PRACTICAL WIRELESS

FEBRUARY
1973

20p

3-RANGE CRYSTAL MARKER • 9 VOLT BATTERY ELIMINATOR

General Coverage RECEIVER

R.S.C. STEREO PACKAGE OFFERS

PACKAGE PRICE FOR ILLUSTRATED UNITS

ONLY **£39·95** Carr. £1·00

Or deposit £6·95 and 9 monthly payments £4·22 (Total £44·93).

Individual Rec. Retail Prices:

LINEAR 505 5 + 5 Watt Amplifier	£17·50
GARRARD 2025 Autochanger + KS40A Cartridge	£13·58
Teak Veneer Plinth with Transparent Plastic Cover	£ 6·10
Pair A55 LOUDSPEAKERS (Inc 8″ × 5″ 10,000 Gauss)	£11·50
TOTAL	£48·68

SEND S.A.E. FOR FREE COLOUR BROCHURE

SAVE £31·60 ON HIGH FIDELITY UNITS

PACKAGE PRICE FOR ILLUSTRATED UNITS

ONLY **£99·95** Carr. £1·75

Or deposit £15·00 and 12 monthly payments £8·00 (Total £111·00)

Individual Rec. Retail Prices:

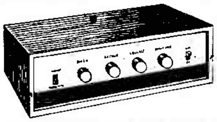
GOLDRING GL72 Transcription Turntable + P.U.	£31·39
GOLDRING G800 Magnetic Cartridge	£12·21
DE-LUXE PLINTH with 'Roll-over' Cover	£10·50
Pair R.S.C. MONARCH LOUDSPEAKERS	£38·70
R.S.C. SUPER 30 Mk III AMPLIFIER	£38·75
TOTAL	£131·55

FANE 'MODE ONE' HIGH FIDELITY SPEAKER KIT

Incorporating a model 803 8″ 13,000 Gauss Bass Speaker with ultra low resonance. P.V.C. surround cone. Printed circuit cross-over assembly with ferrite cored coils. Model 303 Pressure Tweeter, Acoustic damping material, Screws, Panels etc., and Instructive diagrams, Frequency Response 25 Hz–2 KHz. Impedance 8–15.

Tremendous Value at **£9·95** post free

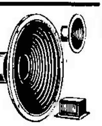
RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER



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 fascia plate and matching control knobs. COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£11·50** Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £14·99 or dep. £2·20 and 9 monthly payments £1·70 (Total £17·50).

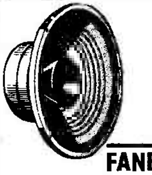
AUDIOTRINE HI-FI SPEAKER SYSTEMS



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. **£5·95** Carr. 30p

OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6·95** Carr. 35p

AUDIOTRINE HIGH FIDELITY SPEAKERS

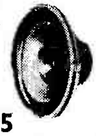


Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE.

Exceptional performance at low cost.

HF808T	8″	10W	£2·88	HF120D	12″	15W	£4·99
HF102D	10″	10W	£3·40	HF126	12″	15W	£5·75
HF120	12″	15W	£4·50	HF126D	12″	15W	£6·25

FANE 807T 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. **£3·85**

PLEASE STATE IMPEDANCE WHEN ORDERING

MODEL 803T 8″ 15w. with parasytic Tweeter. Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8–15. **£4·95**

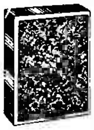
HIGH FIDELITY LOUDSPEAKER UNITS

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.

MONARCH Size 19 × 10 × 9in. approx. Rating 10 watts. Inc. 13 × 8in. speaker with highly flexible P.V.C. cone surround, long throw voice coil and 10,000 line magnet. High flux pressure tweeter. Handsome design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. See 'package offers' for illustration. Carr. 50p **£19·35**

HI-FI SPEAKER ENCLOSURES MODERN DESIGN



Teak veneer finish. Acoustically lined. Sizes approx. Carr. 35p. per enc.

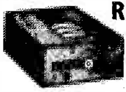
JE8 Size 16 × 11 × 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

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

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

SE12 For excellent performance with 12in. Hi-Fi speaker and tweeter Size 25 × 16 × 10½in. **£7·87**

R.S.C. BATTERY/MAINS CONVERSION UNITS



TYPE BM1. An all-dry battery eliminator. Size 5½ × 4½ × 2in. approx. Completely replaces batteries supplying 1·5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available. COMPLETE 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, 9¼ × 2¾ × 5½in. Attractive brushed silver finish facia plate 10½ × 3½in. and matching knobs. **Complete kit of parts with full wiring diagrams and instructions.** **£7·75** Carr. 40p.

OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £10·95

NOW IN STOCK!

FANE 'CRESCENDO' GROUP/DISCO LOUDSPEAKERS

Send S.A.E. for leaflet on this range of extraordinarily efficient units including the very latest BASS CRESCENDO '12'. 100 WATTS

FULL DISCOUNT to Genuine Trade Customers. CARR. FREE.

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 × 2⅝ × 2½in.

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	£2·65
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	£3·80

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.

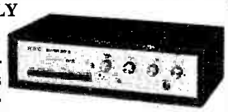
SMOOTHING CHOKES

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

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

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET

Only high grade components by leading manufacturers



- * Push Button Selector Switching
- * Jack Socket for Headphones
- * Neon Indicator
- * Satin Silver Finish Metal Fascia
- * Solid State Circuitry
- * Twenty Silicon Transistors
- * Four Diodes, Four Rectifiers

Send S.A.E. for full descriptive leaflet.

For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz ± 1½ dB.

COMPLETE KIT (less cabinet). Carr. 65p. Cabinet if req. £5 extra. **£25**

FACTORY BUILT UNIT INC. CABINET with 12 months' guarantee. Or Dep. £7 and 9 monthly payments £3·99 (Total £42·91). **£38·75**

R.S.C. STEREO FM TUNER. Visually matches Super 30 Mk. III at **£44·95**

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

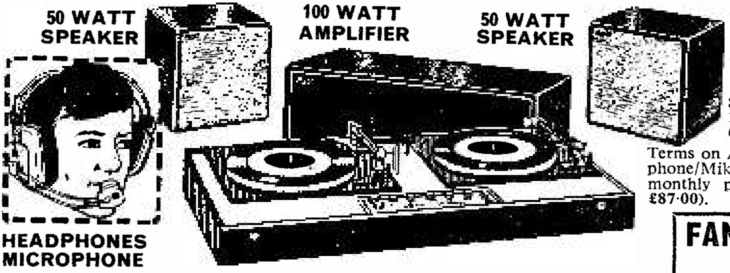
- ★ Moderate size only 25 × 14 × 10in. approx.
- ★ Response 30-20,000 c.p.s. Impedance 15 ohms
- ★ Performance comparable with units costing considerably more

COMPLETE KIT **£23** Carr. 65p

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 GROUP/DISCO UNITS



PACKAGE OFFER

Units listed below
(a) 100w POWER AMPLIFIER
(b) PAIR OF HI-FI HEADPHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to headphones)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18" × 18" × 8"

(a)(b)(c)&(d) **£72·85** Carr. £1·25

Terms on Amps. Speakers and Headphone/Mike. Deposit £15 and 18 monthly payments of £4·00 (Total £87·00).

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Sonotone or Acos 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. see illus. on left

Carr. £1·25 **£67·10**

Or Dep. £13·25 and 9 mthly pymts £6·88 (Total £75·17) or Dep. £15 and 18 mthly payments £3·62 (Total £80·16).

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

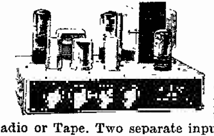
All types 15 Ohms covered in Rexine and Vynair
TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C312 30-40 WATTS Fitted two exceptionally efficient, low feedback howl characteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £3 and 9 m'thly payments £2·22 (Total £22·98) Carr. 50p. **£19·95**

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 £3·37 (Total £34·33) Carr. 75p **£31**

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. £11 and 12 mthly. pyts. £5·18 (Total £73.16). **£65** Carr. £1

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, EL34, EL34, 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. for mixing purposes, 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Twin-handled perforated cover £1·90. **12 MONTHS' GUARANTEE.** Carr. 65p **£19·75**

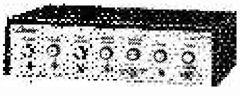
TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

LINEAR T40/60D 50W GROUP/DISCO AMPLIFIER

- ★ FULL MONITORING FACILITIES
- ★ Individual Bass and Treble controls
- ★ Twin jack output sockets for speakers
- ★ Input sockets for medium or high impedance Microphones or Guitar P.Us and Crystal or Ceramic Gram. P.Us
- ★ Frequency response 30-20,000 Hz.
- ★ Output overload protection plus double fusing

FRONT PANEL (Jack inputs) Gram, Gram, Microphone/Guitar P.U; plus monitoring socket.

CONTROLS Vol. (1) (2) (3) and (4). Bass, Treble, Master Vol., Monitor Selection Switch Gram (1) or (2), Mains Switch



£49·50 Carr. free

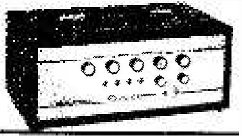
Or Deposit £7·50 and 9 monthly payments £5·37 (Total £55·83)

Simulated black rexine, plastic bonded metal case.

ALSO STOCKED LINEAR T80/100D £69·75

FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.

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 Speaker/s 3 to 30 ohms. Size 17" × 7" × 7½". 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £7·25 & 9 monthly payments £3·55. Total £39·20. **£34·95** Carr. 75p.



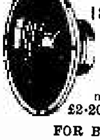
RSC PHANTOM '50'

Combined 50w Amplifier and 12in. Loudspeaker. For Lead Guitar, mic., Gram, Radio, Tape (Not for use with Bass instruments). Inc. 3 inputs and 2 vol. controls plus Treble Bass and Presense. Output Jack for additional 15ohm Speaker. Attractively finished in black with silver-fin. fascia and trimmings. Compact size. Fitted carrying handle. Available early February.

£55·95 Carr. £1·50 Terms Deposit £8·95 and 9 monthly pymts. £6 (Total £62·95

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE
High flux ceramic magnets. ALL CARRIAGE FREE.



'POP' 100	'POP' 60	'POP' 50
18" 100 Watt 14,000 gauss 8/15Ω **£22·95** Dep: £6 and 9 mthly payments £2·20 (Total £25·80)	15" 60 Watt 14,000 gauss 8/15Ω **£12·90** Dep. £3·30 and 9 monthly payments. £1·30 (Total £15).	12" 50 Watt 13,000 gauss 15Ω **£10·90** Dep £2 and 9 monthly payments £1·20 (Total £12·80) PAIR SUITABLE ALL PURPOSES

FOR BASS GUITAR, ELECT. ORGAN, ETC.

FANE SPEAKERS 'POP' 25/2 12 in. 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). Carr. free **£6·75** or Dep. £1·25 and 9 mthly payments 75p (Total £8·00).

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER **PR. FANE POP 25/2 25W L/SPEAKERS** Terms: Deposit £6.50 and 9 monthly payments of £4.92 (Total £50.78)	£34·95 £13·50 £48·45	PACKAGE PRICE **£45** carr. £1
F.A.L. PHASE 50 MK.III AMPLIFIER **PR. FANE POP 50 L/SPEAKERS** Terms: Deposit £10 and 9 monthly payments of £5·37 (Total £58.33)	£34·95 £21·80 £56·75	PACKAGE PRICE **£52** carr. £1
F.A.L. PHASE 50 MK.III AMPLIFIER **PAIR L12/25 25W L/S in cabinets** Terms: Deposit £10 and 9 monthly payments of £5·88 (Total £62·92)	£34·95 £23·90 £58·85	PACKAGE PRICE **£56** carr. £1·25
LINEAR T40/60D AMPLIFIER **PAIR L12/20 L/S in cabinets** Terms: Deposit £9·95 and 9 monthly payments of £7·67 (Total £78·98)	£49·50 £23·90 £73·40	PACKAGE PRICE **£69·95** carr. £1·50
F.A.L. PHASE 100 AMPLIFIER **4 FANE POP 50 L/SPEAKERS** Terms: Deposit £15·95 and 9 monthly payments of £10·73 (Total £112·52)	£61·95 £43·60 £105·55	PACKAGE PRICE **£99·95** carr. £2

HIGH QUALITY LOUDSPEAKER UNITS

ALL TWO TONE REXINE AND VYNAIR FINISH

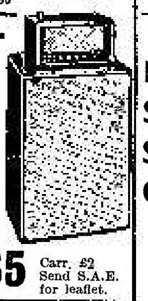
L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£34·50**
Or deposit £5·50 and 9 monthly payts. of £3·70. Total £38·80

L12/20 12" 20-25 WATT 13,000 lines 15 ohms. Carr. 50p. **£11·95**

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

✱ CREDIT TERMS AVAILABLE ON PURCHASES OVER £8 (Kits Excepted)
INTEREST CHARGES REFUNDED ON CREDIT SALES Settled in 3 months

RSC BASS-REGENT 50 WATT AMPLIFIER

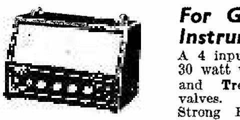


A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit either horizontal or vertical mounting.

- ★ Two extra heavy duty 12in. 50w Loudspeakers.
- ★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls.

Credit Terms: Deposit £15 & 9 monthly payments of £6·25. (Total £71·25.) **£65** Carr. £2 Send S.A.E. for leaflet.

RSC GP30 HI-FI AMPLIFIER



For Guitar, Vocal or Instrumental Group

A 4 input. 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £4·40 and 9 monthly payments of £2·45 (Total £26·45). **£23·50** Carr. 65p

NOW FOUR NEW BRANCHES

NOTTINGHAM 19/19A MARKET STREET
SUNDERLAND 5 MARKET SQUARE
STOCKPORT 8 LITTLE UNDERBANK
COVENTRY 7 SHELTON SQUARE

New premises at **HULL & NEWCASTLE**
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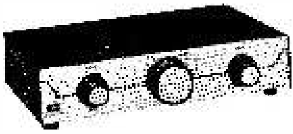

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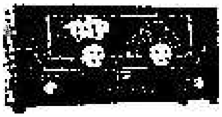

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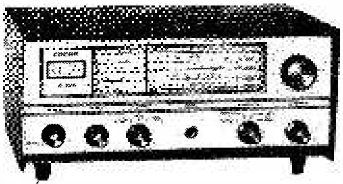

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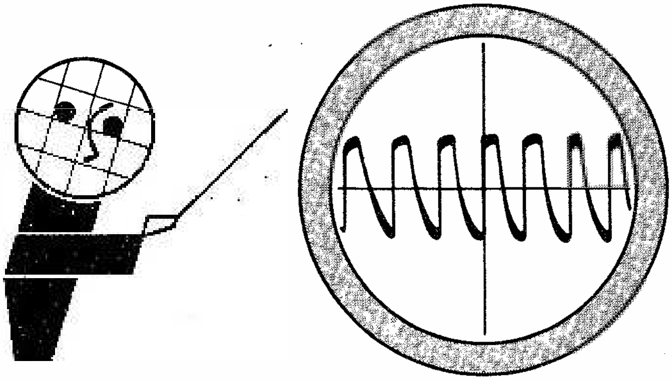

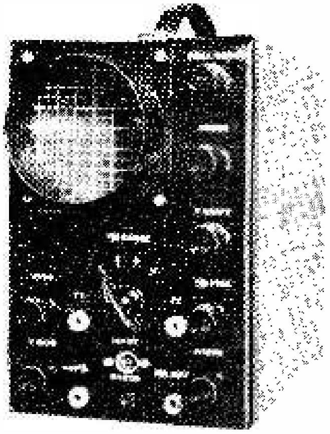

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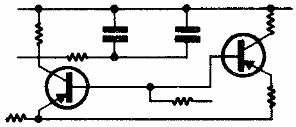

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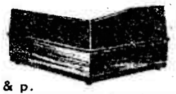

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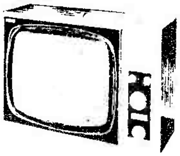

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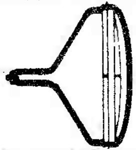

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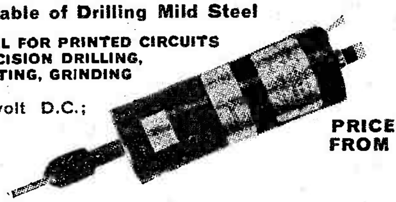

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Other components including Teak Cabinet—**£24·00** + Postage.

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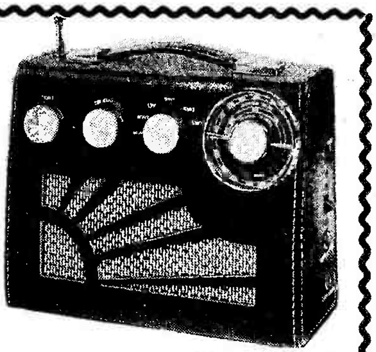

ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS ALSO AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Fine tone moving coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9″ × 7″ × 4″. Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building cost £8·50

P. P. & Ins. 50p

(Overseas P. & P. £1)

ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).
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Total building cost £6·98 P. P. & Ins. 45p.
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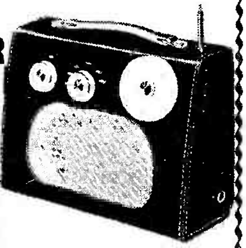

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts).
Earpiece with plug and switched socket for private listening 30p extra.

Total building costs £5·98 P. P. & Ins. 45p.
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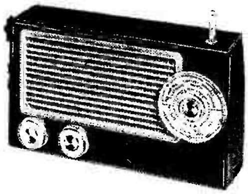
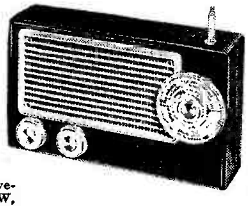
ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3, Trawler, band plus an extra Medium waveband 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 Attractive black. case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2⅝in. approx. Easy build plans and parts price list 25p (FREE with parts).

Total building costs £3·98 P. P. & Ins. 30p
(Overseas P. & P. £1)

TRANS EIGHT

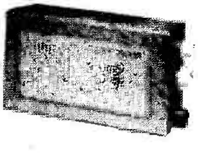


8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band.
Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2⅝in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

Total building costs £4·48 P. P. & Ins. 32p
(Overseas P. & P. £1)

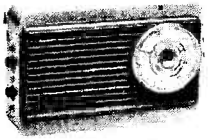
POCKET FIVE



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 5¼ × 1½ × 3¼in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs £2·29 P. P. & Ins. 23p
(Overseas P. & P. 63p)

TRANSONA FIVE



5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial. tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ × 4½ × 1½in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs £2·50 P. P. & Ins. 24p
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POCKET FIVE ☐ EDU-KIT ☐

Parts price list and plans for ....

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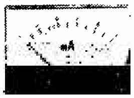
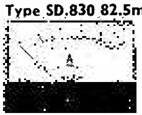


50μA	£3·80	5 amp. D.C.	£3·40
50–0–50μA	£3·80	300V. A.C. ..	£3·40
100μA	£3·80	VU Meter ..	£4·15
100–0–100μA	£3·70		
500μA	£3·50		
1mA	£3·40		
20V. D.C. ..	£3·40		
50V. D.C. ..	£3·40		
300V. D.C.	£3·40		
1 amp. D.C.	£3·40		

Type SD.830 82.5mm x 110mm Fronts



50μA	£2·75	10mA	£2·50
50–0–50μA	£2·70	50mA	£2·50
100μA	£2·70	100mA	£2·50
100–0–100μA	£2·70	500mA	£2·50
200μA	£2·70	1 amp.......	£2·50
500μA	£2·55	5 amp.......	£2·50
1mA	£2·50	10 amp.	£2·50
5mA	£2·50	5V. D.C. ..	£2·50
		10V. D.C. ..	£2·50
		20V. D.C. ..	£2·50
		50V. D.C. ..	£2·50
		300V. D.C.	£2·50
		15V. A.C. ..	£2·75
		300V. A.C. ..	£2·75
		VU Meter ..	£3·00

Type SD.640 63.5mm x 85mm Fronts

50uA	£2·60	500mA	£2·35
50–0–50μA	£2·55	1 amp.......	£2·35
100μA	£2·55	5 amp.......	£2·35
100–0–100μA	£2·55	10 amp	£2·35
200μA	£2·55	5V. D.C. ..	£2·35
500μA	£2·35	20V. D.C. ..	£2·35
1mA	£2·35	50V. D.C.	£2·35
5mA	£2·35	300V. D.C.	£2·35
10mA	£2·35	15V. A.C. ..	£2·40
50mA	£2·35	300V. A.C. .	£2·40
100mA	£2·35	VU Meter	£2·70

Type SD.460 46mm x 59.5mm Fronts

50μA	£2·40	1 amp.......	£2·15
50–0–50μA	£2·35	5 amp.......	£2·15
100μA	£2·35	10 amp.	£2·15
100–0–100μA	£2·35	5V. D.C. ..	£2·15
200μA	£2·35	10V. D.C.	£2·15
500μA	£2·20	20V. D.C. ..	£2·15
1mA	£2·15	50V. D.C. ..	£2·15
5mA	£2·15	300V. D.C.	£2·15
10mA	£2·15	15V. A.C. ..	£2·30
50mA	£2·15	300V. A.C. ..	£2·30
100mA	£2·15	VU Meter ..	£2·55
500mA	£2·15		

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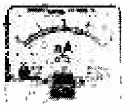
Type MR.85P. 4¼in. x 4¾in. fronts



		50mA	£3·10
		100mA	£3·10
		500mA	£3·10
		1 amp.......	£3·10
		5 amp.......	£3·10
		15 amp.	£3·10
		30 amp	£3.20
		20V. D.C.	£3·10
		50V. D.C.	£3·10
50μA	£3·95	150V. D.C.	£3·10
50–0–50μA	£3·40	300V. D.C.	£3·10
100μA	£3·40	15V. A.C. ..	£3·10
100–0–100μA	£3·30	300V. A.C. ..	£3·10
200μA	£3·30	S Meter 1mA	£3·15
500μA	£3·20	VU Meter ...	£3·95
500–0–500μA	£3·10	1 amp. A.C.*	£3·10
1mA	£3·10	5 amp A.C.*	£3·10
1–0–1mA ..	£3·10	10 amp. A.C.*	£3·10
5mA	£3·10	20 amp. A.C.*	£3·10
10mA	£3·10	30 amp. A.C.*	£3·10

Type MR.52P. 2⅜in. square fronts

50μA	£3·40	10V. D.C. ..	£2·20
50–0–50μA	£2·85	20V. D.C. ..	£2·20
100μA	£2·85	50V. D.C. ..	£2·20
100–0–100μA	£2·75	300V. D.C.	£2·20
500μA	£2·55	15V. A.C. ..	£2·30
1mA	£2·20	300V. A.C. ..	£2·30
5mA	£2·20	S Meter 1mA	£2·30
10mA	£2·20	VU Meter ..	£3·50
50mA	£2·20	1 amp. A.C. *	£2·20
100mA	£2·20	5 amp. A.C. *	£2·20
500mA	£2·20	10 amp. A.C. *	£2·20
1 amp	£2·20	20 amp. A.C. *	£2·20
5 amp	£2·20	30 amp. A.C. *	£2·20

Type MR.65P. 3⅜in. x 3⅛in. fronts

50μA	£3·70	10V. D.C. ..	£2·40
50–0–50μA	£3·00	20V. D.C. ..	£2·40
100μA	£3·00	50V. D.C. ..	£2·40
100–0–100μA	£2·90	150V. D.C.	£2·40
200μA	£2·90	300V. D.C.	£2·40
500μA	£2·65	15V. A.C. ..	£2·55
500–0–500μA	£2·40	50V. A.C. ..	£2·55
1mA	£2·40	150V. A.C. ..	£2·55
5mA	£2·40	300V. A.C. ..	£2·55
10mA	£2·40	500V. A.C.	£2·55
50mA	£2·40	S Meter 1mA	£2·60
100mA	£2·40	VU Meter ..	£3·70
500mA	£2·40	50mA A.C. *	£2·40
1 amp.......	£2·40	100mA A.C. *	£2·40
5 amp.......	£2·40	200mA A.C. *	£2·40
10 amp.	£2·40	500mA A.C. *	£2·40
15 amp.	£2·40	1 amp. A.C. *	£2·40
20 amp.	£2·40	5 amp. A.C. *	£2·40
30 amp.	£2·55	10 amp. A.C. *	£2·40
50 amp.	£2·75	20 amp. A.C. *	£2·40
5V. D.C. ..	£2·40	30 amp. A.C. *	£2·40

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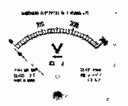
Type MR.38P. 1 21/32in. square fronts



		200mA	£1·75
		300mA	£1·75
		500mA	£1·75
		750mA	£1·75
		1 amp.......	£1·75
		2 amp.......	£1·75
		5 amp.......	£1·75
		10 amp.	£1·75
		3V. D.C. ..	£1·75
50μA	£2·30	10V. D.C. ..	£1·75
50–0–50μA	£2·10	15V. D.C. ..	£1·75
100μA	£2·10	20V. D.C. ..	£1·75
100–0–100μA	£1·95	50V. D.C. ..	£1·75
200μA	£1·95	100V. D.C.	£1·75
500μA	£1·80	150V. D.C.	£1·75
500–0–500μA	£1·75	300V. D.C.	£1·75
1mA	£1·75	500V. D.C.	£1·75
1–0–1mA ..	£1·75	750V. D.C.	£1·75
2mA ...	£1·75	15V. A.C. ..	£1·85
5mA	£1·75	50V. A.C. ..	£1·85
10mA	£1·75	150V. A.C. ..	£1·85
20mA	£1·75	300V. A.C. ..	£1·85
50mA	£1·75	500V. A.C. ..	£1·85
100mA	£1·75	S Meter 1mA	£1·85
150mA	£1·75	VU Meter ..	£2·30

Type MR.45P. 2in. square fronts

50μA	£2·50	5 amp.......	£1·85
50–0–50μA	£2·30	10V. D.C. ..	£1·85
100μA	£2·30	20V. D.C. ..	£1·85
100–0–100μA	£2·05	50V. D.C. ..	£1·85
200μA	£2·05	300V. D.C.	£1·85
500μA	£1·95	15V. A.C. ..	£2·00
500–0–500μA	£1·85	300V. A.C. ..	£2·00
1mA	£1·85	S Meter 1mA	£2·05
5mA	£1·85	VU Meter ..	£2·50
10mA	£1·85	1 amp. A.C. *	£1·85
50mA	£1·85	5 amp. A.C. *	£1·85
100mA	£1·85	10 amp. A.C. *	£1·85
500mA	£1·85	20 amp. A.C. *	£1·85
1 amp.......	£1·85	30 amp. A.C. *	£1·85

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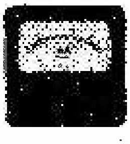
Type PE.70. 3 17/32in. x 1 15/32in. x 2¾in. deep

50μA	£3·40	500μA	£3·05
50–0–50μA	£3·30	1mA	£2·70
100μA	£3·30	300V. A.C. ..	£2·70
100–0–100μA	£3·20	VU Meter ..	£3·75
200μA	£3·20		

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts

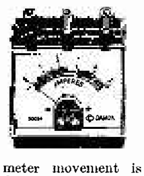


		1 amp.......	£2·15
		5 amp.......	£2·15
		15 amp.	£2·15
		30 amp.	£2·15
		50 amp.	£2·15
		5V. D.C. ..	£2·15
		10V. D.C. ..	£2·15
		20V. D.C. ..	£2·15
		50V. D.C. ..	£2·15
		150V. D.C.	£2·15
		300V. D.C.	£2·15
25μA	£3·85	50mV. D.C.	£2·40
50μA	£3·00	100mV. D.C.	£2·40
50–0–50μA	£2·60	30V. A.C. *..	£2·20
100μA	£2·60	50V. A.C. *..	£2·20
100–0–100μA	£2·50	150V. A.C. *	£2·20
500μA	£2·45	300V. A.C. *	£2·20
500–0–500μA	£2·15	500mA A.C. *	£2·15
1mA	£2·15	1 amp. A.C. *	£2·15
1–0–1mA ..	£2·15	5 amp. A.C. *	£2·15
5mA	£2·15	10 amp. A.C. *	£2·15
10mA	£2·15	20 amp. A.C. *	£2·15
50mA	£2·15	30 amp. A.C. *	£2·15
100mA	£2·15	50 amp. A.C. *	£2·15
500mA	£2·15	VU Meter ..	£3·40

Type S-80 80 mm. square fronts

50μA	£3·50	5 amp. D.C.	£2·85
50–0–50μA	£3·40	300V. A.C. ..	£2·85
100μA	£3·40	VU Meter ..	£3·70
100–0–100μA	£3·30		
500μA	£3·05		
1mA	£2·85		
20V. D.C ..	£2·85		
50V. D.C. ..	£2·85		
300V. D.C.	£2·85		
1 amp. D.C.	£2·85		

"SEW" EDUCATIONAL METERS



Type ED.107. Size overall 100mm x 90mm x 108mm

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100μA	£5·10	50V. d.c. ..	£4·85
1mA	£4·85	300V. d.c. ..	£4·85
50–0–50μA	£5·10		
1–0–1mA	£4·85	Dual range	
1A d.c.	£4·85	500mA/5A d.c.	£5·10
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10V d.c.	£4·85		

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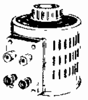
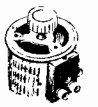
"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality · Low price · Immediate delivery

S-260 General Purpose Bench Mounting



1 Amp	£7·00
2·5 Amp	£8·05
5 Amp	£11·75
8 Amp	£15·90
10 Amp	£22·50
12 Amp	£23·60
20 Amp	£49·00
25 Amp	£58·00
40 Amp	£82·50



S-260B Panel Mounting

1 Amp	£7·00
2·5 Amp	£8·05

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ALL MODELS
INPUT 230 V 50/60 CYCLES
OUTPUT VARIABLE 0-260 VOLTS
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150 W	£2·70	P. & P. 18p
300 W	£3·60	P. & P. 23p
500 W	£5·25	P. & P. 33p
1000 W	£7·50	P' & P. 38p
1500 W	£10·20	P. & P. 43p
2250 W	£17·25	P. & P. 50p
5000 W	£35·00	P. & P. £1

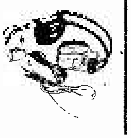
230 VOLT A.C. 50 CYCLES RELAYS

Brand new. 3 sets of changeover contacts at 5 amp rating. **50p** each. P. & P. 10p (100 lots **£40**) Quantities available.

MCA.220 AUTOMATIC VOLTAGE STABILISER

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

BH.001 HEAD SET AND BOOM MICROPHONE



Moving Coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms. **£4·62.** P. & P. 15p.

240° Wide Angle 1mA Meters

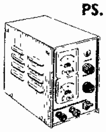
MW 1-6 60mm square	£3·97½
MW 1-8 80mm square	£4·97½

P. & P. extra

RP214 REGULATED POWER SUPPLY

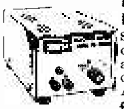
Solid state. Variable output 0–24V DC up to 1 amp. Dual scale meter to monitor voltage and current Input 220/240V AC. Size 185 × 85 × 105mm. **£8·97** P. & P. 25p.

PS. 200 REGULATED P.S.U.



