AT6 | 35p | 5763 | 70p | PCC189 | 55p | | |
| 6AU6 | 25p | 6146 | 160 | PCF80 | 30p | | |
| 6AV6 | 30p | AZ31 | 55p | PCF82 | 34p | | |
| 6BA6 | 25p | CY31 | 35p | PCF84 | 60p | | |
| 6BE6 | 30p | DAF91 | 30p | PCF86 | 60p | | |
| 6BH6 | 75p | DAF96 | 45p | PCF800 | 80p | | |
| 6BJ6 | 50p | DF91 | 22p | PCF801 | 50p | | |
| 6BQ7A | 40p | DF96 | 45p | PCF802 | 50p | | |
| 6BR7 | 90p | DK91 | 40p | PCF805 | 80p | | |
| 6BR8 | 70p | DK92 | 55p | PCF806 | 70p | | |
| 6BW6 | 85p | DK96 | 50p | PCF808 | 75p | | |
| 6BW7 | 80p | DL92 | 35p | PCL82 | 35p | | |
| 6BZ6 | 40p | DL94 | 48p | PCL83 | 65p | | |
| 6C4 | 38p | DL96 | 45p | PCL84 | 45p | | |
| 6CD6 | 125p | DM70 | 40p | PCL85 | 40p | | |
| 6CL6 | 50p | DY86 | 32p | PCL86 | 45p | | |
| 6CW4 | 65p | DY87 | 33p | PFL200 | 65p | | |
| 6F1 | 62p | E88CC | 100p | PL36 | 55p | | |
| 6F6G | 35p | E180F | 100p | PL81 | 50p | | |
| 6F13 | 45p | EABC80 | 35p | PL82 | 45p | | |
| 6F14 | 70p | EAF42 | 35p | PL83 | 45p | | |
| 6F15 | 65p | EB91 | 20p | PL84 | 40p | | |
| 6F18 | 50p | EBC41 | 55p | PL500 | 75p | | |
| 6F23 | 35p | EBC81 | 30p | PL504 | 80p | | |
| 6H6 | 17p | EBF80 | 40p | PY32 | 55p | | |
| 6J4 | 50p | EBF83 | 40p | PY33 | 68p | | |
| 6J5 | 25p | EBF89 | 32p | PY80 | 40p | | |
| 6J6GT | 30p | EBL21 | 60p | PY81 | 30p | | |
| 6J6 | 20p | EC86 | 60p | PY82 | 35p | | |
| 6J7 | 45p | EC88 | 60p | PY83 | 38p | | |
| 6K8G | 40p | ECC40 | 65p | PY88 | 40p | | |
| 6L6GT | 45p | ECC84 | 30p | PY800 | 40p | | |
| 6LD20 | 50p | ECC85 | 40p | PY801 | 50p | | |
| 6Q7 | 40p | ECC88 | 40p | U25 | 80p | | |
| 6SA7 | 40p | ECF80 | 35p | U26 | 80p | | |
| 6SG7 | 40p | ECF82 | 35p | U50 | 40p | | |
| 6SJ7 | 40p | ECF86 | 65p | U52 | 35p | | |
| 6SK7 | 40p | ECH21 | 57p | U191 | 75p | | |
| 6SL7 | 35p | ECH35 | 100p | U281 | 40p | | |
| 6SN7 | 35p | ECH42 | 75p | U282 | 40p | | |
| 6SQ7 | 40p | ECH81 | 30p | U301 | 40p | | |
| 6U4 | 65p | ECH83 | 45p | U801 | £1·80 | | |
| 6V6G | 25p | ECL80 | 45p | UABC80 | 40p | | |
| 6V6GT | 32p | ECL82 | 35p | UAF42 | 55p | | |
| 6X4 | 35p | ECL83 | 70p | UBC41 | 50p | | |
| 6X5G | 30p | ECL86 | 40p | UBC81 | 40p | | |
| 6X5GT | 40p | EF37A | 120p | UBF80 | 40p | | |
| 10C2 | 50p | EF39 | 50p | UBF89 | 35p | | |
| 10F1 | 75p | EF40 | 50p | UCH34 | 40p | | |
| 10P13 | 60p | EF41 | 65p | UCC85 | 40p | | |
| 10P14 | £1·10 | EF42 | 70p | UCF80 | 55p | | |
| 12AT6 | 30p | EF80 | 25p | UCH21 | 60p | | |
| 12AT7 | 30p | EF85 | 35p | UCH42 | 70p | | |
| 12AU7 | 30p | EF86 | 30p | UCH81 | 40p | | |
| 12AX7 | 30p | EF89 | 28p | UCL82 | 35p | | |
| 12AV6 | 40p | EF91 | 30p | UCL83 | 60p | | |
| 12BA6 | 40p | EF92 | 35p | UF41 | 60p | | |
| 12BE6 | 40p | EF183 | 35p | UF80 | 35p | | |
| 12BH7 | 45p | EF184 | 35p | UF85 | 40p | | |
| 19AQ5 | 35p | EH90 | 40p | UF89 | 40p | | |
| 20D1 | 50p | EL34 | 50p | UL41 | 65p | | |
| 20F2 | 65p | EL33 | £1·25 | UL84 | 40p | | |
| 20L1 | £1·10 | EL41 | 60p | UY41 | 48p | | |
| 20P1 | 50p | EL42 | 65p | UY85 | 40p | | |
| 20P3 | 60p | EL81 | 55p | VR105/30 | 38p | | |
| 20P4 | £1·10 | EL84 | 25p | VR150/30 | 35p | | |
| 20P5 | £1·20 | EL85 | 43p | *Add 12p in £ for postage* | | | |
| 25L6 | 50p | EL91 | 35p | | | | |

### DIODES & RECTIFIERS

| | | | | | |
|---|---|---|---|---|---|
| 1N34A | 10p | BA154 | 12p | GJ7M | 37p |
| 1N914 | 7p | BAX13 | 12p | OA5 | 25p |
| 1N916 | 10p | BAX16 | 7p | OA6 | 12p |
| AA119 | 7p | BAY31 | 7p | OA10 | 25p |
| AA129 | 10p | BAY38 | 15p | OA9 | 10p |
| AAZ13 | 10p | BY100 | 15p | OA47 | 10p |
| AAZ15 | 10p | BY103 | 22p | OA70 | 10p |
| BA100 | 15p | BY122 | 37p | OA73 | 10p |
| BA102 | 30p | BY124 | 15p | OA79 | 10p |
| BA110 | 25p | BY126 | 12p | OA81 | 8p |
| BA111 | 27p | BY127 | 15p | OA85 | 7p |
| BA112 | 70p | BY164 | 57p | OA90 | 8p |
| BA115 | 7p | BY210 | 35p | OA91 | 7p |
| BA141 | 32p | BYZ11 | 30p | OA95 | 7p |
| BA142 | 32p | BYZ12 | 30p | OA200 | 7p |
| BA144 | 12p | BYZ13 | 25p | OA202 | 10p |
| BA145 | 20p | BYZ16 | 40p | OA210 | 17p |

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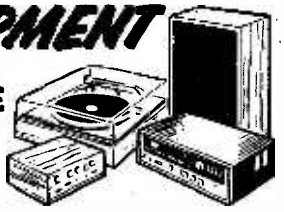

## RECORD DECKS

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|---|---|---|---|
| **B.S.R.** | | | |
| Mini Mono† | £4·97 | | |
| C129† | £6·70 | SP25 III | £10·50 |
| MP60 | £10·75 | SL65B | £13·45 |
| 610 | £14·65 | AP76 | £18·90 |
| 510 | £11·85 | SL72B | £23·95 |
| 310 | £9·65 | SL75B | £26·50 |
| 810 | £34·47 | SL95B | £32·95 |
| MP60 TPD1 | £17·65 | 401 | £29·95 |
| MP60 TPD2 | £15·85 | ZERO 100A | £45·95 |
| 610 T.P.D.1 | £20·97 | ZERO 100S | £42·75 |
| 510 T.P.D.I. | £18·75 | **GOLDRING** | |
| 210 Package* | £9·85 | GL69/2 | £18·97 |
| H.T.70 | £15·55 | GL69P | £25·95 |
| H.T.70 Pack. | £22·50 | GL72 | £23·25 |
| **THORENS** | | GL72P | £30·25 |
| TD125 | £59·65 | GL75 | £29·97 |
| TD125AB | £94·25 | GL75P | £38·50 |
| TX25 | £6·70 | LID 72 | £3·75 |
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| TX11 | £3·77 | GL101 | £26·60 |
| **GARRARD** | | G99 | £19·95 |
| 2025 T/C* | £8·50 | **PIONEER** | |
| 3500* | £9·75 | PL12AC | £36·50 |

† Mono * Stereo Cartridge
All other models less Cartridge
Carriage 50p extra any model.

### RECORD DECK PACKAGES

Decks supplied ready wired in plinth and cover fitted with cartridge. Garrard

| | |
|---|---|
| 2025 T/C with Sonotone 9TAHCD | £18·95 |
| Garrard SP25 Sonotone 9TAHCD | £15·95 |
| Garrard SP25III Goldring G800 .... | £18·95 |
| Garrard AP76 Goldring G800 .... | £29·95 |
| Garrard SP25III/Shure M75-6 .. | £19·95 |
| Garrard AP76/Shure M75-6 ..... | £30·95 |
| B8R MP60 Audio Technica AT.55 .. | £21·00 |
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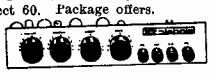
### SINCLAIR EQUIPMENT

Project 60. Package offers.



2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. **£16·75** Carr. 37½p. Or with PZ6 power supply **£18·85** Carr. 37½p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. **£20·25**. Carr. 37½p.
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● SUGGESTED SYSTEM ●

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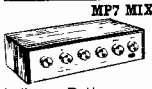
### MP7 MIXER PREAMPLIFIER



5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½" x 5" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.
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All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. **£5·97**. P. & P. 15p.

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Exceptional budget price amplifier. All silicon transistor. Handsome Walnutcase. Switched input selector, separate balance, volume, treble, bass controls. Output 2×6W RMS. Inputs Mag. Tape. Xtal, Tuner, Tape Out. **£14·75**. Carr. 37p.

### EA.41 REVERBERATION AMPLIFIER

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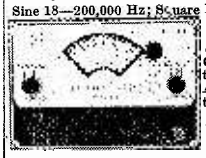
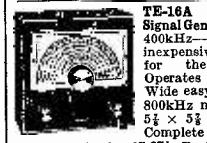
Input 88–125 V AC or 176–250 V AC. Output 120 V AC or 240 V AC. 200 VA rating. **£11·97**. Carr. 50p.

### BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

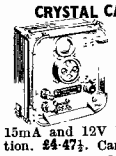


Sine 18—200,000 Hz; Square 18—50,000 Hz Output max. + 10 dB (10 K ohms) Operation internal batteries Attractive 2-tone case 7¾" × 5" × 9". Price **£17·50**. Carr. 17½p.



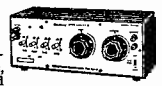
**TE-16A Transistorised Signal Generator.** 5ranges 400kHz—30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5½ × 5¾ × 3½in. Complete with instructions and leads. **£7·97½**. P. & P. 20p.

### CRYSTAL CALIBRATORS NO. 10



Small portable crysta controlled wavemeter. Size 7 × 7½ × 4in. Frequency range 500 Kc/s–10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300V. D.C. 15mA and 12V D.C. 0.3A. Excellent condition. **£4·47½**. Carr. 37½p.

### TE111. DECADE RESISTANCE ATTENUATOR



Variable range 0–111dB. Connections, Unbalanced T and Bridge T. Impedance 600Ω range (0.1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (−3dB). Accuracy: 0.05dB. +Indication dB × 0.01. Maximum input less than 4W (50V). Built in 600Ω load resistance with internal/external switch. Brand new. **£27·50**. P. & P. 25p.

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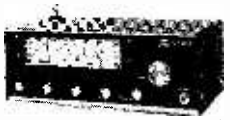

### UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 550kc/s–30mc/s. FET, S Meter, Variable BFO for SSB, Built-in Speaker, Bandspread, Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12½" x 4½" x 7". Brand new with instructions. **£25**. Carr. 37½p.

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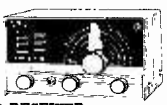

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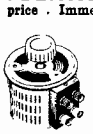

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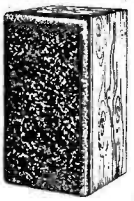
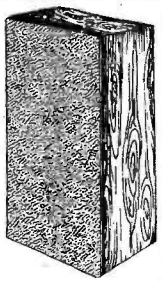


## ELF

An extension speaker of quality; 9 x 5½ x 3½in. veneered in natural teak with smart gold and mottled Vynair front 3 ohm speaker. The baffle is half inch thick. A real bargain at **£1·85** P. & P. 37½p.



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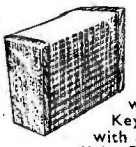

## IMP

Wedge shaped extension speaker 7½ x 6½ x 4in. (max.). Covered in walnut wood grain cloth with mottled Vynair front. Keyhole slot at back. Fitted with 3 ohm speaker unit. Only **£1·25.** P. & P. 36p each

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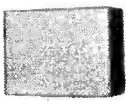

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11" wide x 8½" x 4½" deep with volume control covered in Black rexine and Mottled Vynair. **£2·25** P & P 25p.

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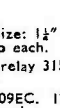

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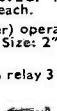

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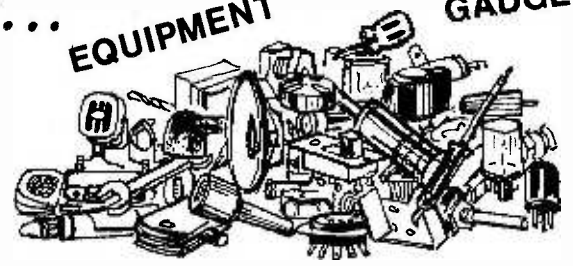

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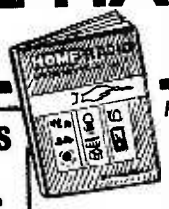

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1A7GT | 45 | 6BA6 | 25 | 6J6 | 20 | 7C5 | £1·18 | 12SR7 | 40 | 27 | 40 | DAF91 | 30 | EBL31 | £1·50 | EL41 | 60 | N78 | £1·50 | PL504 | 80 | U404 | 60 |
| 1CP31 | £6·00 | 6BE6 | 30 | 6J7M | 45 | 7C6 | 75 | 14H7 | 50 | 42 | 50 | DAF96 | 45 | EC90 | 33 | EL42 | 65 | N108 | £1·50 | PL508 | 90 | U801 | £1·18 |
| 1D5 | 50 | 6BH6 | 75 | 6J7G | 30 | 7D5 | 60 | 19AQ5 | 50 | 50B5 | 50 | DCC90 | £1·35 | ECC81 | 35 | EL84 | 25 | OA2 | 38 | PL509 | £1·10 | UABC80 | 40 |
| 1H5 | 50 | 6BJ6 | 50 | 6J7GT | 45 | 7H7 | 50 | 20D1 | 70 | 50C5 | 50 | DF33 | 55 | ECC82 | 30 | EL95 | 35 | OC3 | 38 | PL802 | 95 | UAF42 | 55 |
| IN5GT | 55 | 6BQ7A | 45 | 6K6GT | 60 | 7R7 | 75 | 20P2 | 70 | 50CD6G | £1·20 | DF70 | 45 | ECC83 | 30 | ELL80 | £1·00 | OZ4 | 40 | PX4 | £2·50 | UBC41 | 50 |
| IR5 | 40 | 6BR7 | 90 | 6K7M | 35 | 7S7 | £2·25 | 20P3 | £1·10 | 50L6GT | 55 | DF91 | 30 | ECC84 | 30 | EM34 | £1·00 | PC86 | 60 | PX25 | £2·50 | UBC81 | 40 |
| IS4 | 30 | 6BR8 | 70 | 6K7G | 35 | 7Y4 | 65 | 20P4 | £1·10 | 75 | 50 | DF92 | 20 | ECC85 | 40 | EM80 | 45 | PC88 | 60 | PY33 | 63 | UBF80 | 40 |
| IS5 | 30 | 6BS7 | £1·30 | 6K7GT | 35 | 9BW6 | 60 | 20P5 | £1·20 | 78 | 45 | DF96 | 45 | ECC88 | 40 | EM81 | 60 | PC97 | 50 | PY81 | 30 | UBF89 | 35 |
| IT4 | 30 | 6BW6 | 85 | 6K8G | 40 | 10C2 | 63 | 25A6 | 35 | 80 | 55 | DH3-91 | £6·00 | ECH21 | 63 | EM84 | 35 | PC84 | 40 | PY82 | 35 | UCC84 | 43 |
| 3A4 | 40 | 6BW7 | 80 | 6K8GT | 50 | 10F1 | 75 | 25L6GT | 50 | 85A2 | 50 | DH77 | 35 | ECH35 | £1·00 | EY51 | 40 | PC89 | 50 | PY83 | 38 | UCC85 | 40 |
| 3Q4 | 50 | 6C4 | 33 | 6K8GT | 50 | 10F3 | 90 | 25Y5 | 65 | 150B2 | 60 | DK32 | 45 | ECH42 | 75 | EY86 | 40 | PC189 | 55 | PY500 | £1·00 | UCF80 | 55 |
| 3Q5 | 50 | 6C5G | 35 | 6K25 | 75 | 10F9 | 60 | 25Z4 | 30 | 150C4 | 60 | DK91 | 40 | ECH81 | 30 | EZ35 | 40 | PCF80 | 30 | PY800 | 50 | UCH42 | 70 |
| 3S4 | 30 | 6C6 | 25 | 6L6G | 50 | 10F18 | 50 | 25Z5GT | 55 | 801 | 60 | DK92 | 55 | ECH83 | 45 | EZ40 | 50 | PCF82 | 35 | PY801 | 50 | UCH81 | 40 |
| 3V4 | 40 | 6CD6G | £1·25 | 6L18 | 45 | 10LD11 | 65 | 25Z6 | 65 | 807 | 50 | DK96 | 50 | ECL80 | 45 | EZ41 | 50 | PCF84 | 60 | R2 | 75 | UCL82 | 35 |
| 5R4GY | 75 | 6CH6 | 60 | 6Q7G | 40 | 10P13 | 60 | 30C1 | 30 | 813USA | £3·75 | DL66 | £1·25 | ECL82 | 35 | EZ80 | 27 | PCF86 | 60 | R19 | 50 | UCL83 | 60 |
| 5U4G | 35 | 6CW4 | 65 | 6Q7GT | 43 | 11E3 | £4·00 | 30C15 | 80 | 866A | 75 | DL92 | 35 | ECL83 | 70 | EZ81 | 29 | PCF801 | 50 | S130 | £1·75 | UF41 | 60 |
| 5V4G | 45 | 6D6 | 35 | 6S7M | 40 | 12AT6 | 30 | 30C17 | 90 | 954 | 60 | DL93 | 40 | ECL86 | 40 | GY501 | 80 | PCF802 | 50 | SP4 | 50 | UF89 | 40 |
| 5Y3GT | 40 | 6E5 | 60 | 6S7M | 75 | 12AT7 | 35 | 30C18 | 80 | 1625 | 55 | DL94 | 45 | ECLL800 | | GZ30 | 40 | PCF805 | 80 | SP41 | 60 | UL41 | 65 |
| 5Z4G | 40 | 6F1 | 70 | 6S7M | 40 | 12AU6 | 35 | 30F5 | 85 | 4022AR | £5·50 | DL95 | 50 | | £1·65 | GZ32 | 48 | PCF806 | 70 | SP61 | 75 | UL84 | 40 |
| 6/30L2 | 80 | 6F5G | 90 | 6S7M | 40 | 12AU7 | 30 | 30FL1 | 75 | 5763 | 70 | DL96 | 45 | EF9 | 75 | GZ34 | 60 | PCF808 | 85 | STV280/80 | | UM80 | 30 |
| 6A7 | 75 | 6F6G | 50 | 6S7GT | 30 | 12AX7 | 30 | 30FL12 | £1·20 | 7193 | 30 | DM70 | 45 | EF37A | £1·20 | HN309 | £1·50 | PCL82 | 35 | | £10·00 | UU6 | £1·05 |
| 6A8G | 40 | 6F8G | 50 | 6S8K7GT | 40 | 12BA6 | 40 | 30FL14 | 85 | 7475 | 50 | DY86 | 33 | EF39 | 50 | KT36 | £1·00 | PCL83 | 65 | SU25 | £1·00 | UU7 | £1·05 |
| 6AK5 | 35 | 6F8GT | 50 | 6S8L7GT | 40 | 12BE6 | 40 | 30L15 | 85 | A61 | 48 | DY87 | 33 | EF41 | 65 | KT61 | £1·25 | PCL84 | 45 | SU2150 | 75 | UU8 | £1·05 |
| 6AM5 | 35 | 6F11 | 40 | 6S8N7GT | 35 | 12BE6 | 40 | 30L17 | 80 | ATP4 | 45 | ES8CC | 65 | EF50 | 25 | KT66 | £2·05 | PCL85 | 40 | T41 | £1·00 | UU9 | 50 |
| 6AM6 | 33 | 6F13 | 45 | 6S8N7GT | 35 | 12CS6T | 55 | 30P4 | £1·12 | ATP5 | 60 | EA50 | 20 | EF80 | 25 | KT81 | £1·75 | PCL86 | 45 | TDD4 | 60 | UY21 | 50 |
| 6AQ5 | 38 | 6F14 | 70 | 6SQ7GT | 40 | 12E1 | £1·80 | 30P12 | 80 | ATP7 | 60 | EABC80 | 35 | EF85 | 35 | KT81(7C5) | | PD500 | £1·30 | TH41 | £1·75 | UY41 | 48 |
| 6AS7G | 85 | 6F23 | 85 | 6U4GT | 65 | 12J5GT | 30 | 30P19 | 85 | AU2 | £4·00 | EAF42 | 55 | EF86 | 30 | | £1·13 | PENA4 | £1·00 | U10 | 75 | UY85 | 40 |
| 6AT6 | 35 | 6F24 | 75 | 6U8G | 40 | 12J7GT | 50 | 30PL1 | 75 | AU5 | 75 | EB91 | 20 | EF89 | 28 | KT88 | £2·00 | PENB4 | £1·00 | U14 | 75 | VMP4G | 85 |
| 6AU6 | 25 | 6F25 | £1·00 | 6V6M | 60 | 12K7GT | 40 | 30PL13 | 93 | AZ1 | 55 | EBC33 | 50 | EF91 | 33 | KTW61 | £1·00 | PEN45 | 75 | U19 | £3·00 | VP4B | £1·25 |
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| 6B8G | 25 | 6F32 | 25 | 6V6GT | 40 | 12Q7GT | 40 | 35A5 | 75 | CBL31 | £1·00 | EBC90 | 35 | EF98 | 75 | ML4 | 88 | PL36 | 55 | U26 | 80 | VR150/30 | 35 |
| 6BA6 | 25 | 6G6 | 25 | 6X4 | 35 | 12SA7GT | 50 | 35L6 | 50 | CCH35 | 75 | EBF80 | 40 | EF183 | 30 | ML6 | 40 | PL81 | 50 | U78 | 35 | VU111 | 75 |
| 6BE6 | 30 | 6H6 | 23 | 6X5G | 40 | 12SG7 | 35 | 35W4 | 35 | CL33 | £1·30 | EBF83 | 40 | EF184 | 35 | MSP4 | 50 | PL82 | 45 | U191 | 75 | VU120 | £1·00 |
| 6BH6 | 75 | 6J5M | 50 | 6X5GT | 40 | 12SH7 | 35 | 35Z3 | 70 | CY30 | 63 | EBF89 | 30 | EL32 | 50 | | | PL83 | 45 | U251 | 80 | VU508 | £3·00 |
| 6BJ6 | 50 | 6J5G | 20 | 7B6 | 70 | 12SJ7 | 40 | 35Z4GT | 60 | CY31 | 43 | EBL1 | £1·00 | EL33 | £1·25 | MU14 | 75 | PL84 | 40 | U301 | 63 | W81M | 63 |
| 6BQ7A | 45 | 6J7G | 30 | 7B7 | 50 | 12SK7 | 50 | 35Z5 | 50 | DAC32 | 50 | EBL21 | 60 | EL34 | 50 | MX40 | 63 | PL500 | 80 | U403 | 60 | Y63 | 50 |

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| | | 2N2218 | 20 | 2N2444 | £1·99 | AD149 | 50 | BC169C | 15 | GET882 | 25 | NKT223 | 33 | OAZ201 | 50 | OC35 | 50 | OC81D | 20 | ZS170 | 10 |
| | | 2N2219 | 20 | 2N4289 | 15 | AD161 | 37 | BFS98 | 28 | GJ7M | 37 | NKT251 | 24 | OAZ207 | 47 | OC44 | 17 | OC82 | 25 | ZS178 P on A | |
| | | 2N2369A | 15 | AAZ12 | 30 | AF115 | 25 | BFY50 | 22 | KS100A | 20 | NKT713 | 25 | OAZ210 | 32 | OC45 | 12 | OC82D | 20 | ZTX107 | 15 |
| 1N914 | 07 | 2N697 | 15 | 2N2646 | 45 | AC126 | 20 | AF117 | 25 | BFY51 | 20 | MJE520 | 87 | OA70 | 10 | OAZ222 | 45 | OC57 | 60 | OC84 | 25 | ZTX108 | 12 |
| 1S113 | 25 | 2N706 | 10 | 2N2904 | 20 | AC127 | 25 | ASY26 | 25 | BY100 | 15 | MJE2955 | | OA71 | 10 | OAZ224 | 45 | OC58 | 60 | OC170 | 25 | ZTX300 | 12 |
| 1S202 | 23 | 2N1132 | 25 | 2N2926 | 10 | AC128 | 20 | BC107 | 10 | BZY88 | 15 | | £1·37 | OA81 | 08 | OAZ241 | 22 | OC59 | 65 | OC171 | 30 | ZTX304 | 25 |
| 2G302 | 22 | 2N1305 | 22 | 2N3055 | 75 | ACY20 | 20 | BC108 | 10 | CR81-40 | 47 | MJE3055 | 87 | OA85 | 07 | OAZ242 | 23 | OC72 | 20 | OCP71 | 97 | ZTX503 | 17 |
| 2G371 | 22 | 2N2147 | 75 | 2N3702 | 10 | ACY39 | 50 | BC109 | 10 | DD003 | 15 | NKT212 | 27 | OA91 | 07 | OAZ246 | 23 | OC72 | 20 | ORP12 | 50 | ZTX531 | 25 |
| 2N404 | 20 | 2N2160 | 60 | 2N3819 | 35 | AD140 | 50 | | | GET102 | 30 | NKT214 | 15 | OA211 | 30 | | | OC81 | 20 | | | | |

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| Garrard SP25 Mk. III with MAG. cartridge plinth and cover | £23·00+£1·50 p&p |
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**SPEAKERS** Duo Type II
Size approx 17″ x 10¾″ x 6¾″. Drive unit 13″ x 8″ with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet.
**£14 pair**+£2 p&p.

Duo Type III Size approx 23½″ x 11½″ x 9½″. Drive unit 13½″ x 8¼″ with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair**+£3 p&p.

**SPECIFICATION** R101
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges). 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within ± 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. −58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾″ x 9″ x 3¾″.

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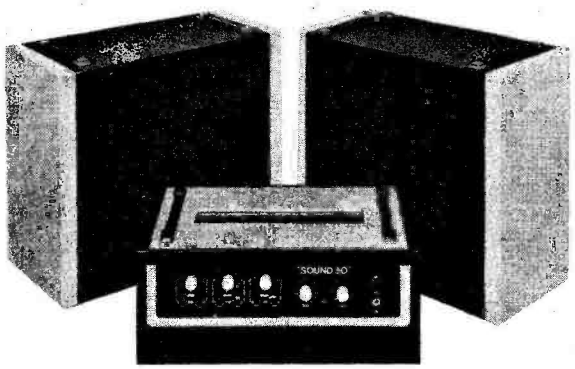
# SOUND 50

## 50 WATT AMPLIFIER & SPEAKER SYSTEM



The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

**Output Power:** 45 watts R.M.S. (Sine wave drive). **Frequency response:** —3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.
**Speaker Impedance:** 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10 KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.
To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.
**SPEAKERS!** Size 20" × 20" × 10" incorporating 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

**COMPLETE SYSTEM** £50 Plus £6 P. & P.
Sound 50 amp and 2 speakers

or available separately. Amplifier **£28.50** plus £1.50 P. & P.
Speakers **£12.50** each plus £2.25 P. & P.

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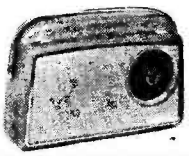

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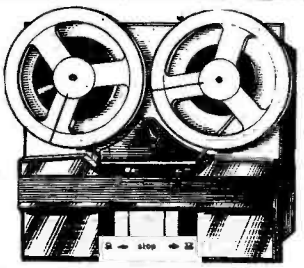

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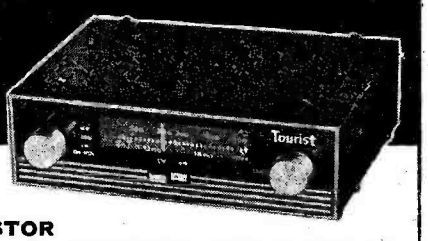
MARK 3

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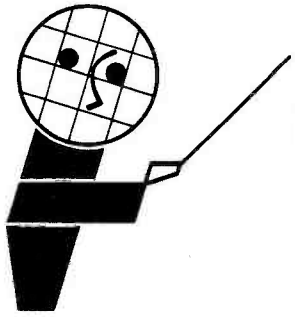

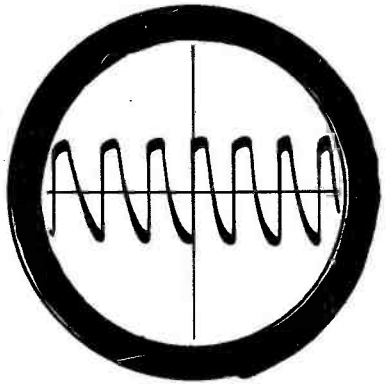

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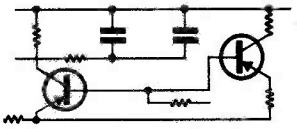

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# PRACTICAL WIRELESS

VOL 47 NO 11
Issue 781

MARCH 1972


## DX JUBILEE

ACCORDING to reliable eye (or ear?)-witnesses, such as our venerable columnist Henry and the antedeluvian researchers Colin Riches and Arthur Dow, founders of *Going Back* (official organ of the P.W. Darby and Joan Club), one of the major impacts at the dawn of broadcasting was not so much the material transmitted as the fascination of hearing something—anything—from a point far removed from the listener's ear.

Although they would have been horrified at the thought, these ancient radio listeners were, in fact, the first DX'ers. It is, of course, a far cry from pulling in 2LO with an adroit twiddle of the catswhisker in 1922 to phasing in an exotic Pacific station with the crystal filter in 1972. Nevertheless the motivation and reactions are similar.

Since the pioneer London broadcasting station 2LO officially opened in November 1922, this year we can celebrate (or mourn, according to taste) 50 years of broadcasting. More apposite to P.W. readers, we can hang out the bunting for 50 years of DXing. In that time, of course, many changes have taken place, not only in equipment but in the art and style of DX listening.

In the early stages of the hobby, the main criterion was actual distance—first the local stations, then Europe, then North America (all on medium waves), followed by the development of the short wave bands which permitted reception of the USA during daylight hours and extended the listening ear to all parts of the world. But then, as useable frequencies became higher, the old aim of maximum distance took a back seat, for on v.h.f., and later on u.h.f., a DX catch could be judged in hundreds instead of thousands of miles. One of the latest activities is DX television.

The style of transmissions has changed dramatically over the years; the early short wave programmes were of the pure entertainment type and they could be picked up on relatively simple receivers on bands that were blissfully uncluttered; amateurs had a wonderful time operating on low power—and getting through. The 30's, however, saw a change of direction. The Spanish Civil War brought with it jamming for the first time, together with the first invasion of amateur territory by propaganda broadcasting. The process has continued to the present day with its multitude of high powered political broadcasters, many disregarding international agreements, and the further erosion of amateur bands and consequent congestion.

Despite all these changes (many of them obviously for the worst), the DX bug still exerts its fascination.

We hope that the wall chart contained in this issue will be helpful to some of the newer recruits to the ranks of long distance listeners.

W. N. STEVENS—*Editor.*

## NEWS AND COMMENT



## CONSTRUCTIONAL



## OTHER FEATURES



**APRIL ISSUE WILL BE PUBLISHED ON MARCH 3rd**

# NEWS... NEWS... NEWS...

## The BBC Stereo Service

The BBC is planning to expand its stereo service considerably during the next few years. The extension beyond the present Radio 3 service will take place in three phases.

(1.) *The installation of stereo origination facilities for Radio 2 (with Radio 1) and Radio 4.* This has called for a major re-equipment programme involving modifications to the continuity suites and central control equipment in London as well as a considerable increase throughout the United Kingdom in the number of tape machines, gramophone desks, studios and outside broadcast units equipped for stereo. This phase is already in progress, and it is expected that it will be possible to originate a major proportion of stereo programmes on Radio 2 by the end of 1972, and also to make possible the transmission of some stereo programmes on Radio 4. Further increases in stereo capability will continue during the succeeding years.

(2.) *The extension of Radio 2 and Radio 4 stereo to those transmitters already radiating Radio 3 in stereo.* For this a new system of s.h.f. radio links is planned, using pulse code modulation (PCM) (see below). It is expected that the three-network service, which involves the construction of several new radio link sites on the main route, will be available in the London area and the Midlands by the end of 1972 and in the North of England during 1973. Rowridge, serving central southern England, will be included in this phase and a full stereo service from Belmont, serving Lincolnshire, will follow the extension to the North of England.

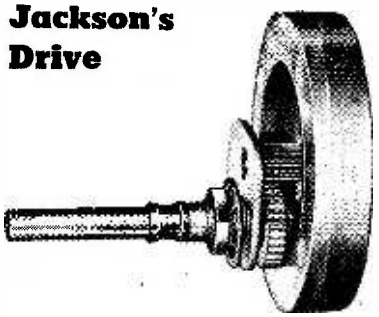
(3.) *The extension of the three network stereo service northwards to Central Scotland and westwards to the Bristol Channel area.* The Post Office Corporation and the BBC are working towards this phase which it is expected will start in 1974. The transmitters expected to be included are Kirk o'Shotts (Lanarkshire), Pontop Pike (Durham), Sandale (Cumberland), and Wenvoe (Glamorgan). It is hoped also to include North Hessary Tor (Devonshire) in this phase, as well as certain of the relay stations associated with the main transmitters mentioned.

The PCM system to be used on the s.h.f. radio links has been developed by the BBC. It will carry 10 audio circuits. Each stereo programme will use two circuits, for the A and B channels, and the stereo coding will be carried out at each main transmitting station. The PCM system will provide improved quality in respect of both audio bandwidth and signal to noise ratio, from which mono as well as stereo listeners will benefit. It thus forms part of the BBC's plan to improve still further the quality of its v.h.f. transmissions throughout the country.

## Golden Silence

Picture shows Gloria Connell, actress daughter of the chairman of the Noise Abatement Society enjoying peace and quiet against a background of noise which would be intolerable without the Ear Defenders which reduce the noise of the road drills to a mere whisper. The Survey Meter's red lamp lights up when noise reaches danger levels. Ideal for "pop" fans who can't stand classical music and "classics" fans who can't stand pop music, the meter costs £10 and the Ear Defenders cost £5 from local stores or carriage paid from *Noise Abatement Society, 6 Old Bond Street, London W.1.*

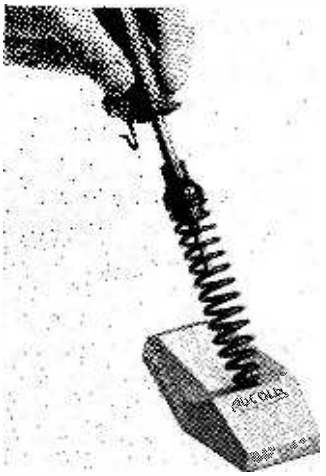
## Jackson's Drive



The *Accelerator Spinwheel Drive* is a cord drive unit intended for modern radio receivers with extra-long scales. It incorporates a $2\frac{1}{4}$-inch-diameter (57mm) zinc-alloy flywheel driven through nylon-to-brass step-up gears at more than twice the speed of the drive-shaft. The complete unit weighs only 6oz (170g) but provides an inertial effect equivalent to a much larger flywheel, permitting rapid traverse of the scale. *Jackson Brothers (London) Ltd., Croydon CR9 4DG, England.*

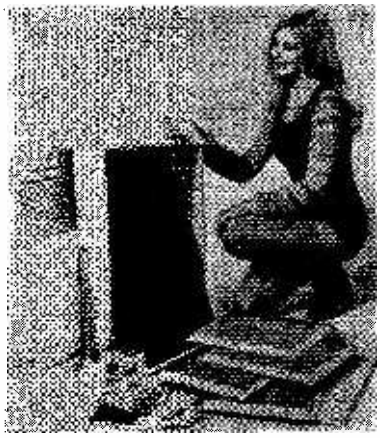
## Adcola Soldering Station

To complement the Invader range of soldering irons, Adcola Products Ltd has introduced the "Invader Soldering Station." It consists of a cast aluminium base, finished in hammered silver grey, containing an integral wiping sponge to facilitate the removal of solder from the tip of an instrument.



# NEWS... NEWS... NEWS...

## EMI Speaker Kits



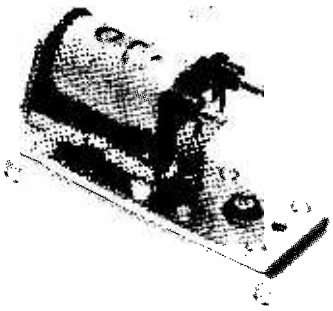
EMI has entered the loudspeaker enclosure market with a range of high quality enclosures in kit form. Available in polished wood veneers, the enclosures have been introduced by EMI Sound Products Limited, of Hayes, Middlesex, for use with its range of matched loudspeaker systems.

The enclosures are priced from £5·80, for a 12in. x 6in. x 8in. bookshelf model, to £29·50 for a large floor-standing enclosure measuring 33in. x 20in. x 15in. They have been designed to incorporate each of the eight different EMI loudspeaker systems which cover the 6 to 35 watts r.m.s. output range.

## Coax Relay

This is the Series 951 Co-axial Relay from Magnetic Devices for aerial switching at frequencies in the order of 450 megacycles.

For further information please contact *Magnetic Devices Limited, Newmarket, Suffolk. Telephone Newmarket 3451.*



## BBC Scholarship

*Mr I. G. Phillipps* graduated with an upper second class honours degree in the Electrical Sciences Tripos at the University of Cambridge in 1971, and has been awarded a three-year BBC Research Scholarship to undertake research in the Department of Engineering at the University of Cambridge, under the supervision of Professor P. S. Brandon, MA. The subject of Mr Phillipps' research will be "ways of reducing the channel capacity required by a television signal or improving the quality of a television image within a given channel capacity, by the use of digital electronic techniques."

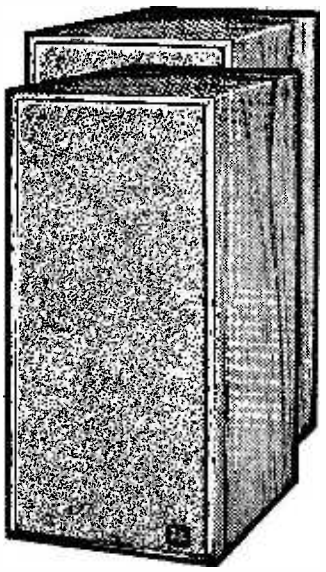
## Radio Amateur Invalid & Bedfast Club

The address to which all correspondence concerning the Radio Amateur Invalid & Bedfast Club should now be sent is: Mrs. Frances Woolley, G3LWY, Woodsclose, Penselwood, Wincanton, Somerset.

Bedfast Club membership is almost at the 400 mark and covers 13 countries. Any handicapped licensed amateur or short-wave listener, wherever he or she may live, who does not already belong to the Club is invited to apply to the Hon. Secretary at the address above for full details of membership, enclosing a stamped, addressed envelope.

Readers will be interested to know that Mr. Cecil Lewis, of Bude, received three letters telling him of the R.A.I.B.C. following his appeal for help which we printed in *Practical Wireless* last year.