Solid state. Variable output 5·20 volt D.C. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240 V. A.C. Size 7½″ × 5⅜″ × 3⅞″. **£14·97.** P. & P. 25p.

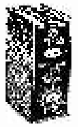
PS.1000B REGULATED POWER SUPPLY



Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240v AC. Size 4″ × 3¼″ × 6¼″. **£11·97.** P. & P. 25p.

230V/240V SMITHS SYNCHRONOUS GEARED MOTORS

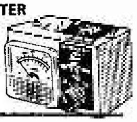
Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 2 RPH ACW; 30 RRH CW;
50p each Post 12p.



LB4 TRANSISTOR TESTER

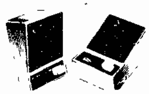
Tests PNP or NPN transistors. Audio indication. Operates on two 1·5v batteries. Complete with all instructions, etc. **£4·50.** P. & P. 20 p.

LB3 TRANSISTOR TESTER



Tests ICO and B, PNP / NPN. Operates from 9v battery. Complete with all instructions, etc. **£3·95** P. & P. 20p.

HOMER INTERCOMS



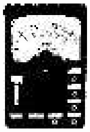
Ideal for home, office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.

2 Station, **£2·97**, 3 Station **£5·25**, P. & P. 15p.
4 Station **£6·62**, P. & P. 17p.

SEND SAE FOR LIST OF SEMI CONDUCTORS & VALVES

G. W. SMITH
& CO. (RADIO) LTD.
Also see next three pages

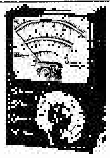
MULTIMETERS *for EVERY purpose!*



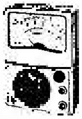
TS60 POCKET MULTIMETER

High-precision at low-cost. Ranges: D.C. 15V, 150V, 1,000V (10,000 opv). A.C. 15V, 150V, 100V (1,000 opv). D.C. Current 150mA. Resistance 100k ohms. **£1·85.** Post 15p.

MODEL 1092 TESTMETER



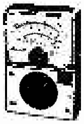
5,000 O.P.V.
0/3/15/150/300/1200 V. D.C. 0/6/30/300/600 V. A.C. 0/300μA/300 MA 0/10K/1 meg Ω
Decibels −10 to +16db
£2·75 each +15p P. & P.



HIOKI MODEL 720X

20,000 O.P.V.
Overload protection
5/25/100/500/1000 VDC.
10/50/250/1000 VAC.
50μA/250mA. 20K/2 meg ohm. −5 to +62db.
£4·97. P. & P. 15p.

HIOKI MODEL 730X

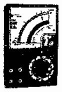


30,000 O.P.V. Overload protection. 6/30/60/300/600/1200 VDC. 12/60/120/600/1200 VAC. 60/μA/30 mA/300 mA. 2K/200K/2 megohm. −10 to +63db. **£6·50.** P. & P. 15p.

MODEL TE-12

20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF· 0·2mFd. **£5·97½.** P. & P. 17½p.

MODEL TE-200



20,000 O.P.V. Mirror scale. overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50 μA/250 mA. 0/60K/6 meg Ω. −20 to +62db. **£3·95.** P. & P. 15p.

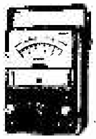
MODEL 500

30,000 O.P.V. with overload protection mirror scale 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω
£8·87½. Post paid.

HIOKI MODEL 750X

50,000 o.p.v. 43 ranges 0–0·3 to 1,200v D.C. 0–3 to 1,200v A.C. 0–30μA/300mA. 0–3K/30 meg ohms. − 10 to + 17dB. **£8·97.** Post 20p.

HT100B4 MULTI-METER

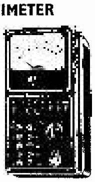


Features A.C. current ranges. 100,000 o.p.v. Mirror Scale. Overload protection.
0/·5/2·5/10/50/250/500/1000 V D.C.
0/2·5/10/50/250/1000 V. A.C.
0/10/250μA/2·5/25/250 MA/10 Amp. D.C.
10 Amp A.C. 0/20K/200K/2 MEG/20 MEG. − 20 +62db.
£12·50. P. & P. 25p.

370 WTR MULTI-METER

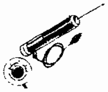
Features A.C. current ranges.
20,000 o.p.v. 0/·5/2·5/10/50/250/500 1000 V. D.C.
0/2·5/10/50/250/500/1000V AC
0/50uA/1/10/100mA/1/10 Amp D.C.
0/100mA/1/10 Amp AC
0/5K/50K/500K/5 MEG/ 50 MEG.
−20 +62db.
£15. P. & P. 25p.

RUSSIAN 22 RANGE MULTIMETER



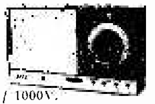
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries. test leads, instructions and sturdy steel carrying case. **OUR PRICE £5·97.** P. & P. 25p

ROUND SCALE TYPE PENCIL TESTER MODEL T.S.68

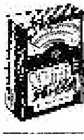


Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0·20K ohms. **ONLY £1·97** P. & P. 13p.

LT601 MULTIMETER



New style 20,000 o.p.v. pocket multimeter. 5/25/50/250/500 / 2500 V. D.C. 10 / 50 / 100 / 500 / 1000V. A.C. 50μA / 250mA. 6K / 6 meg ohms. −20 to + 22 dB. **£3·57.** Post 20p.



MODEL TH-12

20,000 o.p.v. Overload protection. Slide switch selector 0 / ·25 / 2·5 / 10 / 50 / 250 / 1000V. D.C. 0 / 10 / 50 / 250 / 1000V. A.C. 0 / 50μA / 25 / 250mA. D.C. 0 / 3K / 30K / 300K / 3 meg − 20 to + 50dB **£4·97.** Post 15p.

MODEL TE-300

30,000 O.P.V. Mirror scale. overload protection 0/·6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm −20 to +63 db. **£5·97.** P. & P. 15p.

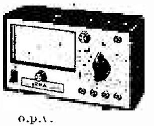
MODEL PL436

20k Ω/Volt D.C. 8k Ω/Volt AC. Mirror scale. ·6/3/12/30/120/600 V D.C. 3/30/120/600 V A.C. 50/600μA/60/600 mA. 10/100K/1 Meg/10 Meg Ω −20 to +46db. **£6·97½.** P. & P. 12½p.

TMK MODEL TW-50K

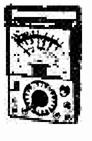
46 ranges, mirror scale, 50K/Vol. D.C. 5K/Volt A.C. D.C.: Volts ·125, ·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1000V, A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: −20 to +81·5db **£8·50.** P. & P. 17½p.

MODEL K228A



Taut band suspension. Overload protection. Polarity reversing switch. 30,000 o.p.v. 0 / ·5 / 2·5 / 15 / 50 / 250/ 500 / 1000 / 2500V. D.C. 0 / 15 / 50 / 150 / 500 / 1000V. A.C. 0 / 50μA / 5 / 50 / 150 / 500mA / 5A D.C. 0 / 3K / 300K / 3 meg. **£8·95.** Post 20p.

HIOKO MODEL 700X

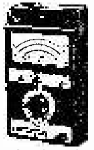


100,000 O.P.V. Overload protection. Mirror scale.
·3/·6/1·2/1·5/3/6/12/30/60/120/300/600/1200V DC
1·5/3/6/12/30/60/150/300/600/1200 V. A.C.
15/30μA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm −20 to +63dB. **£13·50.** P. & P. 20p.

MODEL C-7080 EN

Giant 6″ mirror scale. 20,000 o.p.v. 0 / ·25 / 1 / 2·5 / 10 / 50 / 250 / 1000 / 5000V. D.C. 0 / 2·5 / 10 / 50 / 250 / 1000 / 5000V. A.C. 0 / 50μA / 1 / 10 / 100 / 500mA / 10 amp. D.C. 0 / 2K / 200K / 20 meg − 20 to + 50 dB.
£13·95. Post 35p.

U4312 MULTIMETER



Extremely sturdy instrument for general electrical use. 667 o.p.v.
0/·3/1·5/7·5/30/60/150/300/600/900 VDC and 75mV.
0/·3/1·5/7·5/30/60/150/300 600/900 VAC.
0/300μA/1·5/6/15/60/150 600MA/1·5/6 AMP. D.C.
0/1·5/6/15/60/150/600MA/1 5/6 AMP. AC.
0/200 Ω/3K/30K Ω.
Accuracy DC 1%. AC 1·5%.
Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. **£9·50** plus P. & P. 25p.

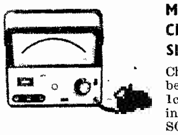
Selected TEST EQUIPMENT

FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and ICO. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads.
£7·50. Post 20p.

Model S-100TR MULTIMETER TRANSISTOR TESTER

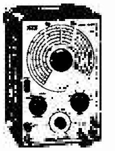
100,000 o.p.v. mirror scale/overload protection. 0/·12/·6/3/12/30/120/600 V DC. 0/6/30/120/600. V AC. 0/12 600μA/ 12/300mA/12 AMP DC. 0/10 K/1 MEG/100MEG. −20 to +50db. 0·01−·2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. **£13·50.** P/P 25p.



MODEL 449A IN CIRCUIT TRANSISTOR TESTER

Checks true A.C. beta in / out. Checks Icbo. Checks diodes in / out. Checks SCR, etc. Beta HI 10 − 500. LO 2 − 50. Icbo 0 -5000μA. 220/240 V A.C. operation
£17·50. Post 25p.

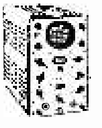
TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s 300 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions **£15.** Carr. 37½p. Size 140 × 215 × 170 mm.

MODEL L-55 FET V.O.M.

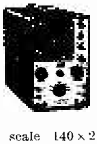
Input impedance 10 meg ohms. 0 / ·3 / 1·2 / 6 / 30 / 120 / 600V. D.C. 0 / 3 / 12 / 60 / 120 / 600V. A.C. 0 / 120μA / 120mA D.C. 0 / 1K / 100K / 10 meg /100 meg ohms
£15·97. Post 15p.



CI-5 PULSE OSCILLOSCOPE

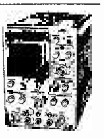
For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100KHz VRMS/mm. ·1-25; HOR. AMP. Bandwidth 500KHz. Sensitivity at 100KHz, V RMS/mm. ·3-25; Preset triggered sweep 1-3,000usec.; free running 20-200,000Hz in nine ranges. Calibrator pips. 220 × 360 × 430mm. 115-230V. AC operation.
£39·00. Carr. paid.

TO-3 PORTABLE OSCILLOSCOPE



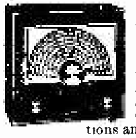
3in. tube, Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1·5cps–800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. **£40·00.** Carr. 50p.

RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE



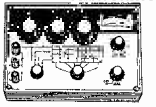
5 mc/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. × 4in. C.R.T. Calibrated triggered sweep from ·2 u/sec. to 100 milli-sec. per cm. Free running time base 50 c/s-1 mc/s. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual
£87. Carr. Paid.

TE-16A TRANSISTORISED SIGNAL GENERATOR



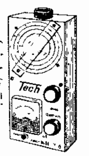
5 ranges 400kHz–30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation.
$5\frac{7}{8}$ × $5\frac{7}{8}$ × $3\frac{5}{8}$in.
Complete with instructions and leads. **£7·97.** Post 25p.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω 11·1 meg Ω 6 Ranges ±1% L.1 μ H − 111 HENRYS 6 Ranges 2 = % C.10pF ±1110mFd 6 Ranges ± 2%. TURNS RATIO 1 : 1/1000−1 : 1/100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size $7\frac{5}{8}$ × 5 × 2in. **£20.** P. & P. 25p.

MODEL TE.15 GRID DIP METER

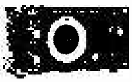


Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 440Kc/s–280Mc/s in 6 coils. 500μA Meter. 9V battery operation. Size 180 × 80 × 40mm.
£12·50. Post 20p.

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 $7\frac{3}{8}$″ × 5″ × 2″.
Price **£17·50.** Carr. 17½p.



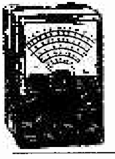
MODEL MG-100 SINE SQUARE WAVE AUDIO GENERATOR

Range 19–220,000Hz Sine Wave 19–100,000 Hz Square Wave. Output Sine or Square wave 10v. P. to P. Size 180 × 90 × 90mm. Operation 220/240v. A.C.
£17·50. Post 37p.

MODEL AT201 DECADE ATTENUATOR

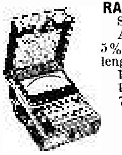
Frequency range 0-200KHz. Attenuator 0–111db, 0·1db step. Impedance 600 ohms. Max. input power 30dbm. Size 180 × 90 × 55mm.
£12·50. Post 37p.

TE-65 VALVE VOLTMETER



28 ranges. D.C. volts 1·5–1,500v. A.C. volts 1·5–1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation Complete with probe and instructions.
£17·50. P. & P. 30p. Additional probes available: R.F. **£2·12½**; H.V. **£2·50.**

MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER



Sensitivity 330 ohms/Volt AC and DC. Accuracy 5% D.C. 1% AC. Scale length 165mm. 0/300/750μA/1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750mA / 1·5 / 3 / 7·5AMP DC 0 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750mA / 1·5 / 3 / 7·5 AMP AC 0 / 75 / 150 / 300 / 750mV / 1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 / 750V DC 0/750mV / 1·5 / 3 / 7·5 / 15 / 30 / 75 / 150 / 300 /750V AC. Automatic cut out. Supplied complete with test leads, manual and test certificates. **£49·00.** Post 50p.

G. W. SMITH
& CO (RADIO) LTD.
Also see opposite page
and next two pages

UNR-30 RECEIVER

4 Bands covering 550Kc/s – 30Mc/s. B.F.O. Built-in Speaker 220/240v A.C. Brand new with instructions. **£15·75**. Carr. 37½p.

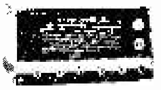
UR-1A SOLID STATE COMMUNICATION RECEIVER

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. 12¾″ × 4¾″ × 7″ Brand new with instructions. **£25**. Carr. 37½p.

SKYWOOD CX203 COMMUNICATION RECEIVER

Solid state. Coverage on 5 bands 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning BFO, AVC, ANL, 'S' meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 × 266 × 150 mm. Complete with instructions and circuit. **£28·50**. Carr. 50p.

LAFAYETTE HA-600 SOLID STATE RECEIVER



General coverage 150–400Kc/s. 550 Kc/s–30Mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter. S. Meter, Bandspread, RF Gain. 15″ × 9⅝″ × 8¼″. 18 lbs. 220/240v. A.C. or 12v. D.C. Brand new with instructions. **£50**. Carr. 50p

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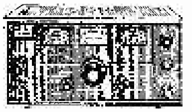
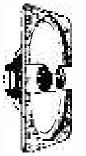


TRIO 9R59DS COMMUNICATION RECEIVER

4 band covering 550Kc/s. to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW. ANL. Variable BFO. S meter. Sep. bandspread dial. IF frequency 455 Kc/s. audio output 1·5w. Variable RF and AF gain controls 115/250v. A.C. Size: 7″ × 13″ × 10″ with instruction manual. **£49·50**. Carr. Paid.

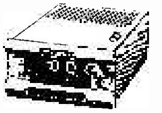


EMI LOUDSPEAKERS

Model 350. 13″ × 8″ with single tweeter/crossover. 20–20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. **£7·25** each P. & P. 37p.

Model 450. 13″ × 8″ with twin tweeter/crossover. 55–13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. **£3·62** each. P. & P. 25p.

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt. current and ohms with optional plug in cards. Specification: Accuracy: ± 0·2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power. 110–230v. A.C. 50/60 cycles. Overall size: 5⅝in. × 2 13/16in. × 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. **£35·50**. Carr. 50p.

SINCLAIR IC-12

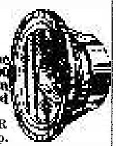
List Price
£2·98

OUR PRICE **£1·80**
P. & P. 10p

SINCLAIR EQUIPMENT

Project 60 Package offers.
2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. **£15·95** Carr. 37½p. Or with PZ6 power supply **£18·00** Carr. 37½p. 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. **£20·25**. Carr. 37½p.
Transformer for PZ8. **£2·97½** extra.
Add to any of the above **£4·45** for active filter unit and **£13·00** for pair of Q16 speakers.
All other Sinclair products in stock.
2000 Amp **£21·95** Carr. 37½p.; 3000 Amp **£28·50** Carr. 37½p.; Neoteric Amp **£43·95**. Carr. 37½p IC12 **£1·80** p. & p. 10p.
NEW PROJECT 605 — **£20·97**, Carr. 37p.

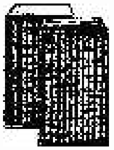
SPECIAL OFFER! GOODMANS AXIOM 301



Hi Fi 12″ 20 watt twin cone full range speaker. 30–16,000 Hz. 16,500 gauss. 8 ohm impedance. Brand new and boxed.
(List price £21.72) OUR PRICE **£12·50** each. Carr. 50p.

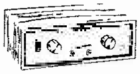
EA.41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7¼ × 3 × 4¾in. **£5·97**. P. & P. 15p.



SPECIAL OFFER! STEREO SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14½″ × 9″ × 7¼″. 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead. **£12·95** pr. Carr. 50p.



HA-10 STEREO HEADPHONE AMPLIFIER

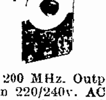
All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. **£5·97**. P. & P. 15p.

SPECIAL PURCHASE ! NEAT G30J STATIC BALANCE PICK-UP ARMS

Identical specification to NEAT G30 arm but with two-tone chrome and black finish. Complete with head shell, pick up rest and plug in phono leads.

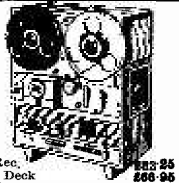
BRAND NEW—
FULLY GUARANTEED
ONLY **£8·95**. P. & P. 25p.

ARF-300 AF/RF Signal Generator



All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine / square 10v. P-P. RF 100KHz to 200 MHz. Output 1v. maximum. Operation 220/240v. AC. Complete with instructions and leads. **£29·95**. Post 50p.

AKAI BARGAINS



SUPER MONEY SAVING OFFERS—
BUY NOW WHILE STOCKS LAST !
BRAND NEW AND FULLY GUARANTEED

1721 Tape Rec.	**£73·95**
X5000 Tape Rec.	**£99·95**
GX365 Tape Rec.	**£327·00**
4000D Tape Deck	**£61·50**
4000DS Tape Deck	**£73·95**
X200D Tape Deck	**£99·95**
GX220D Tape Deck	**£164·95**
GX280D Tape Deck	**£249·40**
X1800SD Tape/8 track Rec.	**£101·95**
X2000SD Tape/Cas/8 Rec.	**£223·30**
CR81 8 track Rec.	**£80·95**
CR81D 8 track Rec.	**£65·95**
CR81T 8 track/Receiver	**£118·90**
CR80SS 8 track system	**£145·00**
CS50 Cassette Rec.	**£79·00**
CS50D Cassette Deck	**£74·95**

GXC40 Cassette Rec.	**£63·25**
GXC40D Cassette Deck	**£66·95**
GXC40T Cassette/Receiver	**£123·95**
GXC45D Cassette Deck	**£95·95**
GXC46D Cassette Deck	**£103·50**
GXC60D Cassette Deck	**£111·25**
GXC65D Cassette Deck	**£110·25**
CS35D Cassette Deck	**£59·50**
AA6200 Receiver	**£74·95**
AA6300 Receiver	**£82·50**
AA6600 Receiver	**£109·00**
AA8500 Receiver	**£175·00**
ADM11 Microphones (Pair)	**£7·50**

Carriage 50p extra. (Recorders & Decks 75p)

DOLBY SYSTEM NOISE REDUCTION UNIT

Improves the performance of cassette and semi-professional recorders. Reduces tape hiss by 3dB at 600Hz, 6dB at 1200Hz and 10dB for all frequencies above 3000Hz. Controls for input levels and noise reduction on record and replay. 2 meters for Dolby level. Off tape monitoring. Frequency response: 20Hz to 15kHz ± 1dB 19kHz −35dB. Size 15⅞″ × 9″ × 3¼″. AC 200/250V.

OUR PRICE **£32·50** Carr. 50p.

1021 STEREO LISTENING STATION

For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6″ × 4″ × 2¼″. **£2·25**, P. & P. 15p.

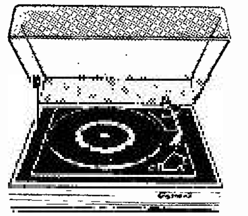
MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9¼″ × 5″ × 3″ Inputs Mics: 3 × 3mV 50K: 2 × 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.
£8·97. P. & P. 20p.

TE-1035 STEREO HEADPHONES

Low cost high performance stereo headphones. Foam rubber ear cups Adjustable head-band. 8 ohm impedance 25–18,000 Hz. With lead and stereo jack plug. ONLY **£1·97½**. P. & P. 12½p.

NEW GARRARD MODULES



Popular range of Garrard decks with Shure cartridge fitted in deluxe plinth with hinged lid.

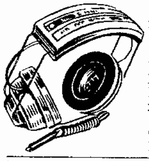
SP25 III Module/M75-6	**£23·50**
AP76 Module/M75-6	**£33·80**
AP96 Module/M75-6	**£38·75**
Zero 100S Module/M93E	**£52·60**

Carr. 50p extra any item.

HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES

Features unique mechanical 2 way units and fitted adjustable level, controls. 8 ohm impedance 20–20,000cps. Complete with spring lead & stereo jack plug **£7·97½**. P. & P. 12½p.

GENUINE BARGAIN!



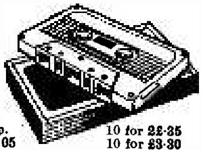
KOSS SP.3XC STEREO HEADPHONES

Response 10–15,000Hz. Impedance 4–6 ohms. Brand new, Boxed & fully guaranteed (List £9.50). OUR PRICE **£6·50**. P. & P. 25p.

HOSIDEN DH-02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable headband. 8 ohm impedance. 20-12,000 cps. Complete with lead and plug. ONLY **£2·37½**. P. & P. 12½p.

TAPE CASSETTES



Top quality Hi-Fi Low Noise in Library cases.

C60	3 for **75p**.	10 for **£2·35**
C90	3 for **£1·05**	10 for **£3·30**
C120	3 for **£1·35**	10 for **£4·20**

Tape Head Cleaner **30p** each.
P. & P. 10p extra.

SPECIAL OFFER! ROTEL RH700 STEREO HEADPHONES

20–20,000Hz. 8–16 ohm. (List £9·95). OUR PRICE **£6·75**. P. & P. 25p.

SPECIAL PURCHASE! LEAK MINI-SANDWICH SPEAKERS

Brand new and fully guaranteed. 8 watts, 8 ohm. Teak finish. (Rec. list £59·50 pr.)
OUR PRICE
£39·50 pair
Carr. £1·00.

TRANSISTORISED FM TUNER

6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator, Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108Mc/s. Ready built ready for use. Fantastic value for money. **£6·37½**. P. & P. 12½p. Stereo multiplex adaptors **£4·97½**.

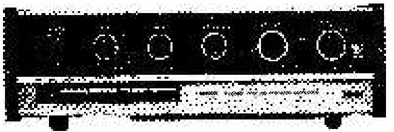
TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms.
£1·97, P. & P. 15p.

G. W.SMITH
& CO (RADIO) LTD.
Also see previous pages
and opposite page

FANTASTIC OFFER!

NIKKO TRM 50 STEREO AMPLIFIER



17 + 17 watts rms stereo amplifier with inputs for Magnetic and Crystal phono, Tuner, Tape, Aux and Tape Monitor. Outputs for two pairs of stereo speakers and Tape. Stereo headphone socket. Full range of controls including loudness control, scratch filter, etc. Size 13″ × 9½″ × 3¾″. Unrepeatable offer—limited stocks!

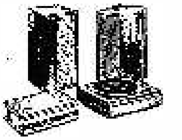
List price £59·50
OUR PRICE
£39·95
Carriage 50p

HI-FI EQUIPMENT

SAVE UP TO 33⅓% OR MORE

SEND S.A.E. FOR FULL DISCOUNT PRICE LISTS AND PACKAGE OFFERS!

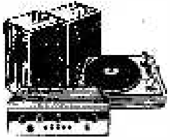
WHARFEDALE LINTON SYSTEM



Wharfedale Linton Amplifier, Linton Turntable, pair of Linton 2 speakers and all leads.

OUR PRICE £105·00 Carr. and Ins. £1·25

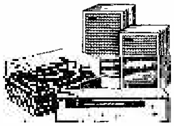
LEAK DELTA 30 SYSTEM



Leak Delta 30 stereo amplifier, Goldring GL75, plinth, cover and G800 cartridge. Pair of Leak 150 speakers and all leads.

OUR PRICE £121·50 Carr. and Ins. £1·50

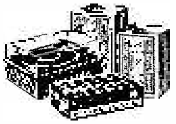
TELETON CR10T/RG42 SYSTEM



Teleton AM/FM 4 + 4 watt stereo tuner amplifier, Garrard 2025 T/C, plinth and cover, stereo cartridge, pair of matching speakers and all leads.

OUR PRICE £35·50 Carr. £1·00

TELETON F2300 SYSTEM



Teleton F2300 AM/FM. 7 + 7 watt stereo tuner amplifier, Garrard SP25 III or BSR MP60, plinth and cover, 9TAHCD cartridge, pair of Stereosound Deluxe speakers and all leads.

OUR PRICE £59·95 Carr. and Ins. £1·50

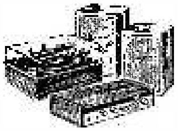
AMSTRAD 8000 II SYSTEM

Amstrad 8000 II 7 + 7 watt amplifier. Garrard SP25 III or BSR MP60, plinth and cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.

OUR PRICE £47·25 Carr. £1·00

Amplifier only, **£14·50**. Carr. 50p.

TELETON SAQ206B SYSTEM

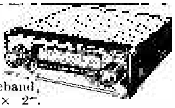


Teleton SAQ206B 8 + 8 watt Amplifier, Garrard SP25 III or BSR MP60, plinth and cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.

OUR PRICE £54·95 Carr. £1·50

Amplifier only, **£22·95**. Carr. 50p.

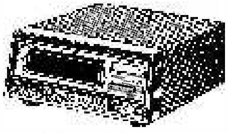
MW/LW CAR RADIO



Fully transistorised, dual waveband, Size 6¼″ × 4¾″ × 2″. 12v. D.C. Neg. or Pos. earth. Complete with fixing kit, speaker and leads. ONLY **£7·50**. Post 20p.

SUPER BARGAIN! 8-TRACK CAR STEREO TAPE PLAYER

Tone, volume and balance controls. Track selector. Complete with matched pair of stereo speakers, connections and fittings. ONLY **£15·95.** Post 30p.

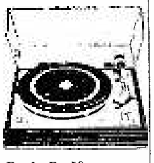


B.S.R. TD8S 8-TRACK STEREO TAPE CARTRIDGE PLAYER DECK

Integrated preamps (output 125 mV) to feed into any stereo amplifier. Automatic and manual programme selector. 4 pole synchronous motor. 210/240 V. A.C.

OUR PRICE £16·25
Carr. 37p

SAVE £££'s PHILIPS GA308 TRANSCRIPTION TURNTABLE

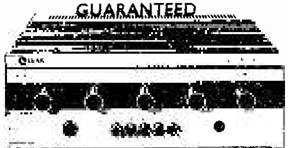


2 speeds 33⅓ and 45 rpm. Lightweight tubular counterbalanced arm. Belt driven low speed synchronous motor. Viscous damped pick up lift/lower device. Complete with teak plinth and hinged cover. GA308 less cartridge (List £36·55).
OUR PRICE **£24·50**. P. & P. 50p.
GA308 PU with GP400 stereo magnetic cartridge (List £47·65).
OUR PRICE **£29·95**. P. & P. 50p.
LIMITED NUMBER ONLY!

LEAK BARGAINS!

LIMITED OFFER!

ALL STOCKS BRAND NEW AND GUARANTEED



Delta 30	£45·95
Delta 70	£55·95
Delta FM	£53·95
Delta AM/FM	£65·95
Delta 75	£125·00
Leak 150 pair	£36·95
Leak 250 pair	£46·95
Leak 600 each	£33·50

P. & P. 50p extra each item.

ROTEL BARGAINS!

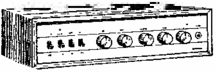
All brand new and guaranteed

RA210 Amp	£23·35
RA310 Amp	£34·95
RA610 Amp	£48·25
RX150 Receiver	£48·95
RX200 Receiver	£60·95
RX400 Receiver	£70·95

P. & P. 50p extra any item.

EAGLE TSA.150 STEREO AMPLIFIER

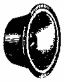
List price £29·60.



Housed in attractive Teak cabinet. 7·5 + 7·5 watts rms. Switched inputs for Mag. Cer. tape, tuner, bass, treble, volume balance controls. Headphone socket. Output for main or remote speakers.

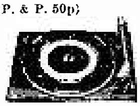
OUR PRICE £16·50
Carr./Ins. 50p.

WHARFEDALE MID-RANGE HI-FI UNITS



As used in world famous system. 5″ dia. Impedance 4/8 ohms. High flux ceramic magnet, 20 watts rms. Brand new **£1·50**. Carr. 37p.

RECORD DECKS (P. & P. 50p)



B.S.R. McDONALD	
C129 Mono	£6·50
C137	£8·35
MP60	£9·75
610	£12·65
810	£31·25
210/TPD3	£8·75
MP60/G800	£12·95
MP60/TPD1	£16·05
MP60/TPD1/G800	£19·50
MP60/TPD2	£14·35
610/TPD1	£18·95
510/TPD1	£17·95
HT70	£13·99
HT70/G800	£17·25
HT70/TPD1	£20·35
HT70/TPD1/G800	£23·90
810 Plinth/Cover	£9·25
CONNOISSEUR	
BD1 Kit	£10·90
BD1 Chassis	£13·60
BD1/SAU2/Plinth	£33·10
BD2/SAU2/Chassis	£26·75
BD2/SAU2/Plinth/C	£33·85
GARRARD	
2025 T/C Stereo	£8·50
40B Stereo	£9·25
SP25 III	£10·25
SP25 III/M75-6	£15·95
SP25 III Module/ M75-6	£23·50
SL65B	£13·75
AP76	£17·95
AP76 Module/ M75-6	£33·80
SL72B	£21·95
SL95B	£32·25
401	£25·95
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Tune into the world with this amazing world radio. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220–240 volt domestic mains supply. 14 Transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the **8 WAVEBANDS**. Complete with Hi-Fi earphone for personal listening. Frequency ranges: **Long wave** 150–350Kcs. **Medium** 353–1605Kcs. **Marine** 1·6–4·5Mcs. **Short Wave** 12–24Mcs. **FM/VHF** 88–108Mcs. **Aircraft** 108–135 Mcs. **PUBLIC SERVICE BANDS** 135–174Mcs. Fully guaranteed.