## Criterion Mk. X

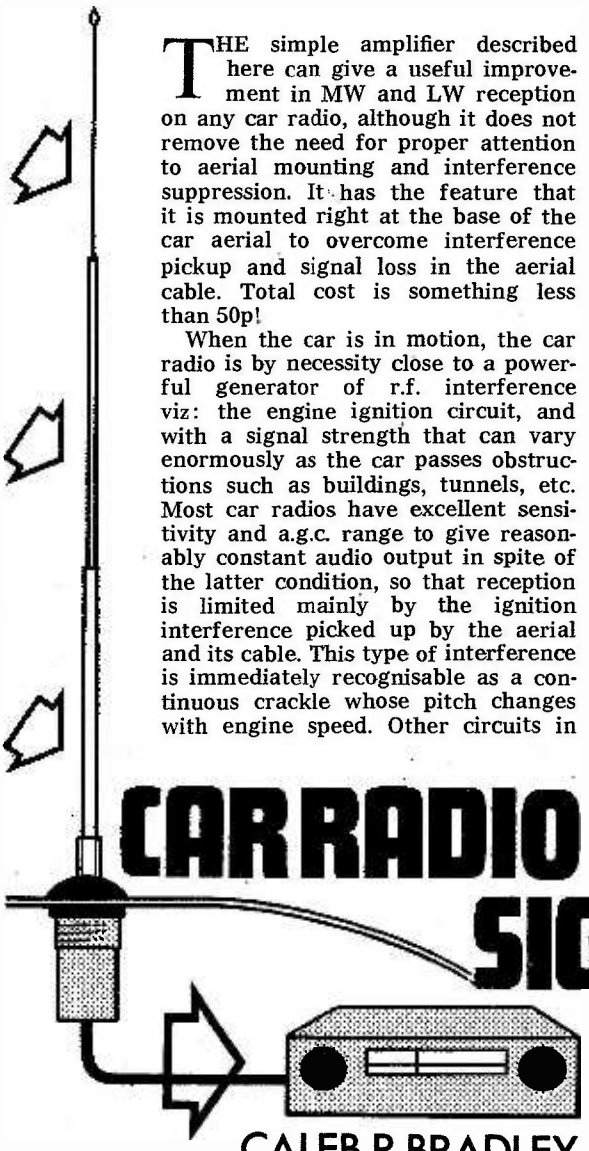


We recently had the opportunity to try the Lasky's Criterion Mk X speakers. They are bookshelf types employing the sealed infinite baffle enclosure principle and they are well worthy of consideration by the budget-conscious Hi-Fi enthusiast. An 8in. woofer, 5in. mid-range and $2\frac{1}{2}$in. tweeter are used and the cabinets are oiled walnut with black woven speaker grilles. Frequency response is 40Hz-20kHz and maximum power handling capacity is 20W. The impedance is 8Ω. A useful feature of these speakers is that two types of speaker lead connection are supplied—phono or screw terminals. Cabinet size is $18\frac{3}{4} \times 9\frac{7}{8} \times 9\frac{7}{8}$in. and the very reasonable price is £25 the pair. Postage is 50p and the speakers are available singly for £13·50. *Lasky's Radio Limited, 3-15 Cavell Street, Tower Hamlets, London, E.1. Tel. 01-790-4821.*

## The Practical Wireless CQ! Column

**Items in the CQ! Column are carried free of charge as a service to readers. We only ask that those making use of the service answer all correspondence resulting and reimburse postage and all reasonable expenses. We cannot guarantee inclusion and requests for inclusion will not be acknowledged and will be dealt with in strict rotation. It would also help if readers could write out their "CQ!" in the style used in P.W. as this would help to speed things up.**

**Material for inclusion should be sent to Practical Wireless Editorial, Fleetway House, Farringdon Street, London, EC4A 4AD.**



# CAR RADIO SIGNAL BOOSTER

CALEB R. BRADLEY

THE simple amplifier described here can give a useful improvement in MW and LW reception on any car radio, although it does not remove the need for proper attention to aerial mounting and interference suppression. It has the feature that it is mounted right at the base of the car aerial to overcome interference pickup and signal loss in the aerial cable. Total cost is something less than 50p!

When the car is in motion, the car radio is by necessity close to a powerful generator of r.f. interference viz: the engine ignition circuit, and with a signal strength that can vary enormously as the car passes obstructions such as buildings, tunnels, etc. Most car radios have excellent sensitivity and a.g.c. range to give reasonably constant audio output in spite of the latter condition, so that reception is limited mainly by the ignition interference picked up by the aerial and its cable. This type of interference is immediately recognisable as a continuous crackle whose pitch changes with engine speed. Other circuits in the car can also contribute interference and in the author's experience capacitor-discharge transistor ignition systems can be especially troublesome.

## INTERFERENCE REDUCTION

The car aerial should be mounted as far from the engine as possible. With front-engined vehicles this means on a rear wing, or at least on the roof. If the existing aerial cable needs to be extended, a 10ft. coaxial cable already fitted with appropriate plug and socket can be purchased (Norman type SL11).

The cable screen must make a good electrical connection to the car body at the aerial end. Paint must be scraped off to permit this and the underside of the aerial mounting should be sealed against road filth as rust can ruin the connection.

All modern cars are fitted by law with ignition suppression in the form of resistance in the high voltage paths, possibly in the form of spark plug connectors incorporating resistors, or special resistive h.t. cable. Add-on suppressor resistors, typically 50kΩ, are sold for older cars or addition to others, and can be screwed into the middle of the h.t. lead from coil to distributor (e.g. Belling-Lee Sparkmaster L.1274/S). In conjunction with stray capacitance, such resistors form a top-cut filter which bypasses the r.f. component of the fast-rising spark voltage but has negligible effect on the strength of the spark.

The metalwork of the engine compartment helps screen ignition interference from the aerial, but poor bonding between the body, the bonnet and the engine block can reduce its effectiveness. The engine compartments of fibreglass bodied cars have to be lined with metal foil to obtain this screening. For ultimate interference suppression it is possible to replace all the h.t. wiring with coaxial cable. Use solid-dielectric TV co-ax as low-loss cellular dielectric type will not withstand the ignition voltage (perhaps 30kV peak), and earth all the screens to the coil mounting bracket. Such measures though are hardly necessary for domestic reception.

Another type of interference is a whine which also changes with engine speed and is caused by the generator. This is cured by connecting a standard car suppressor capacitor (still called *condenser* in the motor trade) between chassis and the brush (larger) terminal. Switches, both manual and automatic such as the brake pressure switch, and the motors of the wipers and heater can similarly be silenced by capacitors across their terminals. Car suppressor capacitors are usually about 0·5μF and are built much more ruggedly than corresponding electronics components.

Other circuits, such as the lights, should not cause interference unless there is an intermittent connection somewhere. Indicator flashers normally contain their own suppressor capacitors.

## HEAD AMPLIFIER

The circuit of the unit is shown in Fig. 1 (negative earth cars) and Fig. 2 (positive earth cars). The difference lies only in the way the h.t. supply is derived, and the voltage readings with respect to chassis are different of course.

Two silicon planar transistors are used with d.c. feedback to stabilise the circuit against wide changes of temperature and supply voltage. Common-emitter stage Tr1 operates at low collector current (100μA) and provides the voltage gain of the circuit. Tuned circuits and chokes could have been used to give more amplification and less noise but in practice a small amount of untuned amplification is quite adequate and avoids overloading the aerial circuit of the car radio. Emitter resistor R2 gives Tr1 a high input impedance to minimise loading of the aerial. The amplified signal across R1 is direct-coupled to emitter follower Tr2 which provides no voltage amplification but acts as an impedance converter, giving a low impedance output to the aerial cable. Bias for Tr1 base is taken from the divider R4/R5 in Tr2 emitter to give negative feedback; R3 has a high value to preserve the high input impedance.

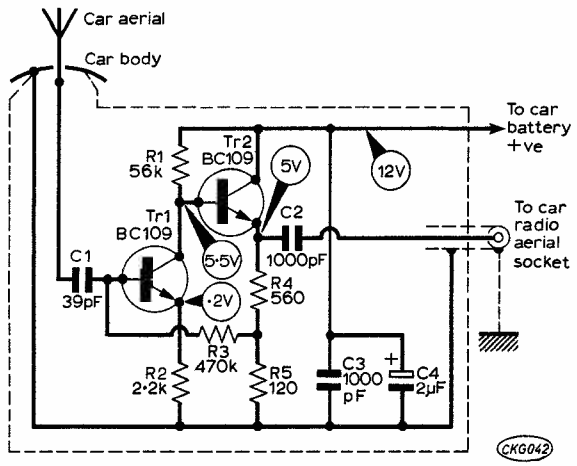



*Fig. 1: Circuit suitable for negative chassis cars. All resistors are ⅛W, 5% and the capacitors should be at least 20V working.*

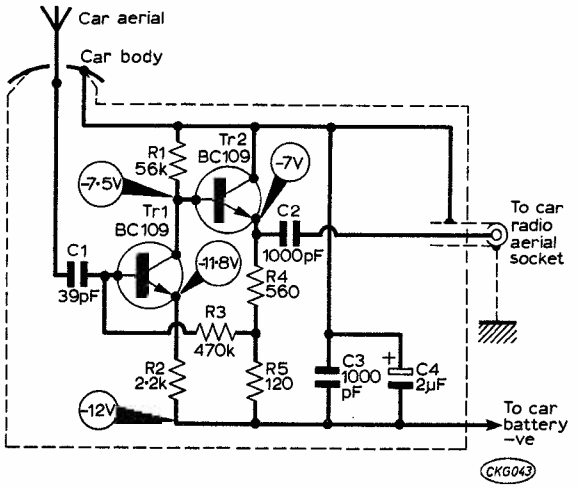



*Fig. 2: The modified circuit designed for use with cars having a positive chassis.*

The output isolating capacitor C2 is not essential since the radio will probably have an aerial isolating capacitor, but it does protect Tr2 against shorts in the cable or plug. It may seem curious that the h.t. supply is decoupled by both a large value electrolytic capacitor C4 and a small value ceramic C3. This is because the electrolytic may not be as effective at r.f. due to its own stray inductance; C3 ensures effective decoupling at r.f.

## CONSTRUCTION

While conventional wiring on, say, a piece of Veroboard can be employed, the method used by the author is simplicity itself. The components are simply wired together and encapsulated in candle wax inside a 35mm film cassette tin which serves as a screen. The arrangement is shown in Fig. 3. If you have a choice of cans use an Ilford tin as it has slightly more room than the Kodak one. The tin cap is held under the aerial mounting nut (with insulating washer between) so it makes good contact with the car chassis. The body of the tin is then screwed onto the cap from underneath. The aerial cable and power wire leave through holes in the base of the tin. The input end of C1 is anchored under the aerial nut with sufficient lead to allow the tin to be screwed through about ¾ turn, all that is required. The chassis connection to the circuit is by a short length of wire that can conveniently be trapped between the body and the cap threads. Note that if this connection is not made the circuit will still amplify, due to the chassis return via the aerial cable screen, but interference will be at a high level.

There is no need to switch the amplifier with the radio since the drain on the battery is negligible; the power lead can therefore be connected to the same point from which the radio gets its supply, often the ignition or light switch. Plug the aerial cable into the radio and unscrew fully the aerial trimmer if the radio has one. Since there is now plenty of signal, this can be done to minimise the loading on the first tuned circuit to improve selectivity.

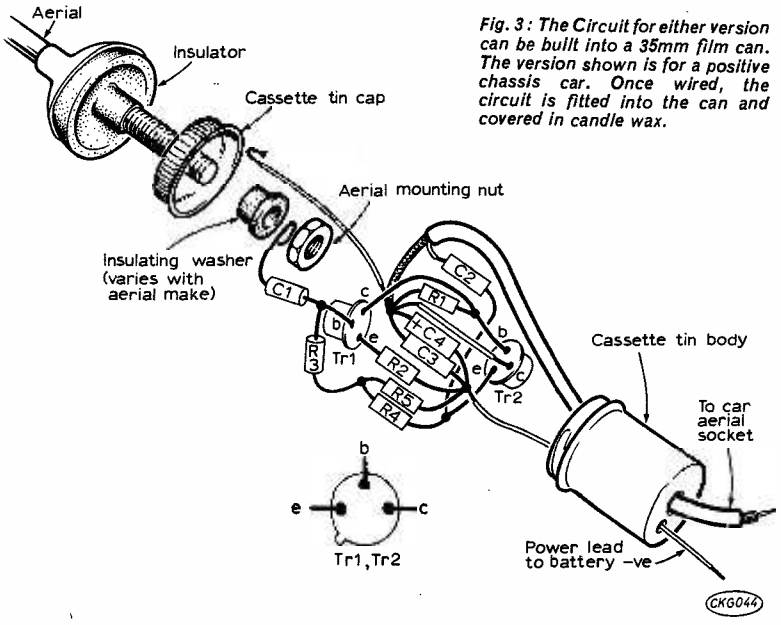



*Fig. 3: The Circuit for either version can be built into a 35mm film can. The version shown is for a positive chassis car. Once wired, the circuit is fitted into the can and covered in candle wax.*

## PERFORMANCE

The design of the amplifier was prompted by the author's difficulty in receiving news bulletins while driving through London, where tall steel-framed buildings prove effective Faraday screens. and in receiving British broadcasts on the continent. While the amplifier cannot cure completely non-existent signals or interference from other vehicles, the improvement is remarkable; it is now just possible to hear uninterrupted Radio 1 while driving under the Holborn Viaduct outside the PW offices (should one ever feel this to be necessary!). ■

# A DARKROOM THERMOMETER

R.A.BOTTOMLEY

THE conventional mercury or spirit filled thermometer is a thoroughly reliable instrument but, especially from the photographic worker's point of view, it is less than ideal on two counts. In the first instance the scale can be difficult to read in daylight let alone in the subdued light of the darkroom. Again, even those which incorporate a magnifying lens have to be viewed from a fairly critical angle and this can be exasperating. Secondly, the slow response time of the conventional thermometer can be an inconvenience. It was with these two points in mind that it was decided to build a thermometer incorporating a thermistor. The thermistor has an almost immediate response time and by use of the appropriate circuitry its measurement of temperature can be presented on the scale of a panel meter which is very much more easily read.

## Principle of operation

The thermistor is a resistor with a very pronounced negative temperature co-efficient. In other words its resistance decreases with increasing temperature. By measuring the value of its resistance, one can arrive at the temperature of the medium in which the thermistor is immersed. One might, as with an ordinary resistor, apply a known voltage and measure the resultant current which flows . . . the principle of the simple ohmmeter. A more precise way to measure resistance, however, is to incorporate the unknown in one arm of a Wheatstone bridge and this is the principle which has been adopted in the instrument to be described. By a suitable choice of component values an expanded scale has been achieved and this scale, as far as can be determined, is linear. The scale can be read to an accuracy of ±0·1°C and, with 20°C at mid scale and plus and minus 6°C spread over the rest of the scale, it should meet most of the darkroom workers' needs.

**SPECIFICATION**

| | |
|---|---|
| Temperature range | 14°C. to 26°C. |
| Mid-scale .. .. | 20°C. |
| Reading accuracy | ±1°C. (Hand cal. scale) |
| " " | ±0·1°C. (From graph). (Straight line graph, micro-amps v. temp.) |
| Inherent accuracy .. | As good as standard thermometer used for calibration. |
| Battery consumption | 12mA. |
| Stability .. .. | Readings unaffected until battery drops below 8V. |
| Life of battery .. | Very extended with average use. |

## Circuit description

A 9V battery (type PP6) powers the instrument. This is preferable to a mains unit since the instrument is going to be handled in proximity to a water supply. This voltage is reduced by way of two zener diodes, ZD1, ZD2, to approximately 3·3V. There are two reasons for this. By adopting a relatively low voltage to energise the bridge, self-heating effects

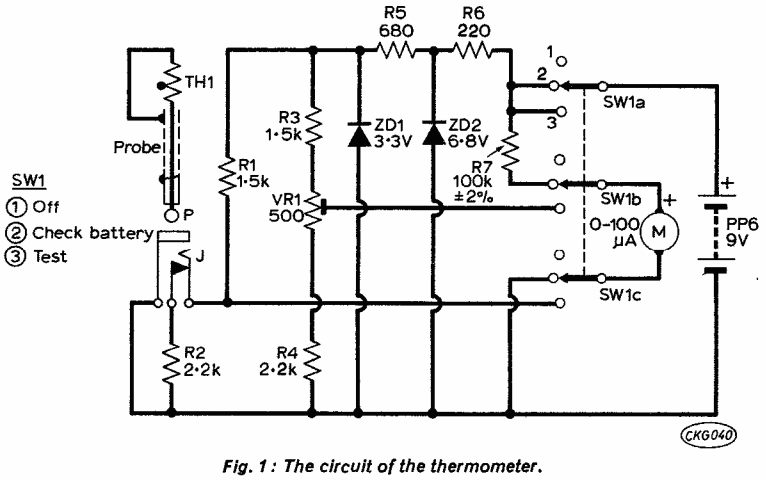



*Fig. 1: The circuit of the thermometer.*

of the thermistor are minimised. Additionally, the cascaded zener diodes stabilise the bridge voltage effectively so that there is no variation of the instrument's indications over the useful life of the battery. The bridge itself is formed by the components TH1, R1, R3, R4 and VR1, and it is in balance at approximately 14°C as indicated by zero deflection of the meter at this temperature. As the temperature rises, so the resistance of the thermistor falls and the pointer of the meter moves up scale accordingly. At this point it might be as well to describe the function of R2. It is only brought into circuit when the probe is disconnected. Were it not for its presence, an excessive current would pass through the meter under this condition. However, it also serves the dual purpose of reference standard whose resistance approximately equals the resistance of the thermistor at 20°C. If all is well, the pointer of the meter will always take up the same position on the scale when the probe is disconnected. A note can be kept of this reading or a "calibration" mark can be inscribed on the scale. The switch SW1 has three positions. In position "1" the instrument is off. In position "2" the meter, in conjunction with R7, is converted to a voltmeter so that one can have an indication of the state of the battery. In position "3" the meter is connected across the detector points of the bridge for temperature measurement.

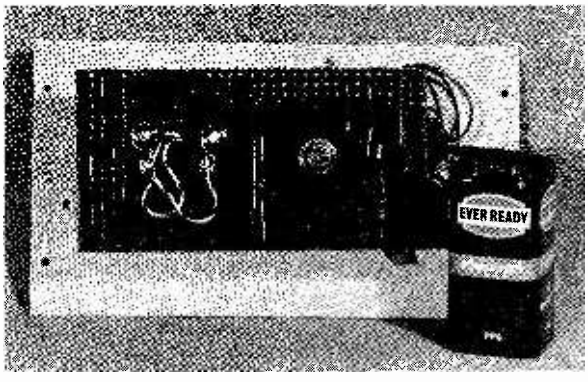
## ★ components list

**Resistors**
R1 1·5kΩ 5%
R2 2·2kΩ 5%
R3 1·8kΩ 5%
R4 2·2kΩ 5%
R5 680Ω 5%
R6 220Ω 5%
R7 100kΩ 2%
All resistors ¼ or ⅓W high stability carbon film.
VR1 500Ω wirewound preset

**Zener diodes**
ZD1 3·3V at 5mA
ZD2 6·8V at 5mA

**Thermistor**
TH1 Type F24 (ITT) (Available direct from ITT Electronic Services, Edinburgh Way, Harlow, Essex. Price £1·10 plus 20p postage. Quote Catalogue No. 2322X1132D)

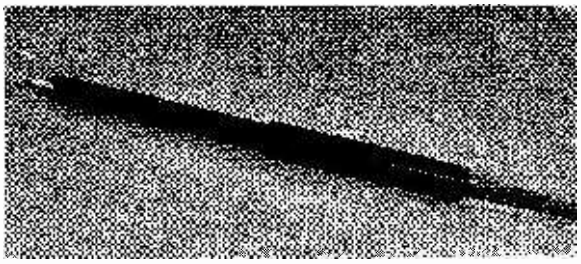
**Miscellaneous**
Meter, 0-100 μA (resistance 1,650Ω) Eagle KM65; Switch 2-pole, 3-way; jack plug and socket, 3·5mm.




*An internal view showing the Veroboard mounted on the meter terminals.*

## Construction

The circuit is so simple that there is no need to elaborate upon its construction. There is absolutely nothing critical about its layout and tag strip, tag board or Veroboard (as in the prototype) can be employed. If a Veroboard layout is adopted there should scarcely be any need to stress that the copper strip should be cleared away around the meter terminals. All the components, with the exception of the switch and the jack, are mounted on the Veroboard panel which is supported by the meter terminals. The meter, switch and jack are mounted on a small aluminium panel and this panel is mounted in a small plywood box covered with leatherette. The thermistor itself is mounted into a suitable housing with the aid of Araldite. In the case of the prototype, this housing took the form of a redundant test-meter probe, turned to a smaller diameter at one end. The case of a spent ballpoint pen suggests itself as another suitable container and in this instance the thermistor tip would be protected, when not in use, by the cap of the pen.



*The thermistor can be mounted into a test probe or a ballpoint pen case.*

There is nothing difficult about calibration but it should be borne in mind that the final accuracy of the instrument depends both on the care with which this is done and upon the accuracy of the thermometer which is used as standard. It is also worth noting that hot and cold water, like most dissimilar liquids, do not mix immediately. It is for this reason that it is recommended that a fairly large basin be used when calibrating and that the water be stirred thorougly before making a reading. First the water bath should be adjusted to 20°C exactly and, when this is stabilised, VR1 should be adjusted so that the meter indicates exactly 50μA or mid scale. Once again adjust the temperature of the water bath, this time to 15°C and when this is stable note the reading on the meter. Increase the temperature of the water bath to 25°C and, once again, note the reading. When plotted on a graph these three points will be found to lie on a straight line and the intermediate points on the scale can be determined from this graph. In the case of the prototype an increase of 1°C was represented by an increase of 8μA, which is four divisions on the meter scale. Thus it can be seen that it is not difficult to read to 0·1°C.

One final note. If the water is not thoroughly mixed during the calibration procedure, the pointer of the meter will be seen to oscillate. This is because the thermistor is so sensitive and has such a fast response time that it indicates the variation in temperature of the water bath due to convection currents.

The instrument is so sensitive that it can even determine the slight temperature gradient between the bottom and top of a 35mm developing tank. ■

# DX reception of VHF "LOCAL" radio

KEITH PITT

THE extension of the BBC local radio network to 20 stations has made available an additional service to about 74% of the population of England. Inevitably, in addition to many areas with no official coverage from any of the locals, there are other areas with signals available from a number of transmitters. The promised new IBA network of 60 commercial stations will add to the choice of programmes in many areas.

The BBC local radio stations are, at present, on v.h.f. mainly in the band 94·6 to 97·0MHz. The main BBC networks, Radios 2, 3 and 4, transmit almost exclusively between 88·1 and 94·5MHz.

The powers used for the local radio transmitters range from 9W for the Rotherham relay to 16·5kW for Radio London. The complete list of stations is given in Table 1. All except Blackburn, Derby and Manchester, use horizontal polarisation. These three use slant polarisation. Very little loss of quality will be observed, except in the weakest signal strength areas, if horizontal aerials are used to receive slant polarisation.

## COVERAGE

The coverage of a v.h.f. station in Band 2 is controlled by a number of factors. Like the other v.h.f. bands its signals behave rather like light waves and are obstructed by objects such as hills where the signal strength on the side away from the transmitter is much reduced. However, unlike Band 3 and u.h.f. which are used for televison, a significant amount of signal is diffracted over a hill or the horizon. This then gives considerably greater coverage than might be expected from simple predictions.

One of the most important factors in determining signal strength at any point is the distance from the transmitter, since the field strength is inversely proportional to the square of the distance. Transmitter power, however, has less effect than might be expected, as the signal is proportional to the square root of the power. The height of both aerials is also of prime importance since these will determine whether or not the receiver is within the radio horizon. Signal strength diminishes quite rapidly beyond it because only diffracted waves bend over it. To a close approximation the distance of the horizon **in miles** is given by 1·3 times the square root of the height **in feet**. To approximate still further, the sum of the distances for the receiving and transmitting aerials gives the radio line of sight between them, assuming there are no major obstacles in the way.

To determine whether worthwhile results may be obtained from any given station, the following actions are necessary. First, the approximate receiving and transmitting aerial heights should be found. Secondly, using an Ordnance Survey map, measure their distance apart and determine whether any large hills get in the way. Thirdly, determine the transmitter power. In practice, a low power station, under half a kilowatt will not be effective for more than 25-30 miles, except under very favourable conditions. Medium power, up to 10-20 kW, will often give reasonable results up to 40-50 miles. A high power station may often be receivable regularly at distances of up to 100 miles.

As a general rule, for long distance reception, the higher the receiving aerial above sea level, the greater the chance of good reception. The author lives in North London at about 350ft. above sea level and regularly has reliable reception from both Rowridge and Tacolneston at about 80-90 miles. Of the "local" stations, both London and Medway, which

**TABLE 1 BBC LOCAL RADIO STATIONS**

| Station | Frequency (MHz) | Max. ERP (kW) | Aprox. height (ft.) (a.s.l.) |
|---|---|---|---|
| Sheffield | 88·6 | 0·03* | 900 |
| Durham | 94·5 | 2·0 | 1400 |
| Stoke-on-Trent | 94·6 | 2·5 | 750 |
| Leeds | 94·9 | 0·14* | |
| Nottingham | 94·8 | 0·14* | |
| Oxford | 95·0 | 2·5 | 900 |
| Rotherham | 95·00 | 0·009 | |
| Manchester | 95·1 | 1·05 | 2250 |
| Leicester | 95·2 | 0·125* | |
| London | 95·3 | 16·5 | |
| Humberside | 95·3 | 4·0 | |
| Bristol | 95·4 | 5·0 | 1800 |
| Newcastle | 95·4 | 3·5 | 1400 |
| Birmingham | 95·6 | 2·5 | 1250 |
| Brighton | 95·6 | 0·5 | 550 |
| Merseyside | 95·8 | 5·0 | |
| Solent | 96·1 | 5·0† | 300 |
| Blackburn | 96·4 | 1·25 | |
| Derby | 96·5 | 5·25 | |
| Teeside | 96·6 | 5·0 | |
| Medway | 97·0 | 5·5 | |

*All transmitters except those marked * have directional aerials. Stations marked S have slant polarisation.*

are transmitted from Wrotham, are received well. (It should be noted that quoted powers are usually the maximum, but that the power radiated may be very low in some directions to avoid interference with other stations or to reduce wastage where coverage is not required.) For this reason, Medway is relatively weak, despite being within line of sight, because its power in a NW direction is very low, while London is beamed strongly in that direction.

Consistent signals are also obtained from Solent at about 85 miles, while Oxford with the same power and half the distance, is very weak. This is because nearby hills obstruct the latter but the former is quite clear for nearly 40 miles.

## AERIALS

Most BBC local radio stations radiate horizontally polarised signals. This means that a single dipole

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| B99 | 200 | Mixed Capacitors. Approx. quantity, counted by weight | 50p |
| H4 | 250 | Mixed Resistors. Approx. quantity counted by weight | 50p |
| H7 | 40 | Wirewound Resistors. Mixed types and values. | 50p |
| H8 | 4 | BY127 Sil. Recs. 1000 PIV. 1 amp. plastic | 50p |
| H9 | 2 | OCP71 Light Sensitive Photo Transistor | 50p |
| H12 | 50 | NKT155/259 Germ. diodes, brand new stock clearance | 50p |
| H18 | 10 | OC71/75 uncoded black glass type PNP Germ. | 50p |
| H19 | 10 | OC81/81D uncoded white glass type PNP Germ. | 50p |
| H28 | 20 | OC200/1/2/3 PNP Silicon uncoded TO-5 can | 50p |
| H29 | 20 | OA47 gold bonded diodes coded MCS2 | 50p |

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| B1 | 50 | Germanium Transistors PNP, AF and RF | 50p |
| H6 | 40 | 250mW. Zener Diodes DO-7 Min. Glass Type | 50p |
| H10 | 25 | Mixed volts, 1½ watt Zeners Top hat type | 50p |
| H17 | 20 | 3 amp. Silicon Stud Rectifiers, mixed volts | 50p |
| H15 | 30 | Top Hat Silicon Rectifiers, 750mA. Mixed volts | 50p |
| H16 | 8 | Experimenters' Pak of Integrated Circuits. Data supplied | 50p |
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| AF239 | 0·37 | 2N711 | 0·50 |
| AF186 | 0·50 | 2N1302-3 | 0·20 |
| AF139 | 0·37 | 2N1304-5 | 0·25 |
| BC154 | 0·25 | 2N1306-7 | 0·30 |
| BC107 | 0·13 | 2N1308-9 | 0·35 |
| BC108 | 0·13 | 2N3819FET | 0·45 |
| BC109 | 0·14 | | |
| BF194 | 0·15 | **Power Transistors** | |
| BF274 | 0·15 | OC20 | 0·50 |
| BFY50 | 0·20 | OC23 | 0·30 |
| BSY25 | 0·57 | OC25 | 0·25 |
| BSY26 | 0·13 | OC26 | 0·25 |
| BSY27 | 0·13 | OC28 | 0·30 |
| BSY28 | 0·13 | OC35 | 0·25 |
| BSY29 | 0·13 | OC36 | 0·37 |
| BSY95A | 0·15 | AD149 | 0·30 |
| OC41 | 0·13 | AUY10 | 1·25 |
| OC44 | 0·13 | 2S034 | 0·25 |
| OC45 | 0·13 | 2N3055 | 0·50 |
| OC71 | 0·13 | | |
| OC72 | 0·13 | **Diodes** | |
| OC81 | 0·13 | AAY42 | 0·10 |
| OC81D | 0·13 | OA95 | 0·19 |
| OC83 | 0·20 | OA79 | 0·09 |
| OC139 | 0·13 | OA81 | 0·09 |
| OC140 | 0·17 | IN9114 | 0·07 |

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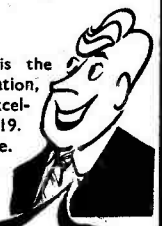

This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819. Data sheet supplied with device. 1-10 **30p** each, 10-50 **25p** each, 50+**20p** each.

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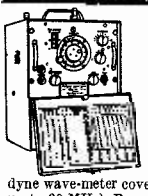

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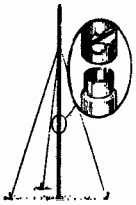

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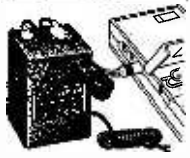

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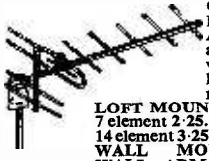

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has some directional properties and thus does not receive equally well from all directions. The maximum signal strength is obtained with the aerial at right angles to a line joining the transmitter and the receiver. An improvement in directivity and gain can be obtained by the addition of a reflector and, perhaps, one or more directors.

Figure 1 shows the dimensions of a simple Band 2 aerial. No attempt has been made to allow for mismatch at the dipole caused by the addition of two directors and a reflector. If need be, the dipole can be folded when the input impedance will then afford a reasonable match to 72Ω coaxial feeder. If the object of the exercise is to obtain as many stations as possible, then, while the additional gain is very useful, the aerial will need re-alignment towards each one. A rotary system would then be worthwhile, but a simple expedient is to use two simple dipoles at right angles with two feeder cables and to switch over to the more effective one when tuning in a station.

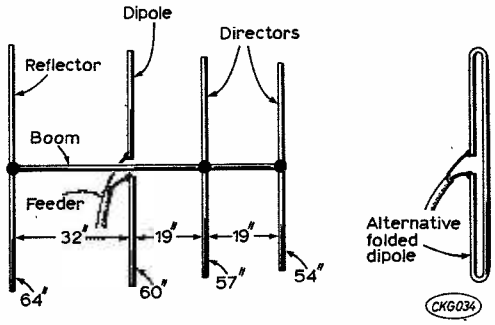


*Fig. 1: A four element Yagi beam. If the dipole is folded it will provide a better match to 70Ω feeder. If constructed of metal tubing the centres of the directors and reflector may be clamped directly to the boom.*

In practice, if only one aerial is possible, whether indoors or outside, it should be mounted as high as possible. Its direction should be chosen so that it gives the maximum possible pickup of the weakest of the available stations consistent with minimum loss on any of the others. The author uses two separate aerials, a four element for Solent, which still gives acceptable results on Medway and London, and a single dipole for Oxford. The latter is insufficient to reduce the interference from the adjacent Radio London. This raises the other critical point in reception of v.h.f. stations; receiver properties.

## RECEIVERS

Most commercial v.l.f. receivers can resolve clearly two adjacent stations 0·5MHz apart, but, in some cases, the spread of a local may be so great that it can cover almost a whole MHz of the spectrum, rendering adjacent stations very difficult to find and resolve. On one portable the author could just separate Oxford on 95MHz from London on 95·3MHz and listen to the former, and yet the same set produced some traces of London on Solent on 96·1MHz. Similarly, other sets spread Wrotham Radio 4 on 93·5MHz from just over 93 to 94MHz. BBC 4 Oxford on 93·9MHz cannot be separated from Wrotham on any of the four sets the author has tried. This spread rather limits the usefulness of some of the weaker stations.

Reception is also made worse by "spurious signals" which sometimes appear at places on the dial where there is no true signal, although this is more a function of the quality of the receiver. Quite often portables give better results using their own aerial, carefully positioned for maximum signal than when using a high outside aerial. This is because spurious signals appear to be produced in many sets much more strongly when an external aerial is used.

In conclusion, there will be many areas where satisfactory results will be obtained from two or more "local" radio stations. Unless they are very strong, a good aerial system will probably be required to give the best results. It will, however, happen that in some cases spread within the set may spoil the reception of weaker signals close to a local. ■

# TAKE 20

JULIAN ANDERSON

## No. 34
## MAGIC CANDLE

PART of the fun of electronics is in being able to 'amaze and mystify' members of the family and friends with little tricks. Those unfamiliar with the mysteries of electronics invariably assume that anyone who has tackled even the simplest crystal set is a true genius and, even when they see how few parts are employed, refuse to believe that 'that's all there is to it'. When they can't *see* the components that make an item tick they are even more impressed —let us not shatter their illusions, let us allow the uninitiated to marvel at our unquestionable brilliance!

Our project this month is purely for fun; to my knowledge it has no practical use whatsoever but it should amuse and it does fall within our budget of £1.

Using the constructional layout shown none of the component leads need be cut short and this will allow the components to be employed later for some more practical purpose.

The title of magic candle is self explanatory: the wick and flame are replaced by a small light bulb; when a lighted match or cigarette lighter is moved near it the bulb lights up and remains alight until "snuffed" by turning it off.

Apart from the battery, only four components are used: a light dependent resistor (LDR), a thyristor (SCR), a potentiometer (VR1) and the bulb itself.

At normal light levels the resistance of the LDR will be several hundred ohms (though this varies enormously with the specimen and the actual light level) and with VR1 at maximum setting there will not be sufficient current flowing in the gate circuit to trigger the SCR. However, if VR1 is reduced in value and the light level on the LDR increases there will be an increase in current, the SCR will turn on and apply the battery volts across the bulb. Because of the action of an SCR, even when the triggering current falls away completely, current will still be passed in the anode-cathode circuit.

VR1 acts as the sensitivity control; when it is set to minimum resistance and with a sensitive LDR, even quite low light levels will trigger the circuit. At maximum resistance the bulb will probably not light at all.

Ideally one would use both a battery and a bulb of the same voltage but SCRs don't seem to work well at voltages much below 9V and 9V bulbs with low current consumption are not widely available. If one can be obtained (note that the current should be no higher than 60mA) the circuit is exactly as shown. However 6V, 40mA bulbs are available and cheap but to avoid blowing it a 68Ω resistor should be wired in series with the bulb at the point marked both in the circuit and the constructional layout.

The circuit is best built to look something like a wax candle. A cardboard tube, such as aluminium foil is supplied on, is suitable. The battery sits on the bottom to give stability with VR1 just above this. For ease of wiring it is best to wire up VR1 first with three long leads, two to come out of the top and one that goes down to the battery and then to fit it into a hole cut out of the side.

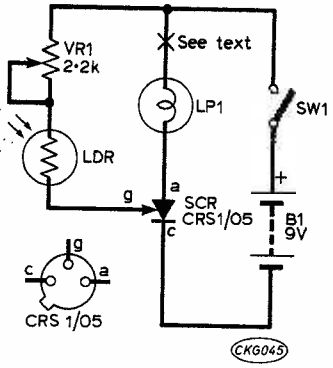


*Fig. 1: Circuit of the 'Magic Candle'.*

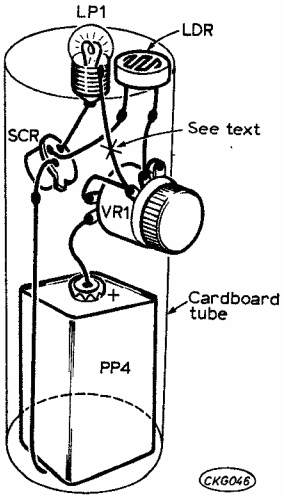


*Fig. 2: The components can all be mounted inside a cardboard tube.*

## ★ components list

| | | | |
|---|---|---|---|
| VR1 2·2kΩ lin. pot with switch | .. | .. | 24p |
| LDR Light dependent resistor .. | .. | .. | 43p |
| SCR CRS1/05 Thyristor, 50V, 1A | .. | .. | 23p |
| LP1 6V, 40mA bulb, see text .. | .. | .. | 5p |
| | | | 95p |

Prices are those recently advertised in *Practical Wireless* and may have changed. No allowance is made for minimum order costs or for postage and packing; these points should be checked carefully before ordering.

A stout card disc, cut to go over the top, can then be fitted with the bulb and the LDR which should be lightly glued under a small hole about $\frac{1}{4}$in. in diameter. This should be as near to the bulb as possible. The SCR can be either left floating as shown or it can be glued to the top cardboard disc. A long wire should be fitted to the cathode which is fed down the tube to the battery negative terminal. Once working the tube and top may be painted white to give the appearance of a candle. ■

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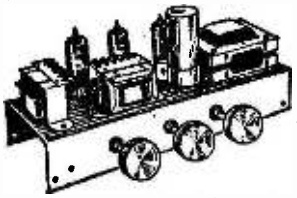

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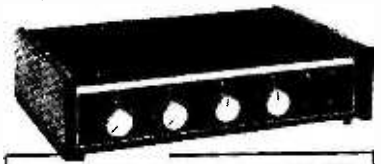

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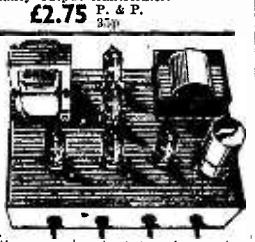

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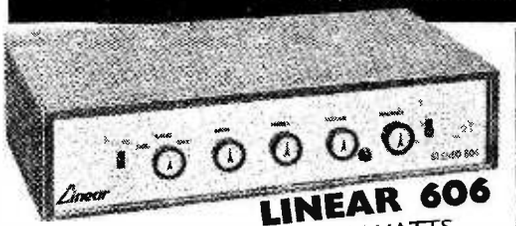

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6+6 WATTS

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**Sensitivities** Mag. P.U. 3·5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K. Radio Tuner 400 m.v. into 400K ohm.

**Crosstalk** 53 dB.

**Hum and Noise**—75 dB min. vol.—65 dB max. vol.

**Total Harmonic Distortion** 0·1% at 1watt into 15 ohms.

**Output** (per channel) 6·5 watts I.H.F.M.

- ★ Individual Bass and Treble Controls.
- ★ Frequency Response ± 1½ dB 20 Hz to 65 KHz.
- ★ Outputs for Speaker impedances between 3 and 15 ohms.
- ★ Stereo/Mono Switch.
- ★ Input Selector Switch.
- ★ Solid State Circuitry.
- ★ Attractive silver finished metal facia and matching control knobs.

## LINEAR 505 5+5 WATTS

- ★ A modestly priced solid state unit.
- ★ The Silver Facia with black lettering enhanced by matching control knobs, provides a high standard of appearance.
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- ★ A wide range of tone variation is provided by the separate Bass and Treble 'lift' and 'cut' controls.
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### TECHNICAL DETAILS

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**Bass Control** ± 12 dB at 60 Hz.

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| 1T4 | ·18 | 30C17 | ·76 | EAF42 | ·50 | EM81 | ·38 | PCL84 | ·34 | UBC41 | ·52 |
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| 3V4 | ·37 | 30F5 | ·64 | EB91 | ·10 | EM87 | ·34 | PCL86 | ·38 | UBF89 | ·33 |
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| 5V4G | ·35 | 30FL12 | ·69 | EBC41 | ·54 | EY86 | ·29 | PCL800 | ·75 | UCC85 | ·35 |
| 5Y3GT | ·26 | 30FL14 | ·68 | EBC90 | ·22 | EZ40 | ·43 | PENA4 | ·77 | UCF80 | ·33 |
| 5Z4G | ·35 | 30L1 | ·29 | EBF80 | ·32 | EZ41 | ·43 | PEN36C | ·70 | UCH42 | ·58 |
| 6/30L2 | ·54 | 30L15 | ·57 | EBF89 | ·29 | EZ80 | ·22 | PFL200 | ·52 | UCH81 | ·32 |
| 6AL5 | ·11 | 30L17 | ·67 | ECC81 | ·17 | EZ81 | ·23 | PL36 | ·49 | UCL82 | ·32 |
| 6AM6 | ·13 | 30P4 | ·57 | ECC82 | ·20 | GZ30 | ·34 | PL81 | ·44 | UCL83 | ·55 |
| 6AQ5 | ·22 | 30P12 | ·72 | ECC83 | ·35 | GZ32 | ·40 | PL81A | ·47 | UF41 | ·56 |
| 6AT6 | ·20 | 30P19 | ·57 | ECC85 | ·34 | GZ34 | ·48 | PL82 | ·31 | UF89 | ·30 |
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| 6J7G | ·24 | AC/VP2 | ·77 | ECL80 | ·30 | PABC80 | ·34 | PY81 | ·25 | Z77 | ·22 |
| 6K7G | ·12 | B349 | ·65 | ECL82 | ·31 | PC86 | ·47 | PY82 | ·25 | **Transistors** | |
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| 6Q7G | ·35 | CCH35 | ·67 | EF39 | ·38 | PC96 | ·42 | PY88 | ·33 | AC127 | ·18 |
| 6SN7GT | ·30 | CY31 | ·30 | EF41 | ·60 | PC97 | ·39 | PY800 | ·34 | AD140 | ·37 |
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| 6X5GT | ·28 | DF91 | ·16 | EF89 | ·26 | PCC88 | ·40 | U25 | ·64 | AF118 | ·48 |
| 10P13 | ·58 | DF96 | ·36 | EF91 | ·13 | PCC89 | ·45 | U26 | ·56 | AF125 | ·17 |
| 12AT7 | ·17 | DH77 | ·20 | EF92 | ·30 | PCC189 | ·48 | U47 | ·64 | AF127 | ·17 |
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| 12AU7 | ·20 | DK91 | ·28 | EF183 | ·28 | PCF80 | ·28 | U50 | ·26 | OC44 | ·12 |
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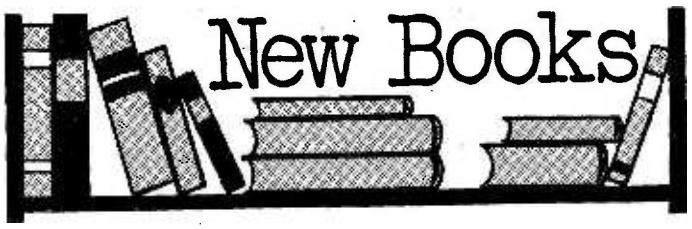



Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in **heavy** type should be quoted.

## HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

**Published by Babani Press**
**78 pages, 7 × 4in. Price: 40p.**

ONE hardly needs to review a book of this type—the title itself (and the modest price) is enough to make the mouth water. Such a book has long been needed and congratulations to the publishers for introducing it.

Personally I have never met anyone who has known more than a handful of the transistor types available and as far as substitutes are concerned no one has worked out the perfect way of presenting these. This handbook has, however, made a brave attempt (and largely successful one) to give equivalents of transistors in a thoroughly practical way. Equivalents, by the way, only refers to parameters and ignores encapsulation, a sensible thing to do as it opens the field considerably.

About 3,000 types have their equivalents given and in most cases several alternatives are shown; take for instance the OC71, an old fashioned but very well known transistor, here 15 equivalents are shown and this is not untypical.

One of the best points (and if all the other virtues were missing this only would make the book a good buy) is the inclusion of a mass of Japanese types. There must be hundreds of thousands of small transistor radios imported from the Far East which have been written off because a dud transistor is unidentifiable. I have never come across a better list of these types.

Altogether an excellent handbook and, for those who need to find equivalents, indispensable. **H.W.M.**

## PUBLIC ADDRESS HANDBOOK

**By Vivian Capel**
**Published by Fountain Press,**
**46 Chancery Lane, London. WC2.**
**208 pages, 8 × 5in. Price: £3.00.**

VIVA Vivian! This contribution to the literature of audio is like a light in darkness. With the growing world of discos, clubs and semi-pro 'do's' at the local Church Hall, some guidance is necessary for the well-meaning PA operator. Until now, his only recourse was to very specialist works that told him a lot about the acoustics of the City Hall in Walamazoo but little about hooking up an ailing 10W amplifier to the vicar's home-made loudspeakers.

Public Address Handbook is very soundly based on the author's practical experience. Anyone who has attempted PA will know that the most unexpected problems can crop up. Mr. Capel has worked in small halls and large, on private jamborees and public demonstrations and passes on to us the benefit of his know-how.

There is little theoretical depth. The author argues that you would not be reading the handbook if you had not at least a glimmering of the background and the acumen to seek out more in the appropriate places. But he takes full cognisance of our probable ignorance where public address is concerned and guides us through the mysteries of microphones and mixers, amplifiers and loudspeakers—always from a practical point of view.

The author is a practising musician and this becomes apparent when one reads his Chapter 10, 'Live Music.' His advice is firsthand and authentic. Practical systems are described in another chapter; nine working hookups based on requirements that vary between the small hall and the football stadium, taking in a factory canteen on the way.

Still more practical, the final two chapters deal with fault-finding and setting-up. I was tickled pink by Mr. Capel's advice on page 80: 'Never panic, even though the programme may be held up while you try to rectify matters!' There speaks the voice of experience as it does, indeed, throughout this excellent and rare book on a little-known and infrequently explored subject. For amateur and professional both, this public address handbook is to be recommended. **H.W.H.**

## GUIDE TO PRINTED CIRCUITS

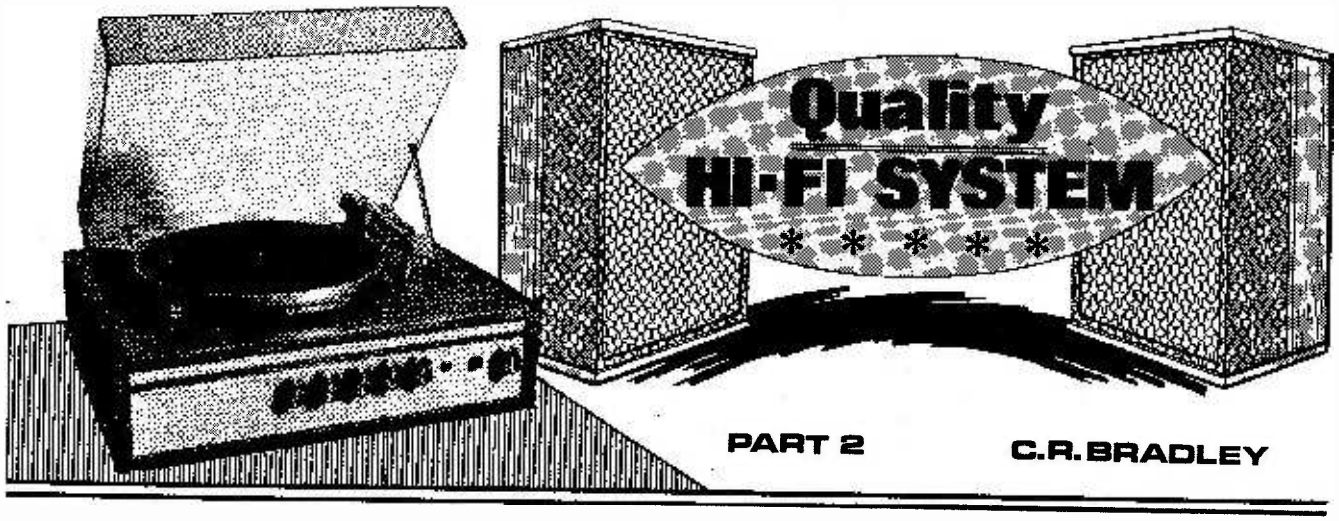
**By Gordon J. King**
**Published by Fountain Press**
**148 pages, 8½ × 5½in. Price: £2·50**

AN excellent and timely book, written, as the author says, "with the enthusiastic amateur, experimenter and the radio service apprentice and technician in mind."

The six chapters begin with the reasons for the introduction of the printed circuit board and the early problems involved and continues with the design methods and manufacture of boards in the electronic industry. For the reviewer the chapter on "rolling one's own" printed circuit boards was the most interesting with its detailed advice and guidance. Interest was maintained at a high level in the following chapter which covers the alternative systems to the pcb, such as Veroboard, Cir-Kit and S-DeC. Many readers will find the information on converting a circuit diagram into a finished circuit board of the greatest use.

A book such as this would not be complete without detailed information on the methods of servicing pcb's. The author, who has accumulated many years of servicing expertise, has been able to incorporate some of that experience into Chapter Five. Other useful guidance covers the field of soldering irons and guns, solders and soldering aids and the few other accessories which will enable the amateur to turn out a professional pcb.

The book is well written with many photographs and line drawings. £2·50 is little enough to pay for such a mine of information. **A.E.D.**




*Continued from the February issue*

The circuit of the plinth is shown in Fig. 6. This comprises the power supply, the left and right power amplifier modules and the left and right preamplifiers. The preamplifiers are separately constructed on pieces of Veroboard which plug into two 24-way edge connectors on the back of the control panel. In return for their small extra cost, the use of edge connectors has some important advantages.

First, construction is simplified since construction of each preamplifier and the fairly complicated wiring around the controls can be separately completed and checked, with improved accessibility in both cases. Secondly, either preamplifier board can be removed in seconds for fault finding; it is very helpful when tracing a fault to be able to swap the preamplifiers and observe whether the fault changes channel. Thirdly, all the small-signal carrying wires are kept as short as possible and run close to the aluminium front panel so that fewer wires have to be screened to avoid instability, hum pickup or radio pickup problems. The latter is especially important since the equipment uses silicon transistors throughout which individually have responses extending far beyond audio into radio frequencies.

## Preamplifier Circuit

This will be fully described as it contains some unusual features. The BC109 transistor was an obvious choice for all stages since it has a very low noise factor and is commendably cheap. Non-branded BC109's may not be as good.

The low level signal is received by the equalisation stage Tr1 and Tr2. These are connected as a d.c. coupled pair in which Tr1 runs at a low collector current of 75$\mu$A to minimise the electrical noise introduced at this vital point. D.C. stabilisation is performed by R8 since if Tr1 collector current should rise, Tr2 base voltage drops, Tr2 emitter voltage follows and Tr1 base bias is therefore reduced. R8 also provides some signal feedback but the main signal feedback path is from Tr2 collector through C3 and the components selected by S1b to Tr1 emitter. For radio tuner input the feedback through R11 provides flat frequency response and 150mV sensitivity at the input. For magnetic cartridge input R13/C5/C6 provide frequency conscious feedback to obtain the standard RIAA disc playback response—see Fig. 8. Almost any desired input sensitivity and impedance can be made available at the AUXILIARY position of S1 by choosing component values from Table 1. Clearly there is scope for arranging any desired selection of inputs by S1 from the values given, although if planning to introduce more complex switching it is important to bear in mind that this area of circuit is where hum pickup and crosstalk are most likely to occur. For the purpose of the components list it is assumed that the AUXILIARY position is fitted with components for 300mV input sensitivity, useful for, say, the low level outputs from a stereo tape recorder.

**TABLE 1**
**Component values for different AUXILIARY input characteristics**

| R1 | Rx | Sensitivity | Input impedance | Suitable for: |
|---|---|---|---|---|
| 470kΩ | 0 | 300mV | 500kΩ | Tape recorder |
| 0 | 62kΩ | 3·5mV | 22kΩ | Dynamic mic. |
| 1MΩ | 62kΩ | 300mV | 1MΩ | Crystal mic. or pickup |

Virtually all of the preamplifier gain is provided by Tr1 and Tr2 which are followed by the stereo volume control VR1. For this a linear track component is chosen rather than the logarithmic type usually used in this position. This has the advantage that the two ganged sections will be better matched than in a cheap logarithmic control so channel balance will be maintained at different volume settings. The preset gain controls VR2 in each channel are a means of overcoming the usual disadvantage of linear volume controls i.e: most of the subjective volume range being compressed into the first few degrees of rotation. The preset controls are intended to be set to give the maximum likely listening

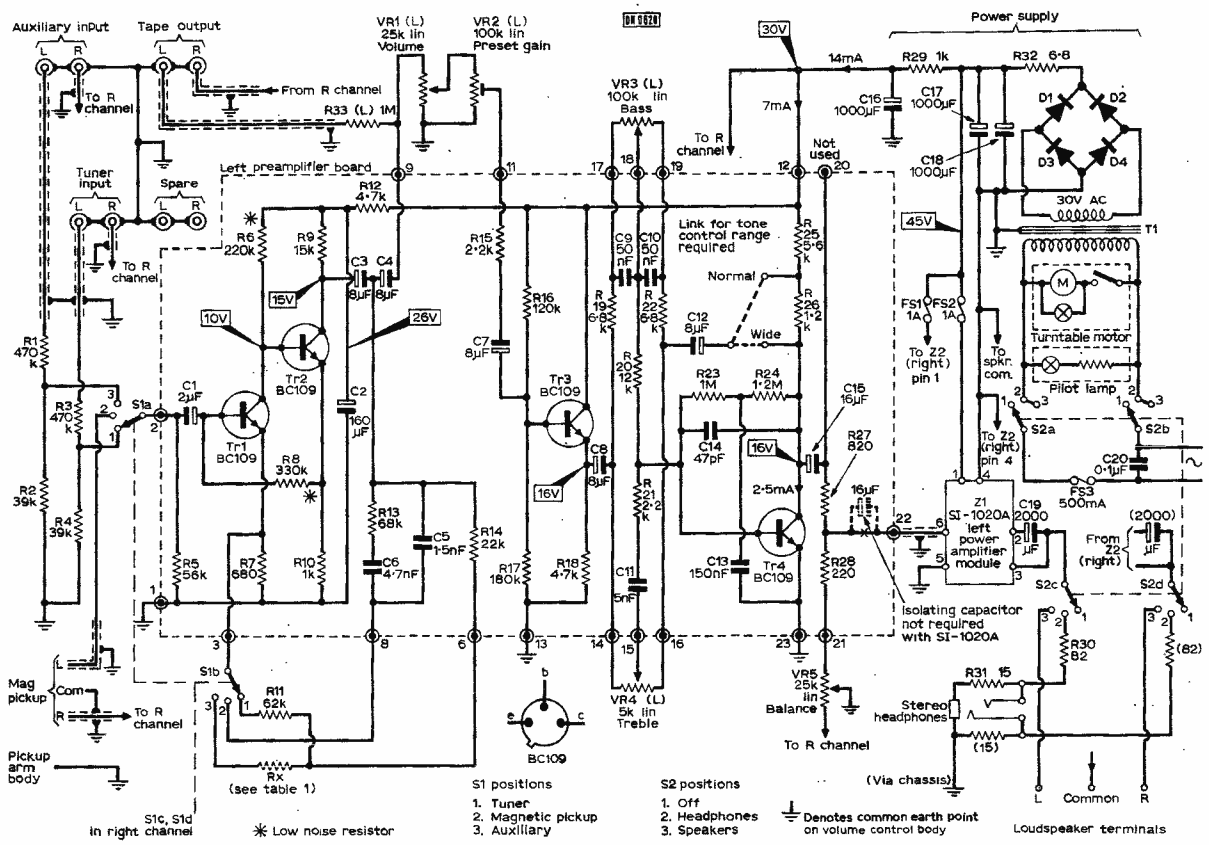



*Fig. 6: Circuit of plinth unit. Preamplifier and power amplifier for left channel only are shown, plus balance control VR5. Some components in right channel speaker output shown for clarity. Right channel is identical. All voltages are positive with respect to chassis.*

volume with the manual control at maximum, so that its whole range can be utilised. They also allow any difference in the gains of the left and right channels, due to component tolerances, to be compensated so that the manual balance control normally rests midway.

## Emitter Follower Buffer

In most preamplifier designs a Baxandall tone control stage follows immediately after the equalisation stage. Here however an extra emitter follower stage Tr3 is used as a buffer between the equalisation stage Tr1/Tr2 and the tone control stage Tr4. This reduces distortion since the high input impedance of the emitter follower minimises the loading (via the volume controls) on Tr2, and the low output impedance ensures a constant-voltage drive to the varying load presented by the tone controls.

## Tone Controls

Although the Baxandall tone control circuit, with its familiar bass and treble boost and cut characteristic shown in Fig. 9, is used with minor variation in almost all modern high fidelity equipment, its operation is seldom explained and is not obvious. It is best

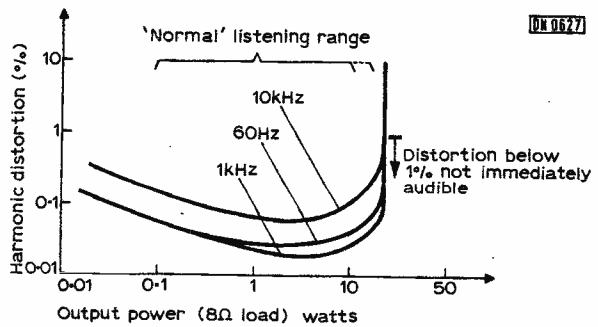



*Fig. 7: Distortion curves for Sanken SI-1020A amplifier module, taken from manufacturer's data sheet*

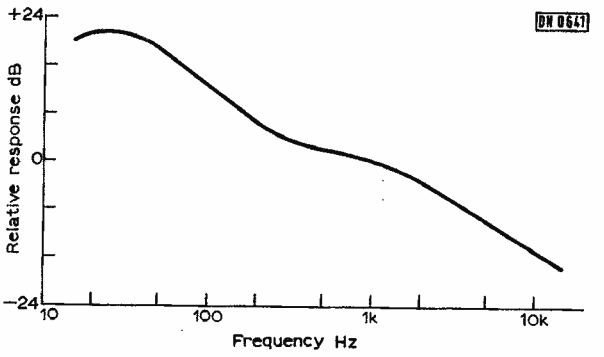



*Fig. 8: On modern L.P. recordings high frequencies are boosted to a standard (RIAA) specification to overcome surface noise. The output of a magnetic pickup must be passed through a preamplifier whose frequency response shown above is a mirror image of the recording response i.e. boost at low frequencies, to regain the original sound.*

understood by separately considering how the circuit appears at high and low frequencies.

Resistors present the same impedance to signals of all frequencies whereas the impedance of capacitors decreases with rising frequency. Hence at very high frequencies C9/C10/C11 are virtually short circuits and the circuit reduces to Fig. 10a. Conversely at very low frequencies the same capacitors are virtually open circuits and the circuit reduces to Fig. 10b. In both these simplified circuits the components which are ineffective are dotted.

Now both the simplified circuits are just elaborations of Fig. 10c in which a transistor base is fed from the slider of a potentiometer connected between input and output. Assuming the transistor itself has sufficiently high gain, the stage gain is Rb (which $\frac{Ra}{}$ simple relation is the root of all operational amplifier theory). This confirms what is fairly obvious, that the gain is high when the slider is at the input

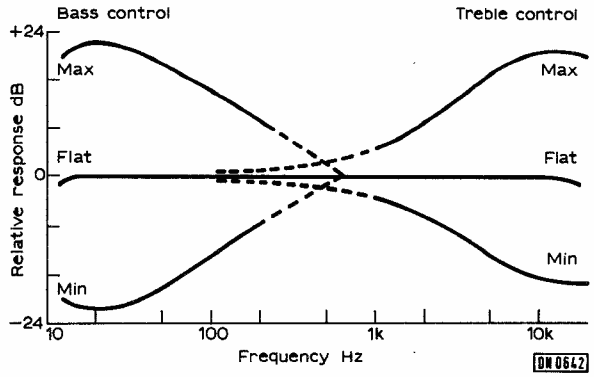



*Fig. 9: Tone control response with C12 linked to NORMAL. Curves are dotted over mid-frequency range where both Bass and Treble controls have some effect.*

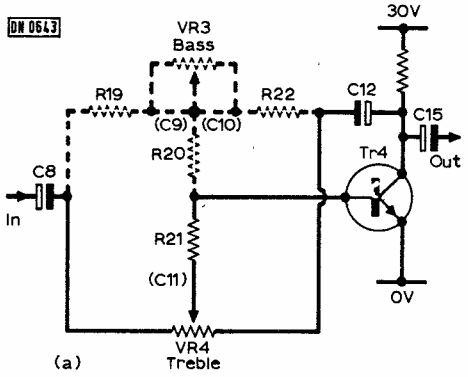



*Fig. 10a: Active parts of tone control circuit at very high audio frequencies*

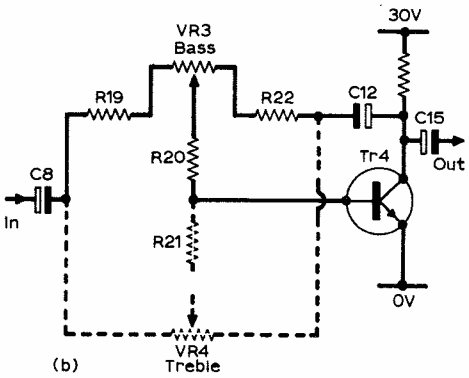



*Fig. 10b: Active parts of tone control at very low audio frequencies*

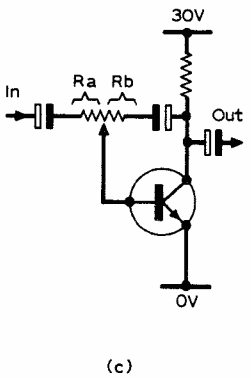



*Fig. 10c; Simplified operation of both Figs 10a and 10b.*

end of the track and drops as it moves to the right due to increasing negative feedback from the output. Thus in Figs. 10a and 10b the active potentiometer simply acts as a gain control at the frequency concerned while the dotted control has no effect. The arrows across the sliders indicate the direction of clockwise rotation and boost. At other than very high or low frequencies the assumptions made about the action of the capacitors become less true and it is only a matter of choosing component values to make the controls progressively effective over desired frequency ranges.

Figs. 10 do not show the base bias arrangement for Tr4 which is a bleed via R23/R24 from its collector with decoupling by C13 to prevent signal feedback by this route. Stability at all tone control settings is ensured by top-cut capacitor C14.

C12 prevents d.c. flowing in the tone controls and is large enough for its impedance to be negligible at all audio frequencies. It is normally connected to the junction of R25 and R26. It can alternatively be connected directly to Tr4 collector whereupon the range of the tone controls becomes wider than the specification since they have more negative feedback to "play" with. For normal listening however there is no need for great extremes of tone control.

The signal at Tr4 collector is taken to a spare pin on the edge connector in case a mono-stereo switch is required. This would just link pin 20 on the left and right preamplifiers for mono operation. But for record playing at least, where a mono record reproduces through both channels anyway, such a switch seems superfluous. If occasionally one wishes to feed an external mono signal (e.g. from an a.m. radio tuner) into both channels, this can be done by making up a suitable linking adaptor to plug into the auxiliary input sockets.

The left and right preamplifier outputs are taken from a resistor divider whose mid-point is the earthed slider of the Balance control. In anticipation that this preamplifier may be used with other power amplifiers there is provision in the board layout for an isolating capacitor at the output. This is not needed (though does no harm) with the Sanken amplifiers specified which contain their own input blocking capacitors.

## Power Amplifiers Z1, Z2

The Sanken SI-1020A monolithic power amplifier has already been described in "IC of the Month" and its internal (and inaccessible) circuit is the conventional quasi-complementary Class AB push-pull arrangement. The convenience of its packaging is far more remarkable since its metal case can be bolted directly to a heatsink without any electrical isolation. This i.c. was possibly overshadowed at its introduction by its 50 watt sister (SI-1050) but its excellent distortion claims are the reason for choosing it for the system.

Fig. 6 shows an unusual arrangement at the loudspeaker outputs which solves two problems common to high power push-pull amplifiers. Firstly one may inadvertently overload stereo headphones with resulting distress to ears and/or headphones. Secondly there is the familiar thump from each speaker when the amplifier is switched on, caused by the output capacitor (C19) charging through the speaker. This may or may not be damaging to the speakers but one is certainly better off without it. Accordingly the on/off switch S2 is arranged to pass through a HEADPHONES position between OFF and SPEAKERS. If it is switched through this intermediate position not too fast, C19 will have charged up via R30 and R31 before being connected to its speaker, so there will be no thump. These resistors also attenuate the headphone signal level to give a reasonable range of volume.

## Power Supply

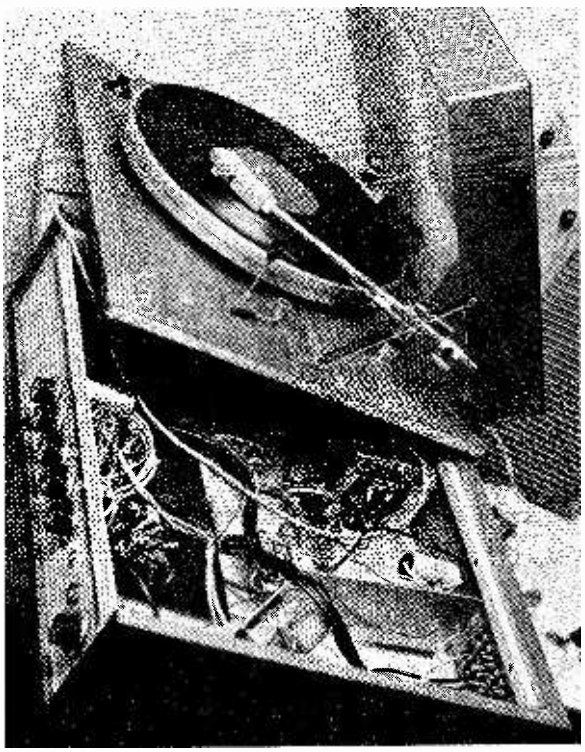
The simple unstabilised power supply in Fig. 6 delivers 45V via separate fuses FS1/FS2 to the power amplifiers, and a well smoothed common 30V supply to the preamplifier boards. The mains input is also fused. A reservoir capacity of 2000$\mu$F is required and can be made up from two 1000$\mu$F capacitors in parallel as shown (C17, C18) or a single component used if available. In either case the capacitor(s) should be good quality components intended for power supply use since there is a hefty 100Hz ripple current from the bridge rectifier D1-4. The current surge as the capacitors charge up at switch-on is limited to a safe value by R32 which should not be omitted.

The mains input is switched by S2a/b to the power supply transformer T1, the turntable (which has its own switch and pilot lamp) and to a neon pilot lamp on the front panel. C20 may be of some use in suppressing r.f. interference from the mains; it is most important that no suppressor capacitor is connected between mains live and the chassis since this would make exposed metal parts live if ever the mains earth connection were broken.

## Turntable, Arm and Pickup

The choice of these three can be left to the constructor since any good quality equipment can be used. Comparative judgments on magnetic cartridges especially are rather subjective.

The author's equipment illustrated uses a Connoisseur Craftsman turntable (very simply but soundly made), Goldring L75 pickup arm and Eagle LC07 moving magnet cartridge. The latter is a fairly recent Japanese product which the author regards as a "best buy" at about £7 since its performance on a test record is comparable to, say, a Goldring G800E at several pounds more. Tracking is at 1$^1_2$gm, which can be set accurately on the Goldring arm without a gauge. Readers might well find the Connoisseur BD1 "do-it-yourself" turntable kit a good buy for the system. For economy one of the better BSR or Garrard players would give fair results but a cheap autochanger should certainly not be used since the amount of wow and flutter would be unacceptable.



*Photograph shows inside of assembled plinth*

## Plinth Construction

The carpentry is straightforward, the cabinet being made up from five pieces of $^1_2$in. chipboard fixed by countersunk screws to $^1_2$in. square corner battens—see Fig. 11. A rectangular aperture is cut in the rear board for the rear panel. The turntable mounting board is cut out to suit the unit and arm chosen after having made sure everything will fit under the Goldring perspex lid. The space available here is about 17$^1_4$in. wide × 13$^1_2$in. deep × 2$^3_4$in. high and it was only barely possible to fit in the author's units, the Craftsman turntable having to be positioned with the motor at rear left. It is not essential for the turntable board to be screwed down to the battens on which its rests, so there need be no screw heads visible after all exposed wood surfaces have been veneered. For access to the electronics the turntable board is simply lifted clear.

Two eyelet screws can be bent to serve as hinges for the rear of the perspex cover and screwed to the turntable board as shown in Fig. 11. A small wood wedge is glued to the board to support the prop-up arm which is part of the lid.

The front panel is an aluminium sheet cut as shown in Fig. 12a. A length of L-shaped aluminium girder is used to hold the two preamplifier edge connectors behind the front panel (or some other support can be arranged) and has tabs ready for

## ★ components list

**PLINTH**

**Resistors:**
All 10% ¼W carbon unless otherwise specified

| | | | |
|---|---|---|---|
| †R1 | 470kΩ | †R17 | 180kΩ |
| †R2 | 39kΩ | †R18 | 4·7kΩ |
| †R3 | 470kΩ | †R19 | 6·8kΩ |
| †R4 | 39kΩ | †R20 | 12kΩ |
| †R5 | 56kΩ | †R21 | 2·2kΩ |
| †R6 | 220kΩ ¼W 5% high stability | †R22 | 6·8kΩ |
| | | †R23 | 1MΩ |
| †R7 | 680Ω | †R24 | 1·2MΩ |
| †R8 | 330kΩ ¼W 5% high stability | †R25 | 5·6kΩ |
| | | †R26 | 1·2kΩ |
| †R9 | 15kΩ | †R27 | 820Ω |
| †R10 | 1kΩ | †R28 | 220Ω |
| †R11 | 82kΩ | †R29 | 1kΩ |
| †R12 | 4·7kΩ | †R30 | 82Ω 1W carbon |
| †R13 | 68kΩ | †R31 | 15Ω |
| †R14 | 22kΩ | R32 | 6·8Ω 5W wirewound |
| †R15 | 2·2kΩ | | |
| †R16 | 120kΩ | †R33 | 1MΩ |

VR1 25kΩ + 25kΩ linear double-ganged carbon potentiometer
†VR2 100kΩ linear miniature skeleton preset potentiometer
VR3 100kΩ + 100kΩ linear double ganged carbon potentiometer
VR4 5kΩ + 5kΩ linear double ganged carbon potentiometer
VR5 25kΩ linear carbon potentiometer

**Capacitors:**

| | |
|---|---|
| †C1 | 2µF 6V electrolytic |
| †C2 | 160µF 25V electrolytic |
| †C3 | 8µF 15V electrolytic |
| †C4 | 8µF 15V electrolytic |
| †C5 | 1·5nF ceramic or polyester |
| †C6 | 4·7nF ceramic or polyester |
| †C7 | 8µF 15V electrolytic |
| †C8 | 8µF 15V electrolytic |
| †C9 | 56 (or 47) nF ceramic |
| †C10 | 56 (or 47) nF ceramic |
| †C11 | 5 (or 4·7) nF ceramic or polyester |
| †C12 | 8µF 15V electrolytic |
| †C13 | 150nF ceramic or metallised film |
| †C14 | 47pF ceramic |
| †C15 | 12·5 (or 16) µF 25V electrolytic |
| C16 | 1000µF 30V electrolytic |
| C17 | 1000µF 50V electrolytic |
| C18 | 1000µF 50V electrolytic |
| †C19 | 2000µF 25V electrolytic |
| C20 | 0·1µF 500V paper tubular |

**Semiconductors:**
†Tr1, †Tr2, †Tr3, †Tr4 BC109
D1, D2, D3, D4 100 PIV 2A silicon diodes
Z1, Z2 Sanken SI-1020A (Photain Controls Ltd., Randalls Road, Leatherhead, Surrey)

† indicates one needed for each channel.

**Switches:**
S1 4P 3W rotary S2 4P 3W rotary

**Fuses:**
FS1, FS2 1¼in. 1A (or 500MA—see text)
FS3 1¼in. 500MA
2 fuseholders to suit

**Sockets:**
Stereo jack socket (Eagle SS34)
8 phono sockets (or 4 stereo pairs)

**Transformer:**
T1 Mains primary 200/250V a.c., secondary 30V 2A e.g. Douglas MT3AT

**Miscellaneous:** Veroboard, 2 24-way Vero edge connectors (0·15in. matrix), knobs, mains pilot neon, screened cable, wood, aluminium, etc.

**ENCLOSURE** (components for each channel)

**Resistors:**
R1, R2, R3, R4 10Ω 1W carbon (not wirewound)

**Switch:**
S1 2P 3W rotary

**Crossover:**
Eagle CN28 8Ω

**Woofer:**
Baker Major 8Ω

**Tweeter:**
Eagle MHT (8 Ω)

**Miscellaneous:** Hardboard, wood, sand, fret, fibre eggbox, carpet felt, knob, screw terminals (2) aluminium panel etc.

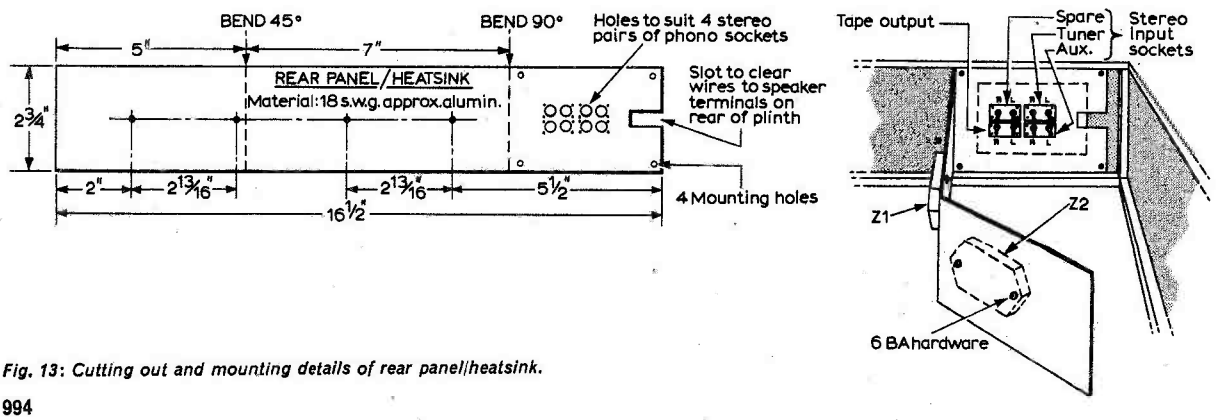



*Fig. 13: Cutting out and mounting details of rear panel/heatsink.*

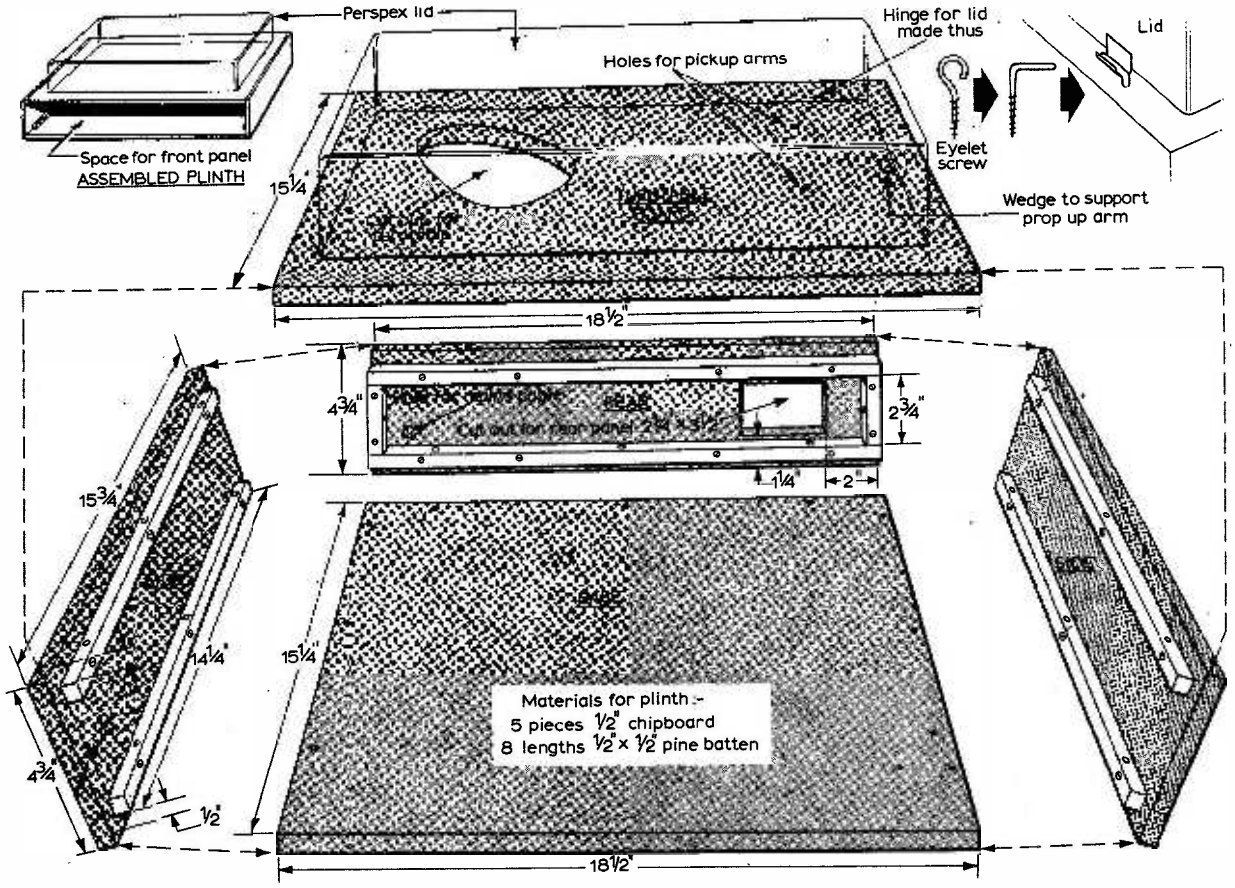



*Fig. 11 : Construction of plinth*

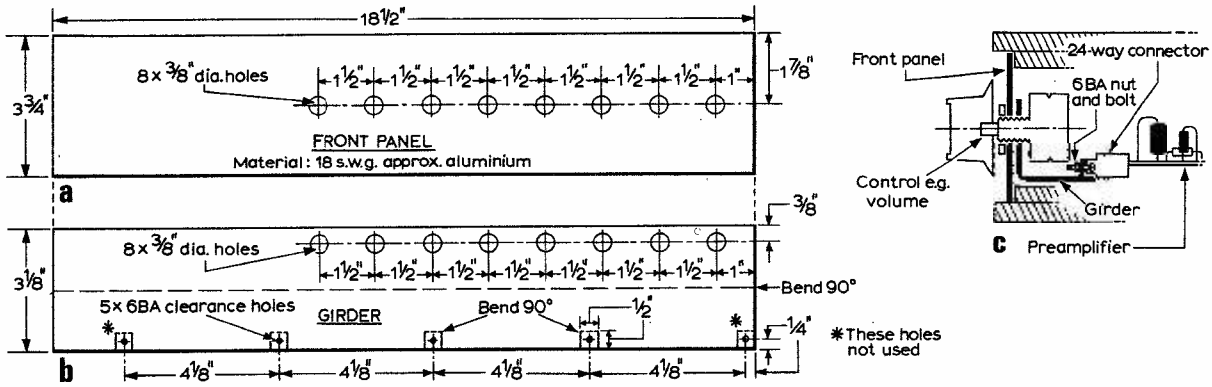



*Fig. 12(a) : Front panel (front view). Fig. 12(b) : Girder. Fig. 12 (c) : Cross section of front panel and girder showing method of fixing connectors.*

mounting two more edge connectors in case of future needs—see Fig. 12b and c. The girder is held to the front panel by the controls so no screw heads need show at the front. The front panel assembly should fit snugly enough in its slightly recessed position to need no fixing to the cabinet.

A second aluminium sheet forms the heatsink for Z1 and Z2 and also the rear panel carrying four stereo pairs of phono sockets—see Fig. 13. It is fixed to the cabinet by four screws from the inside. The amplifiers should be bolted tightly to the aluminium making sure they make contact over the whole of their bases. A thermally conductive grease can be used to improve the heat transfer but this is **not** essential for normal listening use.

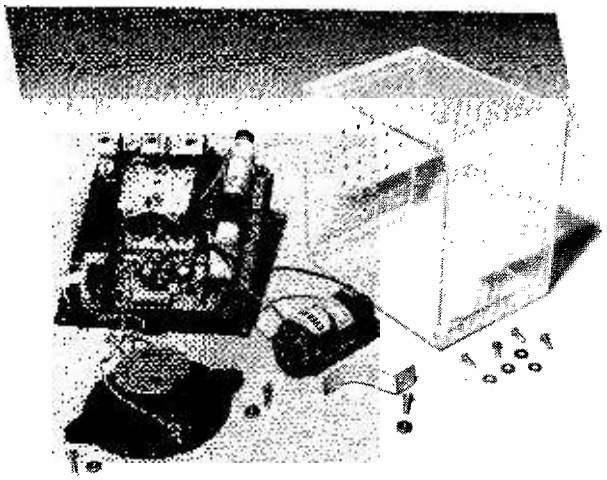
## NOTE

*On page 905 of the February issue, reference is made to strip "S in Fig. 1." This should have referred to Fig. 2.*

*To the materials list on page 907, the following shouuld be added to the FRAME: 4 off 16 in. × ⅞ in. × ⅞ in. pine.*

*The construction details of the inner sheets on page 907 show screw holes in the vertical corner edges of the hardboard—these should be ignored. It would be impossible to use wood screws in this position and they are in fact unnecessary.*

**TO BE CONTINUED**



# The pw Cube Radi

## 7 Transistor Superhe

R. F. GR

THIS is an attractive 7-transistor receiver of straightforward construction, tuning long and medium waves. The receiver is assembled as a complete working unit on a single piece of Veroboard (except for the loudspeaker) and actual building is simplified by using a small, ready-made audio amplifier module. Thus only the mixer and i.f. amplifier are built from separate components.

## CIRCUIT

Fig. 1 is the circuit, and a brief description should be helpful to beginners.

**Ferrite Aerial.** The ferrite rod has medium wave section L1 and long wave section L2. Switch S1 shorts out the l.w. section for m.w. reception. VC1 tunes the aerial together with trimmer TC1. Trimmer TC3 is for l.w. trimming. A coupling winding on L1 and tapping on L2 applies the signal to Tr1 base via C1. Tr1 is an OC44 mixer/oscillator.

**Oscillator Coil L3.** This is tuned by VC2, with trimmer TC2. Capacitor C4 provides "tracking" so that the oscillator circuit always tunes 470kHz higher in frequency than the aerial circuit. With S1 in the l.w. position C3 and TC4 are across the oscillator winding for long wave reception.

**Intermediate Frequency Amplifier.** The 470kHz output of Tr1 passes to the first intermediate frequency transformer IFT1. Signals pass to the first i.f. amplifier Tr2 an AF117, then from IFT2 to Tr3, another AF117. The three IFTs are tuned to 470kHz by means of adjustable cores.

**Emitter Detector.** The OC71 Tr4 demodulates the output of IFT3 and amplified audio signals appear at the collector and are taken via C11 to the volume control VR1.