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COLBERT

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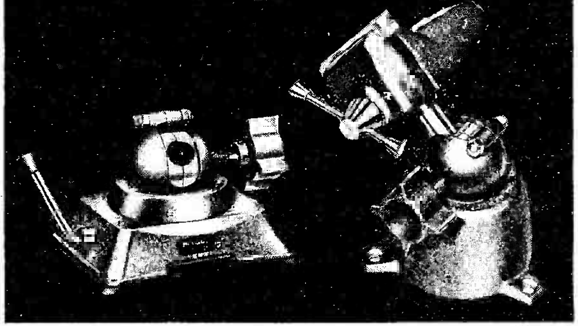

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TEXAN 20+20 WATT. STEREO AMPLIFIER

Electro Spares can now supply all the components to build the "Texan" Amplifier, featured in *Practical Wireless* May/June 1972. All components are brand new with fibre glass p.c. board, all metalwork, knobs, finished silver trim front panel, etc. etc.

TOTAL COST OF COMPLETE COMPONENTS ONLY £27·85—POST FREE!

All components are available separately, to enable the constructor to obtain just what parts he requires at any one time. Please send S.A.E. for free list.

SPECIAL CONTEMPORY STYLE SLIMLINE METAL CASE WITH WOODEN END CHEEKS IS NOW AVAILABLE FOR THIS AMPLIFIER—DETAILS INCLUDED WITH ALL LISTS, OR AVAILABLE ON RECEIPT OF S.A.E.

P. E. 'GEMINI' STEREO AMPLIFIER

30 Watts (R.M.S.) per Channel into 8 Ohms!!
Total Harmonic Distortion 0·02%!!
Frequency Response (–3 dB) 20Hz–100kHz!!

This high quality Stereo Amplifier for the Home Constructor was described in a series of articles in "Practical Electronics", from November 1970 to March 1971. It is now recognised as practically the ultimate in High Fidelity and is certainly equal to anything one can buy, no matter what the cost, but it is well within the capabilities of the ambitious constructor.

We can now supply a reprint of the articles in booklet form, price 55p plus 4p postage, with free complete component price list.

For free price list only, or a complete free specification, please send a foolscap size S.A.E.

All parts available separately.

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QUALITY ● SERVICE ● VALUE

Why take the risk?

of damage to expensive transistors and integrated circuits, when soldering?

Use Antex low-leakage soldering irons

as selected for the DESIGN CENTRE

220-240 Volts or 100-120 Volts **Model X25**

The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with it's truly remarkable heat-capacity will easily "out-solder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8".

2 other bits available 3/32" and 3/16".

Totally enclosed element in ceramic and steel shaft Bits do not "freeze" and can easily be removed

PRICE: £1.75 (rec. retail)

Suitable for production work and as a general purpose iron

Model CCN 220 volts or 240 volts

The 15 watt miniature model CCN. also has negligible leakage. Test voltage 4000v. A.C. Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32"

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OR Fitted with triple-coated, (iron, nickel and Chromium) bit 1/8"

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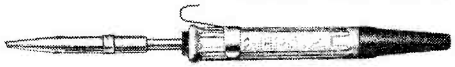
A SELECTION OF OTHER SOLDERING EQUIPMENT.



MODEL CN

Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 3/64" to 3/16". Voltages 240, 220, 110, 50 or 24

PRICE: £1.70 (rec. retail)

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Miniature 15 watt soldering iron fitted with nickel plated bit 3/32". Voltages 240 or 220.

PRICE: £1.70 (rec. retail)

MODEL G

18 Watt miniature iron, fitted with long life iron-coated bit 3/32". Voltages 240, 220 or 110.

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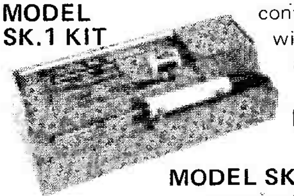
MODEL SK.1 KIT



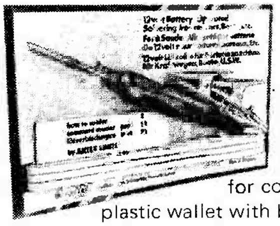
contains 15 Watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE £2.75 (Rec. retail)

MODEL SK.2 KIT

contains 15 Watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder and booklet "How to Solder"

PRICE £2.40 (Rec. retail)



MODEL MES.KIT Battery-operated 12v. 25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet with booklet "How to Solder." **PRICE £1.95 (Rec. retail)**

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EXCLUSIVE
stereosystem

LASKYS Super New Year Offer

Lasky's bring the pleasure of real stereo to you for the New Year at a bargain price – with the exclusive RIGONDA "Electroacoustic" stereo system. This tremendous quality system comprises two RIGONDA combined amplifier/speaker units (each containing bass, and treble speakers) housed in handsome teak veneer cabinets, with brushed aluminium grille panel. All controls including bass, treble, and volume together with input sockets etc., are neatly inset at side of cabinet. The system is completed by an attractive B.S.R. 4 speed Auto-record changer with cartridge and sapphire stylus, styrene plinth and tinted cover. The RIGONDA Stereo system will bring all the magic of stereo to your home with rich tone and ample six watts (max each unit) output power. Size – each RIGONDA: 23 x 10⅜ x 9¼in. Player size: 13¾ x 8 x 5½in. All units AC mains operated. RIGONDA units may also be used singly to provide enhanced sound and power from Transistor Radio sets, mono tape recs. and record players with suitable output. 9V DC output provided to power radio or cassette recorder. **Complete with all leads etc.** *Fully guaranteed.* ***DEFINITELY THE STEREO BARGAIN OF THE YEAR***

ORIGINAL LIST VALUE OF THE SYSTEM AS OFFERED OVER £46.00!

COMPLETE STEREO SYSTEM—NO EXTRAS

LASKYS SUPER NEW YEAR OFFER PRICE *ONLY* £29·75 C & P £1·25.

RIGONDA units are available separately for use with existing equipment or any record player of your choice **£11·50 each** – C & P 50p or **£22·00 per pair** – C & P 85p.

See Laskys full page advertisement for addresses.

4-STATION INTERCOM

£7.25

Solve your communication problems with this **4-Station Transistor Intercom** system **(1 master and 3 Subs)**, in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from **Master to Subs and Subs to Master.** Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 66ft. and other accessories. P. & P. £0.40.

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No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On off switch and volume control. Price £12·40 P. & P. £0.55

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OUR PRICE ONLY £3.35

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 66ft. connecting wire. Battery 14p. P. & P. £0.25.

Transistor TELEPHONE AMPLIFIER

£2.99

Why not boost business efficiency with this incredible De-luxe **Telephone Amplifier.** Take down long telephone messages or converse without holding the handset. A useful office aid. On/off switch. Volume Control. Battery 14p. extra. P. & P. 22p. Full price refunded if not satisfied in 7 days.

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B.H. COMPONENT FACTORS LIMITED

MULLARD POLYESTER C280 250V. (μF) 0·01, 0·015, 0·022, 0·033, 0·047, **3p.** 0·068, 0·1, 0·15, **4p.** 0·22, **5p.** 0·33, **7p.** 0·47, **8p.** 0·68, **10p.** 1·0, **13p.** 1·5, **20p.** 2·2, **23p.**

MULLARD POLYESTER C296: 160V. (μF) 0·01, 0·015, 0·022, **2p.** 0·047, 0·068, **3p.** 0·15, 0·22, **4p.** 0·33, **5p.** 0·47, **6p.** 0·68, 1·0, **10p.** 400V: (μF) 0·001; 0·0015, 0·0022, 0·0033, 0·01, **2p.** 0·015, 0.033, **3p.**

MULLARD ELECTROLYTIC C426. 5p. each. (μF/V) 0·64/64, 1·6/25, 4/40, 8/40, 10/40, 10/64, 16/40, 20/64, 25/25, 32/10, 40/16, 64/10, 80/16, 80/25, 100/6·4, 125/16, 125/10.

MULLARD C437: 64/64, 160/25, 640/6·4, **9p.** 160/40, **11p.** 1600/6·4, **14p.**

LARGE ELECTROLYTIC: 500/25, **10p.** 500/50, **12p.** 1000/12, **10p.** 1000/25, 2000/12, 2500/12, **15p.** 1000/50, **35p.** 2000/25, **25p.** 2500/25, **30p.** 3000/50, **65p.** 5000/50, **85p.** 2500/50, **55p.**

CERAMIC PLATE. 750V: (pF) 5, 10, 25, 40, 70, 220, **2½p.** (μF/V) 0·0047/30, 0·01/350, **2½p.** 0·047/30, **3p.** 0·1/30, **4p.** 0·1/100, **5p.** 22pF-0·01μF, 50V. **2p.** (E12 series up to 1,000pF' E6, above).

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SPECIAL RESISTOR KITS (¼W 5% Carbon Film)
10E12KIT. 10 each E12 value, 10ohms-1M
A total of 610. **£2·80** net
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A total of 1525. **£6·50** net

VEROBOARD	**0·1**	**0·15**
2½" × 5"	**25p**	**25p**
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3¾" × 5"	**29p**	**30p**
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Pins, Pkt. 25	**8p**	**8p**

CARBON POTS 5K-2M Log and Lin single **15p**, single with SW. **24p**, dual **42p.**

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PVC Wire 7/0076, 5 × 10 yds.	**30p**
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Min. Push button, push to make	**10p**
Mains Transformer 32-0-32 at 150mA	**5pp**

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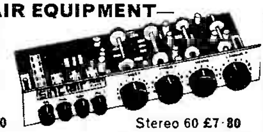
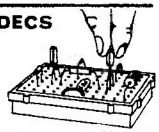
LEIGHTON BUZZARD, BEDS., LU7 9AQ.
Tel.: Cheddington 668446 (STD Code 0296)

SINCLAIR EQUIPMENT—



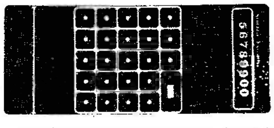
IC12	**£2·00**
Z50	**£4·25**
PZ5	**£3·97**
Z30	**£3·50**
Project 60 tuner	**£16·80**
AFU	**£4·50**
Stereo 60	**£7·80**
Project 605	**£19·00**

S-DECS AND T-DECS



S-DECS	**£1·40**
T-DECS	**£2·80**
μDEC A	**£3·00**
16 dil IC carriers	**£1·25**

SINCLAIR EXECUTIVE CALCULATOR



Weighs only 2½oz. Fits the pocket. Runs for 3 months average use on one set of tiny hearing aid batteries. Contains 7000 transistors. Brilliant 8 digit display. Adds, subtracts, multiplies and divides. Constant multiplier facility. Floating point or fixed point with 2, 4 or 6 decimal places. Subject to manufacturer's complete 5 year guarantee. Comprehensive after sales back up is supplied by Sinclair's famous service dept. If any Executive purchased from us fails to give satisfaction and is returned undamaged in 10 days we undertake to refund the whole purchase price.

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32 Goldsel Road, Swanley, Kent

Mail order only. Postage 10p per item.
Our Hi-Fi colour catalogue is 10p post free.
Official credit orders welcome.

1 R.P.M. MOTOR

Smiths. 240V 50 cycle mains working. Ideal motor to drive clock mechanisms. Price **£1** each or 10 for **£9.**

3 PIN PLUG AND SOCKET

Our Ref. No. PSO1. Flat pins American style rated at 10A 250v. Socket panel mounting. Plug is white and intended for flex. Useful where non standard power outlet is required. Also suitable for speaker leads, etc. etc. Price **25p** per pair.

THERMOSTAT WITH PROBE

Our Ref. No. TH01. Made by Ranco. Range 0-107°C 16A 250v switch. Joined to a 10″ probe by approx. 40″ of capillary tubing. 1 hole fixing. Normal control spindle **85p** each.

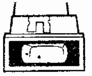
PUSH PUSH SWITCH

Our Ref. No. S04. This is fitted to tablelamps etc. Superior quality and reliable (Leviton). Conservatively rated 1A 250v. Has 2 flex leads attached measuring 40″ and 12″ each respectively. Price **10p** each.

INDUCTION MOTOR

Made by G.E.C. Normal type with approx. 1″ of 3/8 spindle. Standard fixing ½″ stack. Brand new **65p** each less usual quantity discounts. Good stocks available.

MINIATURE ROCKER SWITCH



Our Ref. RS01. 10amp 240v. Self-fixing into hole size approx. 1″ × ⅜″ by famous French maker Russemburgh. Price **10p** each.

ROCKER SWITCH

Our Ref. RS02. 13amp self-fixing into hole approx. 1 × ⅜″. Made by the Carr Fastener Co. Very reliable. Price **8p** each.

PHOTO TRANSISTOR

OCP70—ideal for burglar alarms and similar applications. Price **65p** each.

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One of our customers has pointed out how easily our box signs can be converted to exit signs. These are illuminated having a 20w fluorescent lamp with associated control gear. The front is very thick, clear plastic. Directly onto this you can stick down the letters available at most stationers. There is room inside the box for a battery and low volt lamp in the case of power failure. Size of sign is 2ft high × 14″ wide × 5″ deep. Solidly made from sheet steel and hammer finished in enamel. Price **£3·50** plus 50p carriage per 200 miles.

6 PIN PLUG AND SOCKET

And metal case with flex grip for one end, this can be fitted either to a plug or socket and the other part fitting to the equipment. Price **40p** per pair—10 pairs **£3·60.**

TAPE HEADS

We are gradually obtaining more information about the Truvox tape heads we have, we are told that these have been wound in a very ingenious way so that winding may be coupled either in parallel or in series depending whether high or low impedance is required. We also have matching erase heads and now offer these in pairs, 1 record and 1 erase head. Price of the 2 track **45p** per pair, 4 track **75p** per pair. Pair mounted on plate **45p** extra.

REED SWITCH COILS

These are solenoids wound on moulded formers of the correct shape and dimensions to take standard reed switches. They have printed circuit board mounting. Six types available:—

RC1	takes	1	reed—	Operates	10–15v 600 ohm	**30p**
RC2	,,	2	,,	,,	10–15v 180 ohm	**25p**
RC3	,,	1	,,	,,	15–30v 1K ohm	**35p**
RC4	,,	2	,,	,,	15–30v 300 ohm	**45p**
RC5	,,	1	,,	,,	45–70v 6500ohm	**35p**
RC6	,,	2	,,	,,	45–70v 3500ohm	**40p**

Standard reed switches available **10p** each or 10 for **90p**, 100 for **£8·50.**

THROAT MICROPHONES

Dynamic type. Made for government contract—many uses: i.e. motor cyclists talking to pillion passengers, under guitar strings. Vibration amplifiers etc. etc. Price **30p** each. 10 for **£2·70.**

MUTUAL INDUCTANCE COIL

Laboratory type. M=0·001H. Inductance of coils 0·0022H and 0·0021H. Coil resistance 0·53 ohms and 0·51 ohms respectively. Maximum current through coils=3 amps. Completely encased with 4 screw down terminals. Overall size 6″ diameter by 3″ deep Price **£4** each.

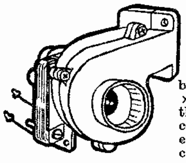
WIRE ENDED FUSES

Useful where you want a quick solder in fuse. Rated 2A 250v. These are about the size of a resistor. Price **5p** each.

BAKELITE INSTRUMENT CASE

Size approx. 6¼″×3⅜″×2″ deep with brass inserts in four corners and bakelite panel. This is a very strong case suitable to house instruments and special rigs, etc. Price **45p** each.

CENTRIFUGAL BLOWER

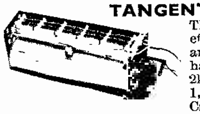


Miniature mains driven blower centrifugal type blower unit by Woods, powerful but specially built for quiet running—driven by cushioned induction motor with specially built low noise bearings. Overall size of blower is approx. 4½″ × 4½″ × 4″. When mounted by its flange air is blown into the equipment but to suck air out mount it from the centre using a clamp, ideal for cooling electrical equipment, or fitting into a cooker hood, film drying cabinet or for removing flux smoke when soldering etc. etc. A real bargain at **£1·85.**

MULLARD I.F. MODULE

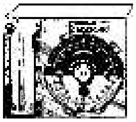
This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10·7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. **85p** each. 10 for **£7·85.** 100 for **£62·50p.** With connection dig.

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 lined case or cabinet. Only need control switch, **£3·50.** 2kW Model as above except 2 kilowatts, **£2·50.** Don't miss this. Control Switch, **45p.** P. & P. **45p.**

ELECTRIC TIME SWITCH



Made by Smiths these are A.C. mains operated. NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp change-over contacts will switch circuit on or off during these periods **£2·50** post and ins., 23p. Additional time contacts **50p** pair

COMPUTER TAPE

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide **£1·00** plus 33p post and insurance with cassette. ¾in wide **£1·00** plus 30p post and insurance with cassette. ½in wide **85p** plus 25p post and insurance with cassette. Spare spools and cassettes—1in **75p**, ½in **75p** each plus 20p post and insurance.

THIS MONTH'S SNIP

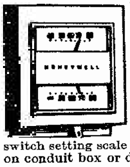
MULLARD 4 WATT AMPLIFIER EP 9000

Suitable for mono or stereo systems. It's output approx. 4w. speech or music into a 12–15 ohm speaker. Power requirements 24 volts 10 watts. Harmonic distortion at typical listening level is less than 2%. Frequency response at typical listening level 50hz to 16khz. Totally enclosed in moulded case size 3¼″ × 2¾″ × 1½″with screw terminal connections. A fantastic bargain at only **£1·45** while stocks last. Don't miss this—it's one of our best bargains ever. **FREE** to all who purchase we give a copy of the Mullard Booklet "Do it yourself stereo" telling all you need to know about building your own stereo system.

HORSTMANN "TIME AND SET" SWITCH

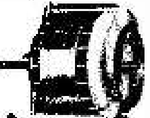
(A 30 amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price **£1·50,** p. & ins. 23p.

HONEYWELL THERMOSTAT



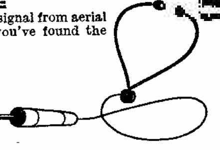
Made by Honeywell for normal air temperatures 40°–80°F (5–25°C). This is a precision instrument with a differential which can be adjusted to better than 1·5°F. A mercury switch breaks on temp. rise—the switch is operated by a coiled bi-metal element and adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows thermometer above and switch setting scale below-size approx 3·8″ × 3·2″ × 1·4″ deep—can be mounted on conduit box or directly on wall. Price **£1·25** each or ten for **£11·25.**

PAPST MOTORS



Est. 1/40th h.p. Made for 110–120 volt working, but two of these work ideally together off our standard 240 volt mains. A really beautiful motor, extremely quiet running and reversible. **£1·50** each. Postage one 23p, two 33p. 230v model **£3.**

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.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take tandard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work, **£2·25** plus 23p P. & I

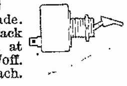
DRILL CONTROLLER *NEW IKW MODEL*

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.

MIGHTY MIDGET

as featured in January issue **£2** complete post paid or send for price list.

CAR PANEL SWITCH



Our Ref. No. SO2. Arco made. Has long flat ended toggle, black and chrome finish. Rated 2A at 250v and is double pole on/off. Listed at 45p. Our price **22p** each.

CAR PANEL AUTO SWITCH

Ref. No. SO3. Again a flat ended toggle. Made by Arrow. A 3 position double pole changeover switch. centre off for auto aerials, reversing motors etc. **30p** each.

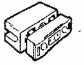
3 PIN REVERSE PLUG & SOCKET

Our Ref. PSO2. For bringing live leads to equipment. All brown bakelite construction, rated 10A 250v. Pirce **35p** per pair.

13 AMP JUNCTION BOXES

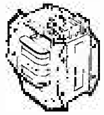
Made to take 7029 cables so ideal for ring mains. Price **8p** each or 10 for **72p.**

PORCELAIN FUSE AND CARRIER



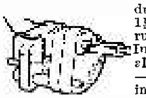
20A 250v. MEM Ref. No. 15LBB/15LRHW. Make your own fuse board. Price **20p** per pair.

AUTO TRANSFORMER



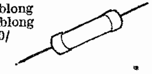
Primary 220-240V. Secondary 110-120v. Well built and varnish impregnated. 250 watt intermittent rating. 150w continuous rating. Size approx. 3¼″ × 3″ × 3″. **£1** plus 20p post and insurance.

SPIT MOTOR



200-250v Induction Motor, driving a carter gear box with 1½″ of output drive shaft running at 5 revs per minute. Intended for roasting chickens also suitable for driving models—windmills, coloured disc lighting effect, etc. etc. **£1·85** plus 20p post and insurance.

PANEL NEON INDICATOR



Our Ref. No. P101. Oblong type self-fixing into oblong hole. Suitable for 200/250v. Price **13p** each.

30KV EHT UNIT

This unit is self-contained and on wheels. It stands approx. 6ft high and 3ft square. On the front panel is a Variac, Voltmeter, a 60 second Timer as well as the normal overload trip on/off switch and cut outs etc. The transformer itself is oil filled and rated at 7 KVA 30KV. The Variac is in the primary so all voltages up to 35KV are available. We believe the normal use for such a unit would be as a breakdown and flash tester. 1 only—not new but in good order. Price **£150,** carriage extra at cost.

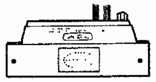
INSTANT START UNITS

For 2ft tubes. Philip's or Smart & Brown in a tray complete with tube clips and tube ends. Price **£1·50** each or 10 for **£13·50.**

FLUORESCENT TUBES

Standard types—Bi pin ends, ideal pelmet lighting as well as for standard replacements—18″ 15 watt, 24″ 40 watt, 36″ 40 watt, 39½″ 40 watt. All first grade tubes offered at one price—**£3·50** per box of 24—i.e. less than 15p each. If not collecting then please add 50p per box per 200 miles.

DIGITAL DISPLAY



Panel mounting unit measuring approx. 3½″× 1″×1½″ deep. Size of the display aperture is approx. 1¼″×1″. Light up to 0·9. Ex equipment but unused and in perfect order. Price **£1** each.

DIGITAL SWITCHES

Small type S.T.C. number SW21/630CAA. These are a snap in fit hole approx. 1¼″ × ½″. Knob engraved 0–9. Gold plated contacts 1 pole 10 way. Thumb wheel operation. These are designed so that they may be stacked in rows. Price **75p** each.

6 DIGIT COUNTER

Operated by 240v A.C. mains through resistor or direct from 115v A.C. or from 80v D.C. Made by Veeder-Root of America. Metal encased for surface mounting. Size approx. 3¼ × 1½ × 2½. Price **£1** each. 10 for **£9.**

COLOURED 13 AMP SOCKETS

Standard Flush mounting available in the following colours: Yellow, Green, Grey and Cream. These are a good quality socket with porcelain interior made by Ward and Goldstone. Useful on control panels. Price 20p each, 10 for **£1·90.**

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26 yards length 70W. Self-regulating temperature control. **50p** post free.

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

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R T V C THE

THE FABULOUSLY SUCCESSFUL VISCOUNT III AUDIO £52 complete

14 + 14 watts r.m.s. 40Hz to 40kHz ±3bB. Total distortion at 10 watts at 1kHz −0·1%

This is real value for money! We have designed 2 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range of bass and treble adjustment.

For both systems we have chosen the famous Garrard SP25 Mk. III deck which comes with fitted magnetic cartridge, simulated teak plinth and tinted accrylic dust cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.

SPEAKERS

Duo Type II Size approx. 17in. × 10¾in. × 6¾in. Drive unit 13in. × 8in. with parasitic tweeter. Max. power 10 watts, 8 ohms. Simulated Teak cabinet. £14 pair + £2 p&p.

Duo Type III Size approx. 23½in. × 11½in. × 9½in. Drive unit 13½in. × 8¼in. with H.F. speaker. Max power 20 watts at 8 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. (suitable 3-15 ohms). Total distortion @ 10W @ 1kHz 0·1%. *P.U.I.* (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) −P.U.I. and radio −65dB, P.U.2 −58dB. *Cross talk* better than −35dB on all Imputs. *Overload characteristics* better than 26dB on all inputs. Size approx. 13¾ × 9in. × 3¾in.

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PRICES: SYSTEM 1

Viscount III R101 amplifier	£22·00+90p p&p
2 × Duo Type II speakers	£14·00+£2 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23·00+£1·50 p&p
Total	£59·00

Available complete for only £52 + £3·50 p&p

PRICES: SYSTEM 2

Viscount R101 amplifier	£22·00+90p p&p
2 × Duo Type III speakers	£32·00+£3 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23·00+£1·50 p&p
Total	£77·00

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UNISOUND FOR THE NEW SOUND

AT £25

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£25 complete plus £2·80 p. & p.
Diamond Stylus £1·25 extra.
Power output: 4 watts per channel into 8 ohms.
Inputs: 120 mV (for ceramic carfridges).
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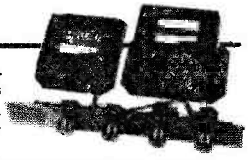

UNISOUND MODULES ONLY £6·95
If you prefer, you can buy the three modules—pre-amplifier, power supply/dual power amplifier, and control panel—by themselves for only £6·95. P. & P. 50p extra.
No soldering, just simply screw together with screwdriver supplied. Their overall specification is the same as shown for the complete Unisound console, using the high efficient I.C. monolithic power chips to ensure very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum.

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THE PULLMAN PB CAR RADIO KIT

Apart from the output stage, which is an integrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulised IF stages which are pre-aligned before despatch. As well as electronic components, this kit also contains 2 diamond-spun aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles. It covers the full medium and long wave bands. Four push-buttons for medium wave, one for long wave. It is permeability tuned and sturdily constructed. Output is a full 2·5 watts into an 8 ohm speaker. But the Tourist PB will operate into any loudspeaker from 8 to 15 ohms. Power consumption is less than 1 amp.

The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale for easy reading at night. Approx. Chassis size is :7in. wide, 2in. high and 4$\frac{13}{16}$in. deep (excluding front panel, etc.).

★ Circuit diagram and comprehensive instructions 50p, free with parts.
★ Fully retractable, lockable, Car aerial £1·25 post paid.

Price only £7·00 + 50p p&p. 8 ohm speaker with baffle and fixing strips £1·50 post free if bought with kit + 25p p&p.

If you can solder on printed circuit board you can build this push-button car radio kit. It's simple— just follow the step-by-step instructions.

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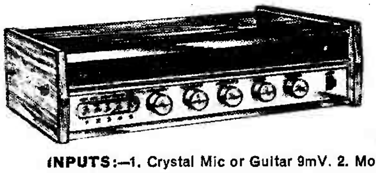
VISIT OUR SHOWROOMS

RELIANT MK.IV



★ 5 Electronically Mixed Inputs. ★ 3 Individual Mixing Controls. ★ Separate bass and treble controls common to all 5 inputs. ★ Mixer employing F.E.T. (Field Effect Transistor). ★ Solid State Circuitry. ★ Attractive Styling. ★ Sides Finished in solid teak

INPUTS:—1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram., Tuner, Monitor, Organ, etc.). All 250mV sensitivity. **CONTROLS:**—3 Volume controls. Bass control range: 13dB @ 60Hz. Treble control range ±12bB @ 15KHz. Separate ON/OFF Switch. Neon indicator. **POWER OUTPUT:**—12 Watts R.M.S. into 3 to 4 ohms speaker. **SIGNAL/NOISE:**— Better than —60dB on inputs 3, 4 and 5 & —50db on 1 & 2. **SUPPLY:**—220-250 AC Mains. **SIZE:**—12½" × 6" × 3½". (VISIT OUR SHOWROOMS)

£10·50
plus p. & p. 60p

JUST ANNOUNCED The new 20 watt (into 8 ohms) version for just £3 extra. All other specifications as above. **£13·50**

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BARGAIN PARCELS 14lb at **£1·45** plus 32½p p.p.; 28lb at **£2·75** plus 52½p p.p.; 56lb at **£4·50** plus £1·25 p.p. Contain pots, Res, Valves, Diodes Tagboards, Chassis, Valveholders, etc. Good value save £££s. Lucky Dip Service.

FANTASTIC BARGAIN. New 6 inch tubes. E450 4/B/16 4VH, medium Persistance, green. Ideal scope tube.

Also 09J 4½in. dia. Length 15in, Also 7BP7 and 5FP7. All unused as new. Price **£1·40** post paid.

NEW HEAVY COAX CABLE dia. ⅜" 70 ohms approx. 50ft. lengths **£1·40**, p. & p. 30p. 100 ft. lengths **£2·70**, p. & p. 50p.

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CRYSTALS AS NEW. Hc 6u, 5,345; 5,030; 4.945; 4,875; 4,840; 4,795; 4,580; 4,660; 4,520; 4,510; 2,300; 2.295 Kc/s. **50p** each plus 8p p.p.

OUR SELECTION OF 6–Ex. Equ. **METERS** consisting of 3in., 2½in., 2in. mill amps, volts, amps. Mixed at the bargain price of **£2 P. & P.** 25p. minimum order of six.

ANY HEIGHT AERIAL TUBULAR SECTIONS ⅞" dia. × 3ft. long. Brass screw in ends, copper coated and painted. Good condition. **20p p. & p. 5p** each. Minimum order 6.

AS NEW AERIAL TUNER UNIT No. 6 RF, consisting of 1½ inch 500 mico/ampmeter 3 gang tuner 75 PF geared BNC type socket size 5½" × 4¾" × 5". Price **£1·50**, p. & p. 25p.

HEADPHONES DI. High impedance. Good condition **75p.** p. & p. 15p. R209. Set of valves **62½p.** p.p. 25p.

NEW AERIAL WIRE ON BOARDS 7/22 UNCOVERED 75ft. **40p**, 90ft **47½p.**)100ft. **55p**, p. & p. 20p.

AERIAL MAST POLES approx. 5ft high 2" dia. Interlocking ends. Minimum order three. New condition. **£1** each section. Carriage 35p each section. ¼" 75 ohms Coax in 50ft coils with BNC plugs good condition. Price **£1** + 30p p.p.

SLIDING RESISTORS, 12 amp, 1 ohm. Approx. 9in. long. 1-4 amp., 14 ohms. Approx. 7in. long. As new Ex Eqp. **75p**, p.p. 15p.