**Automatic Gain Control.** Strong signals increase Tr4 collector current causing an increased voltage drop across R10. The base potential of Tr2 thus becomes more positive, the change in voltage being applied via R6. As a result, amplification provided by Tr2 is reduced when strong signals are present,

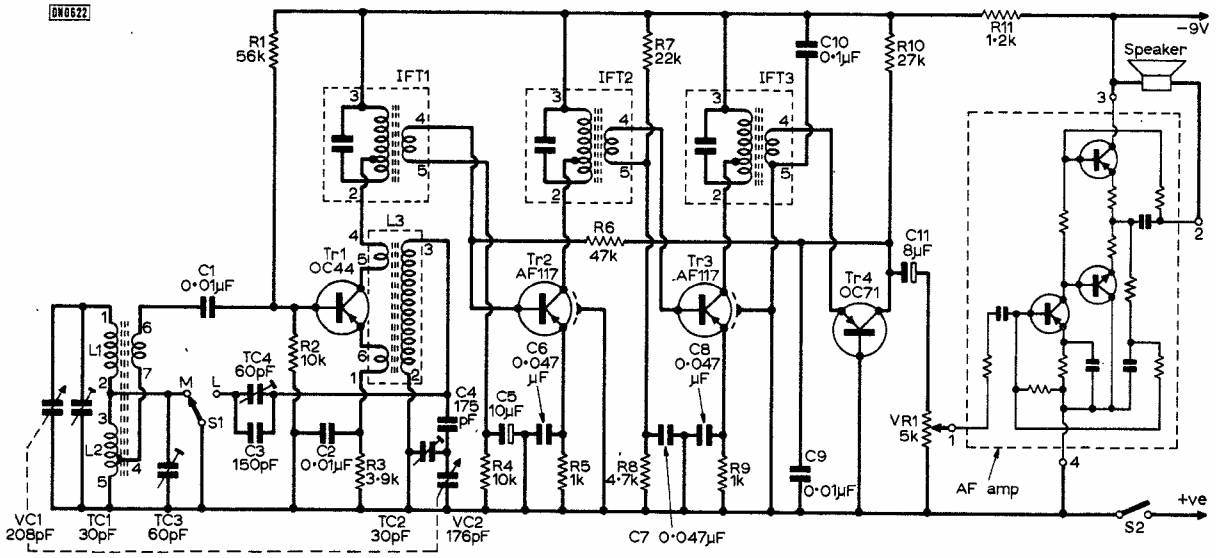
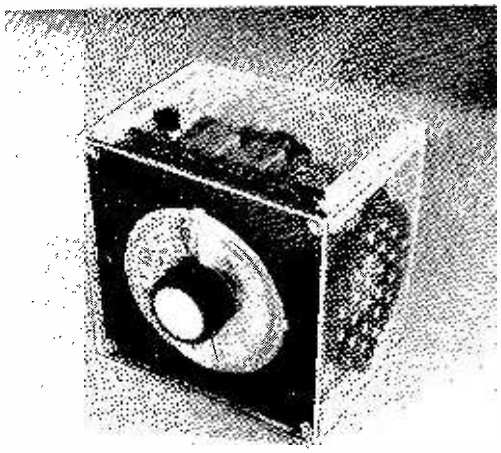



*Fig. 1: Circuit of the Cube Radio. The audio amplifier is obtained as a module, the circuit being given here for reference purposes only.*



and the output of the i.f. amplifier is relatively constant, despite changes in signal level.

**Audio Section.** The slider of VR1 is taken to pin 1 of the a.f. module which is a small separate unit, mounted on the receiver board, and having only four external connections. The module contains a driver/amplifier, followed by a pair of transistors in a complementary single-ended push-pull circuit. This drives a 40 ohm or similar miniature speaker, $2\frac{1}{2}$in in diameter.

## CIRCUIT BOARD

The plain Veroboard is $3\frac{7}{8} \times 3\frac{5}{8}$in. to fit inside the 4×4in. case. It is cut to clear the corner strips and speaker as in Fig. 2.

Holes are drilled or enlarged to match the pins and screening can tags of L3 and the IFT's, noting that L3 will be fitted in the way which results in pins located as in Fig. 2.

Holes are also drilled for TC3 and TC4, the rod mounting and 6BA bolts holding the a.f. amplifier. A clearance hole is needed for VC1/2, and three holes which match up with the tapped holes in the front of the capacitor frame.

In many places resistor ends and other leads are soldered to Vero pins inserted in the board. These are most easily inserted with the correct tool, which resembles a small screwdriver with a hole, so that when a pin is pushed in it projects equally each side of the board. With Tr2, Tr3 and Tr4 it is more convenient to put the wire ends through the holes, anchoring only the collector of Tr3 at a pin.

When wiring is complete, the Veroboard is secured to a 4×4in. panel of $\frac{1}{16}$in. black polished paxolin with about $\frac{7}{16}$in. space between the two, to clear wiring, pins and VR1. VC1/2 is secured with 4BA bolts or studding which can project about $\frac{1}{16}$in. on the capacitor side of the board. Longer bolts will damage the capacitor plates. Another way is to secure the capacitor with short bolts, with washers under their heads, if required. Panel and board are then drilled with matching holes to take three 6BA bolts. These are countersunk at the panel, and have extra lock nuts, so that panel and board will be held about $\frac{7}{16}$in. apart. The positions of the bolts does not matter, provided they clear resistors, etc., since their heads will be covered by the metal dial.

## FERRITE AERIAL

As the ferrite rod normally supplied is too long for the case, it was snapped off at about $3\frac{1}{2}$in. by securing it in a vice and giving the rod a sharp tap.

L1 is placed so that the base winding 6-7 is towards the middle of the rod. Thin sleeving was put on all leads. Lead 1, Fig. 3, goes to the larger section (front) of the capacitor, VC1/2. Lead 2 runs to the wavechange switch S1.

L2 is put on the rod so that its turns are in the same direction as those of L1, which can be seen by looking at the windings. If L2 is reversed, l.w. alignment is impossible, and the winding should be taken off the rod, turned round, and replaced. The

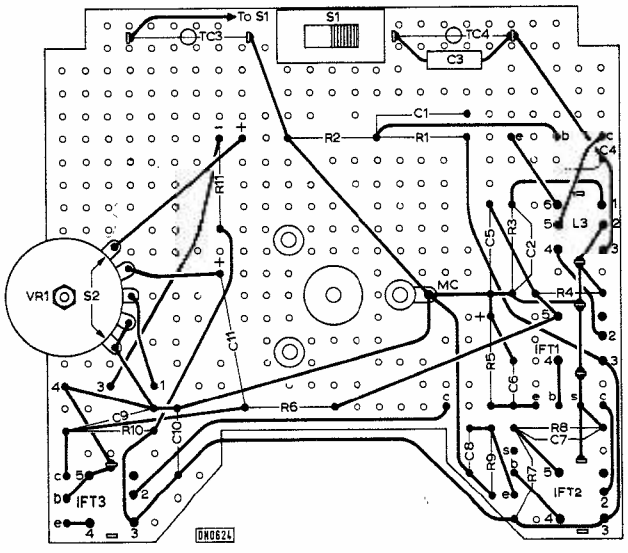



*Fig. 2 : Wiring details of the underside of the Veroboard panel on which the receiver is constructed.*

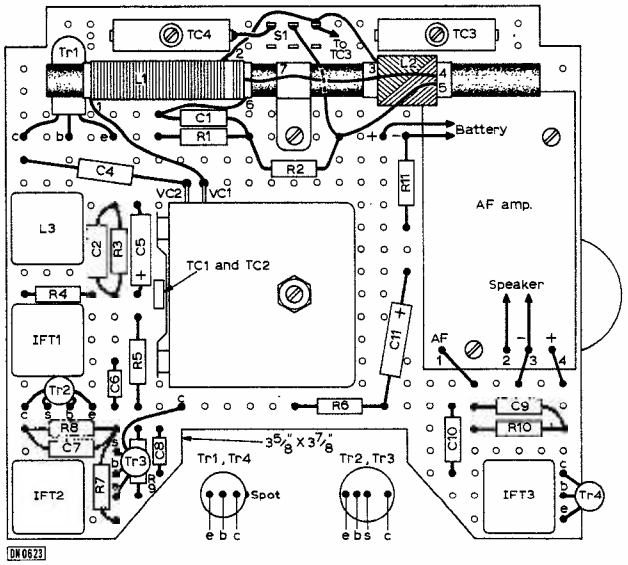



*Fig. 3 : Topside of board showing location of the major components. Ensure that IFT's and L3 are correctly orientated to give pin positions shown in Fig. 2.*

outer lead 3 of L2 joins lead 2 at the switch. The lead 5 taken to positive line must be that which is adjacent to tap 4, which is not at the centre of the winding.

Those lead ends which are single strand wire can be cut, if necessary, carefully scraped, and soldered. But the finely stranded (Litz) wire is difficult to deal with, so the ready tinned ends should be left. Excess length can be taken round the rod in the same direction as the winding.

The rod is mounted by means of a strip of plastic material clamped round it, with a $\frac{3}{4}$in. 6BA bolt and spacer, or extra nuts, so that it easily clears TC3, TC4, etc. It is as well to leave fitting of the rod until last.

## WIRING

Switch S1 is mounted by passing its tags through holes in the board. The tag MC is securely held at one of the fixing screws of VC1/2.

Place transistors so that their leads come as in Fig. 3, with sleeving on the wires. Put suitable lengths of sleeving on the wires which project, bend these over, and solder to the IFT's etc. as in Fig. 2.

The screening can tags of the IFT's and L3 must be connected to the positive line, as in Fig. 2. It proves helpful to use red sleeving on this circuit, black on negative circuits, and some other colour on other wiring; 26s.w.g. or similar tinned copper wire and small sleeving will be convenient.

## ★ components list

**Resistors:**

| | | | | | |
|---|---|---|---|---|---|
| R1 | 56kΩ | R5 | 1kΩ | R9 | 1kΩ |
| R2 | 10kΩ | R6 | 47kΩ | R10 | 27kΩ |
| R3 | 3·9kΩ | R7 | 22kΩ | R11 | 1·2kΩ |
| R4 | 10kΩ | R8 | 4·7kΩ | | |

All ½W 10%

VR1 5kΩ miniature pot, with switch (S2)

**Capacitors**

| | | | |
|---|---|---|---|
| C1 | 0·01μF | C7 | 0·047μF |
| C2 | 0·01μF | C8 | 0·047μF |
| C3 | 150pF 2% SM | C9 | 0·01μF |
| C4 | 175pF 2% SM | C10 | 0·1μF |
| C5 | 10μF | C11 | 8μF |
| C6 | 0·047μF | | |

Minimum working voltage, 9V

TC1/2 part of VC1/2

TC3 60pF compression trimmer

TC4 60pF compression trimmer

VC1/2 208 + 176pF, slow motion, with trimmers (Jackson)

**Semiconductors**

| | | | |
|---|---|---|---|
| Tr1 | OC44 | Tr3 | AF117 |
| Tr2 | AF117 | Tr4 | OC71 |

**Inductors**

L1/2 Ferrite rod aerial (Denco MW/LW5FR)

L3 Oscillator coil (Denco TOC1)

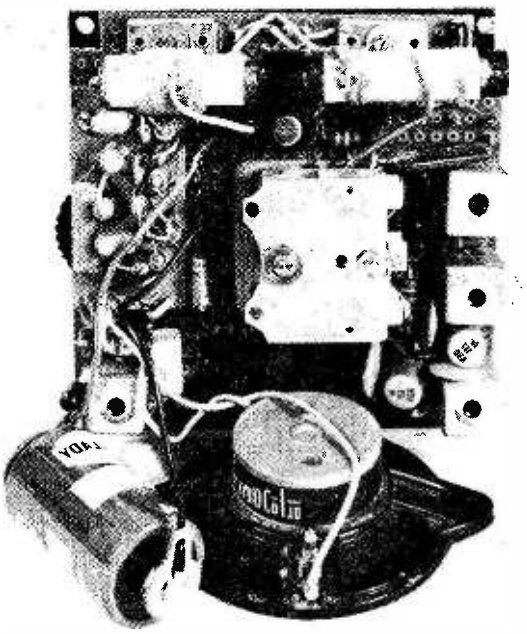
IFT1 IF Transformer (Denco IFT13)

IFT2 IF Transformer (Denco IFT13)

IFT3 IF Transformer (Denco IFT14)

**Miscellaneous**

Switch S1, two-way slide switch. Audio amplifier 125mW (Newmarket PC1). Dial and knob (Home Radio DL64 and KN64). Plain veroboard 0·15in. matrix, 3$\frac{7}{8}$ × 3$\frac{1}{8}$in. Speaker, 2$\frac{1}{2}$in. diameter, 30 to 80 ohms.



*A general view of the completed receiver. It may be tested and aligned in this form before finally fitting it into its case.*

Volume control VR1 is fixed with a small bolt and connected as in Fig. 2. Solder the correct clips to red and black flex for the battery.

## AF AMPLIFIER

Connections shown in Fig. 3 are when looking at the amplifier from the components side. Thread thin wires down through the small holes, and solder to the foil below.

Mount the amplifier with bolts, using a few washers to avoid contact with the bolt holding VR1. Take lead 1 through the board to VR1 slider (centre tag). Twist leads 2 and 3 together, leaving these long enough to reach the speaker. Take a second lead 3 through the board to battery negative, Fig. 2. Lead 4 goes to the positive line.

Leads 2 and 3 should be soldered to the speaker so that the receiver can be tested before adding the panel.

## IF ALIGNMENT

Use a Denco TT5 or other correct tool for adjusting the IFT's and L3 since a screwdriver or wedge-shaped blade may easily break the cores.

If a signal generator is to hand, set it to 470kHz, connect it to C1, and adjust the IFT cores for best volume, keeping this low by reducing generator input.

If no generator is available, alignment may be made with any signal tuned in, following by more careful adjustment with a weak signal, if necessary. Do not use strong signals, with VR1 turned towards minimum volume, because the a.g.c. action tends to make adjustment of the cores seem flat with no sharp peak.

When IF alignment is finished, these cores need not be touched again.

## MW ALIGNMENT

The core of L3 has a considerable influence on band coverage. With S1 at m.w., tune in a station with VC1/2 near maximum capacity and move L1 on the rod for maximum. If dial readings are badly in error, rotate the core of L3, following the signal with VC1/2, to correct this and re-adjust L1 on the rod.

Move to the h.f. end of the band (VC1/2 nearly fully open) and set TC2 for a suitable dial indication, peaking TC1 for maximum volume.

These adjustments should be repeated a few times until no further improvement is obtained. If a generator is available use it at suitable frequencies instead of selecting actual stations.

## LW ALIGNMENT

With S1 at l.w., tune in any transmission, and move L2 on the rod for best volume. Subsequently, it will be found that oscillator coverage can be adjusted with TC4, so that the setting of TC4 and core position of L3 governs band coverage. Then TC3 is peaked for best results towards the h.f. end of the band, and L2 is moved on the rod at the l.f. end of the band.

If any slight adjustment is made to the core of L3, m.w. alignment will have to be repeated. Otherwise merely touch up m.w. adjustments, after completing l.w. alignment.

## CABINET

The cabinet is made of clear Perspex for its novelty effect. The bottom is 4×4in. and $\frac{1}{8}$in. thick while the sides are 4×3in. and $\frac{1}{16}$in. thick. Front and back are also $\frac{1}{16}$in. thick, but are $4\frac{1}{8}$×3in. to overlap the sides. The front is drilled to take the speaker with a grid of holes over the cone area.

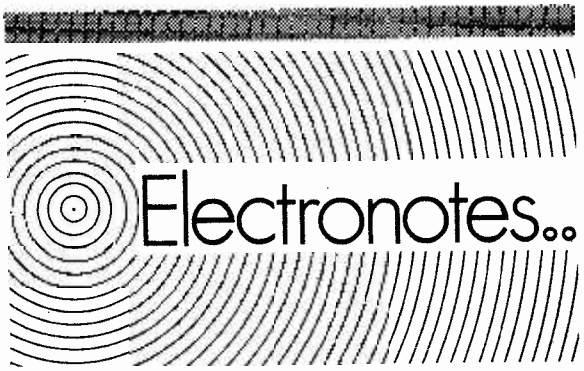
The pieces should be accurately cut and the edges smoothed with a file. After cementing together a strip $\frac{1}{4}$×$\frac{1}{4}$in. and $2\frac{3}{4}$in. long is cemented in each corner to strengthen the box. The strips were tapped 6BA at the top, to take four bolts which pass through the receiver panel, which is slightly inset in the case top. The Perspex could be drilled for self-tapping screws.

A clip is made and fixed to the case bottom with a countersunk bolt, to hold the battery. The speaker leads are long enough to allow the receiver to be lifted out leaving the speaker in the case. A slot is filed to clear the knob of the volume control. Another slot is required for the wave-change switch.

## DIAL

The dial listed has four metal lugs, which pass through slots in the panel. The slots can be made by drilling two or three small holes very closely together and finishing with a very small flat file.

The panel is fixed in the manner described earlier and the dial then put on the lugs being turned over behind the panel. The tuning indicator fitted was a disc of $\frac{1}{16}$in. Perspex, with a black line each side to travel over the m.w. and l.w. scales, and fixed to a brass bush which is locked on the capacitor spindle with a set-screw. A Perspex disc is readily cut with an adjustable tank cutter and the bush made by sawing through a $\frac{1}{4}$in. brass shaft coupling. An alternative is to use a stout wire pointer. ■




HAVE you ever thought just how those complex integrated circuits are made? These innocent looking little slabs of plastic with some 16 pins sticking out of the side are now common to most shops selling components for the constructor.

One of the most difficult parts of the whole process is aligning masks. A slice of silicon is taken and coated with a photoresist. A photographic mask is then laid carefully over the slice and an exposure made. The resultant image is transferred to the slice which, in turn is then taken for processing.

After this first processing, the slice is given the same treatment again; another coating and exposure, then further processing. There may be several printing exposures made during the manufacture of the slice which can quite easily contain thousands of individual tiny semiconductors.

As can be appreciated, because individual devices on the chip are so very very tiny, it is absolutely imperative that during the printing of the individual masks, these must be aligned very, very precisely.

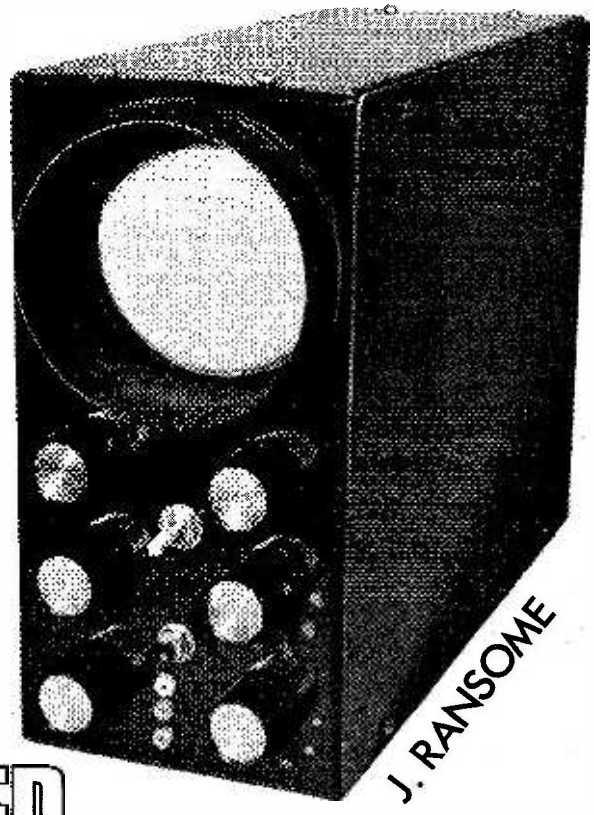
A normal method is to have an operative peering at the chip and the relevant mask through a high powered microscope and the mask guided into position by the operative. While this is successful it does take time since, if the mask is not aligned accurately, several hundred integrated circuits on the slice may be ruined.

A British company has now developed a machine which will align the mask and chip automatically. The secret is the printing of two minute crosses between the pattern for the circuit required. These crosses have their members made up of shaded lines. The machine uses these to align subsequent masks to within 10 micro-inches. Circuit patterns down to 0·0001in. can be printed. The entire printing process from when the operative puts the new slice into the holder to the time it is ejected is only 25 seconds.

A further advantage of this British invention is that the masks are not in direct contact with the slice. Thus there is no abrasion on either slice or mask and the life of the masks, which are very expensive indeed to produce, is considerably prolonged.

Once set up, the machine needs no further attention during the run. The slices are lifted automatically in and out of the photo-electric system by precision mechanical arms. The machine is also self-checking and will stop and/or throw up warning lights if anything goes wrong. For example, if there were no slice in the input receptacle the machine would stop. If a slice were to be damaged the machine would stop and flash a light.

Last month the first part of this article described the case, power supply, display units and initial testing. This second part concludes the article.




# TRANSISTORISED OSCILLOSCOPE

## PART 2

## DEFLECTION AMPLIFIERS

The next phase of the construction is concerned with the deflection amplifiers. Two of these are required, one each for the X and Y plates. The deflection sensitivity of the CRT used is such that about 100V peak-to-peak is required to give a full scan on the tube. Most cathode ray tubes require push-pull deflection to give a scan which is free from trapezium distortion. In order to give something extra in hand on scanning ability the push-pull deflection amplifiers have been designed to give 140V peak-to-peak scan.

The theoretical circuit of the deflection amplifiers is shown in Fig. 10. Tr3a acts as a phase splitter and low gain amplifier. Counterphase signals of equal amplitude appear across R15a and R16a. The only disadvantage of this type of phase splitter is that the two signals have differing source impedances. We therefore push the outputs from the phase splitters into the emitter followers of Tr4a and Tr6a which have a high impedance and are not fussy about signal source impedance. The emitter followers serve a further purpose of controlling the working points of the output transistors Tr5a and Tr7a by means of the standing currents in R19a and R20a. Tr5a and Tr7a are directly coupled to these emitter followers. The voltage gain of the complete amplifier is 12 when referred to a single ended output or 24 when referred to the push-pull output. As the transistors Tr4a and Tr6a control the working points of the output transistors they must be low leakage types. Suspect transistors must be avoided at all costs.

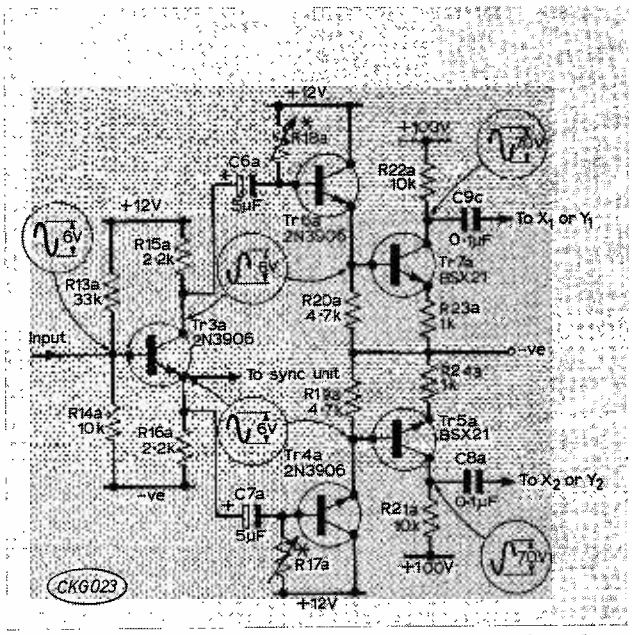



*Fig. 10: Circuit of the deflection amplifiers—two are required, one for the X and one for the Y amp. See text regarding R17 and R18.*

## CONSTRUCTION

The remaining units are built up on a 0·1in matrix Veroboard panel. The board used in the prototype was $6\frac{1}{2}$in × 4in. It is recommended that at this stage all the breaks in the copper strip should be milled out before construction commences. This prevents disasters due to cross wiring as a result of forgetting a hole (here again the voice of experience speaks). The Veroboard layout, also including the Timebase and Y preamplifier, is shown in Fig. 13.

When using 0·1in matrix Veroboard, some care is necessary to avoid shorting out between conductor strips and when the wiring is complete, run a penknife along between the strips to make sure that no solder overlaps the conductors and that no small blobs of solder are shorting out any of the copper

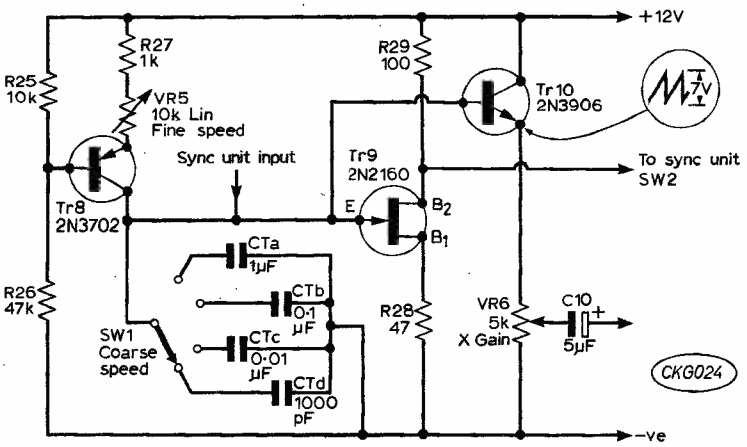



*Fig. 11: The Timebase unit circuit.*

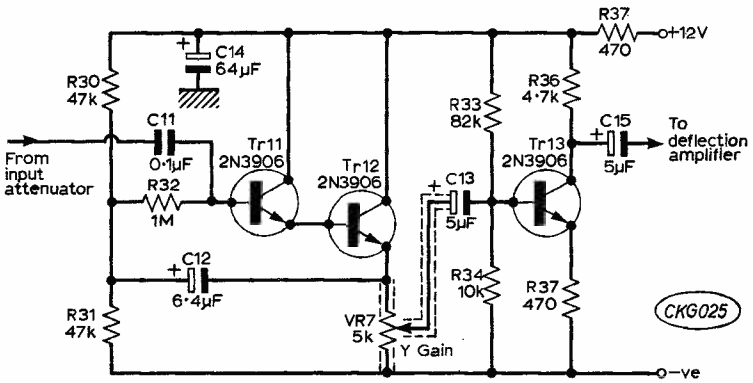
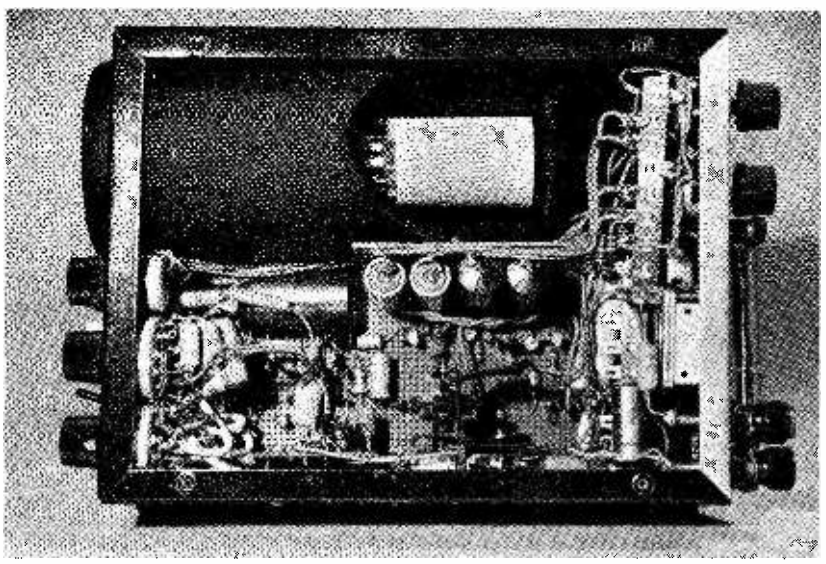



*Fig. 12: The Y-preamp circuit. Note that the emitter resistor of Tr13 should be shown as R35, not as R37; the value shown is correct.*



*An internal view of the completed prototype. The main circuit board can be seen face on while C8 and C9 (a and b) can be seen mounted below the c.r.t. The sync unit is mounted on the base and cannot be seen.*

strips. Wire in all the components with the exception of R17a and b and R18a and b when fixed resistors are preferred as their value must be determined empirically. Do not connect in the h.t. ends of the resistors R21a and b and R22a and b.

Connect the meter between R21a and the h.t. line and switch on. Only a very small leakage current should be indicated on the meter (250µA maximum). If the current is more than this, switch off and check the wiring. If the wiring looks satisfactory, check Tr4a for leakage. If all is well R17a may be wired in place and adjusted to give a standing current of 4mA in the collector of Tr5a. For those wishing to use a fixed resistor for R17a the following procedure should be followed. Take a 330kΩ resistor and bridge between the base of Tr4(a) and the 12V line. Note the current taken. If the current taken by Tr5a is more than 4mA, increase the value of the bridging resistor until there is a standing current of 4mA through the collector of Tr5a if the current is less than this figure—decrease the value of this resistor. Repeat the above procedure for R18a and Tr7a.

The construction and testing of the second deflection amplifier (b components) follows exactly that outlined above.

When all is satisfactory connect the output capacitors to the relevant input terminations on the display unit.

## TESTING

Switch on the complete unit and connect the low level signal to the X amplifier input. A horizontal line of approximately 4cm long should be shown on the tube face. Next apply the signal to the Y amplifier input when a similar line in the vertical plane should be displayed. Next couple the X and Y inputs to the test unit via two 0·1µF capacitors when a circle or elipse similar in shape to that shown when testing the display unit should be seen. Whatever shape is displayed it should be regular with no flats, ripples or waves in it. Any distortions which do occur will almost certainly be due to incorrect selection of the bias resistors R17a and b and R18a and b.

## TIMEBASE UNIT

The theoretical diagram of the ramp generator is shown in Fig. 11. Tr8 acts as a constant current source—the current being determined by the variable resistor VR5 and R27. The output from the constant current source is used to charge the timing capacitor CT selected by SW1. The charge on the capacitor rises until the voltage on the capacitor is sufficient to cause the unijunction transistor Tr9 to fire. When

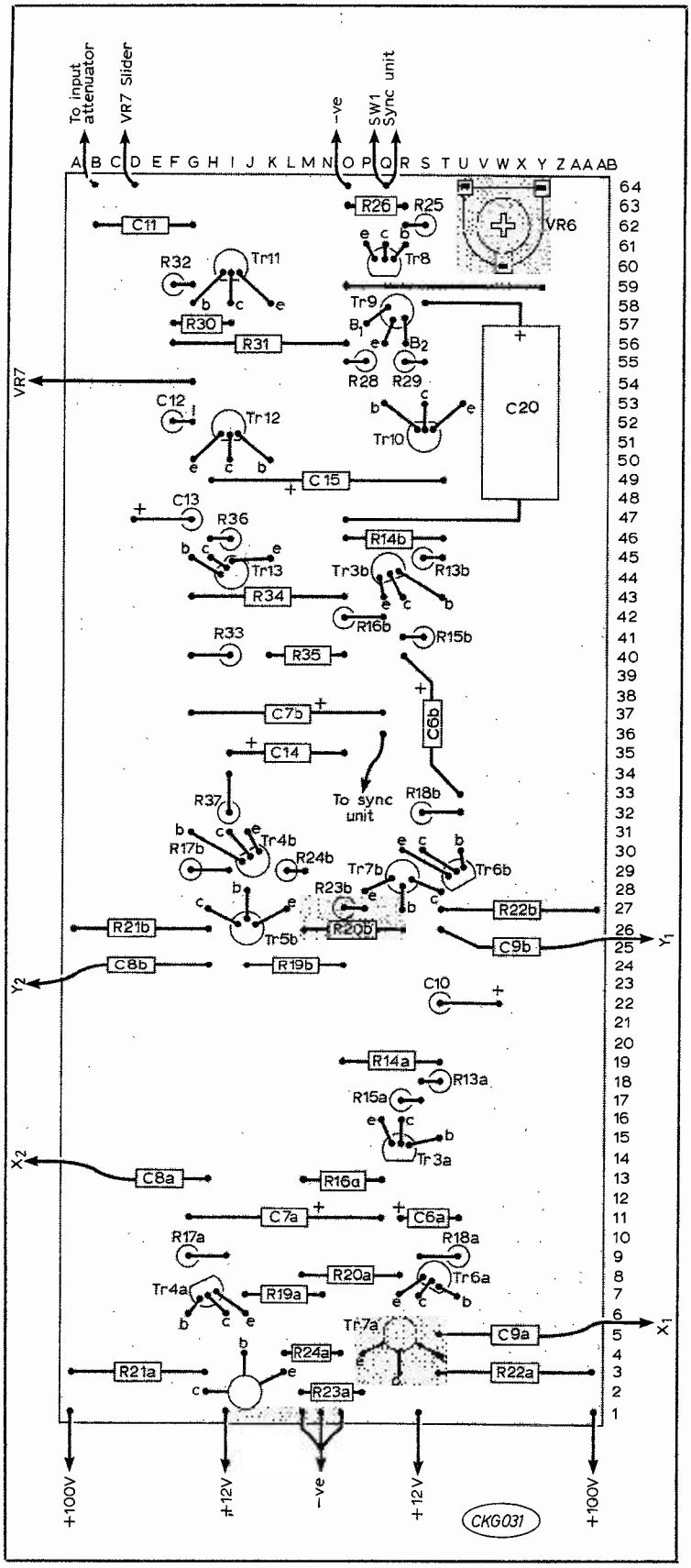



*Fig. 13 (left): The main component board. The deflection amplifiers are in the middle and at the bottom; the Y-preamp is top left and the Timebase top right.*

Tr9 fires it discharges the capacitor and the cycle repeats.

The voltage across the capacitor takes the form of an almost pure sawtooth waveform. Tr10 is employed as an emitter follower—serving to isolate the timing capacitor from the loading effects of the deflection amplifier. VR6 varies the voltage output and, therefore, the scan width. The main advantage of the circuit is that the amplitude of the output waveform is independent of operating frequency for all practical purposes.

## CONSTRUCTION

The scan generator is built on the same piece of Veroboard as the main deflection amplifiers and comprises the components on the top right-hand side of Fig. 13. SW1 and the frequency control resistor VR5 are mounted on the front chassis and flying leads taken back to the Veroboard. The timing capacitors CT are mounted around the course frequency control SW1. Note that Tr8 is a PNP type and is, therefore, connected upside-down in the circuit.

The timing capacitors CTa to CTd are the subject of individual choice but for general purpose audio work the values shown in Fig. 11 should suffice.

Having connected the timebase unit to the X amplifier switch the coarse speed control switch SW1 to select the 1$\mu$F capacitor. Connect the power supply and set VR6 to the top end (emitter end) of its travel. A horizontal line should now be traced across the screen. Adjust VR6 until the ends of the trace are just visible at each end of the tube. Some adjustment of the X shift control may be required. Apply a signal from the low level output of the test generator to the input of the Y amplifier. A sine-wave should now be displayed on the tube face. The number of waves seen will depend on the setting of the fine speed control VR5. It may be that the peaks of the sine-waves may disappear over the top and bottom of the tube—this is quite in order—the tops of the sine-waves should, however, not be flat. Any flattening of the trace is due to incorrect adjustment of the standing current in the Y amplifier output transistors.

The performance of the X amplifier may also be checked for correct biasing by applying the timebase output to the Y amplifier and the test signal to the X amplifier and following the above procedure.

## Y PREAMPLIFIER

The theoretical circuit of the Y pre-amplifier is shown in Fig. 12. Tr11 and Tr12 are employed as a bootstrapped amplifier. This configuration offers a very high input impedance (most desirable for an oscilloscope) but gives very little gain, as a consequence the bootstrapped amplifier is followed by the voltage amplifier of Tr13. The gain of the pre-amplifier is controlled by VR7 which is placed in the low impedance part of the circuit to minimise stray current pick-up in the connecting leads.

The input impedance of the original unit was measured as 1·8MΩ and the voltage gain 7.

## CONSTRUCTION

The pre-amplifier is built on the main Veroboard panel shown in Fig. 13. The components around Tr11 and Tr12 must have leads which are as short as possible as a precaution against pick-up of stray signals. Screened leads must be used for the connection to VR7 earthing the outer braid to the chassis line *at one point only*. If the leads of the input capacitor are longer than 10mm each these too should be screened.

## TESTING

This is probably the easiest circuit to test! Switch on the whole unit and apply a finger to the input capacitor C11. With a 1μF capacitor switched in on the time base unit, a series of sine-waves will be displayed on the tube face (the amplitude of which may be varied by VR7). The input capacitor C11 should now be shorted to chassis—no vertical trace should be seen on the CRT face. If a trace can be seen then more attention must be paid to input screening. The area to concentrate on is the circuitry around Tr11 and Tr12.

## INPUT ATTENUATOR

The circuit of the input attenuator is shown in Fig. 14. The attenuation provides two decades of attenuation—10 and 100. As is the convention, the 100 stage is assigned the level 1 and the two other switch positions are referred to this and represent x10 and x100 gain. In the x1 position the sensitivity is 20V/cm, 2V/cm in the x10 and 200mV/cm in x100 position.

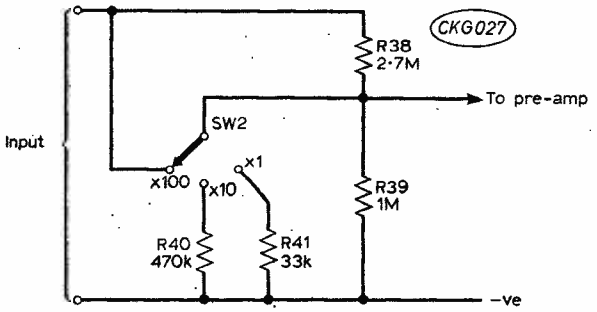



*Fig. 14: The input attenuator circuit.*

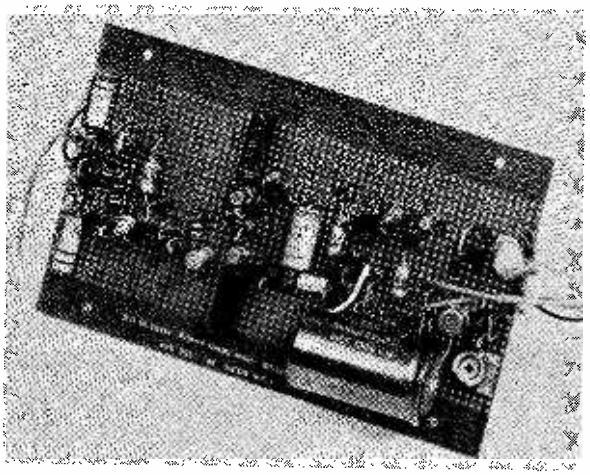
## CONSTRUCTION

All components are mounted on the switch. As the layout is absolutely straight forward and depends to a large extent on the components used, no wiring diagram is shown.

## SYNC CIRCUIT

The theoretical circuit of the sync unit is shown in Fig. 15. The function of the sync unit is to present a stable trace on the CRT screen. While this can be achieved by careful adjustment of the fine frequency control, the sync unit enables traces of waveforms of varying frequency to be displayed.

Tr17 acts as a switch and is effectively wired across



*The main component board; compare this with Fig. 13.*

the timing capacitor CT. When Tr17 is switched on, CT is shorted and cannot charge from the constant current source. As soon as the base of Tr17 is open circuited Tr17 then becomes effectively a high resistance across CT allowing CT to charge in the normal way. The resistance of Tr17 in the open circuit mode is sufficiently high not to affect the charge in CT.

Tr17 is switched by the bistable built around Tr15 and Tr16. Negative pulses applied to the base of Tr16 switch off Tr17. Negative pulses applied to Tr15 base switch Tr17 on.

The operational sequence is as follows: as the unijunction Tr9 fires and discharges the timing capacitor CT, a negative pulse is developed across R29. This pulse is fed to the base of Tr15 and this switches Tr17 on—shorting out the timing capacitor CT. The timebase is now switched off and will not start again until a negative pulse is applied to the base of Tr16, thereby "opening the gate". These negative opening pulses are effectively the sync pulses and are derived from the Y amplifier circuit.

The sync pulses are derived from the Y amplifier by means of the squarer circuit around Tr14. Tr14 is an over-driven amplifier producing square waves from any sine-wave or square wave input. The square-wave produced across R42 is put into the differentiator circuit of C16 and R43. From the differentiator circuit two sets of pulses are produced —one set positive going and the other negative going. The positive pulses are rejected by D7 and only negative going pulses are applied to Tr15. It must be noted that the resistor R43 does not repre-

sent the full resistance in the differentiator as the resistance of R45 is effectively across R43 during the negative pulse.

The input to the squarer circuit is derived either from R16 "b" in the Y amplifier or from an input on the front panel for external sync.

## CONSTRUCTION

The original unit was built as a separate unit from the main chassis although there is more than ample room for the sync unit on this board. The layout is shown in Fig. 16.

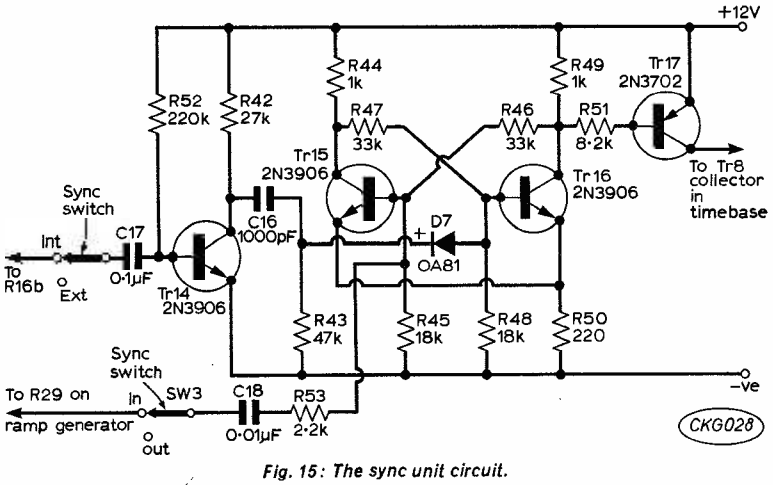



*Fig. 15: The sync unit circuit.*

## TESTING

Wire in the complete unit with the exception of the connection to R29. Switch on and apply a signal to the Y input. The timebase should run as normal. Disconnect the input to the Y pre-amplifier and make up the connection to R29. It will be found that the timebase will not run. Next apply a signal to the Y input when the timebase will fire normally. The degree of synchronisation can be assessed by noting the intensity of the spot at the right hand side of the trace. The brighter the spot the wider the difference between the fundamental frequency of the timebase and the input frequency signal. The "pull-in" range of the sync unit will be found to be very wide.

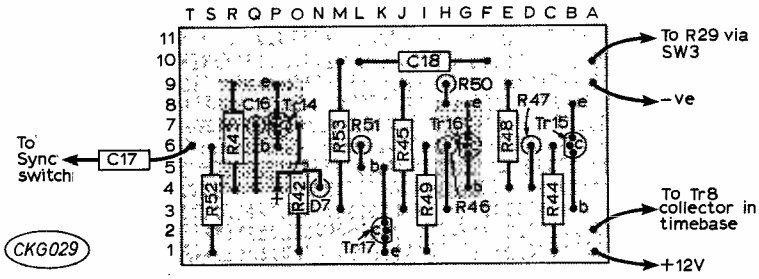



*Fig. 16: The component layout of the sync unit.*

## CALIBRATION

For maximum usefulness the Y amplifier must be calibrated to determine the deflection sensitivity and the timebase frequency evaluated. The Y amplifier sensitivity can be calibrated using the circuit of Fig. 7. With a mains input of 240V, a peak-to-peak voltage of 48V is obtained from the high level output and 4·3V peak-to-peak from the low level output. By feeding the appropriate output from the calibrator into the Y input, the deflection sensitivities can be measured. It is usual to express the sensitivity in terms of volts per centimetre.

The timebase frequency may now be determined. Before proceeding further the multivibrator of Fig. 17 must be constructed. With the highest value capacitor switched into the CT position, feed in a 50Hz signal from the calibrator (Fig. 8). Count the number of complete cycles displayed. As each complete cycle occupies 20 milliseconds, the ramp speeds may be computed. The timebase speed is expressed in terms of milliseconds per centimetre. Set the timebase speed so that only one complete cycle is displayed with the sync unit switched off. Apply the output from the calibration multivibrator to the Y input. Set the timing resistor VR300 so that 20 sets of complete square waves are seen. The multivibrator is now set to 1kHz and is, therefore, producing pulses with a repetition speed of 1 millisecond. This 1 millisecond calibrator may then be used to measure the

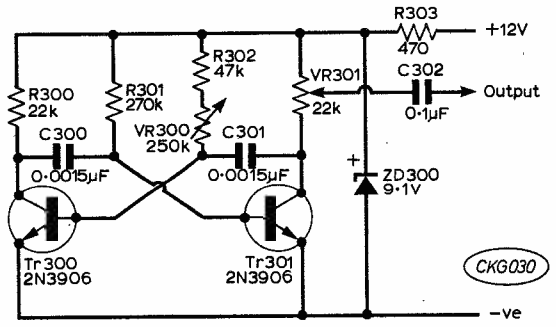



*Fig. 17: A circuit which may be used for calibration.*

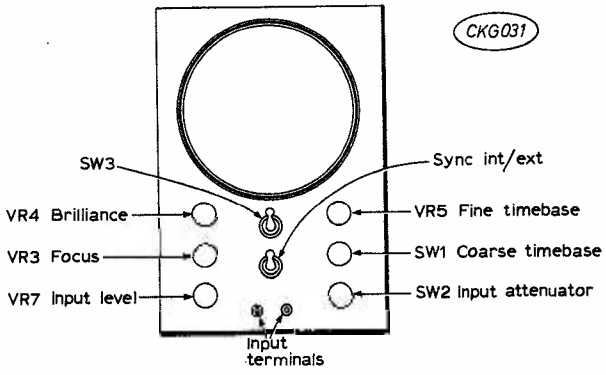
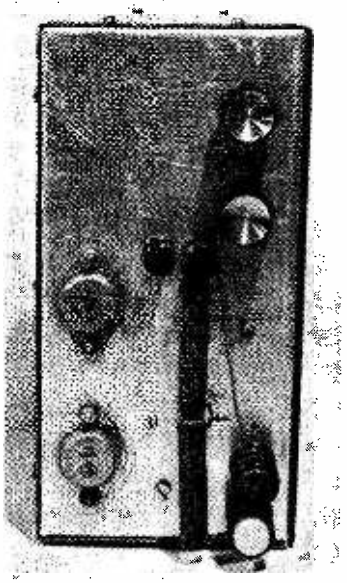



*Fig. 18: The siting of the controls on the front panel.*

speed of the timebase on the higher ranges.

Using the calibrated Y input set the output of the multivibrator to 1V peak-to-peak and seal the output potentiometer VR301 and the timing resistor VR300. The calibrator may then be built into the oscilloscope unit if required. No constructional details are given of this simple circuit.



*A rear view of the completed unit showing the resistors making up R12.*

## GENERAL

As stated in the introduction, a wide range of transistors may be used in the circuit. With the exception of the deflection output transistors all the NPN transistors can be almost any type satisfying the following criteria:

a Silicon construction (or *low* leakage germanium)
b $V_{ce}$ greater than 15V
c Dissipation greater than 250mW
d Gain greater than 40

The PNP transistors must be of silicon construction as the circuits in which they are employed rely on the transistors having low leakage. Within this limit any silicon PNP working at a low voltage greater than 15V will be satisfactory.

The output transistors can be any type having a $V_{ce}$ greater than 120V and a gain greater than 20. ■

### Back Numbers

We regret to inform readers that owing to the closure by the Company of the department concerned it will no longer be possible to supply back numbers of **Practical Wireless** and **Television.**

To ensure obtaining regular copies of these magazines readers are strongly urged to place a regular order with their local newsagent, or to take out an annual postal subscription.

Reference to past issues of the magazines may sometimes be obtained at certain public libraries who may hold bound volumes. A few libraries are said to offer a photostat service. Alternatively, we are always willing to insert a free request for specific back numbers in our "CQ" column which appears in most issues.

# COMPREHENSIVE MULTIBAND RECEIVER

## (PW Nov-Dec. 1971)

## FURTHER NOTES

By

## F. G. RAYER

On the short wave ranges, coverage is approximately 1·7-5·0MHz, 5-15MHz and 11-31MHz, similar to that provided with many receivers. As plug-in coils are used, it is easy to split up coverage to include one extra range. This opens out tuning a little, but its main advantage arises if a v.h.f. convertor requiring continuous tuning from 4-6MHz is added, as this then falls in a single range, avoiding coil-changing.

To add this range, adjust the coil cores for ranges of 1·6-3·8MHz, 7-14·5MHz and 13-31MHz. The new or additional range is 2·5-6·0MHz. The coils for this coverage are as follows:

**Aerial.** "Blue" Range 3. Remove 12 turns from the tuned section, and re-solder.

**Mixer.** "Yellow" Range 3. Modify as for aerial coil.

**Oscillator.** Use a "White" Range 3 oscillator coil, instead of the "Red" Range 3 oscillator coil, padder values and connections remaining unchanged.

Proper ganging will be obtained, after adjusting the aerial and mixer coil cores in the way described.

### TUNING METER

Space is available to the left of the tuning scales for a 42mm square S-Meter (1mA f.s.d.), and a suitable circuit is shown in Fig. 1. With aerial shorted to earth, VR1 is rotated until the S-Meter reads zero. When a signal is tuned in, the a.g.c. voltage reduces the i.f. stage cathode current through R1. Less voltage is dropped across R1, causing the negative terminal of the meter to become negative, so that a reading is produced. Sensitivity can be modified by changing the value of R2.

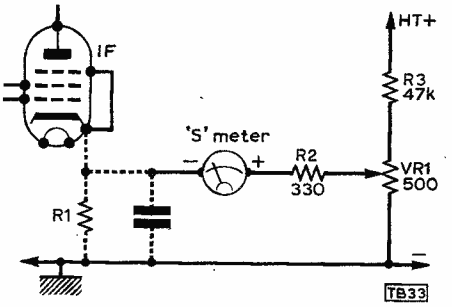
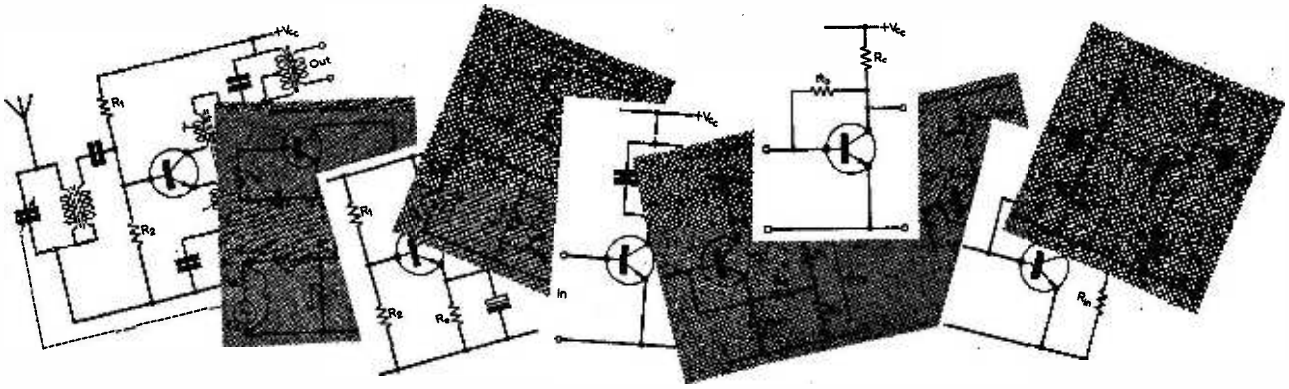



*Fig. 1: Additional circuitry required for installing the S-meter*

All trimming or other receiver adjustments are directed towards obtaining the highest meter reading. External improvements, as to the aerial-earth system, will also increase meter readings. ■



# TRANSISTOR CIRCUITRY for beginners

## PART 6

H.W. HELLYER & MICHAEL HOLLIER

### Upper and Lower-case

Those of you who are still with us, and old hands at transistor circuit building, may not need reminding; newcomers may wonder what the heck I am talking about; but recent correspondence reveals that it is necessary to recap on one vital point—the use of upper-case (capital) and lower-case (small) letters when we are discussing transistor parameters.

More than ever necessary when we ourselves are guilty of the cardinal error of using them wrongly. My excuse could easily be that I could not read Michael's scribble that accompanied the little module that we made the subject of Part 5. But I should have spotted that in the section headed "input Impedance", the second sentence of the second paragraph began . . . "H parameters again, but $h_{ie}$ simply means. . . ."

That capital H should have been a small one, of course, and I should have rewritten the sentence so that it did not kick off with "H".

Later on, talking about the base bias, I committed a similar crime. "The base current $I_B$ is found from the formula $I_B = \frac{I_C}{H_{FE}}$ where $H_{FE}$ is the d.c. current gain of the transistor.

Our capitals are quite right on the suffix—FE refers to the d.c. current gain, certainly, while fe is the forward current gain with output shorted and in the common emitter mode. But the capital H is wrong. As you will have noted from the December 1971 issue, page 711, hybrid parameters have their own strict code of symbolism, and we use h, as in $h_{ie}$ or $h_{fe}$ or $h_{FE}$, and so on. On another page, friend Henry, who is probably poking gentle fun at our flounderings, would be quick to tell you that capital H means something quite different!

### Super Alpha

Back then to our subject, the Darlington Pair of transistors, or, to give them their alternative title, the Super Alpha circuit. Their purpose, to recap to the end of Part 5, to increase the input impedance of our buffer amplifier circuit, without despoiling any other of its good points. Remember, we pointed out that good matching was more easily achieved if the impedance of the device into which the signal was being fed was ten times or more that of the output which was feeding it.

There is no cast-iron rule about this, but the generalisation needs stating, for, so often, manufacturers fail to agree with any known standard in stating their specifications, and 100kΩ might mean the input "wants to see" 100kΩ, and is actually considerably higher if measured, or might mean that it actually is 100kΩ.

Then, you see, if you try to match some circuits with 100kΩ output into this "specified" input, you simply would not get the conditions that the specifications might have led you to expect.

This is a practical problem, and I make no apology for introducing it at this point, for the Darlington circuit, on the face of it, looks like a complicated way of achieving what could be done much more simply. Not so, as we shall demonstrate by a step-by-step design exercise.

### Why high?

Accept, first of all, that we need a high impedance input. Harking back to the prototype that Mike built, we were able to measure 105kΩ input impedance on the built-up model, and could probably have improved somewhat on this with a bit of fiddling. But did you notice the underlined remark that followed? To summarise, frequency limits are affected by the source impedance.

There are occasions when we want to match something whose source impedance is (a) much higher than a tenth, or even a fifth, of our input impedance, or (b) alters drastically with frequency, i.e., is reactive. A perfect case in point is the crystal microphone. There are a lot of these about, and they are often capable of giving much better results than they do when matched into the tape recorders or "Disco" mixers with which they are sold. Don't always blame the microphone: if you don't believe me, ask Cosmocord Ltd., who market a wide range of these devices under the Acos label and get very hot under the collar when they think of some of the ways in which their products are used—or misused!

So, what are the limiting factors that prevent us achieving a higher input impedance, or, to be technical $Z_{in}$? First, the forward current gain, $h_{fe}$. The larger this is, the greater the input resistance will be, $h_{ie}$. Check back with part 5 to see the significance of this and go on to $r_e$. This (often overlooked) internal resistance of the transistor itself matters a lot. Because it doesn't show up on circuit diagrams, the clever dicks who simply alter calculated circuits, like the well-engineered Mullard, Ferranti or Motorola published circuits, find their finished construction behaving in unpredictable ways. It is a fixed value. It cannot be altered, but, though small in relation to RE, it has to be allowed for.

RE, the external resistance, seems to give us scope for manoeuvre. Increase this and, as we have seen, we increase the input impedance. Lovely—except that an increase in resistance here will mean an increase in the voltage dropped across the resistor, so we now need a higher supply. Even if this can be made available, it is not always desirable for input stages, where, in general, the higher the operating voltages, the more the noise problem rears its ugly head.

Base bias resistors also have to be considered. Remember, in Part 5, we were very concerned with their effect on the overall circuit. To put it into plain language, if you calculate them to get the best d.c. conditions, you may very well find your circuit unable to cope with the a.c. conditions or the matching—which, after all, is why the darned thing is being built!

If the values of base bias resistors are increased, we can reduce their shunting effect on the transistor input d.c. resistance ($h_{ie}$). But under a.c. conditions, we may very well find the stability of the circuit seriously affected.

So, accepting that there are limits to what we can do in the way of altering components and voltages of a common emitter amplifier circuit in order to achieve a high input impedance, let's turn immediately to the solution, and see what, in fact, it does.

## Darlington Pair

There is nothing magical about the term Darlington. Without delving into the historical context, we are simply referring to a method of combining two transistors in such a way that they effectively form one, but with different characteristics.

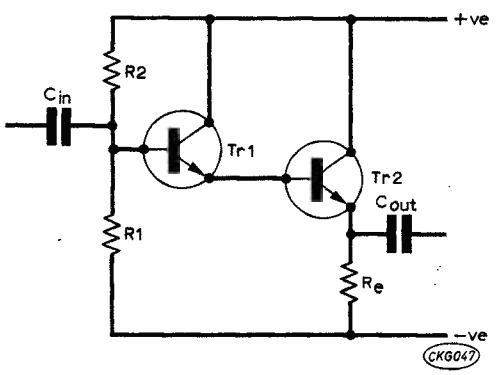



*Fig. 26: The rudiments of the Darlington Pair circuit.*

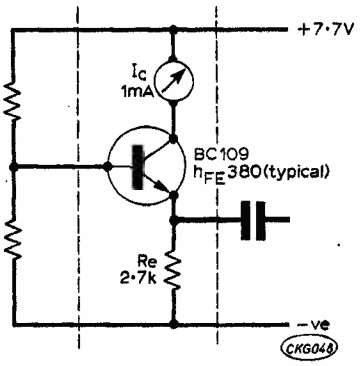



*Fig. 27: Consider only Tr2, isolated from the rest of the circuit, with imaginary bias.*

Take a look at Fig. 26, and you will see this done in the emitter follower mode. As I hope to show later, this is not the only configuration in which it applies, but it suits our purpose at the moment to rip it to bits and discuss the design.

If you want to make a buffer circuit yourself, with a high impedance output, then the following notes may help you adapt your own bits and pieces rather than have to mourn about "those lucky blokes at PW who can lay their hands on anything they want" as a recent correspondent said.

Fig. 26 shows two n.p.n. transistors, connected so that both collectors are taken to the positive rail, the input to the base of the first, Tr1, is biased in the way we have already seen, but whose emitter is taken to the base of Tr2. Looked at one way Tr2 forms the emitter load of Tr1; another way, Tr1 and its operating conditions, determine the base input conditions of Tr2.

Looking first at Tr2, and referring to Part 5, we see that the output is taken across $R_e$, the emitter resistor, via $C_{out}$, but the base bias, instead of being derived from two resistors (as with Tr1) depends on Tr1 and its operation. So let's pretend for a moment that Tr1 doesn't exist, and that Tr2 has conventional biasing, repeating last month's circuit, but with dotted lines to show that the BC109 between them is really the Tr2 of our present Fig. 26. We now have Fig. 27, where some values are inserted and a few more details are given.

## Calculations

Recapping again, we chose a typical transistor and typical operating conditions, so in Fig. 27 we state an $I_c$ of 1mA, an $h_{FE}$ of 380 and as the base current $I_b$ is the former dividend by the latter,

$$I_b = \frac{I_c}{h_{FE}} \text{ or } \frac{1mA}{380}$$

which is 2·6μA.

If now we refer back to Fig. 26. and connect Tr1 in the base circuit of Tr2, making them similar transistors, as it happens, though they don't necessarily have to be, we shall see that base current of Tr2 will flow through Tr1 emitter, so we can immediately say that the emitter current of Tr1 is 2·6μA.

Unfortunately—there's always a catch, isn't there? —at such a low current, almost all forms of transistor likely to be used in our buffer circuits

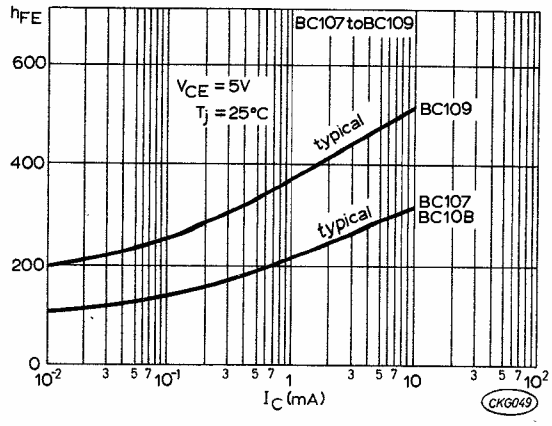



*Fig. 28: Typical variations of forward current transfer ratio $h_{FE}$ with collector current $I_C$. Note that curve is for specific collector voltage $V_{CE}$.*

would have a very small a.c. current gain $h_{fe}$ in these circumstances. Now do you see why I began with that upper-case and lower-case argument.

We must do something about this. Increasing the current in Tr1 is the obvious first thought, so we refer to the $h_{FE}/I_c$ graph for the transistor in question.

Messrs Mullard, as ever, are immensely helpful, and can provide graphs that tell us practically everything except the Sign of the Zodiac when the transistor was born, so our Fig. 28. is a reproduction of their "typical variation of forward current transfer ratio with collector current". Please note, this is at a particular collector-emitter voltage, in this case $V_{CE}=5V$. But from this we can get some idea of what we want, and this is the sort of collector current it would be desirable to use. Here, we see the lowest usable value is down around 10μA. We shall use a collector current of around 50μA, and from the graph we can see that this will give us a d.c. current gain, $h_{FE}$, of somewhere around 260.

## Increasing $I_E$

We have 2·6μA of emitter current so far, and we need 50μA. Let's just revert to previous theory and stick in another resistor $R_{e1}$ from the emitter of Tr1 to the negative line, as in Fig. 29. Now, this circuit is not for construction: it is deliberately drawn to illustrate the design theory; please bear with me!

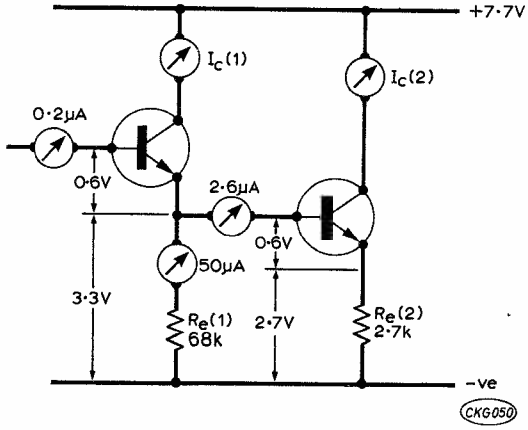



*Fig. 29: The voltage and current plan of the simple circuit from which the final working model will evolve.*

We have included the known voltages and currents, that is the collector current of Tr2, which is 1mA, and the base current of Tr2, which is 2·6μA. So the emitter current is effectively the same as the collector current, as the effect of the very small base current, which also flows through $R_{e2}$, can be ignored. 1mA flowing through 2·7kΩ gives a voltage drop of 2,700/1,000 or 2·7V. That's our emitter voltage of Tr2 fixed.

The base to emitter voltage of a silicon transistor is around 0·6V, so we come up with a base voltage for Tr2 of 2·7 + 0·6=3·3V. Take another look at Fig. 29. This is now the emitter voltage of Tr1, which was one of the missing factors. Again add 0·6V and we get a figure for the base voltage of Tr1, i.e., 3·3 + 0·6=3·9V.

$R_{e1}$ is the mystery component. The emitter current of Tr1 will be the sum of that base current previously considered and the current flowing through $R_{e1}$. But we have already said that the required emitter current is to be 50μA. So that leaves us with 50 + 2·6 or 52·6μA as the actual emitter current.

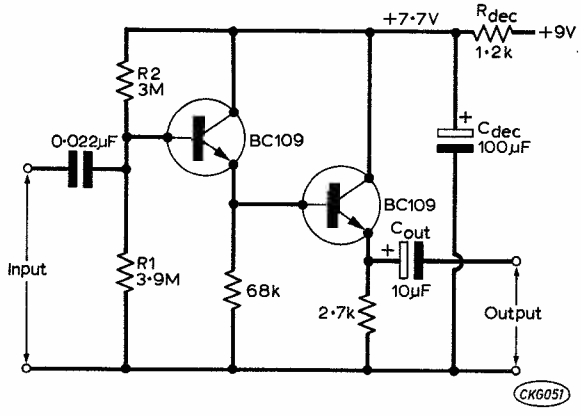



*Fig. 30: The end result, a Darlington Pair input circuit with reasonably high impedance, good stability and the gain required.*

The collector current $I_C$ of Tr1 flows through $R_{e1}$ and we know the emitter voltage. So $R_{e1}$ the emitter resistor

$$\frac{3{\cdot}3V}{50\mu A} \text{ or } \frac{3{\cdot}3}{50 \times 10^{-6}} \text{ or } \frac{3{\cdot}3 \times 1{,}000{,}000}{50} = 66{,}000\Omega$$

Choosing components within a 5% tolerance range, we can settle for a preferred value of 68kΩ, and this is now marked in on Fig. 29.

## Base current Tr1

We now have the correct base current in Tr2 and the correct emitter current in Tr1 so can go on to calculate the values of bias resistor we shall need.

The base current of Tr1 will be its collector current (which we know) divided by $h_{FE}$, the d.c. current gain. But this base current is only a very small fraction of the emitter current, and can be ignored for the next calculation.

Taking the collector current $I_c$ of Tr1 to be the same as its emitter current, 52·6μA, we prove this point by saying:

$$I_{b(1)} = \frac{I_{c(1)}}{h_{FE(1)}} = \frac{52{\cdot}6\mu A}{260}$$

somewhere near 0·2μA.

Developing our final circuit, Fig. 30., and ignoring for the moment that I've already marked in the values of R1 and R2, let's calculate their ohmic values from what we already have. First, a proviso: for good stability, we want about five times as much current flowing in the bias chain as we have base current. So, 0·2 × 5 = 1μA as a guiding value.

We know the base voltage of Tr1 is 3·9V. The lower resistor, R1, has our desired figure of 1μA through it, so the value is

$$R1 = \frac{3{\cdot}9}{1 \times 10^{-6}} \quad \text{or } 3{\cdot}9 \times 1{,}000{,}000 = 3{\cdot}9M\Omega$$

This is a standard value, and a 5% tolerance component would be used.

R2 has a voltage dropped across it which is the difference between the collector voltage (in this case, the positive rail after decoupling) and the base voltage, = 7·7 − 3·9 = 3·8V. So

$$R2 = \frac{3{\cdot}8}{1{\cdot}2 \times 10^{-6}}$$

where the denominator in this case is the 1μA flowing through R1 plus the 0·2μA of base current.

$$R2 = \frac{38{,}000{,}000}{12} = 3{,}166k\Omega$$

A 3MΩ resistor, 5%, is near enough, and two 1·5MΩ resistors in series may be a more practical solution.

**If you are in doubt about this tolerance business and having to make up values with series or parallel resistor combinations, bear in mind the simple rule: in series, variations in the biggest resistor have most effect—in parallel, variations in the smallest resistor have most effect.**

## Input resistance

Looking into the base of Tr1, ignoring R1 and R2 for the moment, the input resistance is calculated from $R_{in} = h_{fe(1)} \times h_{fe(2)} \times RE(2)$. Approximately—because we now ignore those tricky hidden resistors, $r_e$ of each transistor, which are now very small in comparison with the values of external $R_e$ we have calculated.

Provided $R_{e1}$ is many times larger than $R_{e2}$, its shunting effect on the input of Tr2 will be negligible. Make it between 5 and 30 times the value of $R_{e2}$ and we shall not have many worries, so our $R_{e1}$ is 68kΩ.

Harking back to the formula for $R_{in}$, we get the $h_{fe}$ figures from the published data sheets ($h_{fe}$ rising as collector current rises, remember), see Fig. 31. $R_{in} = 240 \times 440 \times 2{,}700 = 285{\cdot}12M\Omega$ to be exact.

The Stage Resistance is the parallel combination of this with R1 and R2, which is—work this one out from the formula

$$\frac{1}{R_{IN}} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R_{in}} = \frac{1}{3{\cdot}9M\Omega} + \frac{1}{3M\Omega} + \frac{1}{285M\Omega}$$

approximately 1·6MΩ

## Decoupling

Theory and practice never coincide, and the desired rail voltage may be quite a lot less than a convenient battery size. So we drop the residual voltage and decouple the line to prevent alternating signals modulating the battery resistance and causing the supply voltage to vary.

The components used are shown in Fig. 30. and are calculated from the voltage difference 9V − 7·7V = 1·3V divided by the total current. This is the collector current of Tr1, 0·05mA, of Tr2, 1mA and in R2, 0·0012mA, total 1·0512mA.

We can take this as 1mA through $R_{dec}$, giving

$$\frac{1{\cdot}3}{1 \times 10^{-3}}$$ or 1·3kΩ. Again, using the nearest preferred value, within tolerance, we'll settle for 1·2kΩ at 5%.

The decoupling capacitor needs to be quite large, as we have already discussed, and a practical value is 100μF. Similarly, a practical value of the output coupling capacitor, $C_{out}$, would be around 10μF.

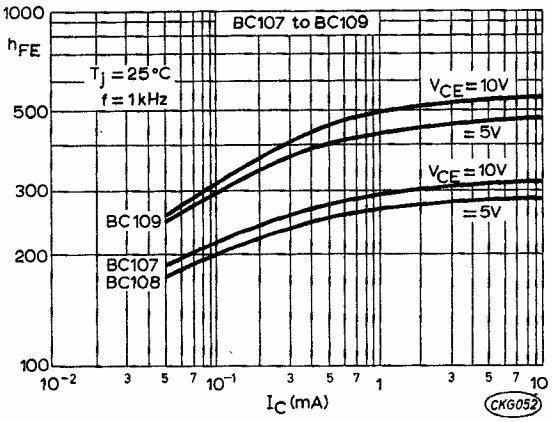



*Fig. 31: Graph of variation of input impedance with collector current.*

But $C_{in}$ need not now be so large as we previously needed. The a.c. resistance (impedance) into which it is feeding is so much higher than before that a value such as 0·022μF could be used. To check this, take the value that gives the same reactance to your desired lower frequency limit as does the input impedance of the circuit—i.e., the −6dB point (voltage). This works out to around 4Hz for 0·022μF which is plenty good enough for our purpose.

Before leaving the subject, I revert to that designation "Super Alpha". The term alpha, symbol α, you will remember from previous notes is in our case the same as $h_{fe}$. As we obtained our $R_{in}$ by multiplying the two $h_{fe}$ figures, the effective $h_{fe}$ of the Darlington Pair is called Super Alpha.

## Other uses

We have only been talking about input circuitry, and an impression may have been given that the Darlington pair is explicitly an input device. Not so, and just to prove it, but without any calculations, Fig. 32 shows four possible configurations of complementary push-pull output stages of audio amplifiers. These are stripped to their essentials, and have all been used in some form or another.

The use of the Darlington pair in power amplifiers

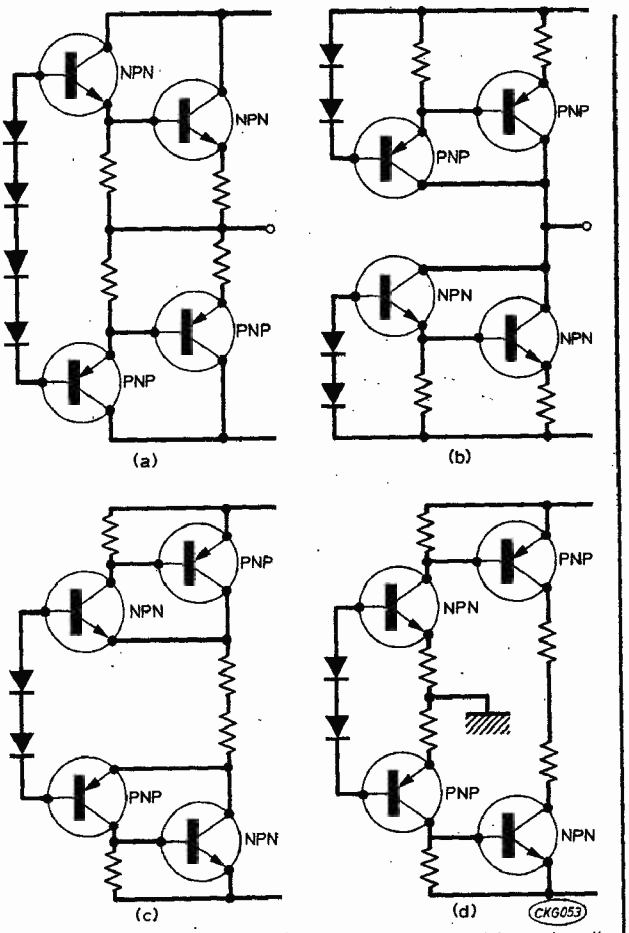



*Fig. 32: Four variations of the Darlington Pair as used in push-pull output circuits of commercial power amplifiers.*

overcomes (to some extent) a disadvantage of complementary symmetry, which is high current dissipation of a Class A driver transistor. Some other solutions exist, of course, such as quasi-complementary circuits, where the driving pair are "opposites" and the driven pair a matched and similar pair of transistors. This is not the place to talk about power amplifiers—a fascinating subject—but to illustrate the Darlington pair, so first to Fig. 32(a), where the two "halves" of the complementary circuit are formed from two pairs, much the same as we have already dealt with.

The drawback here is a biassing problem: base/emitter voltage at the point of conduction differs widely between driver and output transistor. Some bias adjustments are needed to supplement the work of the diodes.

Fig. 32(b) is an alternative, solving some problems, but really doing no more than turning the Darlington pairs upside down.

If we try, instead, the pair "inside out", we produce the cascaded complementary configuration of Fig. 32(c) where each set operates as an emitter follower. It is easier to provide bias because the diodes are more easily matched, but Fig. 32(d) shows the more usual solution, where we get the power gain of the two cascaded common emitters and a better bias system. But it has a drawback not always taken care of in eventual construction, and that is a more touchy thermal stability.

**TO BE CONTINUED**

**CHARLES MOLLOY**

# THE Medium Wave Column

**E. WILDMAN** of Southall, Middlesex has been busy with his Practical Wireless medium wave loop antenna. North American stations logged include WOR New York on 710kHz; CBM Montreal on 940kHz; WINS New York 1010kHz; CBA Moncton on 1070kHz; WBAL Baltimore 1090kHz; WNEW New York 1130kHz. He asks if medium wave DX is best during periods of anti-cyclonic weather. Although high pressure systems affect v.h.f. reception they appear to have no effect on the medium waves. Propagation on the lower frequencies is through the ionosphere which lies far above the thin shell of weather that surrounds the earth.

**P. J. Kay** who lives in Magull near Liverpool, reports reception of WNEW 1130kHz at 0030hrs on November 15th using a Perdio transistor portable. Very occasionally, high power North American medium wave stations such as WNEW, which is 50kW, are received in this country at considerable strength and can be heard from a favourable location on simple equipment. More reliable reception will be obtained by using a sensitive and selective receiver of communications standard along with an outdoor aerial or an indoor medium wave loop. Search before midnight for the following stations, all of which have been logged frequently during recent months. CBN St John's, Newfoundland on 640kHz; CJOX Grand Bank, Nfld and WOR New York, both on 710kHz; WDHN Boston on 850kHz; CJON St. John's 930kHz; CHER Sydney 950kHz; WINS New York 1010kHz; CBA Moncton 1070kHz; WNEW 1130kHz. These broadcasters are easy to identify as they use their callsigns frequently. After midnight look for Godhavn in Greenland on 650kHz. It can usually be heard with programmes in Danish or "Greenlandic", when reception from North America is favourable.

**Harold Emblem** of Mirfield, Yorkshire, reports reception of the new EAK5, Radio Popular Las Palmas in the Canary Islands on 836kHz. Michael Barraclough of Whitby mentions that this newcomer to the band is anxious for reception reports which should go to AP744, Las Palmas de Gran Canaria-1, Canary Islands. Harold has also logged the new outlet at Abu Dhabi in the Persian Gulf on 809kHz at 0230 hrs. Radio Pakistan has been heard testing on 1010kHz and has been logged by the writer at 2320hrs. This station is believed to be in West Pakistan.

**Gordon Darling** of South Harrow draws attention to a recent supplement to the Post Office Guide which says that Commonwealth Reply Coupons are no longer accepted in Canada, Australia, Ceylon, Trinidad and Tobago. In future, MW DXers sending reports to Canada will have to enclose an International Reply Coupon.

Please send reports and information about the medium waves to the author at 132 Segars Lane, Southport, PR8 3JG.

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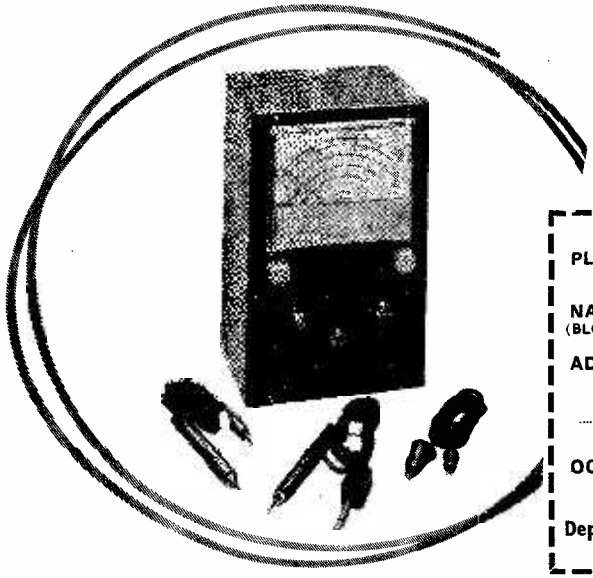

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# ON THE SHORT WAVES

## MONTHLY NEWS FOR DX LISTENERS

# THE BROADCAST BANDS

Malcolm Connah

**Frequencies in kHz ● Times in GMT**

NOW that we have all recovered from the Festive Season we can get back to our shacks and start logging some DX. Many of you will have received new equipment as presents so how about putting it to good use and sending in a report.

## Logs

The first report this time comes from **Bryan Ewing** in Seven Kings, Ilford. Bryan's equipment consists of a Codar CR70A, an ATU and a 50 foot long-wire, his log included:—

6025 *Radio Portugal* at 2112.
6075 *R.A.I., Rome,* Italy at 0436.
6120 *S.B.C., Berne,* Switzerland at 0152.
6170 *Radio Sofia,* Bulgaria at 1900.
7105 *R.N.E., Spain* at 2030.
7230 *Radio Monte Carlo* at 1125.
7290 *Trans World Radio, Monaco* at 1525.
9460 *Radio Pakistan* at 2005.
9525 *All India Radio* at 2015.
9615 *H.C.J.B., Quito,* Ecuador at 0402.
9625 *Radio Sweden* at 1115.
9645 *Vatican Radio* at 2030.
9680 *Trans World Radio,* Monaco at 0925.
9710 *H.C.J.B., Quito,* Ecuador at 0146.
9912 *All India Radio* at 2015.
11710 *R.A.E., Argentina* at 2345.
11730 *R. Nederland, Bonaire* at 0200.
11750 *Finnish B.S.* at 1000.
11815 *Trans World Radio, Bonaire* at 0110.
11830 *Radio Havana,* Cuba at 0109.
11835 *R.T.V. Algerienne* in French at 2100.
11875 *R.S.A., South Africa* at 2347.
11895 *All India Radio* at 2330.
11955 *Voice of the Lebanon* at 0230.
15200 *Vatican Radio* at 1500.
15200 *Voice of Nigeria* at 0648.
15325 *Radio Canada* at 1520.
15410 *United Nations Radio* at 1700.
17820 *Radio Canada* at 0743.
17945 *Radio Pakistan* at 1345.
21545 *Radio Accra, Ghana* at 1445.
21590 *Radio Pakistan* at 0806.

(All these transmissions were in English except where otherwise stated.)

**Robin Yates** of Deganwy, Caernarvonshire heard the following stations on his Alba stereogram:—

5960 *H.C.J.B. Quito,* Ecuador at 0800.
5990 *Radio Canada* at 0715.
7310 *Radio Vilnius,* Lithuania at 2230.
9530 *All India Radio* at 1930.
9690 *WNYW, U.S.A.* at 2100.
9805 *Radio Cairo* at 2145.
11935 *FEBA, Seychelles* noted at 1730.
15130 *WNYW, U.S.A.* at 2000.
15155 *Radio Havana, Cuba* at 2010.
17720 *WINB, Red Lion* noted at 1930.
17855 *NHK, Japan* at 0800.

**Clive Jones** of Colliers Hatch near Epping describes his equipment as "a four valve domestic receiver with a looped, coiled and bent, untuned dipole!" This equipment enabled him to hear:—

6025 *Radio Portugal* in English at 2100.
9009 *Kol Israel* in English at 2120.
9480 *Radio Kiev, Ukraine* at 1950.
9545 *R. Accra, Ghana* in English at 2115.
9630 *R. Sweden,* Saturday Show at 1100.
9695 *R.S.A., South Africa* at 0040.
11720 *Radio Canada* in English at 2120.
11765 *Radio Australia* at 0900.
17880 *H.C.J.B., Quito,* Ecuador at 1915.

**Julian Moss** of Rayleigh has a Meridian 10 transistor superhet and a 60 foot long-wire enabling him to hear:—

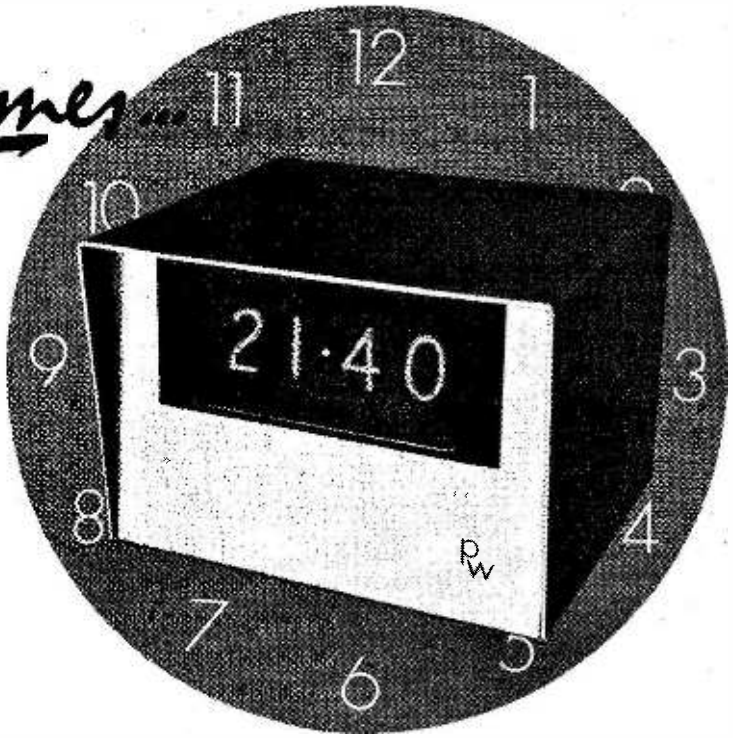
5960 *H.C.J.B., Quito,* Ecuador at 0815.
6025 *R. Portugal,* Voice of the West at 2130.
7235 *R. Australia* in English at 1530.
9460 *R. Pakistan* with news at 2100.
9525 *R.S.A., South Africa,* English at 2245.
9530 *A.I.R., Delhi* in English at 1915.
9530 *V.O.A., Monrovia,* sign-off at 2230.
9545 *R. Accra, Ghana* in English at 2045.
9550 *Finnish B.S.* in English at 1830.
9570 *R. Australia* with DX News at 0735.
9575 *R.A.I., Rome* in Italian at 2130.
9620 *R. Belgrade,* Yugoslavia at 1550.
9625 *R. Sweden* in English at 1255.
9625 *Radio Canada* at 0720.
9670 *Damascus, Syria,* news in English at 2030.
9690 *WNYW, U.S.A.* at 2000.
9695 *R.S.A., South Africa* in English at 2215.
9745 *R. Baghdad,* Iraq in German at 2045.
11720 *Radio Canada* in English at 2120.
11765 *Radio Australia* in English at 0735.
11770 *A.F.R.T.S.,* football match at 1950.
11790 *A.I.R., Delhi;* news in English at 2200.
11805 *VOA, Greenville,* N. Carolina at 1930.
11970 *R.S.A., South Africa* news in English at 2238.