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3S4	·24	DAF91	·21	ECC83	·21	EL33	·54	PCF802	·38	U251	·60
3V4	·46	DAF96	·35	ECC85	·31	EL41	·52	PCF805	·56	U329	·65
6/30L2	·24	DF91	·14	ECH35	·53	EL84	20	PCL82	·28	U801	·78
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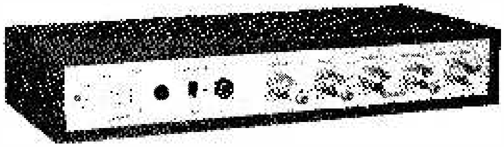

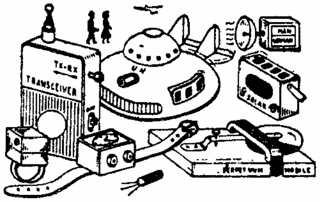

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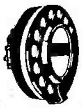

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ROGERS Ravensbrook (cased)	105·35	78·45
ROTEL RX 150	67·93	45·95
ROTEL RX 150A	69·90	50·95
ROTEL RX200A	89·50	65·95
ROTEL RX 400A	107·50	78·95
ROTEL RX 600A	149·00	109·95
ROTEL RX 800A	189·50	139·95
ROTEL RX 154A Quadraphonic	129·50	94·95
SOLARVOX TAM 1105 2 x 5 watts RMS AM/FM Multiplex comp. with 2 speakers and featuring Matrix 4 channel	38·50	29·95
TANDBERG 1171 MPX	103·03	84·95
TANDBERG TR200 MPX	106·00	85·95
TANDBERG TR1000 FM MPX (teak)	156·00	129·60
TANDBERG TR 101 AM/FM MPX	169·00	139·95
WHARFEDALE LINTON WE40	115·00	95·95
TELETON CR55	125·26	68·50
TELETON R8000 AM/FM	42·16	21·95
All the above take magnetic cartridges except Teleton R8000 which takes ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where M8 decoder is extra.		
TURNTABLES		
CONNOISSEUR BD1 kit	13·34	10·95
CONNOISSEUR BD2 Chassis	32·71	25·95
CONNOISSEUR BD2 P/C/SAU2	41·29	33·95
GARRARD SP25 Mk. III	16·17	10·50
GARRARD 40B	13·63	10·95
GARRARD SL65B	20·93	13·75
GARRARD SL95B	49·21	32·25
GARRARD 401	39·04	25·95
GARRARD SL72B	32·60	21·95
GARRARD AP76	28·44	17·25
GARRARD Zero 100A	57·42	38·95
GARRARD Zero 100S	52·83	36·95
GARRARD WB4 Base Mk. 11Z to fit Zero 100 and Zero 100S	6·55	4·95

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

GARRARD SP25 Mk. 111 with Goldring G800	**Special Price £18·50**
McDONALD MP60 with Goldring G800	**Special Price £17·50**
McDONALD MP60 with SHURE M 44/7	**Special Price £18·95**
McDONALD MP60 with SHURE M 44/E	**Special Price £19·95**
McDONALD HT70 with Goldring G800	**Special Price £25·50**
GARRARD AP76 with Goldring G800	**Special Price £26·50**
GARRARD AP 76 with Shure M55E	**Special Price £30·50**
GARRARD AP76 with Shure M75EJ	**Special Price £32·50**
GARRARD 2025 with Sonotone 9TAHC	**Special Price £12·75**
GOLDRING GL 75 with G800	**Special Price £39·50**
THORENS 150 AB complete with TX11 cover, Shure M55E cartridge	£60·35 **£49·95**

Base and cover to fit GARRARD SP25, SL55, SL65B	Sp. Price	3·60
GOLDRING G101P/C	29·64	20·50
GOLDRING GL72 Chassis	31·39	20·95
GOLDRING GL72P	40·81	27·50
GOLDRING GL75	41·86	26·95
GOLDRING GL75P	51·62	35·25
GOLDRING GL85P/Cover	87·19	56·95
Covers for 72P	4·71	3·25
Cover for 75P (de Luxe)	5·23	3·50
Cover for 85P	6·98	4·95
C99-plinth and cover for G99	15·35	11·95
GOLDRING G99	29·64	19·25
LEAK Delta	69·50	52·50
JVC Nivico SRP 473 Quadraphonic, including plinth and cover	69·50	58·95
McDONALD MP60	14·78	9·50
McDONALD 610	18·75	12·95
McDONALD HT70	20·63	14·50
Base and cover for MP60 and 610	Sp. Price	3·95
PHILIPS GA212 Electronic	69·00	57·50
PIONEER PL12D with base and cover	49·18	34·50

	Rec. Retail Price	Comet Price
TURNTABLES—*continued*		
PIONEER PL61 with base and cover	176·83	119·95
THORENS TX25 cover	8·85	6·50
THORENS TD125	76·73	52·95
THORENS TD125 Mk. II	82·63	66·50
THORENS TD125AB	115·69	79·95
THORENS TD 125AB Mk. II with TP 16 arm	124·54	99·95
THORENS TD 160/c including base and cover	69·80	56·95
THORENS TD150 Mk. II	36·30	28·95
THORENS TD150A Mk. II	46·33	35·95
THORENS TD150AB Mk. II	50·17	39·95
THORENS TX11 cover	4·49	3·60
WHARFEDALE Linton	37·50	26·95
PICK UP ARMS AND HEADS		
AUDIO Technica AT 1005 Mk. 11	18·78	14·25
AUDIO Technica L2 lifts	2·61	1·95
CONNOISSEUR SAU2	14·61	11·95
GOLDRING Lenco 75	13·96	9·25
GOLDRING Lenco L69	10·46	6·50
GOLDRING PH6 Head Shell	2·97	1·99
SME 3009 with S2 Shell	32·34	23·95
SME 3009 HE with S2 Shell	33·71	24·95
SME 3012 with S2 Shell	34·44	25·50
SME 3012 HE with S2 Shell	35·81	26·50
SME S2 Headshell	2·59	1·95
SPEAKERS		
AMSTRAD 138 (pair) Teak	26·00	13·95
AKAI SW 155	64·50	44·95
B and W Model 70	159·50	109·95
B and W DM2	69·99	47·50
B and W DM4	49·66	37·95
B and W DM5 (pair)	59·48	43·95
CELESTION COUNTY (pair)	47·94	35·95
Ditton 120 (pair)	56·40	38·50
Ditton 15	37·40	26·00
Ditton 25	65·00	42·50
Ditton 44	54·00	35·00
Ditton 66	99·00	70·95
FERROGRAPH S1 inc. stand	95·00	67·95
GOODMANS Minister Pair	49·20	35·95
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Magister	65·63	42·50
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Goodwood	55·00	36·95
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DIN 20 NT Kit	12·19	8·50
KELETRON KN 400 2-speaker system (pair)	15·86	11·95
KN600 3-speaker system (pair)	26·46	16·95
KN800 3-speaker system (pair)	31·80	18·95
KN1100 4-speaker system (pair)	40·80	23·95
KN1600 3-speaker system	25·20	14·95
KN2100 3-speaker system	30·60	18·95
LEAK 150 (pair)	50·00	37·50
LEAK 250 (pair)	63·00	47·95
LEAK 600	49·50	34·50
LINEAR 10 watt Teak (Pair)	Sp. Price	13·50
MARSDEN HALL Annexe 100 Walnut (pair)	30·00	17·95
METROSOUND HFS 103 (pair)	29·21	20·95
202	21·50	14·75
Duplex 15	32·00	21·95
Duplex 25	56·00	37·50
PIONEER CS53	46·72	29·95
SINCLAIR Q16	8·98	6·50
TANDBERG Tan 7	29·50	23·60
Tan 11 (pair)	40·00	31·95
TL 12 Teak (pair)	55·50	44·50
TL 25 Teak (pair)	71·50	56·95
TL 50 Teak	68·00	50·95
TELETON 8000 (pair)	21·08	11·95
THORPE GRENVILLE TG100 (pair)	28·95	16·95
TG200 (pair)	41·95	24·95
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WHARFEDALE Denton Mark II (pair)	42·00	28·95
Linton Mark II (pair)	52·00	37·50
Triton 111 (pair)	65·00	46·95
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Unit 5 speaker kit	27·50	18·75
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GOODMANS Twin-axiom 8	9·12	6·95
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AMSTRAD 900D	8·10	5·40
AMSTRAD 900 EX	11·90	8·50
AUDIO TECHNICA AT 66	6·47	3·45
CONNOISSEUR Ceramic SCU1	6·09	4·95
GOLDRING G850	6·10	3·10
GOLDRING G800	12·21	4·50
GOLDRING G800E	17·67	7·00
GOLDRING G820	11·62	8·25
GOLDRING G820E	17·44	12·25
GOLDRING G820 Super E	23·25	16·25
GOLDRING G800 Super E	24·41	15·25
EMPIRE 1000ZE/X	62·22	39·95
EMPIRE 999VE/X	44·44	28·95
EMPIRE 999TE/X	26·13	18·95
EMPIRE 999SE/X	21·11	13·95
EMPIRE 999E/X	16·36	10·95
EMPIRE 909E/X	12·79	8·50
EMPIRE 90EE/X	9·94	6·95
SHURE M3DM	6·10	3·75
SHURE M31E	11·63	6·95
SHURE M32E	10·73	6·50
SHURE M44-G	8·30	4·95
SHURE M44-7	7·90	4·50
SHURE M-44C	7·90	4·90
SHURE M44E	8·60	4·75
SHURE M55E	9·70	5·60
SHURE M75G	14·70	8·35
SHURE M75-6 (S)	8·36	5·45
SHURE M75-6	13·60	7·60
SHURE M75EJ	15·40	8·75
SHURE M75ED	19·00	10·15
SHURE M75E/95G	20·80	12·95
SHURE M91ED	18·45	9·95
SHURE V15-11	39·40	24·95
*SONOTONE 9TAHC Diam/Saph	3·75	1·45

Starred cartridges above are ceramic. All others are magnetic.

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C90	1·45	0·85
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40 mins.	1·50	0·90
80 mins.	1·80	1·10
SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
5″ L.P. 900	1·88	1·10
5¾″ L.P. 1200	2·20	1·30
7″ L.P. 1800	2·95	1·80
SCOTCH HI-FI DYNARANGE DOUBLE PLAY		
5″ D.P. 1200	2·31	1·40
5¾″ D.P. 1800	3·15	1·95
7″ D.P. 2400	4·03	2·50

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CONNOISSEUR Plinth BD1	5·57	4·50
CONNOISSEUR Cover	4·17	3·40
CONNOISSEUR P.U. Mount Board	0·95	0·75
GARRARD WB1 Base	3·78	2·95
GARRARD WB4 Base	5·60	4·25
GARRARD SPC1 Cover	3·68	2·75
GARRARD SPC4 Cover	4·38	3·25
Special Offer of Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500	Sp. Price	3·60
GARRARD WB4 base MK 11z to fit Zero 100 and Zero 100S	6·55	4·80
GOLDRING Plinth 75	9·77	6·75
GOLDRING Plinth 72	9·42	6·50
GOLDRING Covers 72P	4·71	3·25
Cover for 75P De Luxe	5·23	3·60
Cover for 85P	6·98	4·95
THORENS TX 25 (for TD125AB)	8·85	6·50
THORENS TX11 Cover	4·49	3·60
SME Plinth System 2000 with motorboard	46·20	35·95
MOTORBOARDS only	5·85	4·45
SME P1 Spacer	0·98	0·75

HEADPHONES

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AMSTRAD HPS5A	7·50	3·90
HPS6A with volume control	10·70	6·70
HPS7A bass and treble controls	13·95	9·90
AKAI ASE9	7·25	4·25
AKAI ASE22	11·90	7·25
AKG K180	28·00	16·95

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	Rec. Retail Price	Comet Price
AKG K60	15·00	8·95
AKG 100	8·00	4·95
AKG 120	10·00	4·50
KOSS HV1	20·00	15·95
KOSS ESP-9 Electrostatic	69·00	52·95
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KOSS K2 plus 2 Quadrafone	45·00	35·95
KOSS PRO 5 L/C	30·00	23·95
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KOSS KO-727B	16·50	12·45
KOSS 747	20·00	14·95
KOSS K-711	10·00	7·75
KOSS K6	12·50	9·50
KOSS K6/LC (with volume control)	14·00	10·50
KOSS K6/LCQ Quadrafone	20·00	16·95
PIONEER SE 50	21·90	13·25
PIONEER SE 30A	12·60	8·25
PIONEER SE 20A	7·88	4·95
PIONEER SEL 20	10·53	6·80
PIONEER SEL 40	17·43	11·30
ROTEL RH 630	6·50	4·50
ROTEL RH 700	9·95	6·75
SOUND MD806	6·40	2·70
WHARFEDALE DD1	12·50	8·75
WHARFEDALE ISODYNAMIC	19·95	14·95

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ALBA UA 552	47·75	29·95
BUSH A1005	69·89	53·25
DANSETTE Consort Stereo	34·43	23·95
DANSETTE 4005	71·45	51·95
DANSETTE 4020	47·99	31·95
DECCA SOUND 613	Sp. Price	46·50
DECCA SOUND 614	Sp. Price	52·95
DECCA SOUND 1204	Sp. Price	70·95
DECCA COMPACT 2	Sp. Price	78·95
DECCA COMPACT 3	Sp. Price	98·95
DECCA 403	Sp. Price	44·95
EKCO ZU4	166·00	125·00
FERGUSON 3450 B with Radio (new model)	79·50	61·95
FERGUSON 3451 B with Radio (new model)	107·00	82·95
FERGUSON 3454	41·50	32·95
FIDELITY UA1 Music Master with Radio	100·00	69·95
FIDELITY UA2 Music Master	43·50	30·95
FIDELITY UA3 Music Master	63·00	45·95
FIDELITY Stereo Nine	38·50	22·95
G.E.C. 2810	79·00	59·95
GROSVENOR MPX 8-400 AM/FM MPX Tuner/Amplifier, magnetic input with built-in 8-track cartridge player with speakers	67·50	39·95
HMV 2451	122·00	95·95
HMV 2452	66·00	49·95
HMV 2453	66·00	49·95
KB 1025 with 662 speakers	48·25	37·95
KB 1250 with KS 653 Speakers	71·00	53·95
KB 2010 with 658 speakers	101·50	77·95
KB 2250 with 658 speakers	124·00	95·95
MURPHY 902 Studio 1, AM/VHF Radio	84·50	64·95
MURPHY 903	84·42	64·95
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PHILIPS GF 824	65·30	49·65
PHILIPS 825	49·50	38·95
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PHILIPS 836	95·00	69·95
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AKAI 4000D 4-track stereo deck	93·65	64·50
AKAI 4000 DS	99·50	73·95
AKAI X201D	179·00	132·95
AKAI X1810	229·00	169·95
AKAI GX221D	229·00	169·95
AKAI GX1900D	239·00	177·95

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	Rec. Retail Price	Comet Price
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AKAI CR81	109·50	80·95
AKAI CR81D	89·50	65·95
AKAI X200D	157·93	99·95
AKAI GX 220D	229·00	164·95
FERGUSON 3258 4-track	70·45	51·95
FERROGRAPH 702/704 Dolby	285·53	241·95
FERROGRAPH 702H Dolby	297·28	251·95
FERROGRAPH 722/724 Dolby	326·65	276·95
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FERROGRAPH 702/704	235·00	172·95
FERROGRAPH 722/724	276·13	198·95
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GRUNDIG TK 121 (twin-track)	56·25	39·95
GRUNDIG TK 141 (4-track)	62·10	45·95
GRUNDIG TK 146 (4-track auto)	66·95	49·95
GRUNDIG TK 147 (4-track auto)	98·65	76·95
GRUNDIG TK 148 (4-tr. auto 2 spd.)	74·10	57·95
GRUNDIG TK 246 4-track Stereo Deck	131·85	101·95
GRUNDIG TK 3200 Hi-Fi (Battery)	141·10	105·95
PHILIPS 4303 Twin-track	39·46	24·95
PHILIPS 4418 4-track stereo	200·00	145·95
TANDBERG 2041 4-track Stereo	130·50	108·50
TANDBERG 1841 4-tr. stereo deck	66·00	49·95
TANDBERG 3021X 2-track stereo	113·00	89·95
TANDBERG 3041X 4-track stereo	113·00	89·95
TANDBERG 4021X 2-track stereo	179·00	145·95
TANDBERB 6021X twin-track stereo	199·30	159·95
TANDBERG 6041X 4-track stereo	199·30	159·95

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	Rec. Retail Price	Comet Price
AKAI CS35D tape deck	79·95	59·50
AKAI CS35 Stereo inc. Speakers	112·50	82·95
AKAI GXC 40D tape deck	95·50	66·95
AKAI GXC 40	112·50	82·25
AKAI GXC 40T recorder, tuner/amp.	167·50	123·95
AKAI GXC 45D tape deck	129·50	95·95
AKAI GXC 46O Dolby tape deck	139·50	103·50
AKAI GXC 65D Dolby auto-reverse tape deck	154·50	110·25
APCO Battery/Mains AM/FM Radio	35·00	22·95
BROWNI Radio/cassette recorder	45·00	19·95
BUSH Discassette DC70	20·62	15·95
BUSH TP 60	27·62	15·95
BUSH TP 66 Battery/Mains	28·18	21·50
BUSH TP 70 Battery/Mains	28·13	19·95
BUSH RTP 100 Battery/Mains with AM/FM Radio	43·95	33·95
BUSH Arena C440 Stereo Deck with chromium dioxide switch	61·73	49·95
CARLTONE LCR 500	Sp. Price	11·95
DANSETTE DCT 105	20·62	14·95
EKCO 350 batt./mns. VHF/MW Radio	39·97	29·95
FERGUSON 3240 with case	24·90	15·95
FERGUSON 3253	42·40	31·95
FERGUSON 3257	56·45	41·95
FERGUSON 3257/7 spkrs. for above	16·00	12·00
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GRUNDIG C210 Batt./mains	48·75	36·95
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JVC Nivico 1710 Radio/Cassette, AM/FM	61·00	42·95
PHILIPS 2202/2203	24·00	17·95
PHILIPS 2204 battery/mains	29·10	24·95
PHILIPS 2405 Stereo with 2 RH401 L/S	72·00	54·95
PHILIPS 3302	21·50	15·95
PIONEER CT 4141 Dolby Deck	150·02	104·95
PYE 9109	20·37	14·95
PYE 9116 Stereo	69·90	49·95
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JR599 receiver	**£185·00**
* Items (A); (B); (D) above ..	**FREE**
Complete Amateur RX Station	**£185·00**

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TS/PS515 Transceiver 180W	**£210·00**
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Complete TX-RX Station ..	**£210·00**

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Microphone Bargains—*continued*

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This is a Nice Unit. Portex X-Ray Unit Model 3. Mains Operated. 2, 3″ Meters 0–250v and 0–20mr. 0–12Sec. Timer. Untested **£2·50** Carriage Paid. Good Breakdown Unit.

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Reclaimed T.V. Tubes. All with 12 Months' Guarantee. AW43/88 **£1·50.** AW43/80 **£1·50.** MW43/69 **£1.** Many other Types in Stock. Carriage and Ins. on any Tube £1·50.

Latest Air Ministry Release. Radio Receiver Type R4187. 2·8 to 18MHZ. In Three Bands. With 17 Miniature Valves, 26 Volt Motor Power Supply. Motor and Manually Tuned. Very clean less Crystals and Untested **£5.** Carr. and Ins. 75p.

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EB91	**4p**	PCC84	**5p**	PY33	**17p**
EF80	**8p**	PCL82	**12p**	U191	**20p**
EF85	**12p**	PCL83	**12p**	6BW7	**10p**
EBF89	**12p**	PCL84	**12p**	6U4	**10p**
ECC81	**10p**	PL81	**17p**	20P1	**15p**
ECC82	**12p**	PL82	**8p**	20P3	**10p**
ECL80	**8p**	PL83	**8p**	30F5	**10p**
EF50	**60p** per doz.	PL36	**17p**	30FL1	**20p**
EF91	**4p**	PY81	**8p**	6/30L2	**20p**
EY86	**20p**				

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SA25-SA35-SA100

LOW-PRICED AUDIO MODULES FOR DOMESTIC & COMMERCIAL USE

THESE THREE MODULES HAVE ENJOYED UNPARALLELED SUCCESS DURING THE FIRST FEW MONTHS OF THEIR BEING MADE AVAILABLE TO THE GENERAL PUBLIC. WE ARE PLEASED TO ANNOUNCE THAT WE CAN NOW OFFER FAST DISPATCH ON MOST OF OUR ADVERTISED ITEMS, INCLUDING THESE THREE MODULES.

SA25 £2·95 carr. free

25 WATTS RMS. 7 transistors 7 diodes

SA35 £4·45 carr. free

35 WATTS RMS. 7 transistors 7 diodes

SA100 £10·90 carr. free

100 WATTS RMS. 11 transistors 6 diodes

ALL THREE MODULES HAVE OPEN & SHORT CIRCUIT PROTECTION, AND THE SA100 IS PROOF AGAINST OVER-DISSIPATION & FAULTY INDUCTIVE LOADS. ONLY ADVANCED DESIGN TECHNIQUES MAKE THESE EXTRA-ORDINARILY LOW PRICES POSSIBLE.

BRIEF SPEC. FOR ALL THREE MODULES

Freq. response	15–40,000 Hz ± 1dB
Distortion	0·2% at 1 kHz
Loads	4 to 16 ohms
Quiescent current	15 mA
Noise	Better than —75 dB
Supply voltage	25–45 volts SA25/35 40–70 volts SA100
Size	4½″ x 4″ x 1″ (SA100) 4″ x 3″ x 1″ (SA25/SA35)

Circuits, connecting instruction and application data are supplied free with all modules.

POWER SUPPLIES FOR THE SA25/35 & SA100 AUDIO MODULES

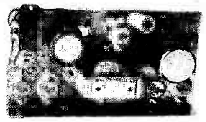
Stab PS45	Stabilized module for 2 SA25's or two SA35's	£3·50 carr. free
MT45	Transformer for above, heavy duty	£2·85 carr. 20p
MT30	Transformer for unstabilized supply complete with rectifier diodes mounted	£3·50 carr. 20p
PU70	Unstabilized supply for one or two SA100	£7·75 carr. 40p
PS70	Stabilized supply module for one or two SA100's	£4·90 carr. free
MT70	Transformer for PS70	£4·90 carr. 40p

ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD AND ARE SUPPLIED FULLY TESTED

OTHER SAXON PRODUCTS. . .

120 WATT HEAVY DUTY MODULE £13·90 + 20p carr. or with supply £18·95 + 40p carr.

Featuring a rugged class A driver stage, this module will run from all our mixers, etc., and most other makes of mixer. It delivers 120 watts into an eight ohm load and employs 4 T03 can (115 watt) output transistors.



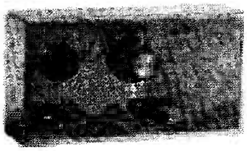
SPECIFICATION

Power output	120 watts into 8 ohms
Freq. response	20-20,000 HZ ± 2dB
Input sensitivity	200 mV into 10K
Construction	Fibreglass board
Size	8″ x 4″ x 4″ (5″ with supply)

Low distortion parallel push-pull output stage.

NEW 160 watt version & supply **£27·90**

SINGLE CHANNEL SOUND/LIGHT CONVERTER



This compact and reliable unit operates from amplifiers with outputs from 5–100 watts. Does not impose a heavy load on the amplifier, or, if connected in the wrong polarity, cause any damage, as with some units.

Operation is simplicity itself and the unit is fully fused. The unit is supplied to function from bass notes but may easily be converted to respond only to treble or mid-range notes by the addition of components costing less than 5p.

SPOT BANKS INCLUDING 3 SPOTS **£8·90** carr. free

STATE COLOURS : RED, BLUE, GREEN.

£10·25 complete, carr. 40p.

THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3000 watt (3kw) this unit is unique for its price in that not only bass, middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads, etc. Supplied in tough white steel case with a blue stelvetite hooded cover. Fully guaranteed. **£19·75** carr. 30p

MONO VERSION £6·50 carr. 20p (As illustrated left S.A.E. details 9 volt operation) Outputs up to 1 volt RMS

£15·80 carr. 30p

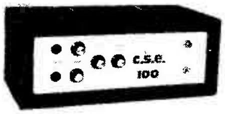
SAXON STEREO CONTROL UNIT

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½″ x 3″ x 4″ deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass, treble, mains on/off.

THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCOTHEQUE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE. (N.B.—Stereo only has mic input.)

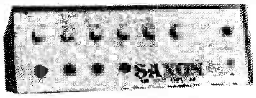
COMPLETE AMPLIFIERS

The CSE 100. £34·90 carr. free



This versatile unit is now available in a black vynide case and so represents even better value than ever delivering speech and music powers of up to 100 watts RMS and continuous signal outputs of 70 watts. Two individually controlled inputs with wide range bass and treble controls. Ideal for small groups D.J.S., etc.

The SAXON 100 £48·50 carr. free



With an RMS output of 120 watts speech and music, 100 watts continuous power, four individually controlled FET input stages and wide range bass and treble controls, this amplifier has established itself as a unit offering quality and reliability at low cost.

LOUDSPEAKERS British made bargains!!

12″ 25 watt 8/15 ohms **£5·95** carr. 30p. 15″ 50W.8/15 ohm **£14·50** carr. 50p.

12″ 40 watt 15,000 gauss magnet system 8/15 ohm **£11·50** carr. 40p.

A.K.G. MICROPHONES suitable for disco, group or general P.A. use.

D11DHL rrp **£11·00** our price **£9·45** post free
D190C High Z rrp **£21·50** our price **£17·45** post free
D1000C 24 ct gold plate rrp **£37·00** our price **£32·00** post free

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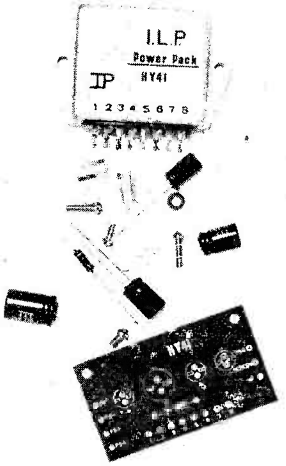


THE HY41

The HY41 supersedes the popular HY40 introduced by ILP last year. This highly improved module achieves true High Fidelity with a dramatic reduction in distortion (typically 0.05% at 1KHz into 8 ohms!) and is electronically and mechanically compatible with the HY40.

With this important improvement the HY41 retains all of the quality characteristics found in the earlier version and P.C. board, Resistor, Capacitors, Hardware Mountings and comprehensive manual are included in the basic kit. No further components are required to construct a complete power amplifier of extremely high performance sufficiently versatile to provide power not merely for Hi-Fi but also for public address systems and industry.

The free manual gives a full circuit diagram of the HY41 and its various applications including a complete stereo amplifier.

Like its predecessor the HY41 is based on conventional and proven circuit techniques developed over recent years.

OUTPUT POWER: British Rating 40 WATTS PEAK, 20 watts R.M.S. continuous.
LOAD IMPEDANCE: 4–16 ohms.
INPUT IMPEDANCE: 30K ohms at 1KHz.
VOLTAGE GAIN: 30db at 1KHz

TOTAL HARMONIC DISTORTION: less than 0.15% (typical 0.05%) at 1KHz.
FREQUENCY RESPONSE: 5Hz–50KHz ± 1db.
SUPPLY VOLTAGE: ± 22.5volts D.C.
SUPPLY CURRENT: 0.8 amps maximum.

PRICE: inc. comprehensive manual, P.C. board, five extra components and P. & P.:–
MONO: £4.90 **STEREO: £9.80**

UNIQUE HYBRID PRE-AMPLIFIER

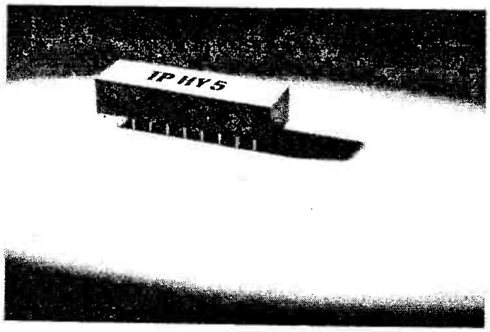
The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an integrated pre-amplifier circuit.

Supplied with the HY5 are two stabilizing capacitors and by the addition of volume, treble and bass potentiometers it is ready for use.

Internally the HY5 provides equalization for almost every conceivable input, the desired function is achieved by use of a multi-way switch or by direct interconnection.

Two distinctive features of the HY5 are its inbuilt stabilization circuit, allowing it to be run off any unregulated power supply from **16–25** Volts and a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo pre-amplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY41 and PSU45 forms a completely intergrated system.



INPUTS
Magnetic Pick-up (within ±1db RIAA curve) 2mV. 47K Ω
Tape Replay (external components to suit head). 4mV. 47KΩ
Microphone (flat) 10mV. 47KΩ
Ceramic Pick-up (equalized and compensatable) 20–2000mV. variable.
Tuner (flat) 250mV. 100K Ω
Auxiliary 1 250mV. 47K Ω
Auxiliary 2 2–20mV. 100K Ω

OUTPUTS
Main Pre-amp output 500mV.
Direct tape output 120mV.

ACTIVE TONE CONTROLS (Bexendall)
Treble ± 12db.
Bass ± 12db.

INTERNAL STABILIZATION
Enables the HY5 to share an unregulated supply with the Power Amplifier.

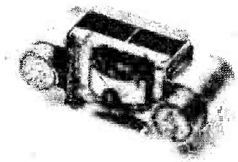
SUPPLY VOLTAGE
16–25 volts

SUPPLY CURRENT
6mA approx.

OVERLOAD CAPABILITY
better than 26db on most sensitive input infinite on tuner and auxl.

OUTPUT NOISE VOLTAGE: 0.5mV.

PRICE: **MONO: £3.60** **STEREO: £7.20**



POWER SUPPLY PSU45

The versatile P.S.U.45 is designed to supply your HY41's +HY5's in stereo or mono format.

Specification

Input: 200–240 Volts.
Output: ± 22.5 Volts at 2 amps.
Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

PRICE: **£4.50 inc. P. & P.**

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PRACTICAL WIRELESS

VOL 48 NO 10
Issue 792

FEBRUARY 1973

Letter from your new Editor

AT the time of going to press we have seen the last of the Apollo series of manned space flights to the moon. Fifteen years ago when the USSR launched *Sputnik 1*, followed by the U.S. launching of *Explorer 1*, little did many people imagine what space research could do to provide further knowledge and skills for everyday living. One could comment in depth on this, but rather than indulging yet again in retrospect, let us look to the future.

NASA space programmes are to be directed towards space laboratories in which man can examine the influences of near sterile conditions on terrestrial activities. Already it is expected that crystal growth in a space laboratory will be tried, so perhaps we who have a particular interest in semiconductor technology will again reap the benefits of such an exercise.

* * *

On a more domestic note, following the celebrations of 50 years broadcasting, further progress is being made to improve communications: The IBA have now used their colour programmes digital converter in service; stereo is established on Radio 2 (v.h.f.), although there is apparently some unexplained mono material intruding; the planning of commercial radio is well underway; the third Goonhilly dish has increased the international telephone capacity to handling almost half of Britain's 60 million calls by satellite; the first UK i.c. radio chip receiver design for home constructors has been published; the BBC has announced the CEEFAX news service for television.

We shall be taking a closer look at the world of communications inside and outside the home; giving you up-to-date information on components and equipment; extending our popular ranges of simple-to-build projects; encouraging readers to participate with us in do-it-yourself communications.

* * *

Many of you will have followed the writings of your new editor elsewhere. To PW newcomers we welcome you to the club; we hope to provide plenty to stimulate your interest in future issues. In the meantime, we are always interested to hear your views on matters appropriate to the magazine. We are also convinced that a great deal of talent exists among the readership in designing projects, as is evident from our correspondence. If you feel that you would like to show others what you do, drop us a line; better still, how about writing it up into an article.

M. A. COLWELL—*Editor*

THE MARCH ISSUE WILL BE PUBLISHED ON FEBRUARY 2nd

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

NEWS... NEWS... NEWS...

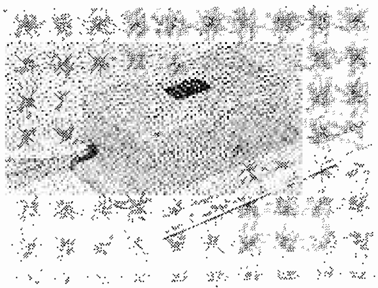
by
Colin Riches

KW catalogue

A new catalogue has just been released by KW Electronics Ltd., Specifications and pictures of KW transmitters, receivers and associated equipment are shown and a price-list is included.