Reports should arrive by the 15th of the month and be addressed to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

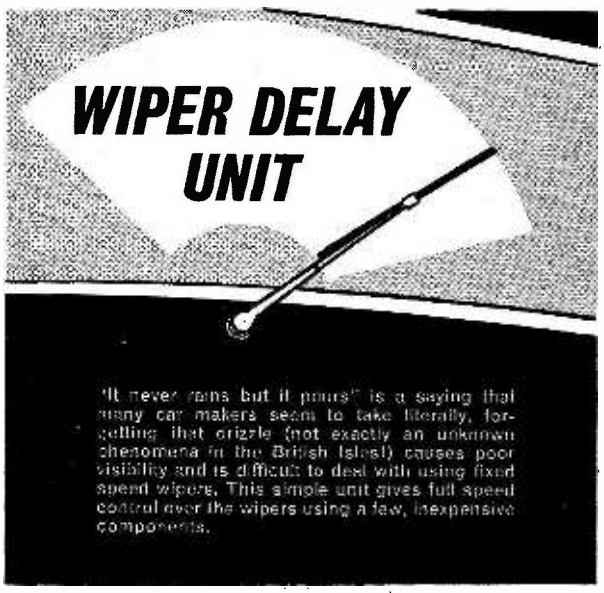
# IN NEXT MONTH'S PRACTICAL WIRELESS

## Changing Times...

# Digital Clock




Times certainly are changing. Eighteen months ago you would have been lucky to afford the components for a digital clock even if you could have found a supplier—but 1972 sees the dawning of a new age. While digital techniques become better known, prices continue to fall (about 50% last year). This digital clock is mains frequency operated and although it uses 12 i.c.'s (price at the time of writing 67p each) there is practically nothing else apart from the readout tubes. For the serious constructor now is the time to enter the digital field and how better than with a really practical project such as our digital clock.




## TRANSISTOR TESTER

Although surplus transistors are excellent value, a small percentage are usually duds. The transistor tester to be described in the April issue has been specifically designed to sort these out. Both NPN and PNP devices can be tested and an unusual feature is that gain is directly read off, even though the meter used is of the cheapest type available. This is a thoroughly ingenious project for its simplicity—be sure not to miss it.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**ALL IN THE APRIL ISSUE ON SALE 3rd. MARCH**

1013

ON THE SHORT WAVES

# THE AMATEUR BANDS

David Gibson, G3JDG

**Frequencies in kHz • Times in GMT**

QUITE an easy month on the Amateur bands with not too many scribes sending in logs. I expect you're all still getting over the excitement of Christmas plus the novelty of the presents. Hands up all those who got a nice new receiver?

Some reporters have bemoaned the difficulties of learning to read c.w. signals and have asked if there is any "easy" way to pick up the morse code. If you own a tape recorder then you're half way there. All you need is some sort of morse key and buzzer (or better still an oscillator) and you can record your own morse. This will give you practice at sending and you can then play the tape back and practice reading also. Advantage is that you can send at just the right speed for your particular ability at receiving. Hint; use groups of mixed letters which don't make any sense, i.e., AMSZX, ATHQP, etc. This stops you anticipating the next character and makes sure that you really do "read" every symbol.

Another aid is the many slow morse transmissions which members of the R.S.G.B. put out specifically for those wishing to learn to read c.w. Topband is a favourite and since these stations are located all over the country there is almost certain to be a local station near you. In any case, you can see how many of the slow c.w. members you can log. There is some very good d.x. to be heard on c.w. On topband, for example, down very close to 1·8MHz you can often hear W stations. So get a copy of the code, learn it and start using your receiver to the full. Incidentally, you need a b.f.o. for c.w. reception and if you are one of the many who are just getting your feet wet on the amateur bands with a commercial broadcast-type receiver which happens to cover short waves but which doesn't have a b.f.o., then take a peep at the January 1972 issue of Practical Wireless. On page iii of the Experimenters Circuits Supplement you will find a very simple circuit for a b.f.o. which can be used in conjunction with most receivers. Check that your receiver has an i.f. of 465kHz or 1·6MHz otherwise you will need to change the i.f. transformer shown in the circuit. Incidentally, this external b.f.o. will also enable you resolve single sideband too.

If you kid yourself that you are already well proficient in the gentle art of reading c.w., try tuning in at 1900g.m.t. on the first Tuesday of each month. Listen on 3·520MHz for the G3BZU morse proficiency transmissions. These rattle merrily away at 20, 25, 30, 35, and 40 words per minute. If you get it all down 100 per cent correct and send it with 10p to the QRQ Manager, RNARS, H.M.S. Mercury, Leydene, Petersfield, Hants, you get a nice certificate which tells all and sundry what a super dot and dash sorter-outer you really are.

Another query which keeps cropping up in the mail is the one involving some poor s.w.l. who, while reading about beams and long wires, is stuck in a room on the umpteenth floor of a "no aerials allowed" block of flats.

One idea is to build an a.t.u. (antena tuning unit) and put a length of wire around the picture rail. Another sneaky (but effective) aerial is made by getting a length of enamelled copper wire, about 24 s.w.g., boring a hole in a small sorbo ball and pushing the end of the wire through and anchoring or tieing it. You can now lower the ball out of the window and play out the wire. You've virtually got a vertical antenna and the good thing is that even with A1 vision, 24 s.w.g. enam. is invisible at more than a few feet. Idea of the rubber ball is to weight the wire and hold it down and also, if it's windy, the ball doesn't stove in someone's window 22 floors down. The idea of using some form of metal rod clipped to the window ledge will work but there is always the hazard that it will fall off and skewer some poor soul to the sidewalk—definitely not recommended!

Gibby's been chattering again and not getting on with the logs, but some questions in the mail come up again and again, so periodically it seems a good idea to answer these.

**Chris Kitchener** (Haverhill) has been swotting for O-levels and the R.A.E. (gd lk OM). Time between "swots" brought signals from SV0WII, SM4DIT/MM, VK2YU, ZD3D, ZL3RB, 4X4SM, 8R1J, 9H1CU and 9J2JY all on a TR500SE receiver and PR30 preselector plus a tank whip at 36ft.

Interesting letter from **John Stevenson** (Woking) who has been playing with a solid state direct conversion receiver. This has two BC108's as a product detector fed from the aerial, BC108 b.f.o. and another three BC108's as an a.f. amplifier. Aerial is 50ft. end fed "wrapped round an oak tree." (Bet it brings in the signals a "Treet"). Preliminary peeps on 14MHz raised visions of CT1BT, IS1LID, IT9CLB, PY7EXY, UA3IQO, UB5AD, ZE1BP, 5Z4GK, 9H1GK.

**Howard Dearing** has dropped the s.w.l. prefix and now talks back signing G3XVX. Rig is a homebrew running 25W p.e.p. and 10W c.w. Receiver is a Hammerlund Super Pro with a homebrew topband converter using 3·1-3·3MHz as an i.f. Howard's log for 1·8MHz stations worked (I'm green already) reads: K2GNC, K8RNE, VE3EK, W1WQC, W2FD, W2IU, W2UEZ, W3GM, W4WFL/1, W4QCW, ZD8AY (Ascension Island) all on c.w. On s.s.b. the log reads: W1WQC, W1HGT, W2HCW. Antenna is an inverted L Marconi with 55ft. vertical section some 10ft. longer than an electrical quarter wave and tuned with a series capacitor. Earth system is a radial affair plus 12 buried copper pipes.

*Logs, in alphabetical order please, to arrive by the 15th of the month to:*

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# TRANSISTORS

## A SELECTION FROM OUR LIST

| | | | | | | | |
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| AAY30 | 10p | BD115 | 75p | OC16 | 50p | 2N1303 | 18p |
| AAY42 | 15p | BD123 | 85p | OC20 | 85p | 2N1304 | 22p |
| AAZ13 | 10p | BD124 | 80p | OC22 | 50p | 2N1305 | 22p |
| AAZ15 | 10p | BD131 | 75p | OC23 | 60p | 2N1306 | 25p |
| AAZ17 | 10p | BD132 | 80p | OC24 | 60p | 2N1307 | 25p |
| AC107 | 35p | BDY11 | | OC25 | 40p | 2N1308 | 25p |
| AC126 | 30p | | £1·50 | OC26 | 25p | 2N1309 | 25p |
| AC127 | 25p | BDY17 | | OC28 | 60p | 2N1613 | 20p |
| AC127Z | 50p | | £1·50 | OC29 | 60p | 2N2147 | 75p |
| AC128 | 20p | BDY38 | 65p | OC35 | 50p | 2N2160 | 60p |
| AC176 | 20p | BDY60 | | OC36 | 60p | 2N2217 | 25p |
| AC187 | 25p | | £1·00 | OC42 | 40p | 2N2218 | 20p |
| AC188 | 25p | | | OC43 | 50p | 2N2218A | |
| ACY17 | 30p | BF115 | 25p | OC44 | 15p | | 25p |
| ACY18 | 25p | BF154 | 20p | OC45 | 12p | 2N2219 | 20p |
| ACY19 | 25p | BF158 | 15p | OC70 | 12p | 2N2219A | |
| ACY20 | 20p | BF159 | 35p | OC71 | 12p | | 25p |
| ACY21 | 20p | BF180 | 35p | OC72 | 20p | 2N2220 | 25p |
| ACY22 | 10p | BF194 | 15p | OC75 | 25p | 2N2221 | 20p |
| ACY39 | 55p | BF195 | 15p | OC76 | 25p | 2N2221A | |
| ACY40 | 20p | BF196 | 15p | OC77 | 40p | | 25p |
| ACY41 | 15p | BF197 | 15p | OC81 | 20p | 2N2222 | 20p |
| ACY44 | 25p | BFX13 | 25p | OC81D | 20p | 2N2222A | |
| AD140 | 50p | BFX29 | 25p | OC81Z | 40p | | 25p |
| AD149 | 50p | BFX30 | 25p | OC83 | 25p | 2N2369 | 15p |
| AD161 | 35p | BFX84 | 25p | OC84 | 25p | 2N2369A | |
| AD162 | 35p | BFX85 | 30p | OC139 | 25p | | 15p |
| AF114 | 25p | BFX86 | 25p | OC140 | 40p | 2N2646 | 40p |
| AF115 | 25p | BFX87 | 25p | OC141 | 60p | 2N2904 | 20p |
| AF116 | 25p | BFX88 | 20p | OC170 | 25p | 2N2904A | |
| AF117 | 20p | BFY18 | 25p | OC171 | 30p | | 25p |
| AF118 | 60p | BFY50 | 20p | OC200 | 40p | 2N2905 | 25p |
| AF124 | 25p | BFY51 | 20p | OC201 | 75p | 2N2905A | |
| AF125 | 20p | BFY52 | 20p | OC202 | 80p | | 25p |
| AF126 | 20p | BFY53 | 15p | OC206 | 95p | 2N2906 | 20p |
| AF127 | 20p | BFY90 | 65p | OCP71 | 97p | 2N2905A | |
| AF139 | 30p | B8X20 | 15p | ORP12 | 50p | | 25p |
| AF180 | 50p | B8X21 | 20p | ORP60 | 40p | 2N2907 | 23p |
| AF181 | 45p | B8Y27 | 15p | ST140 | 15p | 2N2907A | |
| AF185 | 50p | B8T95A | 12p | ST141 | 20p | | 25p |
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| AF239 | 40p | BU105 | £2·25 | TIP30A | 60p | 2N2926 | 10p |
| ASY26 | 25p | BY100 | 15p | TIP31A | 60p | 2N3011 | 20p |
| ASY27 | 30p | BY126 | 12p | TIP32A | 70p | 2N3053 | 20p |
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| 3 watt | | | | | |
| 3TZ series | 30p | 27p | 25p | 22p | 20p |
| 10 watt | | | | | |
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### TRIACS

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| SC40A | 100 | 6 amps | 90p |
| SC40B | 200 | 6 amps | £1·05 |
| SC40D | 400 | 6 amps | £1·00 |
| SC45A | 100 | 10 amps | £1·05 |
| SC45B | 200 | 10 amps | £1·15 |
| SC45D | 400 | 10 amps | £1·25 |
| SC50A | 100 | 15 amps | £1·35 |
| SC50B | 200 | 15 amps | £1·45 |
| SC50D | 400 | 15 amps | £1·75 |
| SC40E | 500 | 6 amps | £1·25 |
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| DIAC SD2 | | | 25p |

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1 AMP MINIATURE PLASTIC WIRE ENDED

| Type | P.I.V. | 1-49 | 50+ | 100+ | 500+ | 1000+ |
|---|---|---|---|---|---|---|
| IN4001 | 50 | 6p | 5p | 4½p | 4p | 3½p |
| IN4002 | 100 | 7p | 6p | 5p | 4½p | 4p |
| IN4003 | 200 | 8p | 7p | 6p | 5p | 4½p |
| IN4004 | 400 | 8p | 7p | 6p | 5p | 4½p |
| IN4005 | 600 | 10p | 9p | 8p | 7p | 6p |
| IN4006 | 800 | 12p | 10p | 9p | 8p | 7p |
| IN4007 | 1000 | 15p | 12p | 10p | 9p | 8p |

### BRIDGE RECTIFIERS

Miniature Potted Silicon ¼" × ¼" × ¾"

| Type | P.I.V. | Current | 1–12 | Type | P.I.V. | Current | 1–11 |
|---|---|---|---|---|---|---|---|
| 1002 | 100 | 2a | 55p | 4004 | 400 | 4a | 75p |
| 2002 | 200 | 2a | 65p | 6004 | 600 | 4a | 80p |
| 4002 | 400 | 2a | 75p | 1006 | 100 | 6a | 70p |
| 6002 | 600 | 2a | 80p | 2006 | 200 | 6a | 75p |
| 1004 | 100 | 4a | 65p | 4006 | 400 | 6a | £1·00 |
| 2004 | 200 | 4a | 70p | 6006 | 600 | 6a | £1·10 |

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| 100 | + 15p |
| 500 | + 12p |
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**2N2646** Motorola **40p**

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| 25 | + 35p |
| 100 | + 32p |
| 500 | + 28p |
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**OC170** Mullard **25p**

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|---|---|
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| 500 | + 15p |
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**BY127** Mullard **15p**

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|---|---|
| 25 | + 12p |
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| 500 | + 9p |
| 1000 | + 8p |

**OC35** Mullard **50p**

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|---|---|
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| 100 | + 40p |
| 500 | + 35p |
| 1000 | + 30p |

**2N2926** Green **10p**

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|---|---|
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| 500 | + 6p |
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| 25 | + 65p |
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**BYZ13** Mullard **25p**

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| 100 | + 17p |
| 500 | + 15p |
| 1000 | + 12p |

**OA202** **10p**

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# LETTERS...

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

## Bottled-up

With regard to Mr. D. Smith's letter (January 1972 issue), I would like to point out to him that he most certainly is not the last of a "dying breed." Speaking as an ardent valve lover, I personally believe that the transistor will never completely overcome the valve, as if it does it would bring about the downfall of amateur radio as we know it. As for integrated circuits, they are beneath contempt and unworthy of further comment. So Mr. Smith is definitely not alone and does most decidedly have "relatives somewhere" as far as valve lovers are concerned — 807's in particular.—**P. I. Martin** *(Sussex).*

* * *

Having worked on several transistor radios which almost fall to pieces when you try to service them I can appreciate D. H. O. Smith's preference for valves.

However I am wondering if valve enthusiasts can take hope, for I notice that quite a number of instruments are using a device which in effect is a miniature valve and called a nuvistor. Is this the valve making a comeback? Having unsuccessfully tried to obtain some literature on these nuvistors I am wishing some day the editor will commission an article on these to lighten our darkness.

Until the happy day when valves return may we not lift any printed circuits with soldering irons or blow up half a dozen transistors when searching for one faulty one.—**K. Freeby** *(Plymouth).*

* * *

I too suffer from being one of that dying breed. Mr. Smith has my complete sympathy. 99·9% of my equipment is fully "bottleized," including a 50 watt r.m.s. (sine wave drive) amplifier which has given no trouble for about 3 years. Everything I build with valves works first time and goes on working. Few people realize how easy and cheap valve equipment is to make, and in my opinion valves are best for starting people off on electronics, because, electrically, they are infinitely more robust than transistors. To any other valve enthusiasts—please, please write to this column and make your existence known. Incidentally the 50 watt amplifier can be made for £30 complete.—**T. Watton** *(Hull).*

* * *

I agree with D. H. O. Smith (Herts) "Dying Breed"—January '72. He is not alone in his support for the radio valve.

I do a fair amount of servicing of valve sets and I would support the valve against the transistor for tone and quality (except for the larger transistor sets which have larger loudspeakers, etc.—**J. F. Wade,** *(Leyland, Lancs).*

## Cassette deck

With the advent of the tape cassette isn't it about time some manufacturers put onto the market a cassette deck.

By this I don't mean a recorder with pre-amps and record amps to be used with an external amplifier such as a Hi-Fi system. But strictly speaking a tape transport. Where the individual can build his own tape recorder as he would with a reel to reel machine. It is pleasing to see in *Practical Wireless* the building of recorders but there is an increasing lack of tape transporters, only one being advertised at the present time in this magazine.

For a variation one has to go to the upper price brackets such as Brenell and TRD decks. So come on manufacturers how about a tape transport for cassette tape-recorders.—**V. C. Watts** *(Bath, Somerset).*

## Join the club

I should be most grateful if some publicity could be given to our club through the medium of *Practical Wirless.* The club was formed early in 1970 and today, with over a hundred members, has its own club rooms at 81 Virginia Street, Glasgow, C1.

Meetings are held each Friday at 8 p.m., at which slow morse is given by GM3HLQ. Lectures by club members and the occasional film form the main subject material of our meetings.

On the premises we have our own club station, with call sign GM4AGG, which is active on the HF bands with a KW2000, 70MHz with a Pye Ranger, and 144MHz with an IC2F.

On December 10th we held our first annual dinner at which GM3AEL (Zonal Rep.)) presented our club with the Scottish N.F.D. Trophy for 1971.—**Victor T. Budas,** *GM3VTB, (Hon. Sec. 28 Kelvinside Gardens, Glasgow, N.W.)*

## Transformed!

May I reply to Mr. R. Wibberley's letter in the December issue in which he condemns modern methods of transformer winding.

He states, "Enamelled wires are clearly inferior and unreliable. More so when wax impregnated." Correctly used, with the layers of wire separated with suitable insulation, enamelled windings are extremely hardy. Why else would they have become practically the standard material in low to medium power transformers? As a bonus, enamelled wire is cheaper and much less bulky than Mr. Wibberley's preferred silk-covered winding.

Mr. Wibberley also says, "Oil insulated windings are inferior, especially when mains voltages are used in primary windings." May I point out that National Grid transformers are completely immersed in oil for cooling purposes and these devices operate reliably at voltages between 11kV and 400kV.—**C. Wright** *(Northants).*

**DIARY DATE:**
Paris Audio Festival
March 9-14

# GOING BACK...


COLIN RICHES
ARTHUR DOW

V. P. MILLS, writing from 9 Fryars Bay, Beaumaris, Anglesey, Wales, says, "I possess a piece of ancient equipment owned by my father. It is a Sterling 2-valve upright cabinet receiver type BR2, instrument number 198 manufactured by Sterling Telephone and Electric Co. Ltd., London. Manufactured circa 1926 and using Marconi-Osram bright emitter valves types R5, red spot and green spot or alternatively type DER. The set is complete with Sterling headphones.

Unfortunately at some time the set was dismantled and whilst I have rescued the components concerned, I am devoid of the all important circuit diagram.

Recently I have been lucky enough to purchase another set found in an old workshop perched on a Welsh hillside. It is an exceptionally small receiver with valve holders and reaction coils located externally on top of the metal case. The set is titled "Polar Twin Receiving Set" (no Model No. or Serial No. given) and bearing a notice stating "Use with Mullard-Polar Valves".

Valves actually used are believed to be PM1 and PM1A. This set is also believed to date from 1925-6.

A very small S. G. Brown Hornspeaker was available, this has been restored and is now operational. There are a few loose ends within the receiver however which I think I can unravel.

I am particularly anxious to get these receivers operational and Hamilton Radio who offer service sheets back to 1925 have not been able to help so I am writing in the hope that as a focal point of Veteran Radio you may be able to help or alternatively suggest a possible source of supply of relevant circuits.

I would also be very pleased to hear of any known source of supply of R5 or DER valves. Meanwhile keep the good work going, I hope to be able to join in shortly."

Mr. D. J. Lord, of 61 Empingham Road, Stamford, Lincs. tells us that although he was not around during the 20's and 30's, he has found the "Going Back" articles on the early days of radio most interesting.

On reading the article in last April's issue, he saw that Mr. F. C. Burgess has an old Marconiphone 2 valve set, which from his description must be very similar to the one that he has himself.

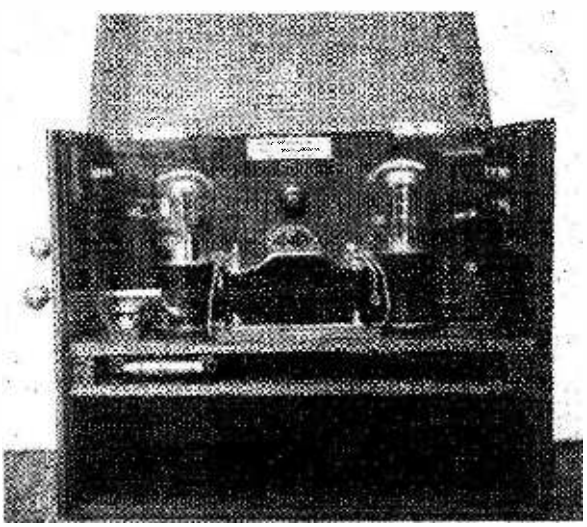
Mr. Lord enclosed a photograph of his set, the details of which are:—

> Marconiphone V2A Long Range Model Type RB1B, Long Range Model M19, Inst. No. S/E 3926, G.P.O. Reg. No. 0175. Approved by the Postmaster Gen.

The set is still in working order, and is complete with a Marconi Distributor Unit for up to four pairs of headphones, and plug in coils and regenerator units covering the range 340-440m, 390-530m and 1300-1700m Long Wave.

The date of manufacture, or the original cost are not known, but he has always assumed that it was about 1923, and would be interested to learn the exact year if any reader can advise him. (We at P.W. would have said about 1924-1926)

He also has a copy of the BBC Hand Book for 1928, which contains an interesting selection of photographs and descriptions of the range of wireless sets available at that time, all of which appear to be of a considerably later design than his Marconiphone model.



*Mr. D. J. Lord's receiver.*

## Vintage CQ

**BOOKS FOR DISPOSAL**

...to sell: "More Practical Valve Circuits" by John Scott-Taggart, published in 1923. The first circuit is No. 68 and they go on to No. 151. Offers invited.—J. H. Greer, North Lodge, Great Ponton, Grantham, Lincolnshire.

...a three-volume copy of the Harmsworth's Wireless Encyclopedia and a bound copy of Wireless World for October 1923 to March 1924. I will sell to the highest bidder.—J. C. Porter, 15 Millais Gardens, Edgware, Middlesex.

...Harmsworth's Wireless Encyclopedia: three volumes with illustrations in good clean condition. Offers please.—C. Lesser, 7 Clippesby Close, Chessington, Surrey.

...a three-volume set of Harmsworth's Wireless Encyclopedia (1923).—Peter Thornhill, 5 Fourth Avenue, Scampton, Lincolnshire.

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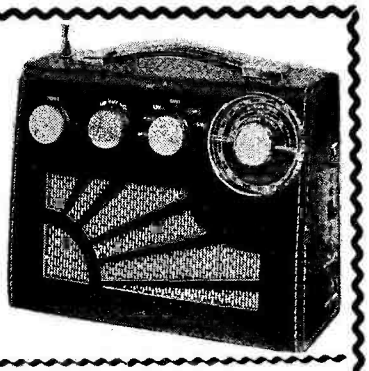
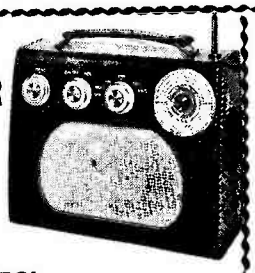


## ROAMER EIGHT Mk I



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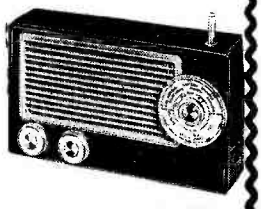
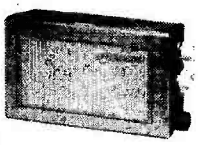


6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening **30p** extra.

**Total building costs** (Overseas P. & P. £1) **£3·98** P. P. & Ins. 26p

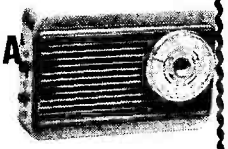
## POCKET FIVE



3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1½ × 3½in. Easy build plans and parts price list **10p** (FREE with parts). Earpiece with plug and switched socket for private listening **30p** extra.

**Total building costs** (Overseas P. & P. 63p) **£2·23** P. P. & Ins. 21p

## TRANSONA FIVE



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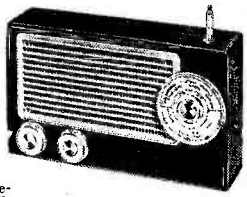
## TRANS EIGHT



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| 4CB6 | .50 | 6F23 | .68 | 10DE7 | .50 | 25Z4G | .28 | AZ41 | .53 | ECC86 | .40 | ELL80 | .75 | PC97 | .36 |
| 5CG8 | .50 | 6F24 | .68 | 10F1 | .75 | 25Z6 | .40 | CL33 | .90 | ECC88 | .35 | ELS60 | .49 | PC900 | .32 |
| 5V4G | .34 | 6F25 | .54 | 10F9 | .45 | 25Z6G | .42 | CV63 | .53 | ECC189 | .48 | EM80 | .38 | PCC84 | .29 |
| 5Y3GT | .26 | 6F28 | .60 | 10F18 | .35 | 30A5 | .44 | CY1C | .53 | ECC804 | .55 | EM81 | .39 | PCC85 | .26 |
| 5Z4G | .34 | 6F32 | .15 | 10LD11 | .53 | 30C1 | .28 | CY31 | .31 | ECC8071 | .70 | EM83 | .75 | PCC88 | .41 |
| 6/30L2 | .55 | 6GH8A | .50 | 10P13 | .54 | 30C15 | .60 | DAF91 | .20 | ECF80 | .27 | EM84 | .31 | PCC89 | .45 |
| 6A8G | .33 | 6GK5 | .50 | 10P14 | 1.08 | 30C17 | .77 | DAF96 | .33 | ECF82 | .26 | EM85 | 1.00 | PCC189 | .48 |
| 6AC7 | .15 | 6GU7 | .50 | 12A6 | .63 | 30C18 | .60 | DF91 | .14 | ECF86 | .64 | EM87 | .35 | PCF80 | .28 |
| 6AG5 | .25 | 6H6GT | .15 | 12AC6 | .40 | 30F5 | .65 | DF96 | .34 | ECF8042 | .10 | EY51 | .38 | PCF82 | .30 |
| 6AK6 | .30 | 6J5G | .19 | 12AD6 | .40 | 30FL1 | .60 | DH76 | .28 | ECH21 | .63 | EY81 | .35 | PCF84 | .40 |
| 6AM8A | .50 | 6J5GT | .29 | 12AE6 | .48 | 30FL2 | .60 | DK40 | .55 | ECH42 | .60 | EY83 | .54 | PCF86 | .44 |
| 6AN8 | .49 | 6J6 | .18 | 12AT6 | .23 | 30FL13 | .69 | DK92 | .35 | ECH81 | .27 | EY84 | .50 | PCF200 | .67 |
| 6AQ5 | .22 | 6J7G | .24 | 12AT7 | .16 | 30FL14 | .68 | DK96 | .35 | ECH83 | .39 | EY86/7 | .30 | PCF801 | .29 |
| 6AR5 | .30 | 6J7GT | .38 | 12AU6 | .21 | 30L1 | .29 | DL96 | .35 | ECH84 | .34 | FW4/800 | .75 | PCL805/85 | |
| 6AT6 | .18 | 6JU8A | .50 | 12AU7 | .19 | 30L15 | .58 | DM70 | .30 | ECL80 | .30 | FW4/500 | .75 | | .40 |
| 6AU6 | .20 | 6K7G | .10 | 12AV6 | .28 | 30L17 | .67 | DM71 | .38 | ECL82 | .30 | GZ30 | .34 | PCL86 | .38 |
| 6AV6 | .23 | 6K7GT | .23 | 19AX7 | .22 | 30P4MR | .95 | DY87/6 | .24 | ECL83 | .58 | GZ32 | .41 | PCL88 | .65 |
| 6AW8A | .54 | 6K8G | .16 | 12BA6 | .30 | 30P12 | .69 | DY802 | .35 | ECL84 | .54 | GZ33 | .70 | PD500 | 1.44 |
| 6AX4 | .39 | 6LI | .98 | 12BE6 | .30 | 30P19/ | | E80F | 1.20 | ECL85 | .54 | GZ34 | .48 | PEN4DD | |
| 6B8G | .13 | 6L6GT | .39 | 12BH7 | .27 | 30P4 | .58 | E83F | 1.20 | ECL86 | .35 | GZ37 | .67 | | 1.38 |
| 6BA6 | .20 | 6L7GT | .38 | 12F1 | .55 | 30PL1 | .59 | E88CC | .60 | EF22 | .63 | HABC80 | .44 | PEN36C | .75 |
| 6BC8 | .50 | 6L18 | .44 | 12J5GT | .30 | 30PL13 | .75 | E92CC | .40 | EF40 | .49 | HL23DD | .40 | PEN45 | .40 |
| 6BE6 | .21 | 6L19 | 1.38 | 12J7GT | .33 | 30PL14 | .65 | E180F | .90 | EF41 | .58 | HL41DD | .98 | | |
| 6BH6 | .43 | 6LD20 | .48 | 12K5 | .50 | 30PL15 | .87 | E182CC | 1.00 | EF42 | .33 | | | | |
| 6BJ6 | .39 | 6N7GT | .40 | 12K7GT | .34 | 35A3 | .48 | E1148 | .53 | EF54 | .98 | | | | |
| 6BQ7A | .38 | 6Q7 | .43 | 12SA7GT | | 35L6GT | .42 | EA50 | .18 | EF73 | .75 | | | | |
| 6BR7 | .79 | 6Q7G | .27 | | .40 | 35W4 | .23 | EA76 | .88 | EF80 | .22 | | | | |
| 6BR8 | .63 | 6R7 | .55 | 12SC7 | .35 | 35Z4GT | .24 | EABC80 | .30 | EF83 | .48 | | | | |
| 6BW6 | .72 | 6R7G | .35 | 12SG7 | .23 | 35Z5GT | .30 | EAC91 | .33 | EF85 | .26 | | | | |
| 6BW7 | .54 | 6SA7GT | .35 | 12SH7 | .15 | 50EH5 | .55 | EAF42 | .48 | EF86 | .23 | | | | |

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| PEN45DP | .75 | UBC81 | .40 | W729 | .60 | BA153 | .15 | OA47 | .10 | | | | | | |
| PEN46 | .20 | UBF80 | .30 | X41 | .50 | BC107 | .13 | OA70 | .15 | | | | | | |
| PEN453DD | | UBF89 | .30 | Transistors | | BC108 | .13 | OA73 | .15 | | | | | | |
| | .98 | UBL21 | .55 | & Diodes | | BC113 | .25 | OA79 | .09 | | | | | | |
| PENDD- | | UC92 | .35 | 2S323 | .50 | BC115 | .15 | OA81 | .09 | | | | | | |
| 4020 | .88 | UCC84 | .33 | AA119 | .15 | BC116 | .25 | OA85 | .08 | | | | | | |
| PFL200 | .52 | UCC85 | .34 | AA120 | .15 | BC118 | .23 | OA90 | .13 | | | | | | |
| PL33 | .38 | UCF80 | .33 | AA129 | .15 | BCY10 | .45 | OA91 | .09 | | | | | | |
| PL36 | .47 | UCH21 | .60 | AAZ13 | .18 | BCY12 | .50 | OA95 | .09 | | | | | | |
| PL38 | .90 | UCH42 | .60 | AC107 | .15 | BCY33 | .20 | OA200 | .09 | | | | | | |
| PL81 | .44 | UCH81 | .30 | AC113 | .25 | BCY38 | .23 | OA202 | .10 | | | | | | |
| PL81A | .48 | UCL82 | .33 | AC127 | .17 | BCZ11 | .38 | OC22 | .38 | | | | | | |
| PL82 | .30 | UCL83 | .48 | AC128 | .20 | BF158 | .29 | OC23 | .38 | | | | | | |
| PL83 | .32 | UF41 | .50 | AC154 | .25 | BF159 | .25 | OC24 | .38 | | | | | | |
| PL84 | .30 | UF42 | .60 | AC156 | .20 | BF163 | .20 | OC25 | .38 | | | | | | |
| PL504/500 | | UF80 | .35 | AC157 | .25 | BF173 | .38 | OC26 | .24 | | | | | | |
| | .62 | UF85 | .34 | AC165 | .25 | BF180 | .30 | OC28 | .60 | | | | | | |
| PL505 | 1.30 | UF86 | .63 | AC166 | .25 | BF181 | .40 | OC29 | .63 | | | | | | |
| PL508 | .90 | UF89 | .27 | AC168 | .38 | BF185 | .40 | OC35 | .32 | | | | | | |
| PL509 | 1.30 | UL41 | .54 | AC176 | .55 | BF194 | .15 | OC36 | .43 | | | | | | |
| PL802 | .75 | UL84 | .31 | AC177 | .28 | BFY50 | .23 | OC42 | .63 | | | | | | |
| PM84 | .34 | UM80 | .33 | ACY17 | .25 | BFY51 | .19 | OC44 | .10 | | | | | | |
| PX4 | 1.16 | UY41 | .38 | ACY18 | .20 | BFY52 | .20 | OC45 | .11 | | | | | | |
| PX25 | .98 | UY85 | .25 | ACY19 | .19 | BY100 | .18 | OC46 | .15 | | | | | | |
| PY33/2 | .50 | U10 | .45 | ACY20 | .18 | BY105 | .18 | OC70 | .13 | | | | | | |
| PY80 | .33 | U12/14 | .38 | ACY21 | .19 | BY114 | .18 | OC71 | .11 | | | | | | |
| PY81 | .24 | U18/20 | .75 | ACY22 | .15 | BY126 | .15 | OC72 | .11 | | | | | | |
| PY82 | .24 | U19 | 1.73 | ACY28 | .18 | BY127 | .18 | OC74 | .23 | | | | | | |
| PY83 | .26 | U22 | .39 | AD140 | .36 | BYZ10 | .25 | OC75 | .11 | | | | | | |
| PY88 | .32 | U25 | .64 | AD149 | .50 | BYZ11 | .25 | OC76 | .15 | | | | | | |
| PY500 | .95 | U26 | .56 | AD161 | .45 | BYZ12 | .25 | OC77 | .27 | | | | | | |
| PY800 | .33 | U45 | .78 | AD162 | .45 | BYZ13 | .25 | OC78 | .15 | | | | | | |
| PY801 | .33 | U47 | .64 | ADT140 | .63 | CG12E | .20 | OC78D | .15 | | | | | | |
| PZ30 | .48 | U191 | .58 | AF106 | .50 | FSY11A | .23 | OC81 | .11 | | | | | | |
| QQV03/10 | | U251 | .65 | AF114 | .25 | FSY41A | .23 | OC81D | .11 | | | | | | |
| | 1.20 | U281 | .40 | AF115 | .15 | GD9 | .20 | OC82 | .11 | | | | | | |
| QS95/10 | .49 | U282 | .40 | AF117 | .19 | GET113 | .20 | OC82D | .11 | | | | | | |
| QV04/7 | .63 | U301 | .40 | AF121 | .30 | GET116 | .40 | OC83 | .20 | | | | | | |
| R10 | .75 | U403 | .33 | AF124 | .25 | GET118 | .20 | OC84 | .24 | | | | | | |
| R11 | .98 | U404 | .38 | AF126 | .18 | GET119 | .20 | OC123 | .23 | | | | | | |
| R16 | 1.75 | U801 | .98 | AF139 | .65 | GET573 | .38 | OC139 | .23 | | | | | | |
| R17 | .88 | U4020 | .38 | AF178 | .68 | GET587 | .43 | OC140 | .95 | | | | | | |
| R19 | .30 | VP23 | .40 | AF180 | .48 | GET873 | .15 | OC169 | .23 | | | | | | |
| SP42 | .75 | VP41 | .38 | AF186 | .55 | GET887 | .23 | OC172 | .35 | | | | | | |
| SP61 | .33 | VT61A | .35 | AF239 | .38 | GET897 | .23 | OC200 | .22 | | | | | | |
| TH43 | .50 | VU111 | .44 | BA102 | .45 | GET898 | .23 | OC201 | .38 | | | | | | |
| TH233 | .98 | VU120 | .60 | BA115 | .14 | M1 | .15 | OC202 | .43 | | | | | | |
| TP2620 | .98 | VU120A | .60 | BA116 | .25 | M3 | .15 | OC203 | .30 | | | | | | |
| UABC80 | .30 | VU133 | .35 | BA129 | .13 | OA5 | .28 | OC204 | .30 | | | | | | |
| UAF42 | .49 | W76 | .34 | BA130 | .10 | OA9 | .13 | OC205 | .43 | | | | | | |
| UBC41 | .45 | W107 | .50 | | | OA10 | .43 | ORP12 | .53 | | | | | | |

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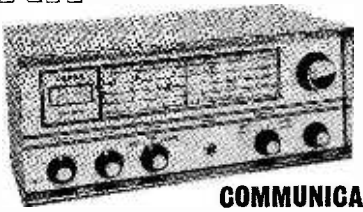

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# I.C. OF THE MONTH

L.A.J. IRELAND

## Number 27 — Toshiba TH9013P 20W Audio Amplifier

SOME time ago this column featured its first hybrid i.c., a 50 watt audio amplifier from Sanken of Japan. The hybrid approach, in which no attempt is made to fabricate the complete circuit of the unit on a single silicon chip (the "monolithic" approach), is particularly suited to high power or ultra high frequency applications.

Operation in these conditions poses requirements, such as component separation for minimum thermal or capacitative interaction, which are difficult to achieve within a single semiconductor slice. In audio circuits in particular it is advantageous to separate the output transistors, with their high current and thermal dissipation problems, from the driver stage which may usefully be monolithic.

Together with "chip" capacitors, which are also difficult to fabricate monolithically, these elements may be assembled into a single module or hybrid integrated circuit. This month's unit is an imported hybrid audio amplifier whose 20 watt rating fills the gap between the Sanken device already mentioned and the increasingly popular monolithics, whose power dissipation is of the order of 5 watts (G.E. type PA246, etc.).

The device is available from Erie Distribution Division, Erie Electronics Ltd., Gt. Yarmouth, Norfolk, and is quoted in the latest available price list at £4·31 for small numbers.

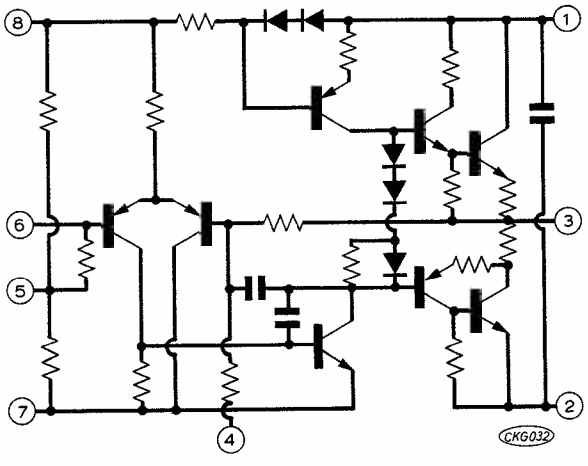


*Fig. 1: Circuit of the hybrid audio amplifier.*

## Circuit

Now for a detailed consideration of the capabilities of the unit. The high intercomponent leakage resistance possible with hybrid construction permits the use of supply voltages higher than is usual in i.c. work, with consequent lower currents for the same output, and the TH9013P therefore has a maximum supply rating of 50 volts at a current of 1·2 amps. The device should be attached to a heat sink of 300 sq.cms., giving a thermal resistance of 4°C/W or lower. This should retain the operating temperature of the device at 50°C or lower, but allowable case temperatures range from 0 to 90°C during operation, giving considerable latitude.

The circuit in Fig. 1 indicates that the device follows fairly conventional Class B lines, with identical n.p.n. silicon power transistors in push-pull, preceded by a complementary pair phase-splitter driving stage. A considerable advantage is the self-regulating character of the circuit, which does not require an external preset resistor to obtain symmetry of operation. Crossover distortion is therefore minimised, and ease of operation assured. In fact, the overall distortion figure quoted for the unit, at a signal frequency of 1kHz, is 0·3% at the full rated output of 20 watts, while the frequency response is flat to within 2dB from 10Hz to 40kHz. So it follows that if a pair of these devices is incorporated in a stereo outfit, departures from hi-fi standards should be sought in the record deck, the speakers or the preamps. Anywhere, in fact, except the power output stages!

## Power supplies

It is recommended that operation of the unit should be from twin power supplies rated at ±22·5 volts. Such supplies are easily constructed using four silicon diodes of appropriate rating to make up a dual full wave rectifier set, working from a transformer with centre-tapped 45 volt secondary followed by suitable smoothing capacitors (at least 500μF, 50V).

Fig. 2 indicates the connections necessary for operation in a standard audio system, with the dual power supply mentioned; it also puts forward a method of operation from a single 45 volt supply should that prove necessary, using a 2000μF d.c.

blocking capacitor between the output of the amplifier and the 8ohm loudspeaker load. It is important to include the fuse link in the circuit; operation into an inadequate load can permanently damage the output transistors and some form of protection is vital. It should be noted that in the single supply case, the fuse link is in the power supply line, since otherwise the charging surge of the blocking capacitor could well blow the fuse.

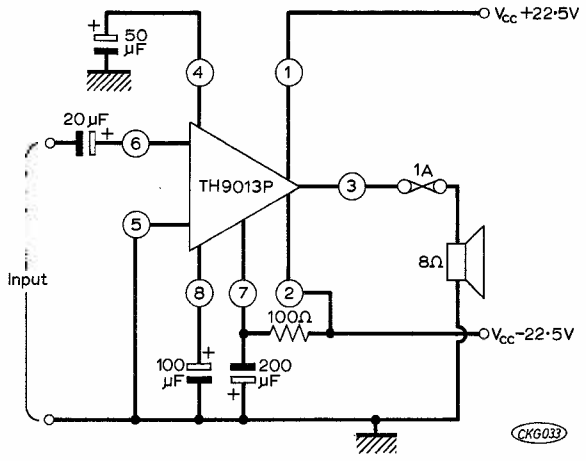


*Fig. 2a: Connections to the TH9013P when using a dual power supply.*

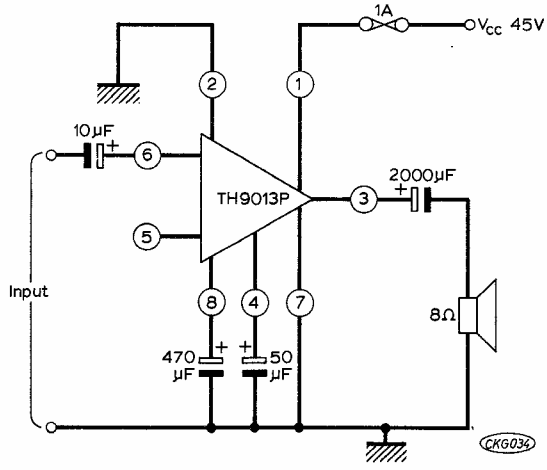


*Fig. 2b: A single 45 volt power supply simplifies the external circuitry.*

## Notes

Several i.c.'s suitable as preamps for the Toshiba unit have appeared from time to time in these columns, with associated tone and volume controls, so details of these accessories will not be pursued here.

The unit is presented in a sealed package 3×2×$\frac{5}{8}$in. with a machined face and mounting holes for heat sink attachment. Connections are via eight pins on the side of the package; the numbering in Fig. 1 is from left, when facing the pins with the heat sinking face downwards. For a convenient, economical and effective power amplifier for domestic applications, the TH9013P is certainly worth consideration. ■


**ISSUES WANTED**

...Practical Electronics Feb. 1971.—P. Arden, Hallam Grange, Hallam Grange Rise, Fulwood, Sheffield, S10 4BE.

...Practical Wireless for June 1969 (final part of "Double 12" article).—W. Pidduck, 128 Lodge Hill, Welling, Kent.

...Practical Wireless December 1963.—D. Hillman, 46 Spenser Street, Bootle, Lancashire, L20 4LW.

...Practical Wireless for May and June 1969. M. Jones, 44 Sturge Street, Sheffield, S2 3DP, Yorkshire.

...Practical Wireless December 1964, January 1969 to July 1970, September 1970, December 1970 and Practical Electronics for June and July 1970.—I. Moor, 6 Dykelands Road, Sunderland, Co. Durham, SR6 8EP.

...Practical Wireless Data Rule.—C. Jolliffe, 43 Holmlea Road, Goring-on-Thames, Reading, Berkshire, RG8 9EX.

...blueprint for the P.W. 35W Guitar Amplifier (May 1964 issue).—R. Cross, 38 Priory Road, Fishtoft, Boston, Lincs.

...Feb. 1971 issue of P.W. and April, May and June 1971 issues of P.E. and any other issues of P.E.—B. Boddy, 27 Gimble Way, Penbury, Kent.

...May 1969 issue of P.W. and Jan to Feb. 1968 issues. T. McKernan, 55 Maryland, Hatfield, Herts.

...P.E. for Jan., Feb., Mar. and Oct. 1965, Feb., Apl., Aug. and Sept. 1966. "Television" for Oct 1967, Apl., Jun. to Dec. 1968, Jan., Feb., Mar. and May 1969 and Feb., Dec. 1970. P. Mohan, 28 Hyde Park Terrace, Leeds, 6.

...P. W. Jan. 1968 to Feb. 1969 and P.E. Jan. 1968 to Dec. 1970.—M. F. Green, 12A West Road, Weaverham, Northwich, Cheshire, CW8 3HQ.

...July 1960 P.W. with article on mods to the R1392 Rx.—G. W. Kilbee, 10 Woodands Road, Ilford, Essex.

...Jan., Feb., Mar. and May P.W. for 1971.—C. Jennings, 13 Stonefield Street, Islington, London, N1 OHW.

...May and Jun. 1969 P.W.—G. A. Brooks, 227 St. Andrews Road, Couldson, Surrey.

...P.W. back numbers in exchange for Indian magazines.—N. Mohanty, M.Sc., Townhall Road, Cuttack-9, Orissa, India.

...P.W. for Apl. 1970 (General Coverage Receiver).—J. L. Littler, 61 Kent Road, Orpington, Kent, BR5 4AB.

... the issue of P.W. containing Mr. Cameron's decoder (May 1970).—G. R. Hunt, 53 Hand Lane, Leigh, Lancs.

...P.W. 1952-1955 and Radio Constructor 1952-1959.—Luxton, 12 The Vale, Acton, London, W3. 7SB.

...P.W. for Aug. 1967, Oct. 1969 and Jan. 1971. P.E. for Mar. 1971 and Radio Constructor for Feb. 1970.—A. D. Tuppen, "Greyholm" Geldeston, Beccles, Suffolk.

...Apl. 1965 issue of P.W. containing PC tuner article.—W. Pleass, 12 Farmadine Grove, Saffron Walden, Essex.

...P.W. for Jan. and June 1970 and P.E. for Jul 1967, Jan. 1968, May 1968, Sept. 1968, Oct. 1968, Feb. 1969, April 1969 and Mar. 1969.—C. Zammit Mangion, 59 St. Mary Street, Sliema, Malta.

...P.W. previous to Jan. 1969. Preferably complete sets. State details and price.—M. Tracey, 2 Manewas Way, Newquay, Cornwall.

...P. W. for June 1969.—M. J. Burrows, 7 Lyndhurst Road, Keynsham, Bristol.

...May 1971 issue of P. W.—A. Vermaak, 82 Kruger Avenue, Discovery, Transvaal, South Africa.

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...anyone who is interested in short wave and radio listening and LP records to correspond. Aged 18-23.—Geoff Dickinson, 5 Quarry Brow, Hawcoat, Barrow-in-Furness, Lancashire.

...Club secretetaes of radio clubs near my home, as I am interested in joining to learn wireless as a hobby.—J. Tyson, 3 Friars Rise, Scaws Estate, Penrith, Cumberland.

...anyone to correspond. I am 13 and interested in electronics and simple circuits.—M. Wigglesworth, 4 Ellabridge Close, Keynsham, Bristol.

...boy or girl of my own age (15) interested in electronics.—Sidney Birla, 3/1 Raja Santosh Road, Calcutta-27, India.

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...Philips Novosonic loudspeaker system type AD5010.—J. C. Wilson, 59 Meadway, Harpenden, Herts.

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...Grundig TK8 motor.—A. Panton, 49 Peaksfield Avenue, Grimsby, Lincs.

...Denco blue coils range 4, white range 4 (one of each). Two 2N2626 transistors, one OCP71 and data of 2N2926 against stamps, view cards and International Reply Coupons.—P.S. Chalokia, 2192, Sector 27C Chandigarh, India.

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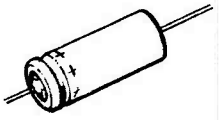

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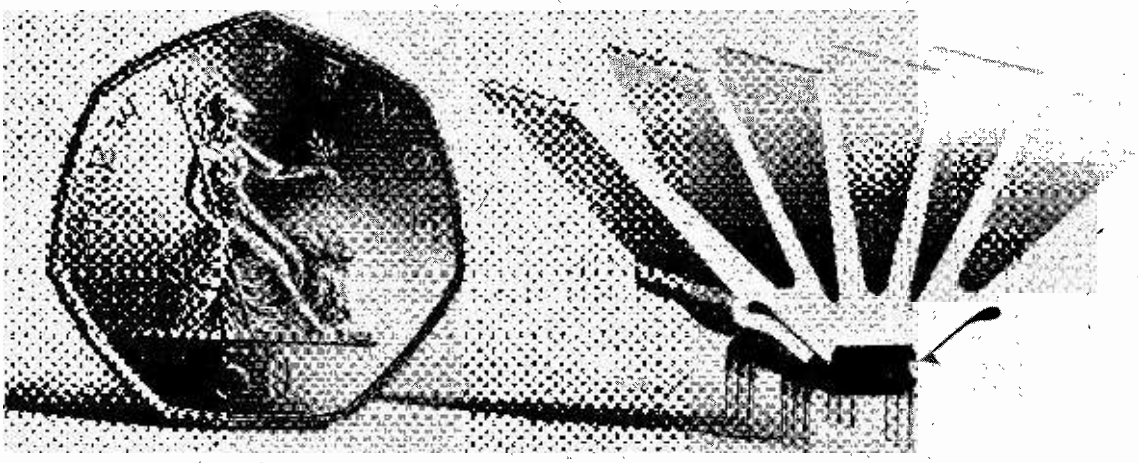
# new

# Super IC-12



## High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor, the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

**Output power** 6 watts RMS continuous (12 watts peak).

**Frequency Response** 5 Hz to 100KHz ± 1 dB.

**Total Harmonic Distortion** Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.

**Load Impedance** 3 to 15 ohms.

**Input Impedance** 250 Kohms nominal.

**Power Gain** 90dB (1,000,000,000 times) after feedback.

**Supply Voltage** 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

**Quiescent current** 8mA at 28 volts; low enough to make the IC.12 ideal also for battery operation.

**Size** 22 x 45 x 28 mm including pins and heat sink.

With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project-60 range such as the Stereo 60 and A.F.U. may be added.

NEW

**FREE** 44 page instruction manual now included with all units. Available free on request to present IC.12 users. Gives full circuit and wiring diagrams for many applications including car-radios, oscillators, etc.

Price, inc. FREE printed circuit board for mounting and manual.

**£2.98** Post free

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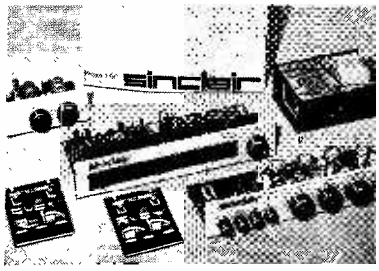
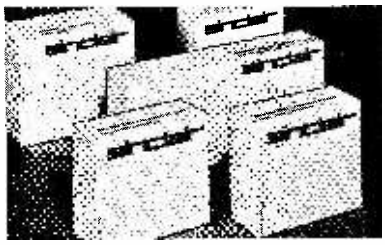
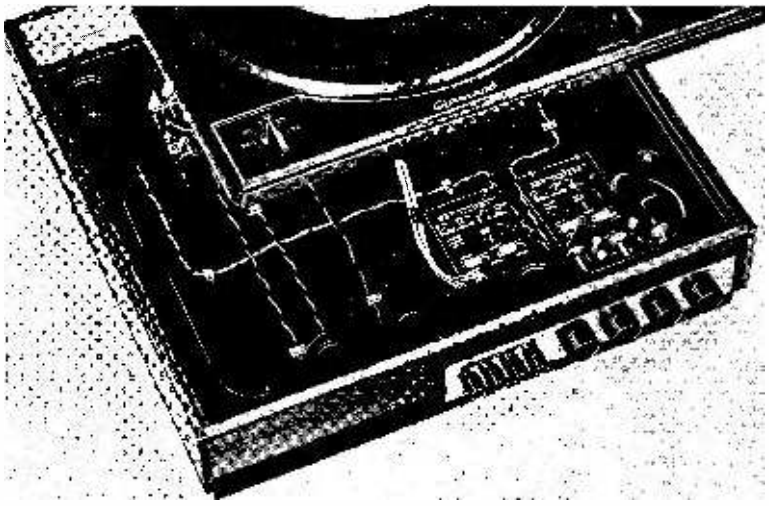
# Sinclair Project 60

## The World's leading range of high fidelity modules





Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.
Performance characteristics are so good they hold their own with any other available system irrespective of price or size.
Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

**Typical Project 60 applications**

| System | The Units to use | together with | Cost of Units |
|---|---|---|---|
| Simple battery record player | **Z.30** | Crystal P.U., 12V battery volume control | **£4.48** |
| Mains powered record player | **Z.30, PZ.5** | Crystal or ceramic P.U. volume control etc. | **£9.45** |
| 20+20 W. stereo amplifier for most needs | **2 x Z.30s, Stereo 60, PZ.5** | Crystal, ceramic or mag. P.U., F.M. Tuner, etc. | **£23.90** |
| 20+20 W. stereo amplifier with high performance spkrs. | **2 x Z.30s, Stereo 60, PZ.6** | High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc. | **£26.90** |
| 40+40 W. R.M.S. de-luxe stereo amplifier | **2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr** | As above | **£34.88** |
| Indoor P.A. | **Z.50, PZ.8, mains transformer** | Mic., guitar, speakers, etc., controls | **£19.43** |

F.M. Stereo Tuner **(£25)** & A.F.U. Filter Unit **(£5.98)** may be added as required.

# New!

## Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

**All you need for a superb 30 watt high fidelity stereo amplifier.**

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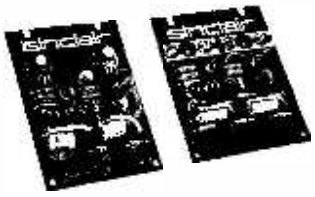
# *from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules*

## Z.30 & Z.50 power amplifiers



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

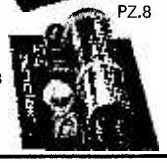
**SPECIFICATIONS** ***(Z.50 units are interchangeable with Z.30s in all applications).***
**Power Outputs**
**Z.30** 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
**Z.50** 40 watts R.M.S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms using 50 volts.
**Frequency response:** 30 to 300,000Hz ±1dB.
**Distortion:** 0.02% into 8 ohms.
**Signal to noise ratio:** better than 70dB unweighted.
**Input sensitivity:** 250mV into 100 Kohms.
For speakers from 3 to 15 ohms impedance.
**Size:** 14 x 80 x 57 mm.

**Z.30**
*Built, tested and guaranteed with circuits and instructions manual.* **£4.48**

**Z.50**
*Built, tested and guaranteed with circuits and instructions manual.* **£5.48**

## Power Supply Units

PZ.5



PZ.8

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

**PZ.5** *30 volts unstabilised* **£4.98**
**PZ.6** *35 volts stabilised* **£7.98**
**PZ.8** *45 volts stabilised (less mains transformer)* **£7.98**
**PZ.8** *mains transformer* **£5.98**

## The Sinclair Guarantee

*If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.*

## Project 60 Stereo F.M. Tuner

***First in the world to use the phase lock loop principle***

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Good reception is possible in difficult areas, and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

**SPECIFICATIONS—Number of transistors:** 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 2μV for 30dB quieting: 7μV for lock-in over full deviation. **Squelch level:** 20μV. **A.F.C. range:** ±200 KHz. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10 Hz – 15 KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC. **Indicators:** Power on/tuning/stereo.
**Size:** 93 x 40 x 207 mm.

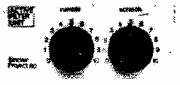
*Built and tested. Post free.* **£25**

## Stereo 60 Pre-amp/control unit

Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

**SPECIFICATIONS—Input sensitivities:** Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A curve ±1dB: 20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE + 15 to —15dB at 10 KHz: BASS + 15 to —15dB at 100Hz.
**Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.
*Built tested and guaranteed.* **£9.98**

## A.F.U. High & Low Pass Filter Unit



For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (–3dB) variable from 28KHz to 5KHz. L.F. cut-off (–3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply (0.02% at rated output. **Size:** 66 x 40 x 90 mm.

*Built tested and guaranteed.* **£5.98**

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| Sinclair IC12 integrated circuit amplifier | £1·85 |
| Eagle TSA 149 7w RMS | £24·95 |
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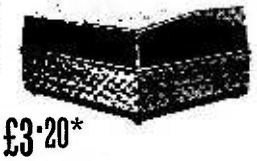

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*All prices correct at time of going to press*

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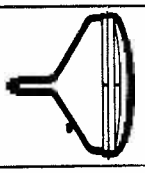

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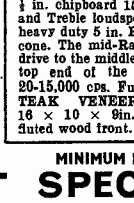

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| 600 | 0·07 | 0·16 | 0·10 | 0·23 | 0·34 | 0·45 | 1·85 |
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| Pak No. | | EQVT |
|---|---|---|
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| T2 | 8 | D1374 OC75 |
| T3 | 8 | D1216 OC81D |
| T4 | 8 | 2G381T OC81 |
| T5 | 8 | 2G382T OC82 |
| T6 | 8 | 2G344B OC44 |
| T7 | 8 | 2G345B OC45 |
| T8 | 8 | 2G378 OC78 |
| T9 | 8 | 2G399A 2N1302 |
| T10 | 8 | 2G417 AF117 |

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| U3 | 75 Germanium gold bonded diodes sim. OA5, OA47 | 0·50 |
| U4 | 40 Germanium transistors like OC81, AC128 | 0·50 |
| U5 | 60 200mA sub-min. Sil. diodes | 0·50 |
| U6 | 30 Silicon planar transistors NPN sim. BSY95A, 2N706 | 0·50 |
| U7 | 16 Silicon rectifiers Top-Hat 750mA up to 1,000V | 0·50 |
| U8 | 50 Sil. planar diodes 250mA, OA/200/202 | 0·50 |
| U9 | 20 Mixed volts 1 watt Zener diodes | 0·50 |
| U11 | 30 PNP silicon planar transistors TO-5 sim. 2N1132 | 0·50 |
| U13 | 30 PNP-NPN sil. transistors OC200 & 2S104 | 0·50 |
| U14 | 150 Mixed silicon and germanium diodes | 0·50 |
| U15 | 25 NPN Silicon planar transistors TO-5 sim. 2N697 | 0·50 |
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| U18 | 8 6-Amp silicon rectifiers BYZ13 type up to 600 PIV | 0·50 |
| U19 | 25 Silicon NPN transistors like BC108 | 0·50 |
| U20 | 12 1·5 Amp silicon rectifiers Top-Hat up to 1,000 PIV | 0·50 |
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| U23 | 30 Madt's like MAT series PNP transistors | 0·50 |
| U24 | 20 Germanium 1-Amp rectifiers GJM up to 300 PIV | 0·50 |
| U25 | 25 300 Mc/s NPN silicon transistors 2N708, BSY27 | 0·50 |
| U26 | 30 Fast switching silicon diodes like IN914 micro-min | 0·50 |
| U29 | 10 1-Amp SCR's TO-5 can up to 600 PIV CR81/25-600 | 1·00 |
| U31 | 20 Sil. Planar NPN trans. low noise amp SN3707 | 0·50 |
| U32 | 25 Zener diodes 400mW D07 case mixed volts, 3-18 | 0·50 |
| U33 | 51 Plastic case 1 amp silicon rectifiers IN4000 series | 0·50 |
| U34 | 30 Sil. PNP alloy trans. TO-5 BCY26, 2S302/4 | 0·50 |
| U35 | 25 Sil. planar trans. PNP TO-18 2N2906 | 0·50 |
| U36 | 25 Sil. planar PNP trans. TO-5 BFY50/51/52 | 0·50 |
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| U44 | 20 Sil. trans. plastic TO-5 BC115/116 | 0·50 |
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Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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| Q13 | 3 | AF117 type trans. | 0·50 |
| Q14 | 3 | OC171 H.F. type trans. | 0·50 |
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| Q16 | 2 | GET880 low noise germ. trans. | 0·50 |
| Q17 | 3 | NPN 1 ST141 & 2 ST140 | 0·50 |
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| Q30 | 7 | Sil. switch trans. 2N706 PNP | 0·50 |
| Q31 | 6 | Sil. switch trans. 2N708 NPN | 0·50 |
| Q32 | 3 | PNP sil. trans. 2 × 2N1131, 1 × 2N1132 | 0·50 |
| Q33 | 3 | Sil. NPN trans. 2N1711 | 0·50 |
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| Q42 | 6 | NPN trans. 2N5172 | 0·50 |
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| BP54 = SN7454 | 0·15 | 0·14 | 0·12 |
| BP60 = SN7460 | 0·15 | 0·14 | 0·12 |
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| BP154 = SN74154 | 1·80 | 1·70 | 1·60 |
| BP155 = SN74155 | 1·40 | 1·30 | 1·20 |
| BP156 = SN74156 | 1·40 | 1·30 | 1·20 |
| BP160 = SN74160 | 1·80 | 1·70 | 1·60 |
| BP161 = SN74161 | 1·80 | 1·70 | 1·60 |
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| BP192 = SN74192 | 2·10 | 1·95 | 1·75 |
| BP193 = SN74193 | 2·10 | 1·95 | 1·75 |
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PRICE-MIX. Devices may be mixed to qualify for quantity prices.
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Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

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**COLOUR :** Neon Red.

**DATA :** Anode supply voltage 180 min Vdc.
Cathode current : 0·35 Nom mA dc.

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*Full data available on request.*

**PRICE 1-5 £1·55. 6-25 £1·40** ACTUAL SIZE

### BRAND NEW LINEAR I.C's—FULL SPEC.

| Type No. | Case | Leads | Description | Price 1–24 | 25–99 | 100 up |
|---|---|---|---|---|---|---|
| BP 201C—SL201C | TO-5 | 8 | G.P. Amp | 63p | 53p | 45p |
| BP 701C—SL701C | TO-5 | 8 | OP Amp | 63p | 50p | 45p |
| BP 702C—SL702C | TO-5 | 8 | OP Amp Direct OP | 63p | 50p | 45p |
| BP 702—72702 | D.I.L. | 14 | G.P. OP Amp Wide Band) | 53p | 45p | 40p |
| BP 709—72709 | D.I.L. | 14 | High OP Amp | 53p | 45p | 40p |
| BP 709P—μA709C | TO-5 | 8 | High Gain OP Amp | 53p | 45p | 40p |
| BP 710—72710 | D.I.L. | 14 | Differential comparator | 53p | 45p | 40p |
| BP 711—μA711 | TO-5 | 10 | Dual comparator | 58p | 50p | 45p |
| BP 741—72741 | D.I.L. | 14 | High Gain OP Amp (Protected) | 75p | 60p | 50p |
| μA 703C—μA703C | TO-5 | 6 | R.F.—I.F. Amp | 43p | 35p | 27p |
| TAA 263— | TO-72 | 4 | A.F. Amp | 70p | 60p | 55p |
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| BP932 | Expandable dual 4-input NAND buffer | 13p | 12p | 11p |
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| BP935 | Expandable Hex Inverter | 13p | 12p | 11p |
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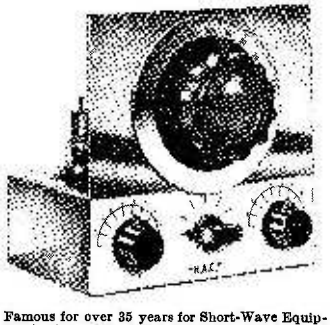

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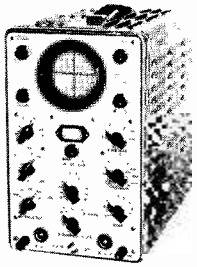
| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OA2 | 0.38 | 6AQ5 | 0.38 | 6EW6 | 0.70 | 6Y6G | 0.70 | 25Z6GT | 0.65 | 50CD6G | 1.20 | DK92 | 0.55 | ECC88 | 0.40 |
| OA3 | 0.45 | 6AQ6 | 0.65 | 6F1 | 0.75 | 7Y4 | 0.65 | 30A5 | 0.50 | 50L6GT | 0.55 | DL96 | 0.45 | ECC89 | 0.50 |
| OB2 | 0.35 | 6AR5 | 0.45 | 6F5 | 0.75 | 9BW6 | 0.60 | 30AE3 | 0.40 | 85A2 | 0.50 | DM160 | 0.65 | ECC91 | 0.20 |
| OB3 | 0.70 | 6AR6 | 0.55 | 6F6G | 0.35 | 10C2 | 0.50 | 30C1 | 0.30 | 90AG | 2.40 | DY86 | 0.32 | ECC189 | 0.65 |
| OC3 | 0.38 | 6AR11 | 1.25 | 6F11 | 0.40 | 10D1 | 0.55 | 30C15 | 0.80 | 90AV | 2.50 | DY87 | 0.33 | ECC807 | 1.25 |
| OD3 | 0.35 | 6AS5 | 0.45 | 6F13 | 0.45 | 10D2 | 0.50 | 30C17 | 0.90 | 90C1 | 0.65 | DY802 | 0.35 | ECF80 | 0.35 |
| 1B3GT | 0.40 | 6AS7G | 0.85 | 6F14 | 0.70 | 10F1 | 0.75 | 30C18 | 0.80 | 90CV | 2.40 | E88CC | 0.65 | ECF82 | 0.35 |
| 1L4 | 0.20 | 6AT6 | 0.35 | 6F15 | 0.65 | 10F9 | 0.60 | 30F5 | 0.85 | 807 | 0.50 | E180F | 1.00 | ECF86 | 0.65 |
| 1R4 | 0.45 | 6AU6 | 0.25 | 6F18 | 0.50 | 10F18 | 0.50 | 30FL1 | 0.75 | 813 | 3.75 | E810F | 2.90 | ECF804 | 1.65 |
| 1R5 | 0.40 | 6AV6 | 0.30 | 6F23 | 0.85 | 10L1 | 0.50 | 30FL12 | 1.20 | 866A | 0.75 | EABC80 | 0.35 | ECH35 | 1.00 |
| 1S4 | 0.30 | 6AW8A | 0.60 | 6F24 | 0.75 | 10LD11 | 0.65 | 30FL14 | 0.85 | 5642 | 0.70 | EAF42 | 0.55 | ECH42 | 0.75 |
| 1S5 | 0.30 | 6BA6 | 0.25 | 6F25 | 1.00 | 10P13 | 0.60 | 30L1 | 0.40 | 5670 | 0.50 | EBC33 | 0.50 | ECH81 | 0.30 |
| 1T4 | 0.30 | 6BE6 | 0.30 | 6F26 | 0.35 | 10P14 | 1.10 | 30L15 | 0.85 | 6080 | 1.60 | EBC41 | 0.55 | ECH83 | 0.45 |
| 1U4 | 0.30 | 6BF5 | 1.00 | 6F28 | 0.65 | 12AB5 | 0.70 | 30L17 | 0.80 | 6146 | 1.60 | EBC81 | 0.30 | ECH84 | 0.45 |
| 1U5 | 0.60 | 6BF6 | 0.55 | 6GK6 | 0.60 | 12AC6 | 0.50 | 30P12 | 0.80 | 6146B | 2.50 | EBF80 | 0.40 | ECL80 | 0.45 |
| 1V2 | 0.50 | 6BH6 | 0.75 | 6J4 | 0.50 | 12AD6 | 0.55 | 30P19 | 0.85 | 6360 | 1.25 | EBF83 | 0.40 | ECL81 | 0.50 |
| 1X2B | 0.50 | 6BJ6 | 0.50 | 6J5GT | 0.30 | 12AE6 | 0.55 | 30PL1 | 0.75 | 6939 | 2.25 | EBF89 | 0.30 | ECL82 | 0.35 |
| 2A3 | 0.50 | 6BK7A | 0.60 | 6J6 | 0.20 | 12AL5 | 0.50 | 30PL13 | 0.93 | 7199 | 0.80 | EC53 | 0.50 | ECL83 | 0.70 |
| 2CW4 | 0.70 | 6BN5 | 0.43 | 6J7 | 0.45 | 12AQ5 | 0.50 | 30PL14 | 0.90 | 7360 | 2.00 | EC86 | 0.60 | ECL84 | 0.55 |
| 2D21 | 0.38 | 6BN6 | 0.45 | 6K6GT | 0.60 | 12AT6 | 0.30 | 35A3 | 0.55 | 7586 | 1.25 | EC88 | 0.60 | ECL85 | 0.55 |
| 3A4 | 0.40 | 6BQ5 | 0.25 | 6K7 | 0.35 | 12AT7 | 0.35 | 35A5 | 0.75 | 7895 | 1.25 | EC90 | 0.32 | ECL86 | 0.40 |
| 3BP1 | 3.00 | 6BR8 | 0.70 | 6K8G | 0.40 | 12AU6 | 0.35 | 35B5 | 0.65 | 9002 | 0.40 | EC91 | 0.60 | EF40 | 0.50 |
| 3B28 | 2.50 | 6BS7 | 1.30 | 6K25 | 0.75 | 12AU7 | 0.30 | 35C5 | 0.50 | 9003 | 0.50 | EC92 | 0.35 | EF41 | 0.65 |
| 3B4 | 0.35 | 6BW6 | 0.85 | 6L6GT | 0.45 | 12AV6 | 0.40 | 35D5 | 0.75 | AZ1 | 0.55 | EC93 | 0.55 | EF42 | 0.70 |
| 3V4 | 0.48 | 6BW7 | 0.80 | 6L7 | 0.40 | 12AV7 | 0.65 | 35L6GT | 0.50 | AZ31 | 0.55 | EC8010 | 2.25 | EF80 | 0.25 |
| 5R4GY | 0.75 | 6BX6 | 0.25 | 6L18 | 0.45 | 12AX7 | 0.30 | 35W4 | 0.35 | CBL1 | 0.90 | ECC35 | 1.00 | EF83 | 0.55 |
| 5U4G | 0.35 | 6BZ6 | 0.40 | 6LD20 | 0.50 | 12AY7 | 0.75 | 35Z3 | 0.70 | CBL31 | 1.00 | ECC40 | 0.65 | EF85 | 0.35 |
| 5V4G | 0.45 | 6C4 | 0.33 | 6N7GT | 0.45 | 12B4A | 0.60 | 35Z4G | 0.35 | CY31 | 0.35 | ECC81 | 0.35 | EF86 | 0.30 |
| 5Y3GT | 0.40 | 6C5GT | 0.40 | 6P1 | 0.60 | 12BA6 | 0.40 | 35Z5GT | 0.60 | DAF96 | 0.45 | ECC82 | 0.30 | EF89 | 0.28 |
| 5Z3 | 0.60 | 6CB6 | 0.35 | 6P28 | 0.65 | 12BA7 | 0.40 | 50A5 | 0.75 | DF96 | 0.45 | ECC83 | 0.30 | EF91 | 0.33 |
| 5Z4G | 0.40 | 6CD6GA | 1.25 | 6Q7 | 0.40 | 12BE6 | 0.40 | 50B5 | 0.50 | DK96 | 0.50 | ECC84 | 0.30 | EF92 | 0.35 |
| 6/30L2 | 0.80 | 6CG7 | 0.55 | 6SA7 | 0.40 | 12BH7 | 0.45 | 50C5 | 0.50 | DK40 | 0.60 | ECC85 | 0.40 | EF95 | 0.35 |
| 6AB4 | 0.35 | 6CH6 | 0.60 | 6SG7 | 0.40 | 12BY7 | 0.60 | | | | | | | | |
| 6AF4A | 0.55 | 6CL6 | 0.55 | 6SK7 | 0.40 | 12K5 | 0.70 | | | | | | | | |
| 6AG5 | 0.22 | 6CW4 | 0.65 | 6SL7GT | 0.35 | 12K7GT | 0.40 | | | | | | | | |
| 6AG7 | 0.40 | 6CY5 | 0.45 | 6SN7GT | 0.35 | 12Q7GT | 0.40 | | | | | | | | |
| 6AH6 | 0.50 | 6CY7 | 0.70 | 6SQ7 | 0.40 | 12SR7 | 0.40 | | | | | | | | |
| 6AJ8 | 0.30 | 6D3 | 0.50 | 6SR7 | 0.40 | 20D1 | 0.50 | | | | | | | | |
| 6AK5 | 0.35 | 6DC6 | 0.80 | 6T8 | 0.35 | 20L1 | 1.10 | | | | | | | | |
| 6AK6 | 0.60 | 6DK6 | 0.50 | 6U4GT | 0.65 | 20P1 | 0.50 | | | | | | | | |
| | | 6DQ6B | 0.70 | 6U8A | 0.40 | 20P4 | 1.10 | | | | | | | | |
| 6AL3 | 0.43 | 6DS4 | 0.75 | 6V6GT | 0.40 | 20P5 | 1.20 | | | | | | | | |
| 6AL5 | 0.20 | 6EA8 | 0.60 | 6X4 | 0.35 | 25C5 | 0.50 | | | | | | | | |
| 6AM5 | 0.35 | 6EH7 | 0.30 | 6X5GT | 0.40 | 25L6GT | 0.50 | | | | | | | | |
| 6AM6 | 0.33 | 6EJ7 | 0.35 | 6X8 | 0.60 | 25Z4G | 0.30 | | | | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EF97 | 0.65 | GZ33 | 0.70 | PL36 | 0.55 | U281 | 0.40 | | | | | | | | |
| EP98 | 0.65 | GZ34 | 0.60 | PL81 | 0.50 | U282 | 0.40 | | | | | | | | |
| EF183 | 0.30 | HABC80 | 0.45 | PL82 | 0.45 | U301 | 0.40 | | | | | | | | |
| EF184 | 0.35 | HK90 | 0.40 | PL83 | 0.45 | U403 | 0.60 | | | | | | | | |
| EK90 | 0.30 | KT66 | 2.05 | PL84 | 0.40 | U404 | 0.60 | | | | | | | | |
| EL34 | 0.50 | KT88 | 2.00 | PL302 | 0.85 | U801 | 0.80 | | | | | | | | |
| EL36 | 0.50 | N78 | 1.50 | PL504 | 0.80 | UABC80 | | | | | | | | | |
| EL37 | 1.60 | PABC80 | 0.40 | PL508 | 0.90 | | 0.40 | | | | | | | | |
| EL41 | 0.60 | PC86 | 0.60 | PL509 | 1.10 | UAF41 | 0.50 | | | | | | | | |
| EL42 | 0.65 | PC88 | 0.60 | PL801 | 0.80 | UAF42 | 0.55 | | | | | | | | |
| EL81 | 0.55 | PC97 | 0.50 | PL802 | 0.95 | UB41 | 0.60 | | | | | | | | |
| EL83 | 0.42 | PC900 | 0.48 | PM84 | 0.60 | UBC41 | 0.50 | | | | | | | | |
| EL84 | 0.25 | PABC80 | 0.40 | PY31 | 0.30 | UBC81 | 0.40 | | | | | | | | |
| EL85 | 0.43 | PCC84 | 0.40 | PY33 | 0.63 | UBF80 | 0.40 | | | | | | | | |
| EL86 | 0.40 | PCC85 | 0.40 | PY80 | 0.40 | UBF89 | 0.35 | | | | | | | | |
| EL90 | 0.38 | PCC88 | 0.55 | PY81 | 0.30 | UBL1 | 0.60 | | | | | | | | |
| EL95 | 0.35 | PCC89 | 0.55 | PY82 | 0.35 | UBL21 | 0.65 | | | | | | | | |
| EL821 | 0.60 | PCC189 | 0.55 | PY83 | 0.38 | UC92 | 0.40 | | | | | | | | |
| EL822 | 1.30 | PCC805 | 0.85 | PY88 | 0.40 | UCC85 | 0.40 | | | | | | | | |
| ELL80 | 0.75 | PCC806 | 0.80 | PY500 | 1.00 | UCF80 | 0.55 | | | | | | | | |
| EM34 | 1.00 | PCF80 | 0.30 | PY800 | 0.40 | UCH21 | 0.60 | | | | | | | | |
| EM71 | 0.80 | PCF82 | 0.35 | PY801 | 0.50 | UCH42 | 0.70 | | | | | | | | |
| EM80 | 0.45 | PCF84 | 0.60 | PZ30 | 0.35 | UCH81 | 0.40 | | | | | | | | |
| EM81 | 0.60 | PCF86 | 0.60 | QQV02-6 | | UCL81 | 0.60 | | | | | | | | |
| EM84 | 0.35 | PCF87 | 0.90 | | 2.25 | UCL82 | 0.35 | | | | | | | | |
| EM85 | 1.00 | PCF801 | 0.50 | QQV03-10 | | UCL83 | 0.60 | | | | | | | | |
| EM87 | 0.70 | PCF802 | 0.50 | | 1.25 | UF9 | 0.60 | | | | | | | | |
| EN91 | 0.38 | PCF805 | 0.80 | QQV03-20A | | UF11 | 0.50 | | | | | | | | |
| EY51 | 0.40 | PCF806 | 0.70 | | 5.25 | UF41 | 0.60 | | | | | | | | |
| EY80 | 0.55 | PCF808 | 0.85 | QQV06-40A | | UF42 | 0.60 | | | | | | | | |
| EY81 | 0.40 | PCH200 | 0.70 | | 5.50 | UF43 | 0.60 | | | | | | | | |
| EY83 | 0.55 | PCL81 | 0.50 | TT21 | 3.00 | UF80 | 0.35 | | | | | | | | |
| EY86 | 0.40 | PCL82 | 0.35 | TT22 | 3.20 | UF85 | 0.40 | | | | | | | | |
| EY87 | 0.43 | PCL83 | 0.65 | TY2-125 | | UF89 | 0.40 | | | | | | | | |
| EY88 | 0.43 | PCL84 | 0.45 | | 10.00 | UL41 | 0.65 | | | | | | | | |
| | | PCL85 | 0.40 | U18/20 | 0.75 | UL84 | 0.40 | | | | | | | | |
| EZ40 | 0.50 | PCL86 | 0.45 | U25 | 0.80 | UM84 | 0.25 | | | | | | | | |
| EZ41 | 0.50 | PCL88 | 0.90 | U26 | 0.80 | UY1N | 0.50 | | | | | | | | |
| EZ80 | 0.27 | PCL800 | 0.93 | U31 | 0.60 | UY11 | 1.00 | | | | | | | | |
| EZ81 | 0.29 | PCL801 | 0.75 | U37 | 2.10 | UY41 | 0.48 | | | | | | | | |
| GY501 | 0.80 | PD500 | 1.30 | U52 | 0.35 | UY82 | 0.50 | | | | | | | | |
| GZ30 | 0.40 | PF86 | 0.65 | U76 | 0.35 | UY85 | 0.40 | | | | | | | | |
| GZ31 | 0.35 | PF818 | 0.85 | U78 | 0.35 | W729 | 0.75 | | | | | | | | |
| GZ32 | 0.48 | PFL200 | 0.65 | U191 | 0.75 | Z759 | 2.00 | | | | | | | | |
| | | PL33 | 0.35 | U201 | 0.35 | Z803U | 1.20 | | | | | | | | |

## TRANSISTORS

| | | | | | |
|---|---|---|---|---|---|
| 2N696 | 0.17 | AC127 | 0.20 | BD123 | 0.80 |
| 2N697 | 0.17 | AC128 | 0.15 | BD131 | 0.85 |
| 2N698 | 0.30 | AC132 | 0.35 | BD132 | 0.85 |
| 2N705 | 0.70 | AC153 | 0.20 | BF115 | 0.20 |
| 2N706 | 0.10 | AC154 | 0.15 | BF167 | 0.18 |
| 2N708 | 0.15 | AC157 | 0.20 | BF173 | 0.20 |
| 2N753 | 0.25 | AC169 | 0.10 | BF179 | 0.30 |
| 2N929 | 0.22 | AC176 | 0.25 | BF180 | 0.35 |
| 2N930 | 0.25 | AC187 | 0.30 | BF181 | 0.25 |
| 2N987 | 0.30 | AC188 | 0.30 | BF184 | 0.25 |
| 2N1131 | 0.25 | ACY17 | 0.275 | BF185 | 0.20 |
| 2N1132 | 0.25 | ACY18 | 0.20 | BF194 | 0.15 |
| 2N1184 | 1.25 | ACY19 | 0.25 | BF195 | 0.15 |
| 2N1301 | 0.40 | ACY20 | 0.20 | BF196 | 0.20 |
| 2N1302 | 0.75 | ACY21 | 0.20 | BF197 | 0.20 |
| 2N1304 | 0.25 | ACY22 | 0.15 | BF200 | 0.35 |
| 2N1305 | 0.25 | AD140 | 0.50 | BFW87 | 0.25 |
| 2N1306 | 0.25 | AD149 | 0.50 | BFW88 | 0.23 |
| 2N1307 | 0.30 | AD161 | 0.35 | BFW89 | 0.20 |
| 2N1308 | 0.25 | AD162 | 0.35 | BFW91 | 0.20 |
| 2N1309 | 0.30 | ADZ11 | 1.25 | BFX88 | 0.25 |
| 2N1613 | 0.22 | ADZ12 | 1.25 | BFY17 | 0.40 |
| 2N1711 | 0.25 | AF114 | 0.20 | BFY19 | 0.60 |
| 2N1756 | 0.75 | AF115 | 0.20 | BFY50 | 0.25 |
| 2N2147 | 0.75 | AF116 | 0.20 | BFY51 | 0.20 |
| 2N2160 | 0.65 | AF117 | 0.20 | BFY52 | 0.25 |
| 2N2217 | 0.30 | AF118 | 0.45 | BSY26 | 0.20 |
| 2N2218 | 0.30 | AF125 | 0.25 | BSY27 | 0.20 |
| 2N2219 | 0.35 | AF127 | 0.20 | BSY28 | 0.20 |
| 2N2369A | 0.20 | AF180 | 0.35 | BSY65 | 0.20 |
| 2N2477 | 0.65 | AF181 | 0.35 | BSY95A | 0.15 |
| 2N2646 | 0.60 | AF186 | 0.40 | OC16 | 0.50 |
| 2N2905 | 0.35 | AF239 | 0.40 | OC22 | 0.50 |
| 2N2923 | 0.15 | AFZ11 | 0.45 | OC23 | 0.60 |
| 2N2924 | 0.15 | ASY26 | 0.25 | OC24 | 0.60 |
| 2N2926 | 0.125 | ASY27 | 0.30 | OC25 | 0.35 |
| 2N3053 | 0.25 | ASY28 | 0.25 | OC26 | 0.25 |
| 2N3054 | 0.60 | ASY29 | 0.30 | OC28 | 0.60 |
| 2N3055 | 0.75 | ASY54 | 0.25 | OC29 | 0.60 |
| 2N3133 | 0.30 | ASZ15 | 0.70 | OC30 | 0.75 |
| 2N3134 | 0.30 | ASZ16 | 0.70 | OC35 | 0.50 |
| 2N3391 | 0.20 | ASZ17 | 0.75 | OC36 | 0.60 |
| 2N3392 | 0.15 | ASZ18 | 0.75 | OC42 | 0.20 |
| 2N3393 | 0.15 | ASZ20 | 0.25 | OC44 | 0.20 |
| 2N3394 | 0.15 | ASZ21 | 0.40 | OC45 | 0.15 |
| 2N3395 | 0.20 | BC107 | 0.125 | OC70 | 0.10 |
| 2N3402 | 0.15 | BC108 | 0.125 | OC71 | 0.12 |
| 2N3403 | 0.15 | BC109 | 0.125 | OC72 | 0.25 |
| 2N3404 | 0.35 | BC113 | 0.25 | OC73 | 0.30 |
| 2N3414 | 0.20 | BC118 | 0.30 | OC75 | 0.20 |
| 2N3415 | 0.15 | BC134 | 0.30 | OC76 | 0.20 |
| 2N3416 | 0.25 | BC147 | 0.175 | OC78 | 0.25 |
| 2N3417 | 0.25 | BC148 | 0.15 | OC78D | 0.20 |
| 2N3702 | 0.12 | BC149 | 0.15 | OC81 | 0.25 |
| 2N3703 | 0.12 | BC152 | 0.15 | OC81D | 0.15 |
| 2N3704 | 0.17 | BC158 | 0.15 | OC83 | 0.20 |
| 2N3707 | 0.15 | BC175 | 0.20 | OC139 | 0.30 |
| 2N3709 | 0.12 | BC186 | 0.25 | OC140 | 0.35 |
| 2N3710 | 0.12 | BCY30 | 0.25 | OC141 | 0.60 |
| 2N3819 | 0.35 | BCY31 | 0.40 | OC170 | 0.25 |
| 2N3906 | 0.20 | BCY33 | 0.25 | OC171 | 0.25 |
| 28702 | 0.50 | BCY34 | 0.30 | OC200 | 0.30 |
| 28746 | 0.25 | BCY72 | 0.20 | OC201 | 0.60 |
| AC113 | 0.15 | BCZ10 | 0.30 | OC202 | 0.65 |
| AC125 | 0.30 | BCZ11 | 0.40 | OC203 | 0.40 |
| AC126 | 0.20 | BD121 | 0.65 | OC204 | 0.40 |

## SYNCHROSCOPE TYPE C1-5



3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2-5-10-30-100-300-1000-3000 $\mu$sec per stroke. Free-running time base 20 c/s to 2000kc/s with built-in crystal calibrator providing timing marks at .05-.2-1-5-20-100 $\mu$ sec.
Amplitude calibrator directly calibrated in volts.
Input attenuator 1-10-100.
Power supplies 127/230v AC.