Free copies of this catalogue may be obtained by writing to *KW Electronics Limited, Dartford, Kent.*

Ignition system

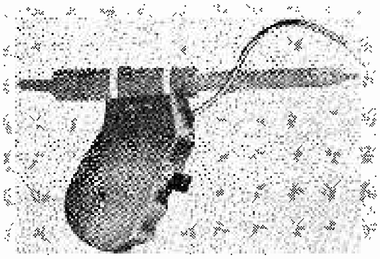


Future Techmatics announce a new low-cost capacitive discharge ignition system, named "Highwayman" and designed for both the fleet owner and the private motorist. The unit priced at £9·90 plus 35p postage is claimed to give fuel economy, improved performance and excellent starting under adverse conditions.

Fitting is simple with only three wires to connect. Using the conventional coil and contact breakers, "Highwayman" produces well over 30,000 volts to the spark plugs with a rise time of 2·6 microseconds. Maximum operating rate is 600 pps. Battery drain is 1·5 amps. The contact breaker resistance limit is 25 ohms and current and voltage at contact breakers is 0·15 amps at 12V.

Further information on the range of electronic ignition systems and other devices, may be obtained from *Future Techmatics Limited, Waldeck House, Waldeck Road, Maidenhead, Berks.*

Solder feed



The Mark 3 Anextra includes several improvements to simplify its main function of eliminating the need for "three hands" when soldering. The reel of solder, 18 to 22 gauge is contained in the pistol grip which is easily attached to most types of soldering iron.

The maximum 4oz. reel of solder is easily changed. The amount of solder fed by each pressing of the trigger is quickly adjusted to suit the joints being made. The operator thus holds both the iron and solder in one hand, being free to hold the work with the other hand.

Supplied with a 1oz. reel of 60/40 22 s.w.g. solder, with simple instructions, the Anextra is £3·75 post free U.K., direct from the makers. If you send an s.a.e. you can obtain a leaflet on the unit. *Anextra Ltd., Chiltern Works, Rear of 77/78 Chiltern View Road, Uxbridge, Middx.*

Working /MDS

Who ever heard of a radio Amateur going mobile on a dog-sled?

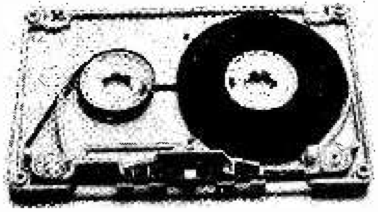
I didn't believe it at first but here's the full story:

Having supplied quantities of radio equipment to the South African Antarctic Expedition, Racal Electronics is naturally in fairly close touch with events and told us of the claim by one of the Expedition's members to have effected the world's first radio contact (QSO) by an amateur from a dog-sled mobile installation. The QSO was achieved on 7MHz between the sled in Antarctica and a station in South Africa. Racal has supplied the Expedition with a number of TR.28 h.f. transceivers which it uses for mobile applications.

The Expedition's base station (call sign ZS1ANT) which is equipped with Racal transmitter and receiver, is in the charge of Frank Schneider, a radio ham who operates most evenings between 1600 and 1900 GMT on s.s.b. at about 14.30MHz (call sign ZS6GE). As Antarctica is classed as a separate continent for many amateur radio certificate awards, a contact with Frank is considered a rare achievement and so his QSL cards confirming radio contact are in great demand among the world's radio amateurs.

If any U.K. hams manage to contact ZS1ANT, the address for QSL cards is 5 Prinshof Street, Pretoria, South Africa, or via the SAARL QSL Bureau.

New Mechanics



The range of "LH" (low, noise high output) ferric oxide compact cassettes from BASF is available with the patented Special Mechanics (SM) developed by BASF technicians in West Germany.

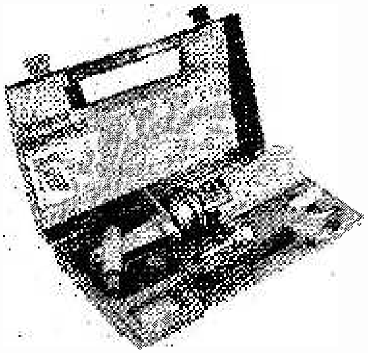
The Mechanics comprise two plastic tusks and a roller system which together guide the tape on and off the spools. They ensure constant free running of the tape and eliminate jerking caused by static.

The improvement in tape running is most noticeable with C120 cassettes which, because of their extreme tape length of over 56 feet and thinness, are prone to running difficulties.

Recommended retail prices, including purchase tax, of the LH SM cassettes are 81p (C60), £1·11 (C90) and £1·51 (C120). *BASF United Kingdom Limited, P.O. Box 473 Knightsbridge House, 197 Knightsbridge House, London, S.W.7 1SA.*

NEWS... NEWS... NEWS...

Ronson Blowtorch



Ronson Products Ltd., the people that make the lighters and shavers recently let me have a look at their blowtorch.

It's hardly the sort of unit you would use on a transistor p.c. board or anything requiring delicate soldering but for heavy soldering jobs, it's ideal.

With its micro-adjustment to give a precision choice of flame size and heat intensity, the Blowtorch when used with its copper soldering tip can undertake relatively fine soldering jobs on metal, wire splices, pipes and tubing, etc. It's ideal, too, for bending or fashioning glass, metal tubing and rod and for all types of hand forging, shrink fitting, enamelling or light brazing.

The range of Ronson Blowtorches is made up of three models. All are supplied complete with the large capacity Hi-Heat butane refill. The standard pack costs just £2·45 or with copper soldering tip at £2·79. The complete Blowtorch kit—at £3·99—comes with three handy attachments (soldering tip, flame spreader and diffuser head) all neatly contained in a packaway case, as can be seen in the photograph. *Ronson Products Ltd., Leatherhead, Surrey.*

"Texan" Reprints

Reprints of the "Texan" 20+20W Stereo Amplifier are available.

They may be obtained by sending 35p (30p+5p postage/packing) to *"TEXAN" REPRINT, c/o Chief Cashier, Practical Wireless, Tower House, Southampton Street, London WC2E 9QX.*

Electrovalue cat.

Electrovalue have sent me their catalogue No. 6—already in its third printing. Including i.c. circuit and connection diagrams as well as semiconductor outlines and technical gen, the catalogue contains many other interesting items plus a purchase refund voucher for the 25p it costs to buy.

Copies can be obtained from *Electrovalue Limited, 28 St. Judes Road, Englefield Green, Egham, Surrey.*

Bib test cassette

Bib recently let me hear their Hi-Fi Stereo Test Cassette which is entitled, "How to get the best stereo and mono reproduction and recording".

The tape, devised by Richard Arbib, managing Director of Bib Sales is recorded by Decca using the Dolby system.

The Max Harris Jazz Trio play some specially composed pieces, illustrating tests including balance control, channel identification speaker phasing, reducing tape hiss and adjusting record volume controls.

Members of the Trio, playing six instruments are used to check cassette recorder reproduction over a wide frequency range.

Side 1 of the cassette deals with reproduction and side 2 with recording. Other advice and tests include wow and flutter, movement between channels and how to clean tape heads.

To illustrate various points, excerpts from Bach's Toccata and Fugue in D minor and Khachaturian's Spartacus are given together with excerpts from Vivaldi's "The Four Seasons" and some Gilbert and Sullivan operas to illustrate high quality sound.

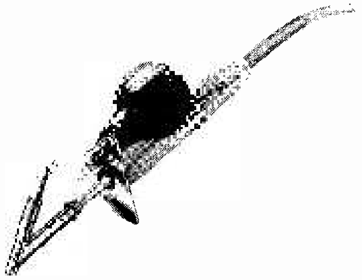
This cassette represents a very useful addition to those who like me suffer from "cassette-itus" and a none too perfect stereo system.

The Bib reference for the cassette is "53" and the price £2·25. The tape plays for 50 minutes, which represents an extra 25% of playing composed with a standard Musicassette. *Bib Division, Multicore Solders Ltd., Hemel Hempstead, Herts.*

Litesold's latest

Light Soldering Developments inform us that they have marketed two new devices. Both are for use with their ETC/1 temperature-controlled and Conquerer irons. The De-Soldering Unit (priced at £·75) slips onto the iron and converts it to a self-contained de-soldering tool.

The i.c. De-Soldering Head, at £2·25, slips on in place of the soldering bit to give simultaneous de-soldering of all leads of 14 and 16 way dual-in-line i.c.'s. *Light Soldering Developments Ltd., 28 Sydenham Road, Croydon, CR9 2LL.*



De-soldering unit

Digital Clock

The 24 hour digital clock shown on the cover this month is mains driven and incorporates an alarm buzzer. It can be obtained from Sternway Electrical Ltd., 111 Fleet Street, London EC4, for £7·95 plus 25p post and packing.

The "CQ" Column

Just a little reminder about the CQ Column. As readers write in, I put all their letters in strict order so that it is a case of "first come, first served." Requests for entries in this column now number many dozens a week and as we cannot always include a "CQ Column" in every issue of *P.W.* there is often some delay before the items appear.

Should there be any immediate urgency for a mention to appear, our Advertising Department will be pleased to accept "small ads" for a small charge.

Guide *for* Constructors

V. CAPEL

EACH issue of both *Practical Wireless* and *Television* carries articles of a constructional nature. With any hobby or interest, the greatest pleasure and reward comes from participation, having a go oneself rather than just reading about or examining the work of others. Thus these constructional features fill a very necessary need and are widely appreciated.

However, modern radio and television techniques are of a complex nature, and it is understandable, that in spite of the clear description, circuit and layout diagrams, readers sometimes get into difficulties, resulting in a written plea for help to the Editor, who in many cases refers it back to the writer of the original article. Many of these difficulties and queries though, would not arise if certain basic principles and precautions were observed. This article is designed to assist constructors prevent problems before they arise.

COMPONENTS

First we will consider the components. It is always best to obtain **all** the components at the start, if at all possible. If any are left out, to be obtained later, it means that the tags or print where they would be connected are left unsoldered and therefore adjoining components are left high and dry. If the omitted component is used as an anchoring point such as a transformer or can electrolytic, then it will not be possible to fit the associated components at all. Where a number of parts are deferred in a complex circuit it is very likely that one or more may be overlooked altogether, and considerable trouble caused in trying to get the circuit to work before the omission is discovered.

Having gathered the components together it is wise to check them for faults. Unfortunately, there is always a percentage of new parts that are defective, as each one cannot be individually checked by the maker. Small though the percentage may be, it means that somebody is going to get one, and that could be you!

Transformer windings should be checked for continuity, and then with the ohmeter switched to its highest range, check for leaks between windings, and between windings and core.

Capacitors are the most likely source of faults especially the miniature electrolytics used in transistor circuits. These should be checked for leaks; some leakage may be found using the high resistance range of the meter, but it should not be very much. If in doubt compare with other electrolytics. Any giving a substantially lower reading than the others should not be used. Of course, a lower reading will be obtained with the meter polarity connected the wrong way round; usually, the polarity on the ohms ranges is **opposite** to that for the voltage and current ranges.

While leaky capacitors are more common than open-circuit ones, the latter condition can be tested for by observing the meter needle kick when the capacitor is connected across it. The larger the value of the capacity the greater the kick, so with low values a response may not be observed. It will not be necessary to check the values on a bridge; if it is not leaky or o/c, the value will probably be right.

Assuming the colour code markings are clear it is very rare for a resistor to be of incorrect value or o/c so these can be taken for granted, especially if there is a large number and checking them all would be rather tedious. However, circuits where close tolerances are necessary such as measuring and test equipment, may demand the individual checking of appropriate resistor values. Also very high values are worth checking as these are generally less reliable than the lower ones. Resistors with dubious markings should be checked.

TOLERANCES

Sometimes queries are received about tolerances and capacitor voltage ratings showing that these limitations are not always understood.

The tolerance means the amount by which the value may deviate from that stated. Thus a 100Ω 10% resistor may be anything from 90 to 110Ω in value. Resistors may be obtained in 1%; 2%; 5%; 10% and 20% tolerances, the 5% ones being indicated by a gold ring and the 10% ones by a silver one. In most practical circuits values of resistance are worked out and then taken to the nearest preferred value, so in most cases the values are not very critical. Unless otherwise stated, the 20% tolerance will be satisfactory, but of course if closer tolerance resistors happen to be available they can be used. The closer the tolerance, the higher the cost, so it is a waste of money using close tolerance components where they are not needed.

If close tolerance is specified in the components list, then the circuit is more critical and the stated tolerance should be used. If for some reason a close tolerance component of the value required cannot be obtained, but there are some of that value with larger tolerance to hand, check these with a meter. It may be that they could fall within the required tolerance. A 20% resistor does not mean that it is **bound** to be 20% outside the stated value, only that it **may** be. The error is guaranteed to be less than 20%. Thus it is often possible to select by measurement a 20% resistor that is spot-on in value, or nearly so.

Critical circuits often contain a preset control which must be set to give a specified voltage or current. Thus the resistors associated with that part of the circuit need not be of close tolerance. In fact, different values that are near to those specified can be used at a push, because the preset will compensate.

The same thing applies to capacitors. Many electrolytics are rated at −20% +100% which means that they may be up to 20% less or 100% more than the stated value. It is usually better to have a little more capacity than less, especially where decoupling circuits are concerned. Some capacitors are available that are −20% +50% if a closer tolerance is required. It can be seen from this that the average electrolytic is likely to be rather higher than its stated capacity. It is also obvious that values are not too critical, so if the required value is not available, the next highest can generally be used. Thus 50μF can be used in place of 25μF, and 16μF in place of 8μF.

Paper and polyester capacitors are usually 20% or 25% tolerance, although for special purposes where accuracy is important 5% tolerance or better can be obtained. As with resistors, if a bridge is available, it is often possible to select from a number one that is quite close to the required value.

Ceramic capacitors are usually made with wide tolerance ratings; −25% +50% is common where value is not too important but a little more rather than a little less is preferred. Such can be used for r.f. decoupling purposes, 1000pF. to 3000pF. being common values. Ceramics can be obtained in the lower values at 10% tolerance or better and these or mica capacitors should be used for tuned circuits and similar r.f. applications.

It may be felt that these tolerances are rather wide, but remember that they are the maximum permissible deviations for the category. Most components will be found to be well within the tolerance rating.

VOLTAGE RATINGS

The voltage rating of capacitors seems to be something with which some readers have difficulty. For d.c. circuits it means simply that the applied voltage must not exceed that for which the capacitor is rated. The minimum rating then, must be the applied voltage plus a safety margin. Thus with a 200 volt h.t. line all h.t. capacitors should be 250 volt working minimum. Lower voltage working capacitors can be used elsewhere such as for cathode bias bypass. For the earlier stages this may be a few volts but output stages run at up to 20 volts bias normally, so 25 volt working capacitors should be suitable. With some stages the bias is higher, and 50 volt capacitors must be used, but these are also often used with lower bias voltages to give a higher safety margin.

The miniature capacitors used with transistor equipment come in various low-voltage ratings. Again, the rating can be selected by considering the supply voltage and circuit position. If the battery voltage is 9 volts, then a rating of say 12 volts or higher would do for any circuit position. Lower voltage ratings can be used for emitter capacitors, usually 6 volt being ample here. Coupling capacitors in both valve and transistor equipment can be rated at about half the supply voltage but it must be remembered that a fault condition may put the whole of the supply voltage across the capacitor, so it is best to use one rated for the full supply voltage.

With one make of record-player, the designers slipped up on this point. It was valved, but with a silicon rectifier. A 150 volt coupling capacitor was used which was amply rated for normal running. When the player was first switched on the supply voltage was instantly available, before the valves had warmed up. This meant that around 250 volts appeared across the capacitor during this period. Needless to say a number of these players found their way into the workshop with short circuited coupling capacitors!

Note from what has been said before, that the capacitor voltage rating **must not be exceeded.** This means that one with a higher rating than is necessary can be used if the desired rating is not available. The higher the voltage, the more bulky the capacitor and with some exceptions, more costly. Generally though, size is the main consideration. If the equipment is small and the space limited use the lowest voltage rating consistent with requirements, but if space is not at a premium, higher ratings can be used if desired.

For a.c. or pulse circuits, the capacitor must be considerably uprated. The peak value of an a.c. sine wave is 1·4 times that of the r.m.s. voltage. The peak-to-peak voltage then will be 2·8 times, so a capacitor should be rated at three times its d.c. working voltage. Thus for 250 volts a.c., a 750 volt working capacitor would be the minimum. Usually, 1000 volt capacitors are used to give a good safety margin.

CONSTRUCTION

Having selected and obtained our components, there are a number of points to watch for when fitting them. First, check the colour coding of resistors and that you are reading them the right way round. For example, a 270kΩ (red-violet-yellow) can be mistaken for a 4·7kΩ (yellow-violet-red) if the coding is read from the wrong end of the resistor. Also, a 1·2kΩ (brown-red-red) resistor can be mistaken for a 220Ω (red-red-brown) one. With the preferred values now in use, these are the only "back-to-front" mistakes that can be made, so be careful when handling resistors. With many resistors, especially in the smaller wattages, mistakes can easily be made. Make sure too, that the colours are what you think they are. Some markings in orange are quite deep in tone and can be mistaken for red, particularly when viewed in artificial light.

Another mistake that can easily be made is to wire in polarised components incorrectly. We all know that electrolytic capacitors should only be connected one way round, but when fitting a large number of parts to a printed board it is easy for the odd one to go in the wrong way round. Double checking is the only answer. Similarly, diodes have to be watched. It anything, it is easier to make a mistake here as the markings and shape of the very small ones are not easy to identify. The ring and rounded end with Mullard diodes indicates the cathode, but often the ring is indistinct, and the other end appears rounded as well.

It is best to work to a system in construction. Do all the mechanical operations first, drilling, cutting circuit boards and fitting components such as transformers, controls and sockets. It is easy to have a mishap and damage some of the smaller components if any of this work is left to later. Wiring of the circuit can now begin. This should be done stage by stage, and when a stage is completed, go back and check component values, electrolytic and diode polarity, and trace through the connections (it is easy to solder a lead to the adjacent tag or printed strip to the one intended). Having satisfied oneself that the stage is wired correctly, then pass on to the next. If the construction has to be left (constructors have been known to go to bed at times!), try to complete a stage. This is a danger-time when errors and omissions can easily be made.

When re-starting it is prudent to check the previous stage again. All this checking may seem tedious and time-consuming, but even experienced engineers can and do make mistakes when constructing things and it is better to check and double-check rather than spend hours trying to correct baffling faults found when the equipment is first switched on.

Modern transistors are less heat-conscious than their predecessors, but they still can be damaged by too much heat. It is a good idea to leave the transistors in any particular stage as the last component to be fitted, then they cannot be affected by heat when soldering in adjacent components. When actually soldering the transistors, leave the iron on the connection only long enough to make a good joint. If for any reason it is not satisfactory and needs re-doing, leave it to cool for a few seconds before tackling it again. It is good practice to use a heat-sink whenever possible.

SOLDERING

When making a large number of joints it is possible that even the expert will make one or two "dry" joints. The only remedy is to be painstaking with each one and not to rush it. Wire-ended components are supposed to be ready tinned, but often solder will not take readily, and if they are soldered into print or to a tag, the solder will flow around the wire but take on the print and appear to make a good joint, but it will be bad inside.

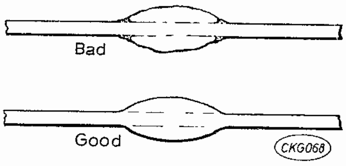


Fig. 1: Many dry joints exhibit an inward curve where the solder meets the wire (top). A smooth contour from wire to solder is usually the sign of a good joint (bottom).

Always tin the wire initially and see that the solder has taken all around before attempting to make a joint. This may mean that the wire must be scraped first. It is sometimes possible to tell a bad joint by the way the solder meets the wire. Reference to Figure 1(a) shows the solder curving inward where it meets the wire. This is due to surface tension in the solder when it was molten and shows that it has not taken on the wire because the solder had a separate surface. Often there will be traces of resin from the solder core at the junction. In Figure 1(b) the solder has bonded itself to the wire and has no separate surface, hence there is a smooth flow from the wire to the bulk of the solder. This is not an infallible way of judging joints as the solder may have taken just at the point where the wire leaves the joint but not inside; or it may have taken inside, as in the first example, but not at the edge; but at least it does give a clue. A further check can be made by gently pulling or twisting the wire to see if there is any movement between it and the joint.

Excess solder must be guarded against, especially on printed circuits where there is a danger of it shorting over to adjacent print. A golden rule which should be observed at all times is never to interrupt the making of a joint. If the wire is pushed through the print or wrapped around a tag, and then one is called away without soldering the joint, more likely than not one will proceed with the next joint on returning. Time and again joints have been left unsoldered because of interruptions. If the house is burning down, let it, but make sure you finish your joint!

More could be said on the important art of soldering but it is hoped to make this the subject of a complete future article.

CIRCUIT BOARDS

There are several printed circuit methods available to the constructor. Veroboard is a popular one because it is versatile and ready to use. When cutting across a section of print to isolate it, remove a complete segment. Just cutting across with a blade may permit the solder to later bridge the cut, or the cut may not be complete to start with. Fig. 2 shows the right and wrong way.

Better still, use the proper spot-face cutter sold for this purpose. The physical mounting of the printed board may pose problems as it is desirable to have access to both sides for servicing. One successful method is to solder a tag board to a strip of unused print at the edge. The tags can then be mounted with nuts and bolts where required. This gives a vertical mounting with access to both sides the tags being bent to give the printed board any desired angle. Fig. 3 illustrates this arrangement.

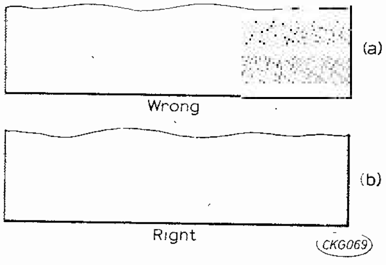


Fig. 2 (a) A narrow cut in a copper rail can is easily bridged with solder or dirt so a wide cut (b) is much preferred.

Wiring should be done with solid rather than stranded wire, because it stays put and can be formed to give a much neater appearance. Bare copper wire can be used with sleeving, or as the usual plastic-covered wire. Whichever is chosen, it is good to use different colours for different parts of the circuit. Quite a range of colours can be obtained. Red can be used for positive supply circuits, black for earth or negative; green for grid or base circuits; grey for a.g.c.; orange, unsmoothed h.t. and so on. This enables future testing to be so much easier, but stick to the coding once it has been decided upon.

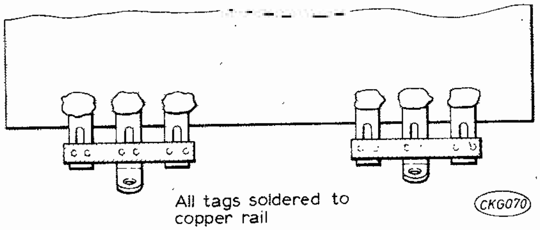


Fig. 3: Method of mounting Veroboard in a vertical position allowing access to both sides of the board.

It is a good practice to earth all appropriate components to one point in each stage. Furthermore, these points can then be linked and earthed to the chassis or frame at one point. This prevents h.f. chassis currents, in the case of radio equipment, leading to common impedance coupling and instability. With audio equipment it reduces the possibility of hum from the same cause. It is true that in many cases it may prove unnecessary, but like providing adequate decoupling, it is good preventive practice and difficult to carry out once the circuit has been wired.

TESTING

Having completed the building of the project, the time eventually comes for the first switch-on. It is not unknown for this action to be accompanied by a blinding flash, smoke or other disquieting phenomena! A simple precaution is to take a resistance reading across the power supply circuits before switching on. The initially low resistance reading should quickly rise as electrolytics charge up from the meter battery. (Remember, the positive side of the test meter is negative battery polarity). Any permanent low resistance must be investigated. Then, wire the meter, switched to a high current range, in series with the supply and switch on. An abnormally high current should prompt an immediate switch-off and examination.

It may be that in spite of all these precautions, the equipment constructed fails to work satisfactorily. Normal fault-finding techniques must now be applied to find the cause of the trouble. Voltage measurements find the majority of faults, so go to work with the meter, and with the aid of the published circuit diagram check to find if there are volts where they should be. Check too, as to whether the voltages are approximately correct. This will depend on the equipment and its function. As a very general rule with transistor stages, the collector voltage should be about half that of the supply, emitter voltage should be about 1 volt and the base should be about 0·1 volt higher than the emitter for germanium and about 0·6 volts higher for silicon transistors. With oscillators, emitter followers and similar stages, voltages will be different from the above.

Directly coupled stages can be confusing and a fault in one can affect the voltages in another. Note though, that the base/emitter voltage difference is present as this forward bias is essential for the transistor to conduct, in normal circuits. Some low-current circuits, as used in the input stages of audio amplifiers, may use a high value resistor of 3MΩ or so from base to collector, to supply bias, and the meter current will cause a much lower reading. This must be allowed for, or if available a valve-voltmeter should be used. Incidentally, when the equipment is working satisfactorily, it is a good idea to take all the voltages and note them down on the circuit, for future reference.

If there are still no results and the voltages seem right, then check through the signal circuits using some form of signal injection. However, by following some of the tips outlined here, construction will not be such a hit-or-miss affair, but one reasonably certain of immediate success.

MODIFICATIONS

Now we come to the question of modifications. Some readers may wish to add extra facilities or to tailor the equipment to their own particular needs. This sometimes leads to letters to the Editor or author requesting modification design details. Now while we try to help as far as possible, producing designs to order is something that cannot be undertaken. Not only is a good deal of time involved, but any theoretical design must be built and development work carried out before it can be passed as workable. Obviously this is not possible.

Minor modifications should be within the capabilities of most readers if they have read carefully the various theoretical and practical articles that regularly appear in radio magazines. More ambitious modifications could provide a subject for private research and experiment; really, with this hobby, there is more satisfaction and pleasure to be derived by experimenting and trying out one's ideas than there is by following a tried and tested circuit. A recommendation though, is to get the unit working as first planned, and then introduce the modifications. If they prove unworkable, one can then revert to the original. ■

Back Numbers
Important Announcement

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.

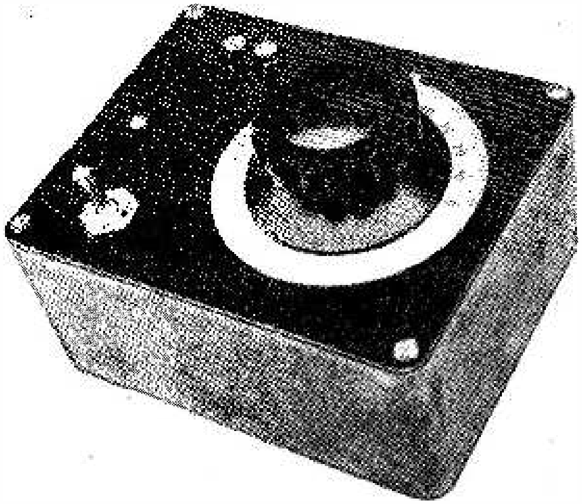
Reference to past issues of the magazines may sometimes be obtained at certain public libraries who may hold bound volumes. A few libraries are said to offer a photostat service. Alternatively, we are always willing to insert a free request for specific back numbers in our "CQ" column which appears in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

VHF Signal Generator

R.H.LONGDEN

WHEN it is necessary to adjust a VHF receiver or converter such as may be used for the 144MHz amateur band, a signal generator covering the required frequency is extremely useful. As an example, even a straightforward unit such as the 144MHz converter in the July 1972 issue of *Practical Wireless* has four circuits which must be tuned to about 144MHz. With such equipment, if all of the circuits are initially considerably off tune, it may not be easy to peak them for maximum noise or reception of signals which are not very strong. On the other hand, when a suitable signal is available, it is easy to trim all the circuits for maximum efficiency.

The generator described here is intended particularly for the frequencies from 105MHz to 170MHz, thus including the 2-Metre Band, but it can be used at frequencies outside these limits, and particularly for checking the coverage and alignment of converters and the simpler types of VHF receivers. It is a small, self-contained solid state unit, providing a modulated r.f. output.



GENERATOR CIRCUIT

In Fig. 1, Tr1 is the audio tone generator or modulator. The transformer T1 is connected in the correct phase to obtain audio oscillation and this modulates the r.f. oscillator, which is supplied through the winding 3-4 of T1.

Tr2 is the r.f. oscillator. L1 is tuned to the required r.f. frequency by VC1, which has a dial for logging frequencies. An adequate signal is generally obtained by having the generator near the equipment being adjusted, but output can be taken to an external lead by the loop L2, if desired.

With a crystal controlled converter such as that mentioned, reception must be at the correct frequency, because VHF signals can only come out at a particular lower frequency. In this particular converter, 144MHz is tuned at 4MHz on the receiver, 145MHz at 5MHz, and 146MHz at 6MHz on the receiver scale. So for adjusting such equipment, there is no real need for VC1 to be calibrated. Instead, VC1 is merely tuned until the VHF signal comes through the converter, which can then be adjusted. In other cases, it is helpful to calibrate VC1, in the way described. This will allow the frequency range of fully tunable equipment to be checked.

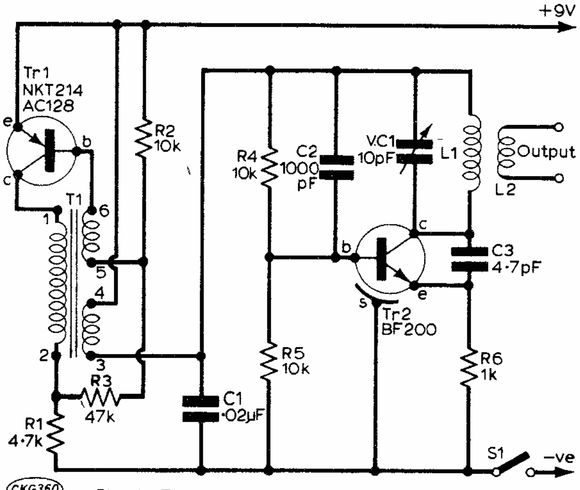


Fig. 1: The complete circuit of the VHF signal generator.

CONSTRUCTION

VC1, Tr2 and the associated items are assembled on a tag board about 1½ x 2 in. as in Fig. 2. As an alternative to the tag or group board, plain Veroboard with 10 pins inserted could be used, or eyelet board, or 1/16 in. thick paxolin drilled to take the leads. Veropins will have to be snipped off nearly

★ components list

Resistors

R1	4·7kΩ	R4	10kΩ
R2	10kΩ	R5	10kΩ
R3	47kΩ	R6	1kΩ

All resistors 10% ¼W

Capacitors

C1	0·02μF disc ceramic
C2	1000pF disc or tubular ceramic
C3	4·7pF silver mica

Transistors

Tr1	NKT214 or AC128
Tr2	BF200 or similar VHF planar epitaxial transistor

Miscellaneous

VC1	Jackson C804 10pF
T1	T/T3, 3·6: 1 + 1 (R.S. Components)

On-off switch
Two small sockets
Tag and insulated board
Case about 4¾ x 3¾ x 2in. deep
0-100 knob dial, KN1, Home Radio (Mitcham)

flush, as if this is not done the spindle of VC1 may not project enough to take the numbered dial.

The board is drilled for VC1. A washer is later put between this board and the panel, on the bush of VC1 and the bush nut then holds the whole assembly to the panel.

All connections in this section should be short, though the wires from Tr2 need not be cut down to less than ½in. Solder these rapidly after other wiring is taken to the tags, and use a heat shunt such as a pair of flat-nosed pliers on the leads while soldering.

L1 is chosen from the details given, for the coverage which is required. L2 is a single turn, some ⅜in. to ½in. from L1, and is the same for all coils.

This section can be tested by connecting the S1 lead to negative on a 9V battery and the lead which runs from C1 to 3 on T1 to a meter, which is clipped on the battery positive terminal. If the circuit is oscillating, current falls slightly when VC1 is shorted by placing a metal tool from moving to fixed plates. Actual current was 4mA, falling to about 3·8mA but this figure is not very important, and will depend on the particular transistor used. However, it *is* important that this change in current is found. If it is not, the circuit is not oscillating and no r.f. is produced.

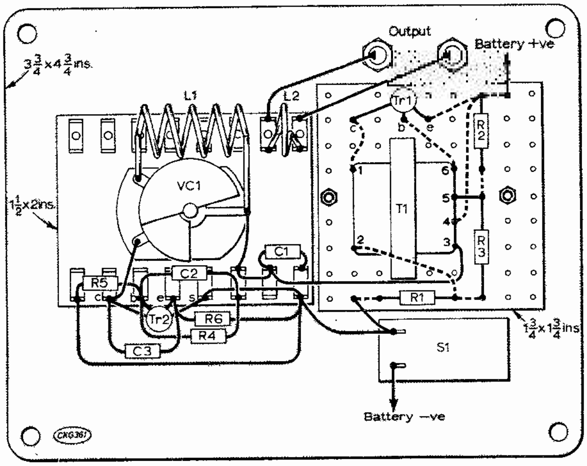
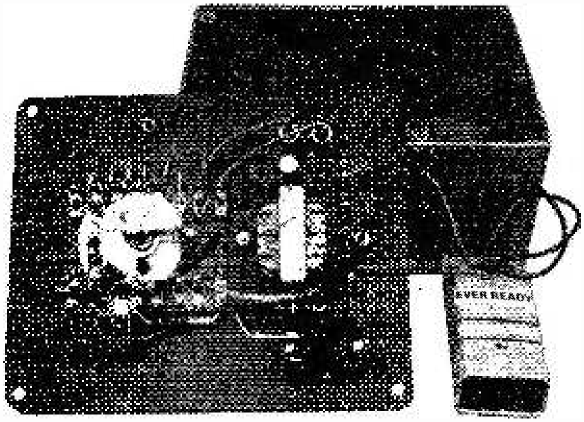


Fig. 2: The component layout.

With particular transistors in the Tr2 position, an upper frequency limit will be found, where oscillation grows weak and ceases. No particular difficulty arises in obtaining oscillation up to 180MHz or so. In fact, a number of transistors will work, and if the one fitted oscillates up to the highest frequency wanted, this is satisfactory. There is no point in using a transistor which could operate at a much higher frequency than required, as these cost considerably more than the popular types suitable for up to 180MHz. On the other hand, some cheap transistors which are supposed to be suitable for this frequency will cease to oscillate or become very inefficient. Should some particular VHF transistor be to hand, and not work with the values given, then the values at R4 (or R5), C3, and R6 may be changed to find if oscillation can be obtained.

T1, Tr1 and the three resistors are mounted on a piece of eyelet or other insulated board about 1¾ x 1¾in. as in Fig. 2. Leave flying leads for the battery positive, S1 (battery negative) and from tag 3 of T1 to go to C1.



An internal view of the prototype.

This part of the circuit may be tested by connecting phones to 3-4 and applying 9V. With the components listed, a clear audio tone should be obtained.

Two countersunk 8BA bolts fix the board as shown. Spacers, nuts or washers are put between the panel and board.

The front panel should be made of paxolin. If it is metal, the bush of VC1 should be isolated from it with insulated washers. VC1 is fitted with a 0-100 degree dial, or with a control knob allowing markings to be made on a paper scale fixed to the panel.

The case was a die-cast box 4¾ x 3¾ x 2in. deep, but a small plastic lunch-box or other case will do equally well. L1 is placed so that it is well clear of metal when the panel is fitted to the box.

L1, FREQUENCY AND CALIBRATION

Exact coverage will naturally depend on individual layout and the length of leads, but should be reasonably close to the figures given. The frequency is lowered by using more turns on L1, by winding L1 to a larger diameter, or by compressing L1 so that its turns are closer together. Fewer turns, smaller diameter, or stretching raises the frequency. In all cases L1 is of 20s.w.g. tinned copper wire, self-supporting. Details of L1 are:

105-125MHz:	5 turns, ½in. outside dia. and ⅝in. long. Ends ⅜in. and ⅝in. long.
125-148MHz:	5 turns, ⅜in. outside dia. and 1in. long. Ends ⅛in. and ½in. long.
148-170MHz:	4 turns, 9/32in. outside dia. and ¼in. long. Ends each ½in. long.

Where a crystal controlled converter is available, or a VHF receiver, these will furnish calibration marks through the ranges they cover. This may prove handy when building other, fully tunable VHF equipment.

The VHF enthusiast can calibrate the oscillator by using a Lecher line and measuring the length of this to find the wavelength in metres. This is practical at these frequencies as the line will only be up to three metres or so long, and resonance produces a dip in battery current.

For some lower frequencies it may be possible to pick up the signal when the generator is tuned so that a harmonic is heard in the receiver. Second harmonic reception will arise when the generator is tuned to one-half the receiver frequency.

When some calibration points have been obtained, these can be entered on a scale or list, or on a graph which will give intermediate frequency readings. ■

EXPERIMENTERS CORNER

NOVEL 'SCOPE CALIBRATOR

J. A. NEKREWS

THE instrument to be described will work well with virtually any oscilloscope and facilitates the voltage calibration of both the X and Y axes in one simple operation. It is easy to build and use and the total outlay, including a suitable case, should not exceed £2.

CIRCUIT

The circuit is basically a conventional phase-shift network with the addition of resistors R2 and R3, and zener diodes D1 and D2. The values of C1 and R1 were found by experiment to give an almost perfect circle output from the phase-shift network. Addition of the zener diodes clips the alternative half cycles and produces the rather novel square display as shown in the photograph. Resistors R2 and R3 simply limit the zener current to an acceptable level and eliminate any chance of loading the phase-shift network. Provision of the ganged potentiometers allows the amplitude of the display to be varied from zero volts to the maximum zener voltage which in the prototype was set to be 5V.

Although a matched pair of zener diodes is to be preferred, odd diodes can be matched by inclusion of series resistance at points marked A and B on the circuit diagram. Indeed the constructor could use virtually any zener diodes that happen to be at hand as long as the nominal zener voltage is equal to, or in excess of, the maximum required for display. It will be found that the polarity of the zener diodes is of no consequence in this circuit, it will operate whichever way the diodes are connected. The prototype used Mullard OAZ201 5·1V types adjusted as above to provide exactly 5V. The rating of the diodes should be at least 250mW.

The constructor is not hindered in any way in the construction of this instrument as the layout is by no means critical and there is considerable flexibility in the selection of components. Any transformer supplying 12-20V will suffice as the current required is negligible. A type MT98 9-0-9V available from Henry's Radio is ideal as it is small enough for Veroboard or printed circuit board mounting. The ganged potentiometer should be a good quality type with a resistance between 500kΩ and 1MΩ. If the reader wishes, separate potentiometers, individually calibrated for each axis, could be used. Resistors R2 and R3 should not be reduced in value or the zener diodes may be damaged. The outputs can be taken via any type of terminals convenient to the constructor. No further constructional notes are considered necessary as the reader is free to use whatever form of construction that he (or she!)* finds most convenient. Of course there is no reason why the unit could not be incorporated as an integral part of an oscilloscope provided sufficient space is available.

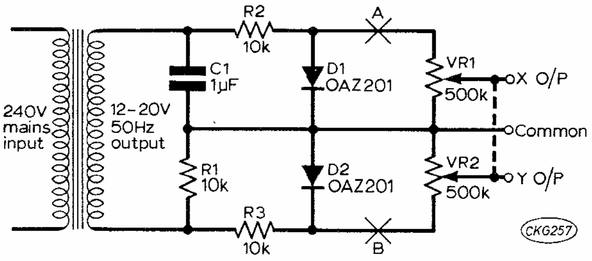
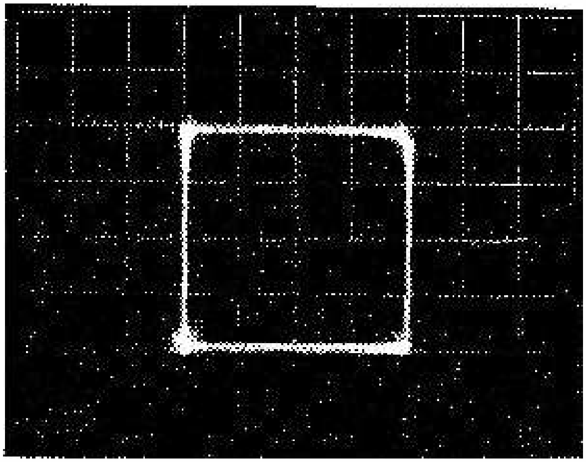


Fig. 1: The circuit of the 'scope calibrator.



CALIBRATION

Having constructed the instrument with an established 5V maximum output, the first step in calibration is to set the potentiometers for maximum amplitude and mark this point as 5V. Then adjust the oscilloscope gain controls until the display is ten divisions of the oscilloscope graticule on each side. This gives a display of 0·5V per division. Then, without touching the scope gain controls, gradually reduce the calibrator output by one division at a time marking the dial at 0·5V steps. You then have a reasonably accurate instrument capable of voltage calibration of both axes of your oscilloscope in a single operation.

There is ample scope for the constructor to tailor the unit to suit his own needs and for this reason constructional details have been cut to a minimum.

---

* *Concession to Women's Lib.—Ed.*

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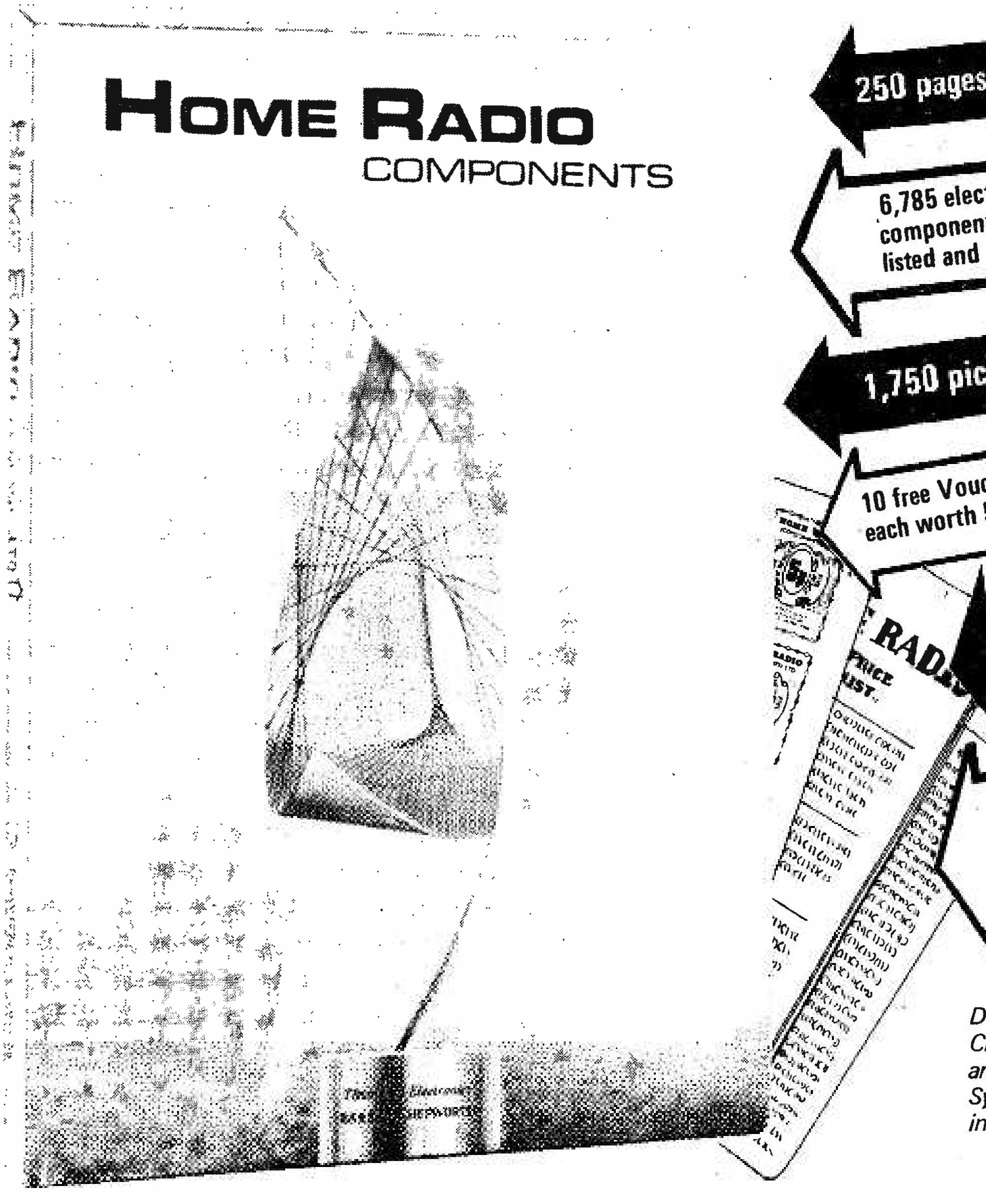

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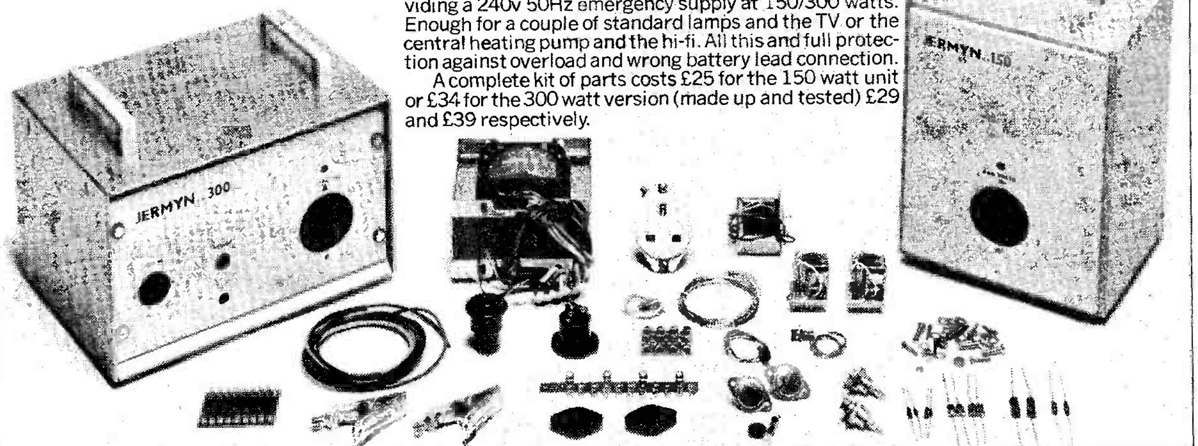

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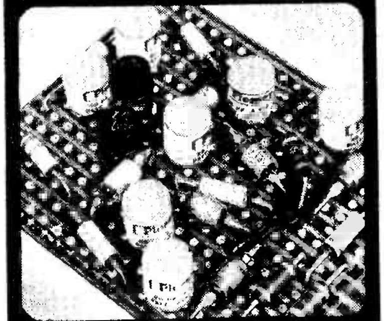

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I.C. OF THE MONTH

L.A.J. IRELAND

Number 35

SGS TBA231 Audio Preamplifier

THE SGS TBA231 i.c. reviewed this month follows along the fairly well established lines of high performance quality audio preamplifiers set by the RCA3052 which has already been reviewed in this column (May 1970). Low noise and high gain coupled with low power consumption are features being demanded more and more both by industry and the discerning audio enthusiast and the tight specifications associated with the TBA231 (noise figure less than 70dB, flat frequency response gain of 29dB) should make this i.c. meet the requirements of any amateur seeking a good quality audio preamp.

In Fig.1, a complete circuit diagram of one of amplifiers in the TBA231 is given. It is not intended to analyse the circuit in detail but a number of the more unusual features in the design will be pointed out. First a string of diodes D1 to D6 accurately control the constant current transistors Tr3 and Tr6 which also act as active bypass elements. In addition provision is made for limiting the output current in the event of a short circuit at pin 1. In this instance, the voltage increase developed across R6 automatically biases off Tr7 and Tr8 thereby preventing damage to the chip from an excessive current flow.

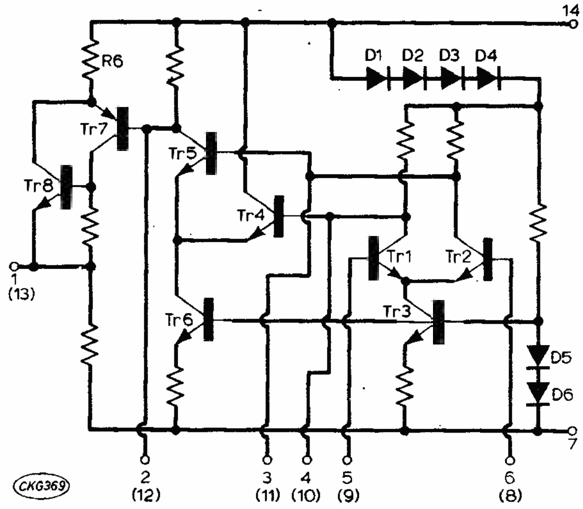

Fig. 1 : Circuit of the TBA231. Numbers in brackets are pin connections of second identical amplifier.

Also, even though the two amplifiers are fabricated and electrically connected on the same monolithic chip, channel separation of 140dB results from careful design and layout. So any inter-channel inter-action will more than likely be caused by poor external bias decoupling or power supply fluctuations.

A typical application of the TBA231 as a hi-fi preamplifier utilising the first section for RIAA equalisation and the second amplifier section as an active tone control unit is illustrated in Fig.2. Typical performance specifications of this design are associated usually only with the more expensive hi-fi amplifier units.

The TBA231 is available from any SGS distributor such as Quarndon Electronics Ltd., Slack Lane, Derby.

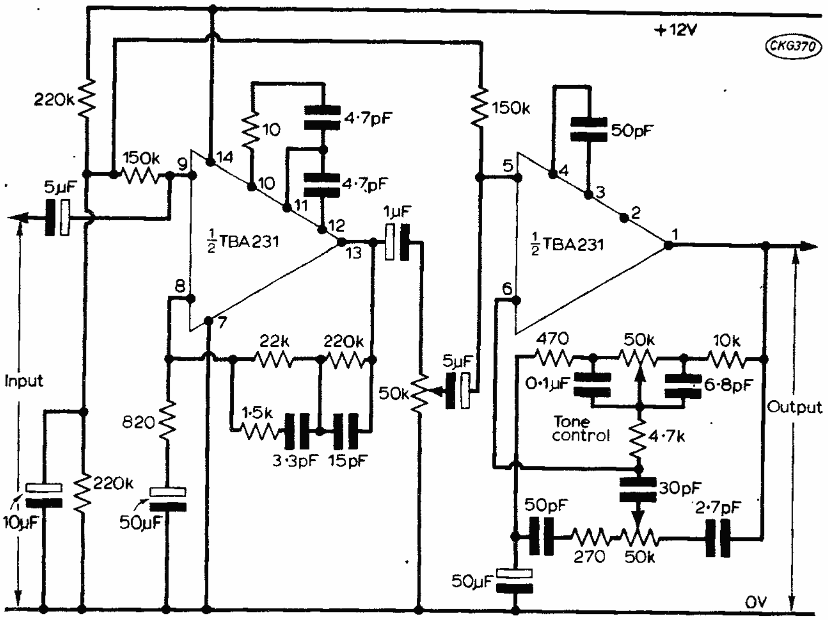

Fig. 2: Amplifier incorporating RIAA equalisation and active tone control circuits.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

EIS again . . .

Further development work carried out on the Electronic Ignition System has indicated that the output voltage of the original circuit was a little high and resulted in an increased possibility of crossfire and distributor cap flashover in damp conditions. As a result the output voltage has been reduced and it is now recommended that for optimum operation the value of the capacitor be increased from 0·47μF to 1·0μF.

Because of the arduous operating conditions imposed on this capacitor it is recommended that a triple foil type with at least 440V a.c. or 1000V d.c. rating be used. A suitable capacitor has been developed specifically for C-D ignitions and these are available from Magtor Ltd., 68 Dale Street, Manchester, at a cost of 35p including post and package. —**Stephen Soar,** *(Manchester).*

. . . and again

Just a brief note on the *PW* Electronic Ignition System. I found that the unit caused interference on my car radio so I bought a filter kit from Magtor Ltd., as advertised in *PW*. I fitted the three components inside a cylindrical aluminium can taken from an old vibrator unit and wired it into the E.I. box. In some cases it might be possible to fit the components into the E.I. box itself.

The filter kit is actually intended to decouple E.I. circuits when a tachometer is also fitted but it certainly proved effective against interference to my radio. —**P. Beaman,** *(Bridgnorth, Shropshire).*

(The decoupling kit can be obtained from Magtor Ltd., 68 Dale Street, Manchester, M1 2HS, price £1 including p and p.)—Editor.

Padding out

I write with reference to the many designs of receiver appearing in *PW* using Denco Miniature plug-in coils.

On reading through the manufacturer's literature on these coils it came to may notice that no padder was required for range five (red) coils. To satisfy my curiosity, I drew a graph of mid range frequency against padder value for each of the five coils. This came out as a straight line, and gave the range five padder to be 6,000pF. This value was then tried in my receiver, which uses these coils, and it gave a marked improvement at the l.f. end of the band. On mentioning this to a friend who has built a receiver along similar lines to mine, he also tried it and got results similar to mine.

I would like to know what other readers, and maybe even Denco Ltd., think on the subject.—**P. Richards,** *(Manchester).*

A bit tight

I am sure many readers, at some time or another, have been frustrated to find that they have been unable to remove the bits from their 25 Watt Henley Solon soldering irons when they are due for replacement.

Having purchased a new iron some time ago, I slightly reduced the diameter of the bit with emery cloth and fitted a sleeve made from aluminium foil to come between bit and the body of the iron. Thus the binding between bit and iron is eliminated.

The foil I used was obtained from a cup containing a mince pie and if other readers follow my example, they can eat the byproduct with their coffee whilst doing a soldering job!—**R. H. Roling,** *GW6WM* (*Glamorgan*).

What do you get?

Please will you tell me what a man who pays £10 plus for a tone arm actually gets for his money?

I have recently constructed a pair of tone arms using standard 'Meccano' parts throughout. Both are heavy, but due to the screw-adjusted counter weight, tracking weights of much less than that of a Meccano nut are easy to arrange. They are about 13in long from pivot to head. Tracking error should not be too great if it is set correctly, which I suppose would involve setting the stylus to point along the groove while the arm is about one-half of the way across the track of the record. I have been unable to test it as yet due to the lack of a cartridge and stylus, which I am not allowed to remove from our Record Player for testing purposes (or any other), therefore, I used a dummy weight to simulate this.

The cost of the arm with the screw adjusted counterweight would be less than £1 if all the parts were bought new.—**S. Sellick,** *(Devon).*

Aerial problem

May I enquire through the columns of *P.W.* for help.

I have a portable receiver which is for use on the 108-136 MHz and 145-175MHz bands. The set is equipped with the usual telescopic aerial, and this is ideal for reception from airborne aircraft or when within sight of an airport control tower.

I would like to build an aerial which I can place on the housetop (40ft above ground) which I am sure would give me better reception from the local airport, which is 5 miles from my home.

I have written to 3 major aerial manufacturers for either details or purchase of a suitable aerial but they do not seem to be interested in the problem.—**J. Stirzaker,** *(4 Maitland Avenue, Anchorsholme, Blackpool, Lancs).*

(The lack of interest may be explained by the fact that the Ministry of P&T has repeatedly pointed out that a Licence [not generally available to the public] is required for the reception of transmissions by Fire Brigade, Aircraft, Shipping, etc.)—Editor.

Help!

At the moment I am having difficulty in obtaining a diagram and aligning instructions for a Perdio wireless PR41 "Town and Country" with trawler band.

I have the service sheet for PR41 but this is the older one and has 8 coils, but the one I want has 9 coils, which must have been the last model made. It has a tone control on the side and tape DIN socket on the back of the case. Can anyone help please?—**Richard Cowley,** *Kerrowglass, Kirk Michael, Isle of Man.*

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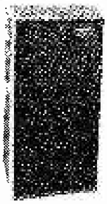

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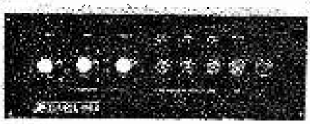

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DISCO-IMP. The latest addition to the Discosound Range of discotheques. Even smaller and more compact than the Disco-Mini, it contains all the necessary features for the smooth running of a mobile unit. Size 29" × 18½" × 7".
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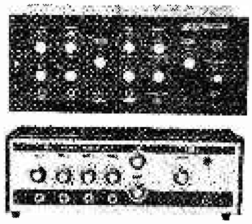
DISCO-SUPER. A slightly larger version of the Disco-Standard. Fitted individual controls for both mic. and deck inputs plus a cross-fade for deck to deck transfer. A built in P.F.L. cueing system, mic. over-ride, also a V.U. meter gives visual indication of output levels. DJ. 30L (3000w) 3-channel psychedelic light unit is a standard fitting. Deck cut out switches are also featured for ease of cueing. Size 38" × 27" × 10".
DISCO-SUPREME. All facilities of the Disco-Super plus a third turntable which can be used for Jingles or other effects without using the main deck system. Flexi lights are also fitted. Size 50" × 27" × 10".

PA—DISCO AMPLIFIERS



DISCO-AMP. 100 watt rms. output for 8-16 ohms, 4 channel inputs, 2-mic, 2 decks. Separate volume control plus masters. Response 30Hz –30KHz, distortion less than 1%. Treble/Bass/PFL/Mic over-ride etc. Panel size 16½" × 7".

DJ.70S MIXER/AMPLIFIER. 70 watt rms. output for 8-16 ohms. 2-mic, 2-aux/decks. Master volume/Bass/Treble. Size 15½" × 5" × 6".

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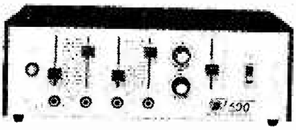

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★ 4 channel mixer with slider controls.

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SPECIFICATION

Frequency Response	50-20,000 Hz ± 3db (10dB Bass Boost at 10 Hz)	
Signal/Noise Ratio	better than =50db.	
Harmonic Distortion	less than 1%	
Speaker Impedance	8–16 ohms.	
Inputs: Mic 1 & 2	5mV at 50K ohms (50 or 600 ohm to order)	
Aux 3 & 4	100mV at 1 meg ohm.	
Size (all models)	15½" × 5" × 6".	
Power Output: (at 8 ohms)	Model D.J.500 —	50 watts R.M.S.
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	Model D.J.1000 —	100 watts R.M.S.

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Hardly larger than a suitcase yet contains all the necessary features for a high quality mobile unit. The pre-amp has separate tone controls for both mic. and decks, and each input has its own individual volume controls and inputs, plus the addition of a cross fade for deck to deck sound transfer. A built in P.F.L. system for cueing, together with mic-over-ride facility are standard on all units. Response 20-20,000 Hz. Mic. input 5mV, 50K. Output 1 volt.
McDonald M.P.60 Turntables are used with high quality ceramic cartridges, and each deck has its own individual cut out switch fitted. This unit is suitable for Discos or Clubs having a power amplifier, or for use with the ·Discmaster' 100 watt power amplifier as above. Size 32" × 20" × 8".

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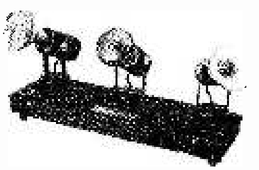
GNOME 150, 150 watt Q1 with Cassette.
LIQUIMATIC, 150 watt Q1 with 6" wheel.
PLUTO TUTOR-2, 250 watt Q1 with Cassette and 6" wheel.
TUTOR-2, with Liquisplode Tank.
KALEIDOSCOPE LENS (for Tutor-2) 6" Liquid Wheel and Crystal Wheel Liquid Cassette and Moire (24 different types to choose from). Portable Hi-Power Strobes.

YOU WILL BE SURPRISED BY THE LOW PRICES & PERFORMANCE

SDL POWER SPEAKERS

High efficiency 12" speakers. Ferrite magnets. Heavy duty voice coils and cones for Disco and Group use.
12" 50 watt rms. 8 ohm Full range.
12" 25 watt rms. 15 ohm Mid-Treble.
15" 50 watt rms. 15 ohm. Full range.
15" 100 watt rms. 15 ohm. Bass.
18" 100 watt rms. 15 ohm. Bass.

DISCO SPOT BANK



Designed to take three E/S Type spot or colour bulbs up to 150 watts each. The unit is of all metal construction and has one 3-pin mains input socket plus one 3-pin mains output socket for connecting more than one bank together if required. The unit can be left free-standing or wall mounted if needed. Black crackle finish gives the unit a very professional appearance.

Size 18" × 6" × 7" (excluding bulbs)

Also in stock: Ultra Violet Spot Lamps and Fluorescent Lamps, Standard and Colour Spot Lamps and Fittings. Rotating Colour Displays. Flexilights, Fibre Optics, Dimmers, Flashers Effects Foils, etc. Your enquiries invited.

MIXER UNITS

DJ.101. Battery powered, 6-channel, variable levels, 3 × 50k mic., 1 × 100mV. aux., 2 × 100mV p.u. Output 250mV.

DJ.102. Mains operated, 4-channel, variable levels. 2 × 50k mic., 2 × 100mV p.u. PFL control, master volume, mic. over-ride, output variable 0-500mV.

DISCO 40. Pre amp part of Disco amp (see above). All facilities. Output will drive up to ten 100 watt amplifiers.