PRICE **£39.00**. Packing and carriage 1.50

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TAA263 Direct coupled 3-stage amplifier up to 600kc. Supply voltage 6-8V output 10mW TO72 outline .. .. .. .. .. .. **0·75**

TAA293. Medium frequency amplifier up to 600kc. Supply voltage 6V. output 10mW TO74 outline .. .. .. .. .. .. .. **0·95**

TAA320. MOST stage followed by a bi-polar stage Gate-to-source voltage 9-14V. Power dissipation 200mW. TO18 outline .. .. **0·65**

TAA570. Four-stage limiter-amplifier with F.M. quadrator detector and remote D.C. volume control facility. Nominal supply voltage 12V. TO74 outline .. .. .. .. **0·95**

TAD100. AM receiver circuit containing all active components (except output stage) required to build a complete receiver .. **£1·95**

SL403D PLESSEY 3-Watts Audio Amplifier **£1·50**

SL432A PLESSEY, limiting I.F. Amplifier and F.M. discriminator .. .. .. .. **£0·75**

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Low sensitivity (667 ohms per volt), 1% accuracy DC and 1·5% AC. 9 DC current ranges 300$\mu$A to 6A. 8 AC current ranges (1·5mA to 6A). 9 AC/DC voltage ranges 0·3-900V. Resistance 0·2-30K.

**£9·75**

**TYPE U4313.** High sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC. Accuracy 1·5% DC and 2·5% AC. 8 DC current ranges 60$\mu$A to 1·5A. 6 AC current ranges 0·60mA to 1·5A. 9 AC and DC Voltage ranges 1·5 to 500V. Resistance ranges 0·5-500 Kohms. **£10·50**

### TYPE U4341 MULTIMETER AND TRANSISTOR TESTER

8-DC voltage ranges 0·3-900V
6-AC voltage ranges 1.5-750V
5-DC current ranges 0·06-600mA
4-AC current ranges 0·3-300mA
4-resistance ranges 0·5-500 Kohms
Transistor cut-off current 60$\mu$A max
Transistor DC current gain 10-350
Sensitivity: 16700 Ω/V DC; 3300 Ω/V AC

PRICE **£10·50**

### TYPE U435

Sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC.
7 DC current ranges 50$\mu$A to 2·5A.
5 AC current ranges 5mA to 2·5A.
7 AC/DC Voltage ranges 2·5 to 1000V.
3 Resistance ranges 0–300 Kohms.
Capacity range 0·5$\mu$F. **£9·00**

All instruments are supplied with steel carrying case and leads.
No protection is incorporated .As the movement can withstand overloads up to 100 times, only basic precautions should be taken to prevent damage through misuse

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## ENGLAND'S LEADING ELECTRONIC CENTRES

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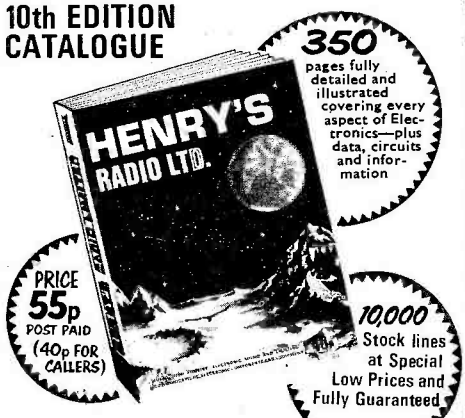
HI-FI · ELECTRONIC COMPONENTS · TEST · P.A. · DISCOTHEQUE · LIGHTING · MAIL ORDER

### 10th EDITION CATALOGUE

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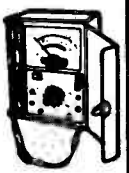

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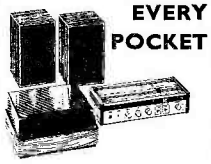

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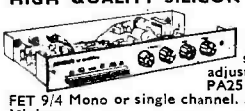

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Fully assembled 4TR Amplifier. Size 5½ x 1⅞ x ⅞in. 1-10mV adjustable sensitivity. Output 3-8 ohms. Fitted Vol. control. 9 volt operated. Thousands of uses plus low cost.
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# DX DATA CHART

# DX DATA CHART

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## INTERNATIONAL ALLOCATION OF CALL SIGNS

The first character or the first two characters of a call sign indicate the nationality of the station using it. In this list the abbreviation O.T. is used for overseas territories or states administered by, or for which the international relations are the responsibility of the country named.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AAA–ALZ | U.S.A. | JAA–JSZ | Japan | VXA–VYZ | Canada | 4NA–4OZ | Yugoslavia |
| AMA–AOZ | Spain | JTA–JVZ | Mongolia | VZA–VZZ | Australia | 4PA–4SZ | Ceylon |
| APA–ASZ | Pakistan | JWA–JXZ | Norway | WAA–WZZ | U.S.A. | 4TA–4TZ | Peru |
| ATA–AWZ | India | JYA–JYZ | Jordan | XAA–XIZ | Mexico | 4UA–4UZ | United Nations |
| AXA–AXZ | Australia | KAA–KZZ | U.S.A. | XJA–XOZ | Canada | 4VA–4VZ | Haiti |
| AYA–AZZ | Argentina | LAA–LNZ | Norway | XPA–XPZ | Denmark | 4WA–4WZ | Yemen |
| BAA–BZZ | China | LOA–LWZ | Argentina | XQA–XRZ | Chile | 4XA–4XZ | Israel |
| CAA–CEZ | Chile | LXA–LXZ | Luxembourg | XSA–XSZ | China | 4YA–4YZ | International Civil Aviation Organization |
| CFA–CKZ | Canada | LYA–LYZ | Lithuania | XTA–XTZ | France and O.T. | | |
| CLA–CMZ | Cuba | LZA–LZZ | Bulgaria | XUA–XUZ | Cambodia | 4ZA–4ZZ | Israel |
| CNA–CNZ | Morocco | MAA–MZZ | U.K. | XVA–XVZ | Vietnam | 5AA–5AZ | Libya |
| COA–COZ | Cuba | NAA–NZZ | U.S.A. | XWA–XWZ | Laos | 5CA–5GZ | Morocco |
| CPA–CPZ | Bolivia | OAA–OCZ | Peru | XXA–XXZ | Portuguese O.T. | 5HA–5IZ | Tanzania |
| CQA–CRZ | Portuguese O.T. | ODA–ODZ | Lebanon | XYA–XZZ | Burma | 5JA–5KZ | Colombia |
| CSA–CUZ | Portugal | OEA–OEZ | Austria | YAA–YAZ | Afghanistan | 5LA–5MZ | Liberia |
| CVA–CXZ | Uruguay | OFA–OJZ | Finland | YBA–YHZ | Indonesia | 5NA–5OZ | Nigeria |
| CYA–CZZ | Canada | OKA–OMZ | Czechoslovakia | YIA–YIZ | Iraq | 5PA–5QZ | Denmark |
| DAA–DTZ | Germany | ONA–OTZ | Belgium | YJA–YJZ | New Hebrides | 5RA–5VZ | France and O.T. |
| DUA–DZZ | Philippines | OUA–OZZ | Denmark | YKA–YKZ | Syria | 5WA–5WZ | W. Samoa |
| EAA–EHZ | Spain | PAA–PIZ | Netherlands | YLA–YLZ | Latvia | 5YA–5ZZ | Kenya |
| EIA–EJZ | Eire | PJA–PJZ | Netherlands Antilles | YMA–YMZ | Turkey | 6AA–6BZ | Egypt |
| EKA–EKZ | U.S.S.R. | | | YNA–YNZ | Nicaragua | 6CA–6CZ | Syria |
| ELA–ELZ | Liberia | PKA–POZ | Indonesia | YOA–YRZ | Rumania | 6DA–6JZ | Mexico |
| EMA–EOZ | U.S.S.R. | PPA–PYZ | Brazil | YSA–YSZ | Salvador | 6KA–6NZ | Korea |
| EPA–EQZ | Iran | PZA–PZZ | Surinam | YTA–YUZ | Yugoslavia | 6OA–6OZ | Somali |
| ERA–ERZ | U.S.S.R. | QAA–QZZ | (Q Code) | YVA–YYZ | Venezuela | 6PA–6SZ | Pakistan |
| ESA–ESZ | Estonia | RAA–RZZ | U.S.S.R. | YZA–YZZ | Yugoslavia | 6TA–6UZ | Sudan |
| ETA–ETZ | Ethiopia | SAA–SMZ | Sweden | ZAA–ZAZ | Albania | 6XA–6XZ | Malagasy |
| EUA–EWZ | Byelorussia | SNA–SRZ | Poland | ZBA–ZJZ | U.K. Overseas Ter. | 6YA–6YZ | Jamaica |
| EXA–EZZ | U.S.S.R. | SSA–SSM | Egypt | ZKA–ZMZ | New Zealand | 7AA–7IZ | Indonesia |
| FAA–FZZ | France and O.T. | SSN–STZ | Sudan | ZNA–ZOZ | U.K. Overseas Ter. | 7JA–7NZ | Japan |
| GAA–GZZ | U.K. | SUA–SUZ | Egypt | ZPA–ZPZ | Paraguay | 7RA–7RZ | Algeria |
| HAA–HAZ | Hungary | SVA–SZZ | Greece | ZQA–ZQZ | U.K. Overseas Ter. | 7SA–7SZ | Sweden |
| HBA–HBZ | Switzerland | TAA–TCZ | Turkey | ZRA–ZUZ | South Africa | 7TA–7YZ | Algeria |
| HCA–HDZ | Ecuador | TDA–TDZ | Guatemala | ZVA–ZZZ | Brazil | 7ZA–7ZZ | Saudi Arabia |
| HEA–HEZ | Switzerland | TEA–TEZ | Costa Rica | 2AA–2ZZ | U.K. | 8AA–8IZ | Indonesia |
| HFA–HFZ | Poland | TFA–TFZ | Iceland | 3AA–3AZ | Monaco | 8JA–8NZ | Japan |
| HGA–HGZ | Hungary | TGA–TGZ | Guatemala | 3BA–3FZ | Canada | 8SA–8SZ | Sweden |
| HHA–HHZ | Haiti | THA–THZ | France and O.T. | 3GA–3GZ | Chile | 8TA–8YZ | India |
| HIA–HIZ | Dominican Rep | TIA–TIZ | Costa Rica | 3HA–3UZ | China | 8ZA–8ZZ | Saudi Arabia |
| HJA–HKZ | Colombia | TJA–TRZ | France and O.T. | 3VA–3VZ | Tunisia | 9AA–9AZ | San Marino |
| HLA–HMZ | Korea | TSA–TSM | Tunisia | 3WA–3WZ | Vietnam | 9BA–9DZ | Iran |
| HNA–HNZ | Iraq | TSN–TZZ | France and O.T. | 3YA–3YZ | Norway | 9EA–9FZ | Ethiopia |
| HOA–HPZ | Panama | UAA–UQZ | U.S.S.R. | 3XA–3XZ | Guinea | 9GA–9GZ | Ghana |
| HQA–HRZ | Honduras Rep | URA–UTZ | Ukraine | 3ZA–3ZZ | Poland | 9KA–9KZ | Kuwait |
| HSA–HSZ | Thailand | UUA–UZZ | U.S.S.R. | 4AA–4CZ | Mexico | 9LA–9LZ | Sierra Leone |
| HTA–HTZ | Nicaragua | VAA–VGZ | Canada | 4DA–4IZ | Philippines | 9MA–9MZ | Malaysia |
| HUA–HUZ | Salvador | VHA–VNZ | Australia | 4JA–4LZ | U.S.S.R. | 9NA–9NZ | Nepal |
| HVA–HVZ | Vatican State | VOA–VOZ | Canada | 4MA–4MZ | Venezuela | 9OA–9UZ | Zaire |
| HWA–HYZ | France and O.T. | VPA–VSZ | U.K. Overseas Ter. | | | 9UA–9UZ | Burundi |
| HZA–HZZ | Saudi Arabia | VTA–VWZ | India | | | 9VA–9WZ | Malaysia |
| IAA–IZZ | Italy | | | | | 9XA–9XZ | Rwanda |

## Radio Propagation Characteristics

| Frequency | Day | Night |
|---|---|---|
| A. 100kHz–400kHz | Reception very dependent on power of station. Reliable reception possible at distances of 1000 miles or more. | |
| B. 400kHz–1·5MHz | Ground wave reception only, usually no more than 200 miles but certain winter conditions can increase this to 1000 miles. | 'Skip' takes place and reception of stations up to 1000 miles is common with not infrequent reception of stations at much greater distances. |
| C. 1·5MHz–3MHz | Similar to B but distant reception more common. | Varies with conditions but similar to, and usually better than, B. |
| D. 3MHz–8MHz | Similar to C but distant stations much easier and more reliable. Distances of several thousand miles especially at night. | |
| E. 8MHz–15MHz | Generally the best frequencies for DX but ground wave absorption limits local reception. | Often good for long distance reception but depends on conditions and time of year. |
| F. 15MHz–25MHz | As for E but DX, although often better, is more dependent on conditions. | Usually poor for long distance reception but dependent on time of year and conditions. |
| G. 25MHz–45MHz | Highly dependent on conditions—sometimes excellent DX is possible but more often unsuitable. | Local reception only. |
| H. 45MHz–120MHz | Local reception except for occasional 'freak' conditions, usually associated with high pressure areas—when stations several hundreds of miles away can be received. | |
| I. 120MHz–250MHz | As for H but freak conditions much less common. | |
| J. 250MHz–1GHz | Local reception only—rarely more than 30 miles. Signals absorbed very easily. Very occasional freak conditions give reception of stations at a few hundred miles. | |

## PRINCIPLE FREQUENCY ALLOCATIONS

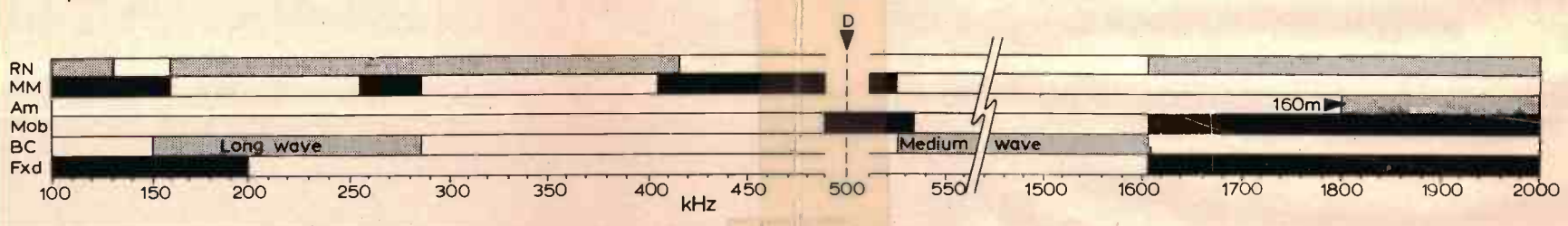
Allocations are for one or more ITU regions. Many other allocations are made to countries and/or services on a shared or secondary basis.

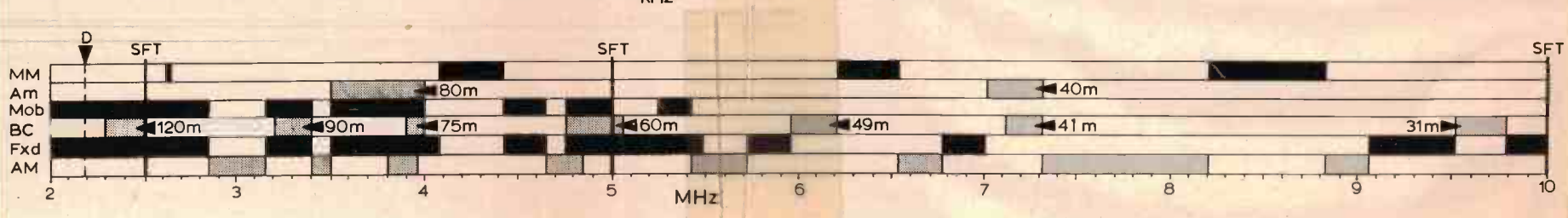
### ITU REGIONS

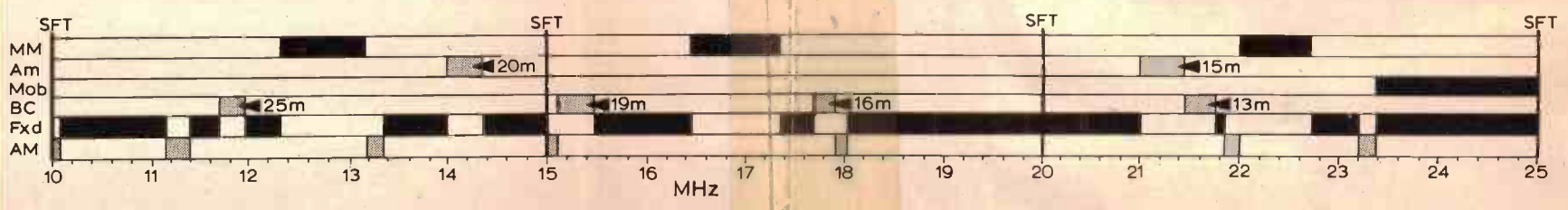
The approximate areas covered are:—
Region 1. Europe, USSR in Asia, Africa, Turkey.
Region 2. N and S America, NE Pacific, Greenland.
Region 3. Asia exc. USSR, Australia, N. Zealand, part of Pacific.

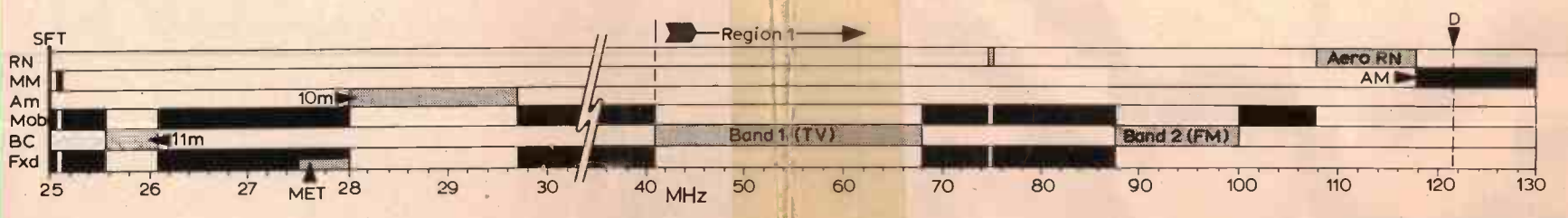
### ABBREVIATIONS

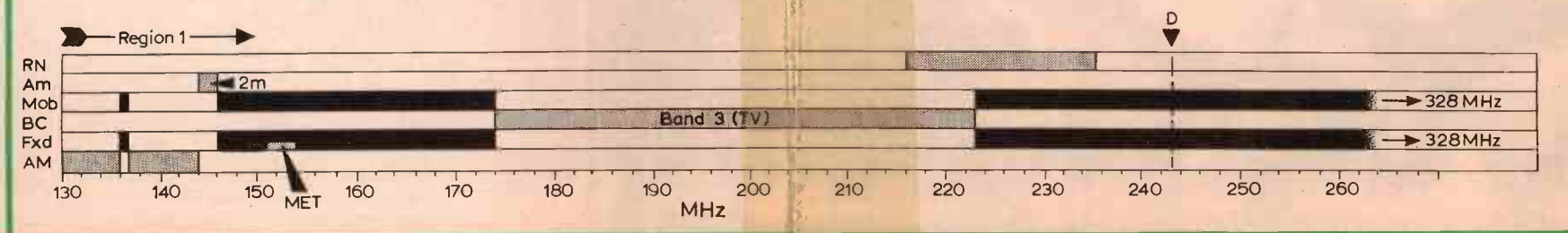
| | | | |
|---|---|---|---|
| MM | Maritime Mobile | AM | Aeronautical Mobile |
| Am | Amateurs | RN | Radio-navigation |
| Mob | Mobile | SFT | Standard Frequency Transmissions |
| BC | Broadcasting | D | Distress Frequency |
| Fxd | Fixed | Met | Meteorological Aids |

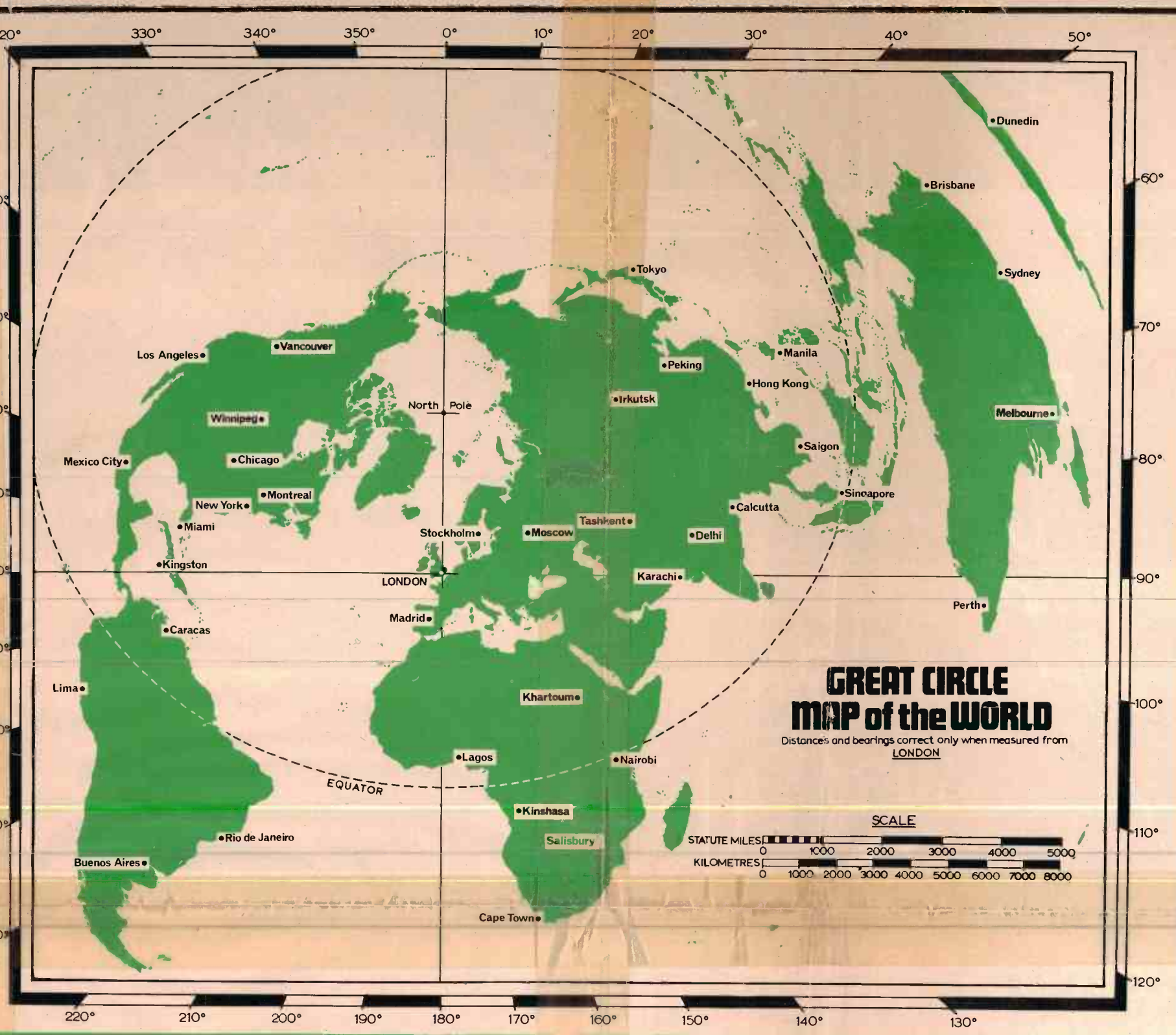





## The Sinpo Reporting Code

| | S | I | N | P | O |
|---|---|---|---|---|---|
| *Rating scale* | *Signal strength* | *Interference* | *Noise* | *Propagation disturbance* | *Overall readability* |
| 5 | Excellent | Nil | Nil | Nil | Excellent |
| 4 | Good | Slight | Slight | Slight | Good |
| 3 | Fair | Moderate | Moderate | Moderate | Fair |
| 2 | Poor | Severe | Severe | Severe | Poor |
| 1 | Barely audible | Extreme | Extreme | Extreme | Unusable |

### BROADCASTING BANDS

| | | |
|---|---|---|
| Long Waves | | 150–285kHz |
| Medium Waves | | 525–1605kHz |
| 120 metre band | | 2·300–2·495MHz |
| 90 | ,, | 3·200–3·400MHz |
| 75 | ,, | 3·900–4·000MHz |
| 60 | ,, | 4·750–5·060MHz |
| 49 | ,, | 5·950–6·200MHz |
| 41 | ,, | 7·100–7·300MHz |
| 31 | ,, | 9·500–9·775MHz |
| 25 | ,, | 11·700–11·975MHz |
| 19 | ,, | 15·100–15·450MHz |
| 16 | ,, | 17·700–17·900MHz |
| 13 | ,, | 21·450–21·750MHz |
| 11 | ,, | 25·600–26·100MHz |

### AMATEUR BANDS

| | | |
|---|---|---|
| 'Top Band' | | 1·80–2·00MHz |
| 80 Metre Band | | 3·50–4·00MHz* |
| 40 | ,, | 7·00–7·30MHz** |
| 20 | ,, | 14·00–14·35MHz |
| 15 | ,, | 21·00–21·45MHz |
| 10 | ,, | 28·00–29·70MHz |
| 4 | ,, | 70·025–70·70MHz*** |
| 2 | ,, | 144·00–148·00MHz**** |

* U.K. allocation 3·50–3·8MHz
** U.K. allocation 7·00–7·10MHz
*** U.K.
****U.K. allocation 144·00–146·00MHz

## RST CODE

**(Readability)**

1. Unreadable
2. Barely readable, occasional words distinguishable.
3. Readable with considerable difficulty.
4. Readable with practically no difficulty.
5. Perfectly readable.

**(Signal Strength)**

1. Faint, signals barely perceptible.
2. Very weak signals.
3. Weak signals.
4. Fair signals.
5. Fairly good signals.
6. Good signals.
7. Moderately strong signals.
8. Strong signals.
9. Extremely strong signals.

**(Tone)**

1. Extremely rough hissing note.
2. Very rough A.C. note, no trace of musicality.
3. Rough, low-pitched A.C. note, slightly musical.
4. Rather rough A.C. note, moderately musical.
5. Musically modulated note.
6. Modulated note, slight trace of whistle.
7. Near D.C. note, smooth ripple.
8. Good D.C. note, just a trace of ripple.
9. Purest D.C. note.

## WORLD TIME

DIFFERENCE BETWEEN LOCAL TIME AND GREENWICH MEAN TIME
The difference marked + indicate the number of hours ahead of G.M.T. Differences marked – indicate the number of hours behind G.M.T.

| | Normal Time | Summer Time |
|---|---|---|
| Alars & Issas | +3 | +3 |
| Afghanistan | +4½ | +4½ |
| Alaska | | |
| Juneau | −8 | −8 |
| General | −10 | −10 |
| Nome and Aleutians | −11 | −11 |
| Albania | +1 | +1 |
| Algeria | GMT | GMT |
| Andorra | +1 | +1 |
| Angola | +1 | +1 |
| Argentina | −4 | −3 |
| Ascension Isl. | GMT | GMT |
| Australia | | |
| (a) *Victoria* New South Wales, Queensland | +10 | +10 |
| Tasmania | +10 | +11 |
| (b) N. Territory S. Australia | +9½ | +9½ |
| (c) W. Australia | +8 | +8 |
| Austria | +1 | +1 |
| Azores | −1 | −1 |
| Bahamas | −5 | −5 |
| Bahrain | +4 | +4 |
| Bangladesh | +6 | +6 |
| Barbados | −4 | −4 |
| Belgium | +1 | +1 |
| Bermuda | −4 | −4 |
| Bolivia | −4 | −4 |
| Botswana | +2 | +2 |
| Brazil | | |
| (a) Eastern & Coastal | −3 | −2 |
| (b) Manaos | −4 | −3 |
| (c) Acre | −5 | −4 |
| Brunei | +8 | +8 |
| Bulgaria | +2 | +2 |
| Burma | +6½ | +6½ |
| Burundi | +2 | +2 |
| Cambodia | +7 | +7 |
| Cameroon | +1 | +1 |
| Canada | | |
| (a) Newfndlnd. | −3½ | −2½ |
| (b) Atlantic | −4 | −3 |
| (c) Eastern | −5 | −4 |
| (d) Central (Alberta) | −6 | −5 |
| | −7 | −7 |
| (e) Pacific | −8 | −7 |
| (f) Yukon | −9 | −8 |
| Canary Isl. | GMT | GMT |
| Cape Verde Isl. | −2 | −2 |
| Central African Rep. | +1 | +1 |
| Ceylon | +5½ | +5½ |
| Chad | +1 | +1 |
| Chile | −4 | −4 |
| China | | |
| General | +8 | +8 |
| Tibet and Urumchi | +6 | +6 |
| Colombia | −5 | −5 |
| Comoro Isl. | +3 | +3 |
| Congo (Zaire) | | |
| Kinshasa | +1 | +1 |
| Lubumbashi | +2 | +2 |
| Congo (Brazzaville) | +1 | +1 |
| Costa Rica | −6 | −6 |
| Cuba | −5 | −5 |
| Cyprus | +2 | +2 |
| Czechoslovakia | +1 | +1 |
| Dahomey | +1 | +1 |
| Denmark | +1 | +1 |
| Dom. Rep. | −5 | −4 |
| Ecuador | −5 | −5 |
| Egypt | +2 | +3 |
| El Salvador | −6 | −6 |
| Ethiopia | +3 | +3 |
| Falkland Isl. | −4 | −3 |
| Faerge Isl. | GMT | GMT |
| Fiji Islands | +12 | +12 |
| Finland | +2 | +2 |
| France | +1 | +1 |
| Gabon | +1 | +1 |
| Gambia | GMT | GMT |
| Germany | +1 | +1 |
| Ghana | GMT | GMT |
| Gibraltar | +1 | +1 |
| Gilbert Isl. | +12 | +12 |
| Great Britain | GMT | +1 |
| Greece | +2 | +2 |
| Greenland | −3 | −3 |
| Guadeloupe | −4 | −4 |
| Guam | +10 | +10 |
| Guatemala | −6 | −6 |
| Guiana | −3½ | −3½ |
| Guiana (French) | −3 | −3 |
| Guinea | GMT | GMT |
| Guinea Equat. | +1 | +1 |
| Guinea (Port.) | −1 | −1 |
| Haiti | −5 | −5 |
| Hawaii | −10 | −10 |
| Holland | +1 | +1 |
| Honduras | −5 | −6 |
| Honduras (Brit.) | −6 | −5½ |
| Hong Kong | +8 | +9 |
| Hungary | +1 | +1 |
| Iceland | −1 | GMT |
| India | +5½ | +5½ |
| Indonesia | | |
| (a) Java, Sumatra | +7 | +7 |
| (b) Borneo, Celebes, Bali | +8 | +8 |
| (c) Moluccas, W. Irian | +9 | +9 |
| Iran | +3½ | +3½ |
| Iraq | +3 | +3 |
| Ireland | +1 | +1 |
| Israel | +2 | +2 |
| Italy | +1 | +2 |
| Ivory Coast | GMT | GMT |
| Jamaica | −5 | −5 |
| Japan | +9 | +9 |
| Jordan | +2 | +2 |
| Kenya | +3 | +3 |
| Korea | +9 | +9 |
| Kuwait | +3 | +3 |
| Laos | +7 | +7 |
| Lebanon | +2 | +2 |
| Leeward Isl. | −4 | −4 |
| Lesotho | +2 | +2 |
| Liberia | −¾ | −¾ |
| Luxembourg | +1 | +1 |
| Libya | +2 | +2 |
| Macao | +8 | +8 |
| Madagascar | +3 | +3 |
| Madeira | GMT | GMT |
| Malawi | +2 | +2 |
| Malaysia | +7½ | +7½ |
| Maldive Isl. | +5½ | +5½ |
| Mali | GMT | GMT |
| Mauritania | GMT | GMT |
| Malta | +1 | +1 |
| Marshall Isl. | +12 | +12 |
| Martinique | −4 | −4 |
| Mauritius | +4 | +4 |
| Mexico Generally | −6 | −6 |
| Mongolia | +8 | +8 |
| Morocco | GMT | GMT |
| Mozambique | +2 | +2 |
| Nauru | +11½ | +11½ |
| Nepal | +5·40 | +5·40 |
| Neth. Antilles | −4 | −4 |
| New Caledonia | +11 | +11 |
| New Guinea | +10 | +10 |
| New Hebrides | +11 | +11 |
| New Zealand | +12 | +12 |
| Nicaragua | −6 | −6 |
| Niger | +1 | +1 |
| Nigeria | +1 | +1 |
| Norway | +1 | +1 |
| Oman | +4 | +4 |
| Pakistan | | |
| (a) West | +5 | +5 |
| (b) East | +6 | +6 |
| Panama | −5 | −5 |
| Papua | +10 | +10 |
| Paraguay | −4 | −4 |
| Peru | −5 | −5 |
| Philippines | +8 | +8 |
| Poland | +1 | +1 |
| Portugal | +1 | +1 |
| Puerto Rico | −4 | −4 |
| Qatar | +4 | +4 |
| Reunion | +4 | +4 |
| Rhodesia | +2 | +2 |
| Rumania | +2 | +2 |
| Rwanda | +2 | +2 |
| Ryukyu Isl. | +9 | +9 |
| Sabah | +8 | +8 |
| Sahara (Sp.) | GMT | GMT |
| Samoa Isl. | −11 | −11 |
| St. Pierre | −3 | −3 |
| S. Tome | GMT | GMT |
| Sarawak | +8 | +8 |
| Saudi Arabia | +3 | +3 |
| Senegal | GMT | GMT |
| Seychelles | +4 | +4 |
| Sierra Leone | GMT | GMT |
| Singapore | +7½ | +7½ |
| Solomon Isl. | +11 | +11 |
| Somalia | +3 | +3 |
| So. Africa | +2 | +2 |
| So. Yemen | +3 | +3 |
| Spain | +1 | +1 |
| Sudan | +2 | +2 |
| Surinam | −3½ | −3½ |
| Swaziland | +2 | +2 |
| Sweden | +1 | +1 |
| Switzerland | +1 | +1 |
| Syria | +2 | +3 |
| Tahiti | −10 | −10 |
| Taiwan | +8 | +9 |
| Tanzania | +3 | +3 |
| Tasmania | +10 | +11 |
| Thailand | +7 | +7 |
| Timor | +8 | +8 |
| Togo | GMT | GMT |
| Tonga Islands | +13 | +13 |
| Trinidad | −4 | −4 |
| Trucial States | +4 | +4 |
| Tunisia | +1 | +1 |
| Turkey | +2 | +2 |
| Uganda | +3 | +3 |
| Upper Volta | GMT | GMT |
| Uruguay | −3 | −3 |
| U.S.A. | | |
| (a) Eastern Zone | −5 | −4 |
| (b) Central Zone | −6 | −5 |
| (c) Mountain Zone | −7 | −6 |
| (d) Pacific Zone | −8 | −7 |
| U.S.S.R. | | |
| Moscow, Leningrad | +3 | +3 |
| Baku | +4 | +4 |
| Sverdlovsk | +5 | +5 |
| Tashkent | +5 | +6 |
| Novosibirsk | +7 | +7 |
| Irkutsk | +8 | +8 |
| Yakutsk | +9 | +9 |
| Khabarovsk | +10 | +10 |
| Magadan | +11 | +11 |
| Petropavlovsk | +12 | +12 |
| Anadyr | +13 | +13 |
| Venezuela | −4 | −4 |
| Vietnam (S.) | +8 | +8 |
| Vietnam (N.) | +7 | +7 |
| Virgin Isl. | −4 | −4 |
| Windward Isl. | −4 | −4 |
| Yemen | +3 | +3 |
| Yugoslavia | +1 | +1 |
| Zaire | | |
| Kinshasa | +1 | +1 |
| Lumumbashi | +2 | +2 |
| Zambia | +2 | +2 |