Discoscene
536, Sutton Road,
Southend, Essex.
(0702) 611577

Discosound
122, Balls Pond Road,
London, N.1.
(01) 254 5779

Discosound
(Birmingham) Ltd.
494, Bristol Road,
Selly Oak, B'ham 29.
(021) 472 1141

Henry's Disco
309, Edgware Road,
London, W.2.
(01) 723 6963

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BRAND NEW SEMICONDUCTORS & COMPONENTS GUARANTEED

WE SUPPLY NEARLY ALL THE COMPONENTS FOR PROJECTS ADVERTISED IN THIS MAGAZINE

TRANSISTORS

2G301	0·15
2G302	0·15
2G303	0·25
2G306	0·30
2G309	0·30
2G344A	0·25
2G345B	0·25
2G371	0·15
2G374	0·15
2G381	0·22
2G417	0·20
2N109	0·49
2N174	1·40
2N176	0·75
2N274	0·75
2N335	0·75
2N351	0·95
2N376	1·00
2N384	0·93
2N388A	0·40
2N404	0·23
2N404	0·20
2N456	0·75
2N456A	0·75
2N457A	0·80
2N491	3·25
2N584	0·26
2N591	0·34
2N696	0·15
2N697	0·15
2N698	0·25
2N699	0·29
2N706	0·10
2N706A	0·12
2N708	0·13
2N709	0·38
2N711	0·30
2N718	0·21
2N718A	0·30
2N720	0·50
2N721	0·55
2N914	0·15
2N916	0·17
2N918	0·30
2N919	0·20
2N929	0·14
2N930	0·14
2N1090	0·23
2N1091	0·24
2N1131	0·20
2N1132	0·20
2N1184	1·27
2N1302	0·16
2N1303	0·16
2N1304	0·20
2N1305	0·20
2N1306	0·22
2N1307	0·22
2N1308	0·25
2N1309	0·25
2N1483	0·90
2N1507	0·24
2N1613	0·20
2N1631	0·35
2N1637	0·30
2N1638	0·27
2N1671	1·00
2N1701	1·10
2N1702	2·15
2N1711	0·17
2N1893	0·34
2N2102	0·30
2N2147	0·70
2N2148	0·60
2N2192	0·40
2N2192A	0·40
2N2193	0·40
2N2193A	0·42
2N2194	0·27
2N2194A	0·30
2N2195	0·37
2N2195A	0·18
2N2218A	0·30
2N2219	0·37
2N2219A	0·51
2N2220	0·20
2N2221	0·20
2N2221A	0·33
2N2222	0·31
2N2222A	0·41
2N2368	0·11
2N2369	0·39
2N2369A	0·17
2N2646	0·41
2N2647	1·20
2N2711	0·12
2N2712	0·12
2N2713	0·17
2N2714	0·17
2N2904	0·18
2N2904A	0·25
2N2905	0·26
2N2905A	0·23
2N2906	0·18
2N2906A	0·23
2N2907	0·18
2N2907A	0·25
2N2913	0·75
2N2923	0·12
2N2924	0·12
2N2925	0·12
2N2926	
Green	0·10
Yellow	0·10
Orange	0·10
2N3053	0·31
2N3054	0·47
2N3054	0·46
2N3055	0·50
2N3390	0·20
2N3391	0·20
2N3391A	0·22
2N3392	0·13
2N3393	0·12
2N3394	0·12
2N3402	0·17
2N3403	0·19
2N3404	0·24
2N3405	0·27
2N3414	0·10
2N3415	0·10
2N3416	0·15
2N3417	0·21
2N3570	1·25
2N3571	1·12
2N3572	0·97
2N3702	0·10
2N3703	0·10
2N3704	0·10
2N3705	0·10
2N3706	0·90
2N3707	0·10
2N3708	0·70
2N3709	0·90
2N3710	0·90
2N3711	0·90
2N3712	0·95
2N3713	1·08
2N3714	1·15
2N3715	1·23
2N3716	1·30
2N3773	2·35
2N3774	3·33
2N3775	4·19
2N3776	5·95
2N3777	4·84
2N3778	2·25
2N3779	3·15
2N3780	4·50
2N3781	3·67
2N3782	3·87
2N3789	1·76
2N3790	1·90
2N3791	2·06
2N3792	2·20
2N3794	0·10
2N3819	0·26
2N3820	0·47
2N3823	0·50
2N3824	0·75
2N3826	0·23
2N3854	0·16
2N3854A	0·16
2N3855	0·16
2N3855A	0·16
2N3856	0·16
2N3856A	0·16
2N3858	0·16
2N3858A	0·16
2N3859	0·16
2N3859A	0·16
2N3860	0·16
2N3866	0·70
2N3877	0·25
2N3877A	0·26
2N3878	1·22
2N3879	1·91
2N3900	0·20
2N3900A	0·21
2N3901	0·32
2N3903	0·20
2N3904	0·17
2N3905	0·21
2N3906	0·22
2N4036	0·63
2N4037	0·42
2N4058	0·12
2N3059	0·90
2N4060	0·11
2N4061	0·11
2N4062	0·11
2N4302	0·25
2N4303	0·32
2N4913	0·80
2N4914	0·87
2N4915	0·95
2N4916	0·11
2N4917	0·17
2N4918	0·50
2N4919	0·53
2N4920	0·60
2N4921	0·50
2N4922	0·55
2N4923	0·60
2N4926	0·90
2N4927	1·00
2N4928	1·80
2N4929	2·23
2N4930	2·25
2N4931	2·70
2N5172	0·08
2N5174	0·22
2N5175	0·26
2N5176	0·32
2N5245	0·43
2N5190	0·92
2N5191	0·96
2N5192	1·24
2N5193	1·01
2N5194	1·10
2N5195	1·46
2N5245	0·43
2N5457	0·30
2N5458	0·33
2N5459	0·38
3N128	0·63
3N138	1·37
3N199	1·36
3N140	0·76
3N141	0·69
3N142	0·54
3N143	0·64
3N152	0·79
3N153	0·74
3N154	0·74
3N159	1·00
3N187	1·30
3N200	2·07
3N201	1·05
40050	0·78
40251	0·81
40309	0·33
40310	0·50
40313	0·92
40316	0·50
40318	0·92
40322	0·92
40360	0·46
40361	0·48
40362	0·44
43063	0·88
40389	0·46
40394	0·56
40395	0·50
40406	0·44
40407	0·33
40408	0·50
40409	0·52
40410	0·53
40411	2·00
40414	3·55
40438	1·44
40467A	0·69
40468A	0·44
40600	0·69
40601	0·67
40602	0·46
40603	0·58
40604	0·56
40636	1·10
40673	0·56
AC107	0·35
AC113	0·16
AC115	0·16
AC117	0·20
AC121	0·13
AC126	0·20
AC127	0·20
AC128	0·20
AC141K	0·30
AC142K	0·25
AC151V	0·14
AC152V	0·17
AC153	0·22
AC153K	0·25
AC154	0·20
AC176	0·18
AC176K	0·20
AC187K	0·20
AC188K	0·26
ACY17	0·25
ACY18	0·15
ACY19	0·20
ACY20	0·20
ACY21	0·18
ACY22	0·13
ACY28	0·18
ACY30	0·42
ACY39	0·55
ACY40	0·17
ACY41	0·17
ACY44	0·31
AD136V	0·96
AD140	0·50
AD140	0·55
AD142	0·50
AD143	0·45
AD149V	0·66
AD149V	1·26
AD150	0·63
AD161	0·37
AD162	0·37
AD161 }	PR
AD162 }	0·69
ADZ11	1·50
ADZ12	1·75
AF106	0·27
AF109R	0·40
AF114	0·25
AF115	0·24
AF116	0·25
AF117	0·20
AF118	0·50
AF121	0·22
AF124	0·24
AF125	0·20
AF126	0·19
AF127	0·20
AF139	0·38
AF170	0·25
AF172	0·25
AF178	0·55
AF179	0·65
AF180	0·50
AF186	0·40
AF200	0·35
AF239	0·41
AF240	0·72
AF279	0·54
AF280	0·54
AFY42	0·74
AF211	0·55
AL102	0·75
AL103	0·70
ASY26	0·30
ASY27	0·36
ASY28	0·28
ASY29	0·30
ASY50	0·20
ASY55	0·35
ASZ21	0·55
AU103	1·25
BC107	0·14
BC108	0·13
BC109	0·14
BC113	0·13
BC114	0·12
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BC116A	0·18
BC117	0·21
BC118	0·11
BC119	0·27
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BC123	0·29
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BC168B	0·13
BC168C	0·11
BC169B	0·13
BC169C	0·13
BC170	0·11
BC171	0·13
BC172	0·11
BC182	0·10
BC182L	0·10
BC183	0·09
BC183L	0·09
BC184	0·11
BC184L	0·11
BC186	0·25
BC187	0·25
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BC206	0·11
BC207	0·10
BC208	0·09
BC209	0·10
BC211	0·30
BC212K	0·10
BC212L	0·12
BC214L	0·14
BC236	0·16
BC237	0·09
BC238	0·09
BC239	0·09
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BC252	0·18
BC253	0·23
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BC258	0·09
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BC261	0·20
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BC263	0·23
BC300	0·42
BC301	0·34
BC302	0·27
BC303	0·54
BC304	0·43
BC307	0·10
BC307A	0·10
BC307VI	0·10
BC308	0·09
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BC308B	0·09
BC309	0·10
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BC309B	0·10
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BC337	0·19
BC338	0·19
BCY30	0·35
BCY31	0·40
BCY32	0·60
BCY32	0·75
BCY33	0·34
BCY34	0·35
BCY38	0·40
BCY39	1·05
BCY40	0·50
BCY42	0·15
BCY43	0·15
BCY58	0·21
BCY59	0·22
BCY66	0·66
BCY67	0·94
BCY70	0·17
BCY71	0·22
BCY72	0·13
BCY87	3·47
BCY88	2·40
BCY89	0·80
BCZ10	0·35
BCZ11	0·50
BD115	0·75
BD116	0·75
BD121	0·75
BD123	0·82
BD124	0·67
BD130	0·57
BD131	0·40
BD132	0·50
BD135	0·43
BD136	0·49
BD137	0·55
BD138	0·63
BD139	0·71
BD140	0·83
BDY10	1·25
BDY11	1·50
BDY17	1·50
BDY18	1·75
BDY19	1·97
BDY20	0·92
BDY38	0·65
BDY60	0·90
BDY61	0·85
BDY62	0·75
BF115	0·23
BF117	0·43
BF119	0·58
BF121	0·25
BF123	0·27
BF125	0·25
BF127	0·27
BF152	0·20
BF153	0·29
BF154	0·16
BF158	0·15
BF159	0·27
BF160	0·23
BF161	0·35
BF163	0·20
BF166	0·35
BF167	0·18
BF173	0·19
BF177	0·25
BF178	0·25
BF179	0·30
BF180	0·35
BF181	0·32
BF182	0·30
BF183	0·40
BF184	0·17
BF185	0·17
BF194	0·14
BF195	0·15
BF196	0·15
BF197	0·15
BF198	0·15
BF199	0·18
BF200	0·35
BF224J	0·14
BF225J	0·19
BF237	0·22
BF238	0·22
BF244	0·16
BF245	0·33
BF246	0·43
BF247	0·49
BF254	0·14
BF255	0·15
BF257	0·41
BF258	0·46
BF259	0·48
BF261	0·23
BF264	1·45
BF270	0·25
BF271	0·21
BF272	0·53
BF273	0·25
BF274	0·28
BF457	0·46
BF458	0·57
BF459	0·57
BFS21	2·10
BFS21A	2·30
BFS28	0·92
BFS61	0·27
BFS98	0·28
BFW10	0·61
BFW11	0·61
BFW15	0·35
BFX13	0·23
BFX29	0·25
BFX30	0·25
BFX37	0·30
BFX44	0·33
BFX63	2·48
BFX68	0·30
BFX84	0·24
BFX85	0·29
BFX86	0·24
BFX87	0·25
BFX88	0·20
BFX89	0·45
BFY10	0·35
BFY11	0·45
BFY17	0·90
BFY18	0·25
BFY19	0·25
BFY20	0·50
BFY29	0·40
BFY37	0·20
BFY41	0·43
BFY43	0·62
BFY50	0·16
BFY51	0·16
VFY52	0·16
BFY53	0·15
BFY56	0·34
BFY64	0·41
BFY75	0·40
BFY76	0·22
BFY77	0·24
BFY78	0·36
BFY90	0·60
BRY39	0·30
BSX19	0·13
BSX20	0·14
BSX21	0·20
BSX26	0·34
BSX27	0·34
BSX28	0·25
BSX29	0·47
BSX30	0·68
BSX59	0·78
BSX60	0·54
BSX61	0·42
BSX76	0·15
BSX77	0·20
ASX78	0·25
BSW70	0·28
BSY24	0·20
BSY25	0·15
BSY26	0·20
BSY27	0·15
BSY28	0·15
BSY38	0·15
BSY39	0·15
BSY51	0·25
BSY52	0·25
BSY53	0·25
BSY54	0·30
BSY56	0·79
BSY65	0·15
BSY78	0·40
BSY79	0·40
BSY790	0·45
BSY95A	0·09
BU104	1·42
BU105	2·25
C111	0·53
D40N3	0·62
GET111	0·45
GET113	0·20
GET114	0·20
GET115	0·50
GET119	0·35
GET120	0·25
GET535	0·20
GET536	0·20
GET538	0·20
GET873	0·12
GET880	0·30
GET883	0·20
GET887	0·20
GET890	0·22
GET895	0·25

RETURN OF POST SERVICE

Post & Packing 13p per order. Europe 25p. Commonwealth (Air) 65p (MIN.) Matching charge (audio transistors only) 15p. extra per pair. Prices subject to alteration without prior notice.

TTL. LOGIC I.C. NEW PRICES

	1–24	25+		1–24	25+		1–24	25+
	£p	£p		£p	£p		£p	£p
SN7400	0·20	0·18	SN7428	0·50	0·41	SN7460	0·20	0·18
SN7401	0·20	0·18	SN7430	0·20	0·18	SN7470	0·30	0·26
SN7402	0·20	0·18	SN7432	0·48	0·42	SN7472	0·30	0·25
SN7403	0·20	0·18	SN7433	0·71	0·62	SN7473	0·40	0·34
SN7404	0·20	0·18	SN7437	0·52	0·45	SN7474	0·40	0·34
SN7405	0·20	0·18	SN7438	0·52	0·45	SN7475	0·45	0·35
SN7406	0·30	0·24	SN7439	0·52	0·45	SN7476	0·44	0·39
SN7407	0·56	0·48	SN7440	0·20	0·18	SN7480	0·75	0·70
SN7408	0·20	0·18	SN7441AN	0·75	0·72	SN7481	1·25	1·07
SN7409	0·20	0·18	SN7442	0·79	0·63	SN7482	0·87	0·61
SN7410	0·20	0·18	SN7443	1·04	0·88	SN7483	1·00	0·82
SN7411	0·22	0·20	SN7444	1·04	0·88	SN7484	0·95	0·85
SN7412	0·42	0·36	SN7445	1·85	1·70	SN7485	2·50	2·30
SN7413	0·30	0·27	SN7446	2·00	1·60	SN7486	0·45	0·40
SN7416	0·45	0·40	SN7447	1·30	1·20	SN7488	12·40	11·80
SN7417	0·45	0·40	SN7448	1·04	0·92	SN7489	4·97	4·40
SN7420	0·20	0·18	SN7449	Price to be		SN7490	0·80	0·75
SN7421	0·22	0·20		announced shortly		SN7491	1·20	1·06
SN7422	0·48	0·42	SN7450	0·20	0·18	SN7492	0·75	0·70
SN7423	0·52	0·45	SN7451	0·20	0·18	SN7493	0·75	0·70
SN7425	0·48	0·42	SN7452	0·20	0·18	SN7494	0·84	0·80
SN7426	0·32	0·28	SN7453	0·20	0·18	SN7495	0·80	0·74
SN7427	0·48	0·42	SN7454	0·20	0·18	SN7496	1·00	0·90

SUB-MIN ELECTROLYTIC

Axial lead **6p each**

Values: (μF/V); 6·64/64; 1/40; 1·6/25; 2·5/16; 2·2/63; 4·7/16; 4·7/25; 6·4/6·4; 6·4/25; 10/16; 10/25; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 40/16; 50/6·4; 50/25; 50/40; 64/10; 80/16; 80/25; 100/6·4; 125/10; 125/16; 200/10.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	8p	9p	10p	11p	12p	15p	20p	—
3A	15p	17p	20p	22½p	25p	27p	30p	35p
6A	—	—	25p	30p	32½p	35p	—	—
10A	30p	35p	40p	47p	56p	66p	75p	—
15A	36p	45p	48p	55p	65p	75p	87p	—
35A	70p	80p	90p	£1·00	£1·40	£1·70	£2·75	—

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	OA82	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

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0·15, 0·22, 0·33 .. .. 5p each
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0·68 .. .. .. 11p
1μF 14p
1·5μF 21p
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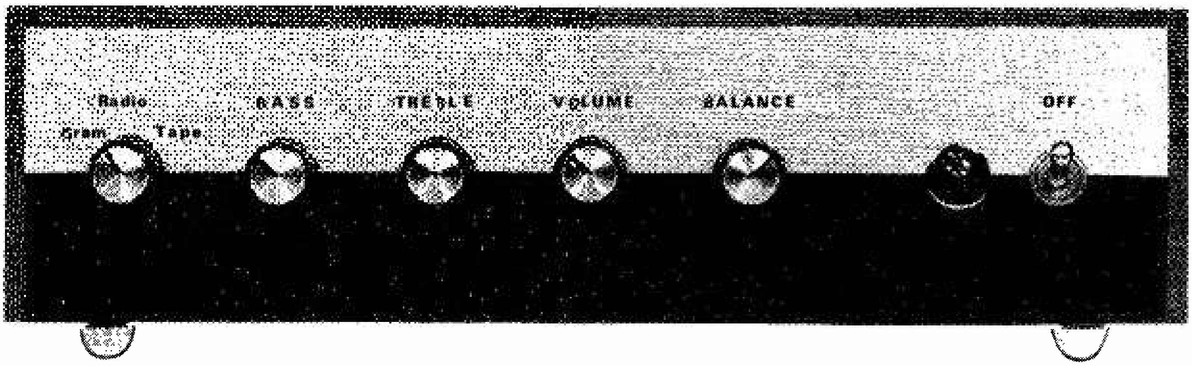


10+10 WATT stereo amplifier

W. CAMERON

PART TWO

PREAMPLIFIER

Construction is on the same lines as the driver amplifier, on a group board with common earth busbar, and is shown for one channel, Fig. 6a and circuit diagram Fig. 6b. Decoupling components R10, R24 and C2 and C12 are common to both channels. Screened leads are used from the input sockets to the selector switch, and from the switch to the input tags and also from the volume control to the driver amp inputs. The switch wiring is shown in Fig. 7a. Note that the equalising components are mounted directly on the switch (Sections c and d).

It is at the input sockets where the only earth connections to chassis are made (apart from mains earth) this is important as hum and distortion can easily occur if earth loops are formed by connecting more than one point to the chassis.

The modular construction of the preamp with its earth bus-bar ensures that its own earth returns are all common to itself. (This applies also to the driver module.)

It will be seen that the chassis earth at the input is carried via the screened leads to the preamp, and then to the earthy side of the volume control, thence to the driver amp, through to the common point on the power supply, where the return from the power amps via the speakers are also returned. This is made clear in the layout drawing Fig. 8. The preamplifier has a number of connections to the controls, and it will be found easiest to solder connecting wires in place on the module before fitting to chassis. Leads of different colours would be a further aid. The leads should then be trimmed to length and taken to their control terminations in pairs. Driver and power amplifier can be treated in a similar manner.

Note that with all the transistors, the collector and case are common, so care must be taken to ensure that the case does not come in contact with other component or earth connections.

Output sockets for "Record" can be fitted if required. These are fed from each channel via a 100kΩ resistor from the negative side of C7, and will provide a signal of 100mV at high impedance, or 1mV per 1kΩ for impedances less than 100kΩ. Connections are shown in Fig. 6b.

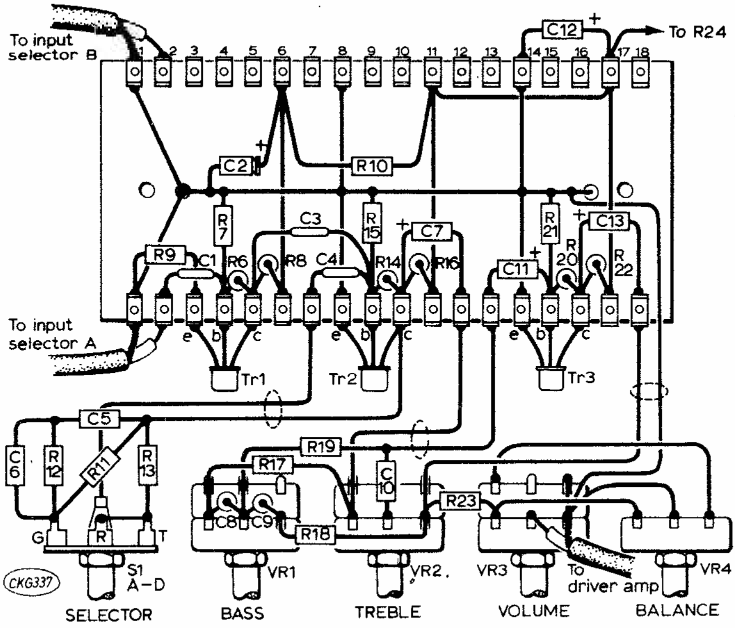


Fig. 6a: The wiring of the preamplifier section, only the components for the R.H. channel are shown; those for the other are mounted on the other side of the board and on the rear section of the pots.

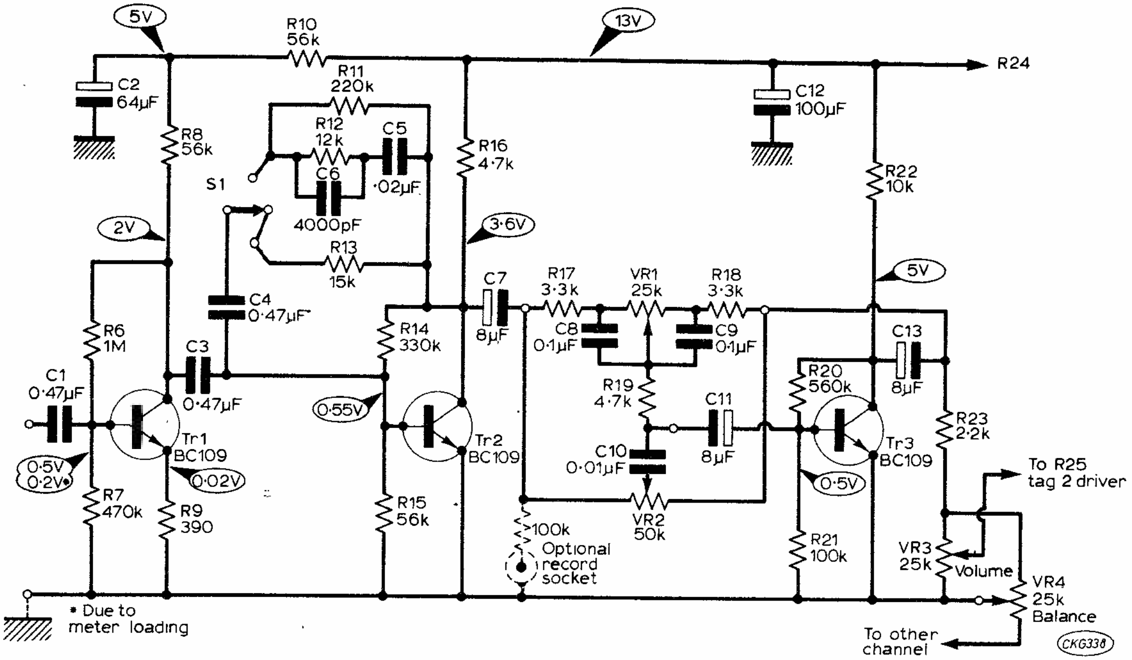


Fig. 6b: The circuit of one channel of the preamplifier. The decoupling components in the positive line are common to both channels.

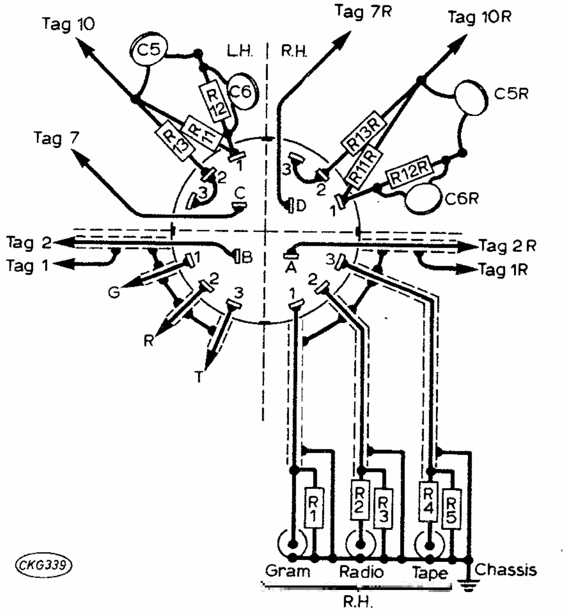


Fig. 7a: The wiring of the selector switch S1.

If the gram input is intended for a ceramic cartridge, this input must be attenuated with a divider of 33kΩ and 6·8kΩ, in the same manner as the radio and tape inputs. This will provide a sensitivity of 100mV and loading to give the pickup similar characteristics to a magnetic type, to suit the equalisation.

If the radio or tape recorder to be used is mono only, the appropriate input sockets should be linked together so that the single input plug is connected to both channels.

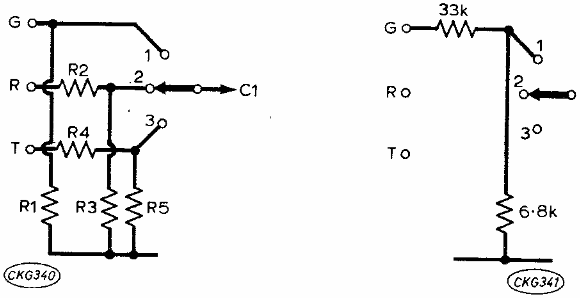


Fig. 7b (left): The circuit of the input selector section.
Fig. 7c (right): Modification for a ceramic pickup.

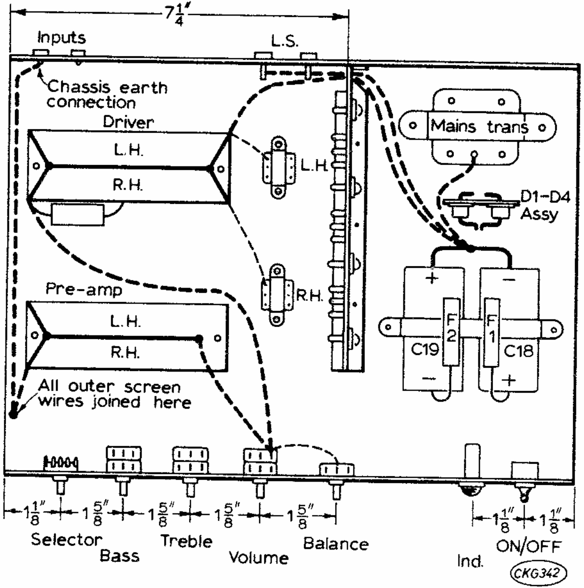


Fig. 8: The general layout showing the connection of the earth line to avoid earth loops.

POWER SUPPLY

The layout and circuit diagram are shown in Fig. 9 and need little comment. The rectifiers are "top-hat" types mounted on a piece of 1in. x 1½in. paxolin. A 2A bridge rectifier can be used here if desired; the symbols shown correspond to the bridge connections.

Capacitors C18 and 19 are held in place with an aluminium strip, to which the fuseholders are also secured.

The mains earth can be made to any convenient chassis point. A useful addition would be a 2-pin mains outlet on the rear panel to feed the gram motor or other ancillary equipment. This would be taken from the 240V connections on the mains transformer, to operate via the amplifier on-off switch. Note that the earth connections to any ancillary equipment comes automatically from the amplifier, and should not be connected to a separate mains earth, which would invariably result in excessive hum.

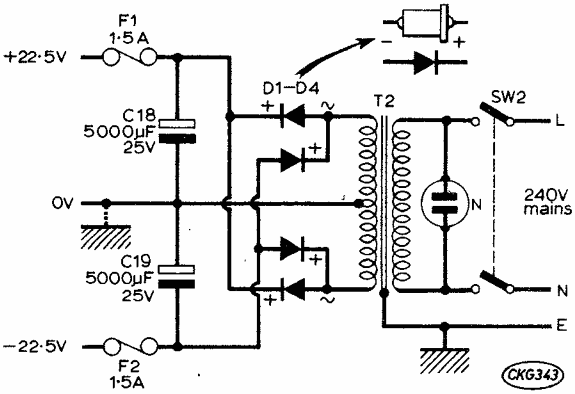


Fig. 9a: The circuit of the power supply.

TESTING

Switching on any equipment for the first time always gives one a little concern, wondering if a mistake has been made somewhere, and if something is going to blow up, knowing that fuses do not *always* blow quickly enough to prevent damage.

Anyone feeling this concern can alleviate it in this case, simply by removing the fuses, and soldering 0·5W resistors of 4·7Ω to 10Ω in their place. Switch on; the resistors will only become warm, particularly the one in the positive line, if everything is well, but will immediately burn if a serious fault exists. One can then switch off before any damage is done, locate the fault and try again, replacing the fuses when satisfied that all is well.

A check can now be made on the voltage readings, starting at the fuses and working forward. The voltages shown are approximate, small variations can occur due to component and transistor tolerances. During this check the volume control should be at minimum, and resistors of 15Ω (or thereabouts) connected in place of each speaker. The resistors need only be ½W or 1W as the amplifier is not delivering any power (or shouldn't be).

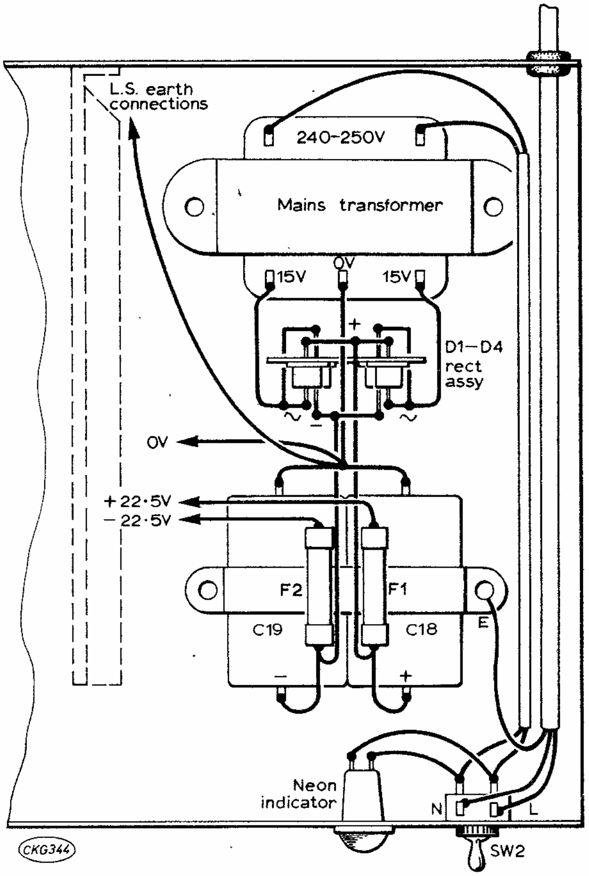
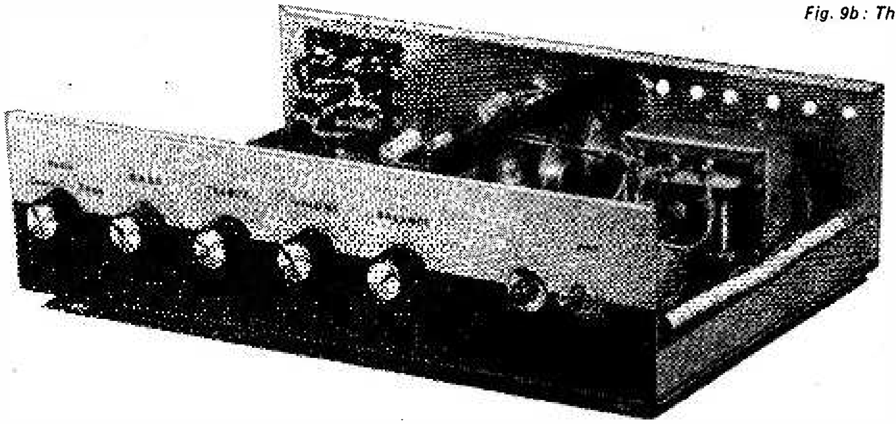


Fig. 9b: The layout of the power supply.

Switch the meter to a.c. (25V) and check that no voltage appears across the speaker sockets at any position of the volume control, tone controls, and selector switch. An a.c. reading of 10-15V would indicate r.f. instability, and the resistor across the speaker sockets would overheat. This would only occur if the layout or wiring differed from that shown to create stray coupling and hence r.f. feedback. The cure would be to connect a by-pass capacitor of 100-250pF from collector of Tr2 to Tr3 to chassis.

The amplifier is now ready to go, and speakers and inputs can be safely connected. Choosing loudspeakers and a record player deck can present a problem to some people. The short answer is to pay as much as one can afford. ■



practically wireless
commentary by HENRY

No. 96

Protection Racket

THE nearest approach Henry ever made to the Grim Reaper—in the course of duty—was when some well-meaning idiot omitted to remove the short-circuit from the safety switch of the supply unit of a high-powered transmitter

True, it was impossible to work on the Army's '10-set' once any of the rack-mounted units had been slid from its rails. A link of wire across the safety-switch contacts became routine test procedure. But lying there, while the petrol-driven generator pumped futile fumes across Breedon Moor, and the Naafi wagon was miles away was no recommendation, for a trust in protective devices.

Hence, perhaps, my present suspicion that regulation, control and 'protection', when not forced upon an electronics manufacturer by law, is usually a kind of gimmick, spawned from convenience, nurtured in wrath, weaned by ingenuity and matured in advertisement.


"Oh, but it shouldn't!" cry the makers.

In particular, the curious convolutions of audio circuit producers (not designers, for Henry is painfully aware that these gentlemen languish in a limbo, surveying the prostitution of their ideas by the pimps of commercialism) result in tinselly circuits with curious protection gadgets, tweaked to safeguard the precious output devices against the ham-fisted handling of the common herd. It causes a budding circuit maker to wonder where expediency leaves off and practicality takes over.

Often quite passable output stages are ruined by utter instability when the supply voltage wanders a touch or two. 'Oh, but it shouldn't', cry the makers. 'The British mains supply system is the best in the world.'

O.K. Henry goes along with that. But, even so, when, on Sunday morning, all the pinafored aspirants to Womens Lib are chickening in; or on Saturday evenings, when the great British publick (sorry, public) is tuning in to David Coleman and that travesty of human behaviour we laughingly call 'Sport'; then, and during those episodes of televisual dramuck that bring a paler shade of Whitehouse to the cheek, the mains supply voltage drops to a level where a Tandberg tape recorder refuses to rewind, a Quad amplifier forgets its steep transfer curve has certain advantages and ninety-nine from a hundred average radios rampage into avid crossover distortion.

For some reason connected with out insular arrogance, British designers expunge the idea of true regulation, protection and control. At the very least, we find a series regulator in the American (well then, Japanese) importations.

Henry is always amused by those models with cut-outs, which pop off dramatically when the impedances of loudspeakers (usually Scandinavian in origin) hit them below the belt. There are others, more genteel, which choke themselves into silence with a strangulated burp, waiting for you to light a cigarette, apologise to the dollybird you were hoping to impress, and switch on again—hoping the fault has now disappeared.

Protection circuits, *per se,* bring trouble. For every attempt by a well-meaning designer to cherish his brain-child, there will be one or two electronic catastropes.

For protection *in excelcis* we turn to the Whichdogs of the Consumer Council (past, present or future—what's in a name?) and some Naderish fumings from across the Atlantic. If you spent an evening, or, God Help You, a cocktail half-hour, in the presence of George Darling, M.P., who steered the Trades Description Act through Parliament, you would come away believing that every maker of electronic equipment conspires to do you down.


. . . the dolly bird you were hoping to impress.

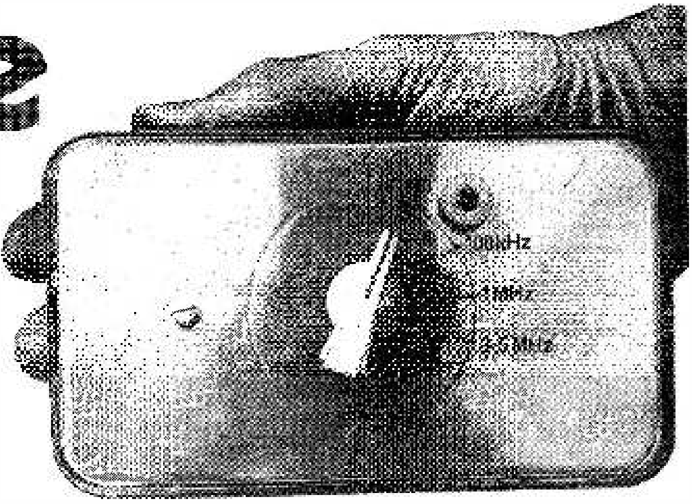
I don't think that is quite true. Seems more like the maker of electronic equipment fearing the user will do *him* down. Why else would Sony label their cassette cutout feeler a 'miserase protecting lever'?

There's a famous amplifier with a delicious FET protection circuit, with a diode from gate to source. The driver stage is wonderfully protected, yes? But when things go wrong, the mid-rail flies up to 55 volts and that driver is only rated at 40V. It goes up in smoke, taking its 47-ohms emitter resistor with it, and often the 2N3055 output transistor as well.

It's about time we constructors were protected from the misborn circuitry and afterthought mods of manufacturers. What about it lads? Join UPESCO—the Union for the Protection and Encouragement of Suffering Constructors.

3-Range Crystal Marker

R. F. GRAHAM



A CRYSTAL marker is used to calibrate receivers, signal generators, transmitter v.f.o.'s and similar equipment or to check their calibration. The marker described here is self-contained and requires few components. Details of typical uses are given later.

CIRCUIT

Fig.1 is the circuit, the single BFY51 transistor operating as a crystal controlled oscillator having three fundamental frequencies selected by a 3-pole 4-way switch. S1a and S1b select one of the three crystals, 100kHz, 1MHz or 3·5MHz. The remaining switch position is "Off."

When the 100kHz crystal is in use C2 is across L1, and the core is adjusted to approximately this frequency. For the higher frequency crystals C2 is not connected, the windings of L1 acting as an r.f. choke. Output is taken from a coupling winding and isolating capacitor C3.

With the unit operating at 100kHz this frequency and its harmonics or multiples will be heard on a receiver. Harmonics such as 500, 600, 700kHz up to 1500kHz allow easy calibration of a receiver or tunable signal generator in the medium wave band.

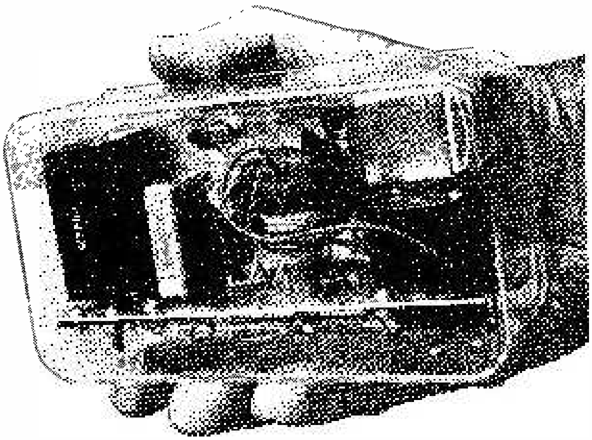
Higher harmonics of this frequency are used for general short wave calibration, or the calibration of a transmitter v.f.o. For example, 1·8, 1·9 and 2·0MHz harmonics for Top Band and 3·5, 3·6, 3·7 and 3·8MHz for the 80m band.

When tuning, especially on higher frequencies, a quick indication of 1MHz points is useful and harmonics of the 1MHz crystal will be found at multiples of this frequency—2, 3, 4, 5MHz and so on.

For amateur band reception, in particular, a band-edge crystal is extremely useful. That fitted here is 3·5MHz, its harmonics appearing at 7·0, 14·0, 21·0 and 28·0MHz as well as the fundamental at 3·5MHz and harmonics 10·5, 17·5 and 24·5MHz which are, of course, remote from amateur bands.

CONSTRUCTION

A piece of sheet aluminium 5 x 4in. is bent as in Fig.2. The whole unit is assembled on this and will afterwards fit in a plastic box approximately $5\frac{1}{2}$ x 3 x $2\frac{3}{8}$in.



Rear view of the finished unit mounted in a plastic box.

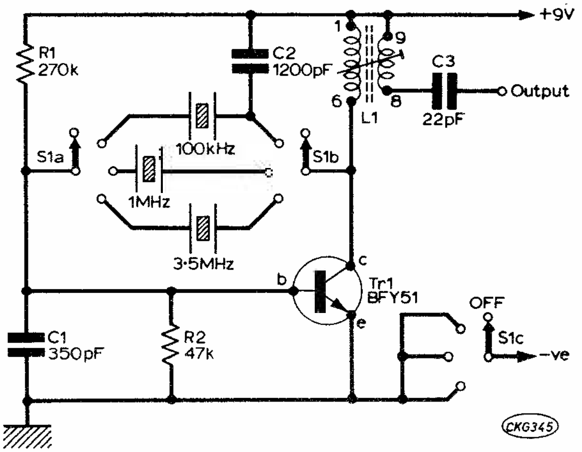


Fig. 1: Circuit diagram of the crystal marker.

Crystal holders to suit the particular crystals used are bolted as in Fig.2. The box lid is also drilled for the switch, output socket and a small bolt to hold a battery clamp. Heavy pressure during drilling may crack the plastic, so a little care is required.

The transistor and most other small components are supported by soldering their leads directly on to the switch tags. Run leads X-X down through a hole to one crystal holder, leads Y-Y to the second holder and connect Z-Z similarly to the remaining holder. A card marked with the switch positions is placed between the case top and metal panel and held together by the switch nut and output socket. A hole is drilled to fix a piece of metal shaped to secure the 9V battery to the left of the switch.

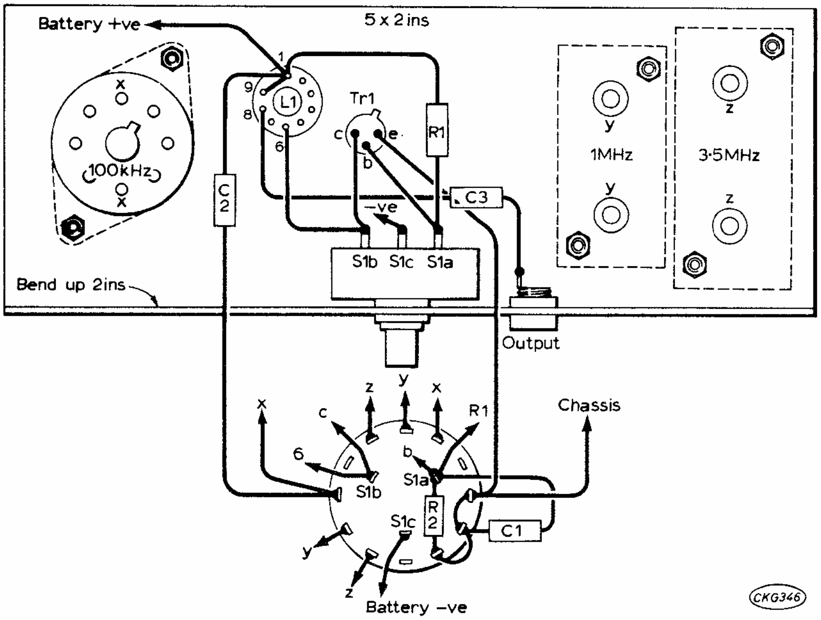


Fig. 2: Layout of components on chassis with details of switch connections.

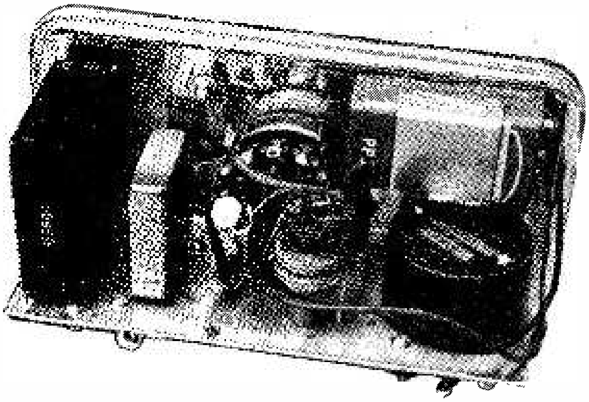
★ components list

Resistors
R1 270kΩ R2 47kΩ ¼W 10%

Capacitors
C1 350pF C2 1200pF C3 22pF

Crystals
100kHz, 1MHz and 3·5MHz surplus types with holders to suit.

Miscellaneous
Tr1, BFY51. L1, "Yellow" Range 1 (Denco valve type). S1, 3-pole, 4 way wafer switch. Aluminium 5 x 4 in. Plastic box 5½ x 3 x 2⅜in. approx. Knob. Insulated socket. Battery 9V with terminal clips.



Another view of the crystal marker. The transistor is wired directly on to the switch tags.

ADJUSTMENT

Rotation of the core of L1 allows the second harmonic of 100kHz crystal to be moved slightly in frequency to secure zero beat with the BBC on 200kHz or MSF on 2·5 or 5MHz. When the marker signal and received transmission are about the same strength, the frequency error of the harmonic will be heard as a low pitched growl, falling to a repetitive swishing sound, or flutter, or seen as a rise and fall of the receiver tuning meter, as the error is reduced. In any case at frequences of 1MHz and higher the error will be only a few parts in a million and accuracy is higher than necessary for any ordinary purpose.

IN USE

The output can be coupled to a receiver by a short lead plugged into the socket and placed near the receiver, or near a short wire in the receiver aerial socket or plugged into the receiver, depending on the strength required. Harmonics grow progressively weaker and the limit to which they can be detected depends on receiver sensitivity. The marker signal is unmodulated, so the receiver b.f.o. should be on and set to zero.

To calibrate a tunable generator or v.f.o., couple its output to the receiver and tune the v.f.o. or generator to zero beat with the appropriate crystal harmonic. The receiver is tuned to the wanted frequency, but receiver tuning has no effect on calibration in this case. The b.f.o. is not in use in this instance.

VFO calibration at 50kHz points can be achieved by tuning the receiver to the second harmonic of the v.f.o., and 100kHz points provided by the crystal will then fall at 50kHz points on the v.f.o. scale. The 10kHz points can be estimated from the v.f.o. scale.

Harmonics can be used to adjust r.f., mixer or i.f. stages for best results, using a meter to read cathode or emitter current of an a.g.c. controlled stage. ■

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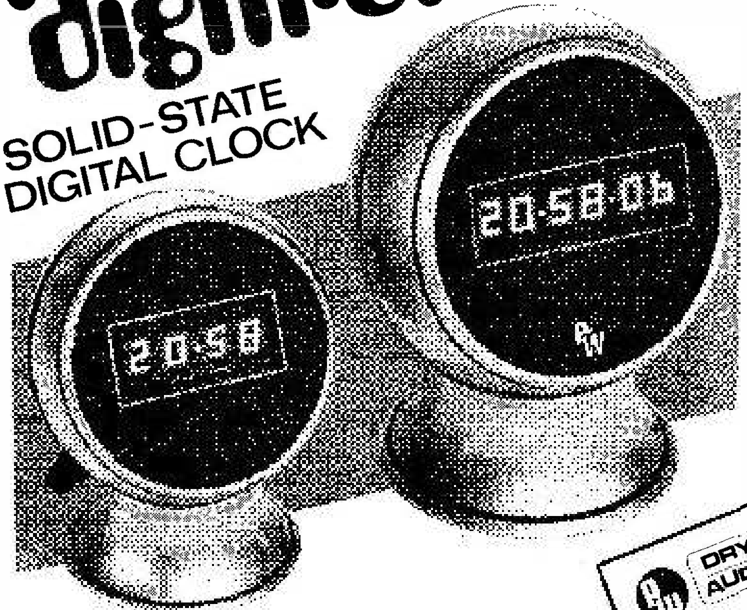

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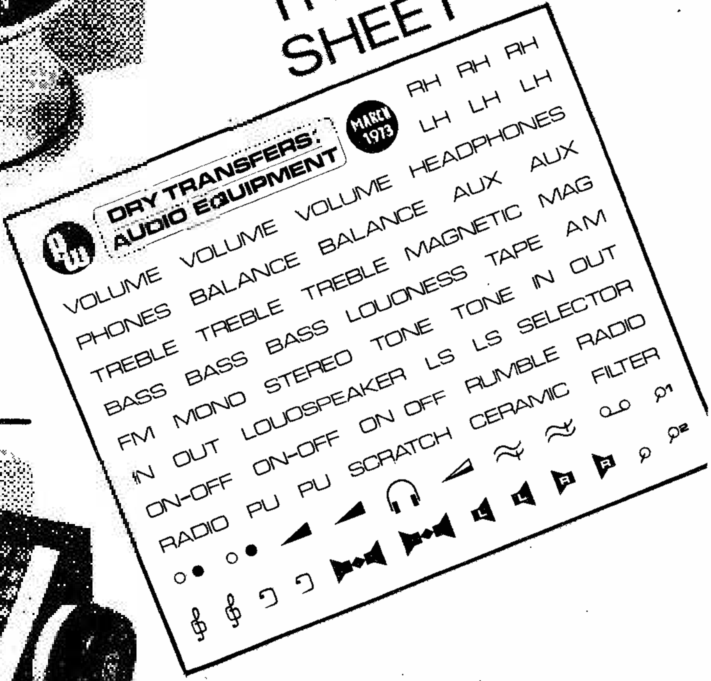

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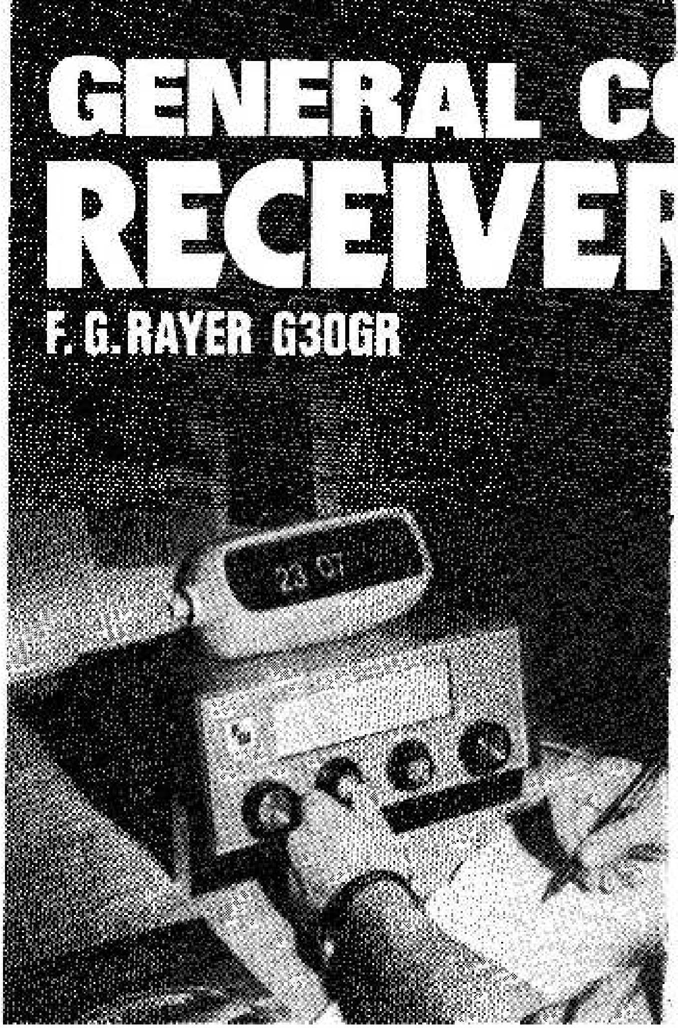
GENERAL C
RECEIVE

F. G. RAYER G3OGR



THIS receiver features modular construction, easy accessibility of units, and complete coverage from 150kHz to 30MHz. It will thus provide reception on long, medium and all the short wave bands from about 200 to 10 metres.

To facilitate construction, wiring and testing the receiver is built as three units—a mixer-oscillator assembly using a dual-gate field effect transistor mixer with separate f.e.t. oscillator; a high gain 2-transistor intermediate frequency amplifier; and a 4-transistor audio amplifier and output section. These units are then assembled into a case which carries the panel and a chassis with coils, etc.

MIXER-OSCILLATOR

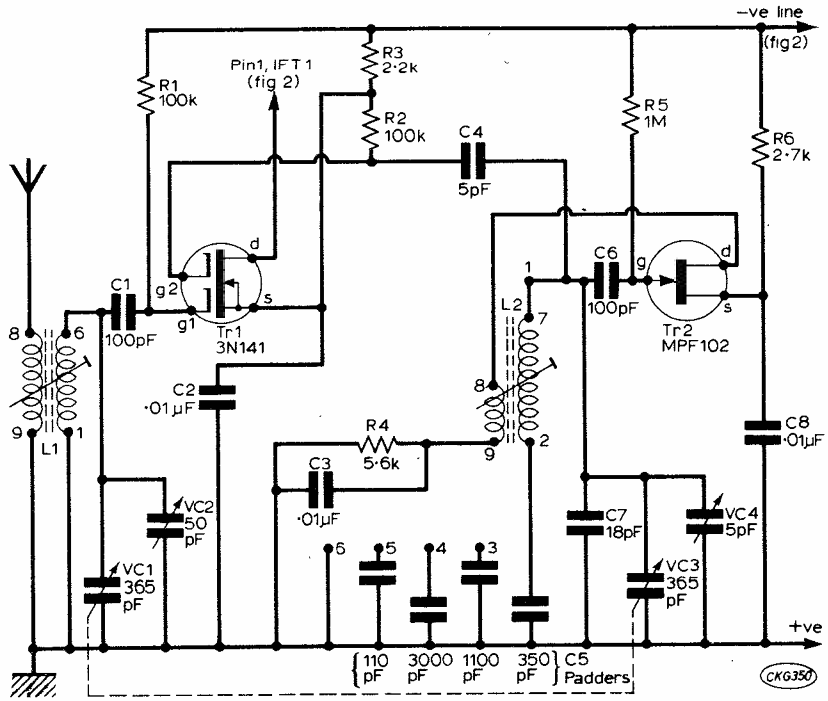
The circuit for this unit is shown in Fig. 1. Tr1, a 3N141, is the mixer, with the signal fed to G1 and oscillator input to G2. Output from this stage is from the drain to the 1st i.f.t. of the i.f. unit.

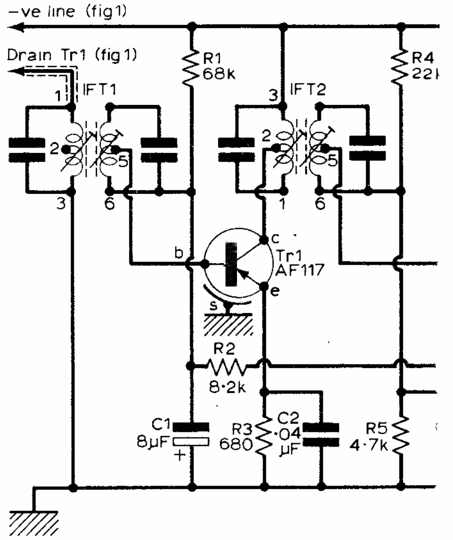
Tr2, an MPF102, is the oscillator with injection to G2 of the mixer via C4. The feedback windings 8-9 of the oscillator coil L2 provide feedback from the drain to the gate of Tr2, to enable this stage to oscillate.

Coils are fitted in pairs, "Blue" in the L1 position and "Red" for L2. Coverage is approximately as follows:

Range 1	150-500kHz	2000-750 metres
Range 2	515-1545kHz	580-194 metres
Range 3	1·67-5·3MHz	180-57 metres
Range 4	5-15MHz	60-20 metres
Range 5	10·5-31·5MHz	28-9·5 metres

Range 1 is for long waves, but in this circuit the i.f. is 470kHz so coverage has had to be curtailed from that listed above or instability arises at the h.f. end of this band. This is easily done by marking the scale for Range 1 to suit. An alternative is to solder

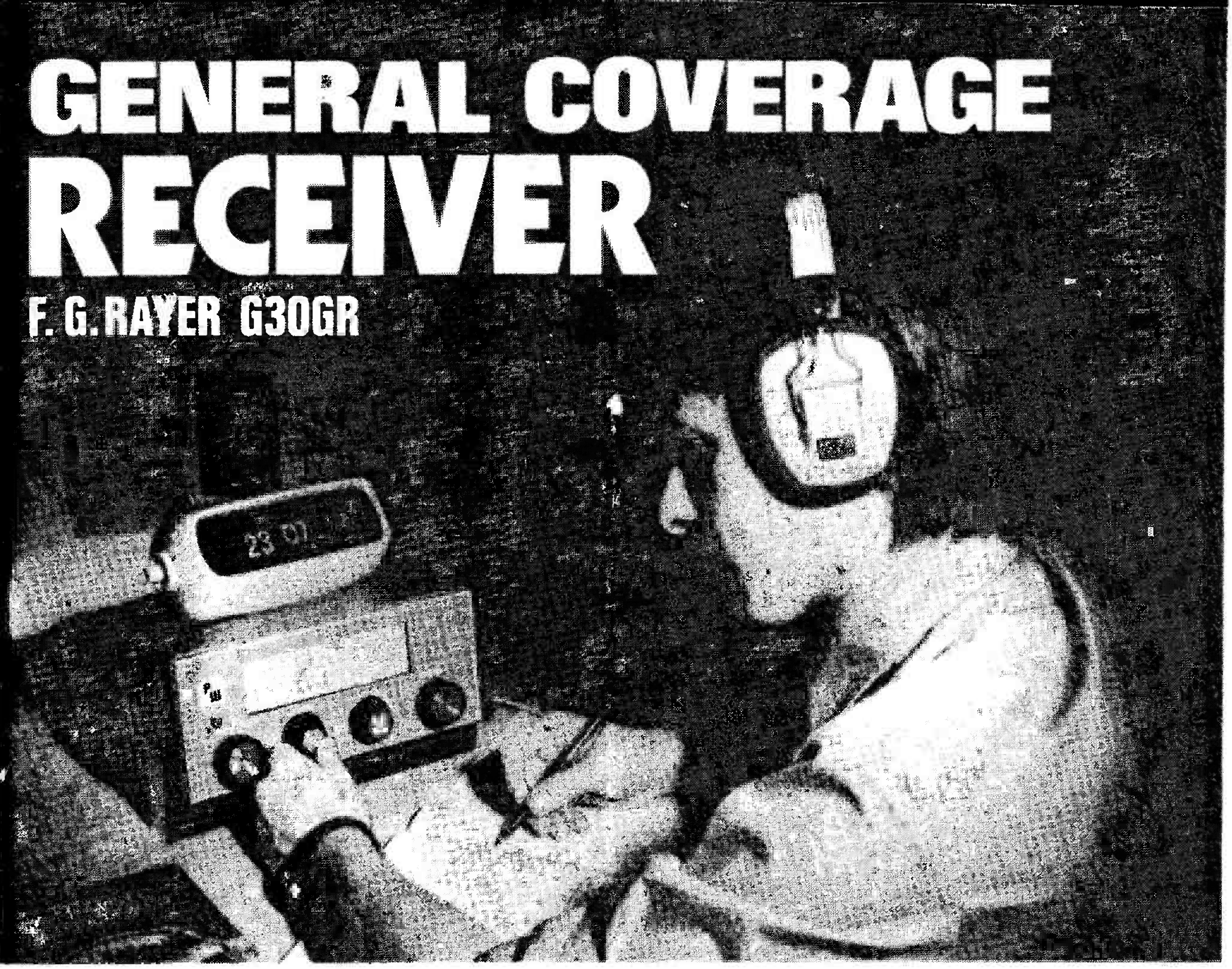


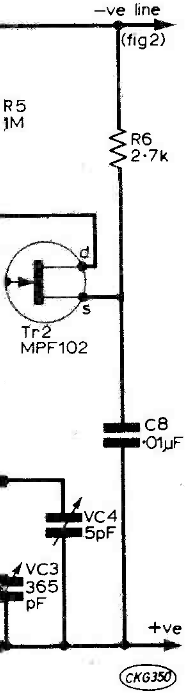


◀ *Fig. 1: Circuit of the mixer-oscillator board.*

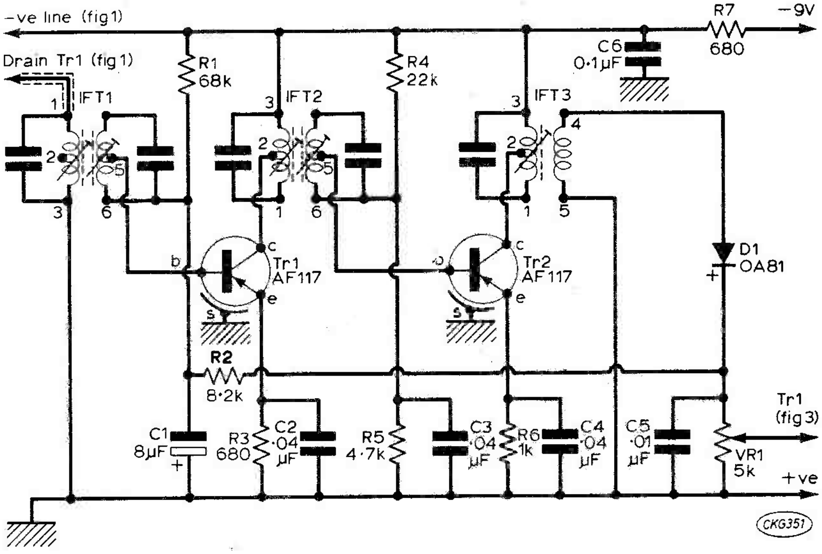
GENERAL COVERAGE RECEIVER

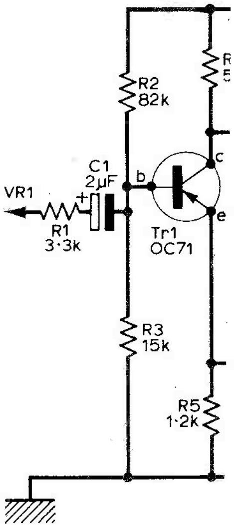
F. G. RAYER G3OGR



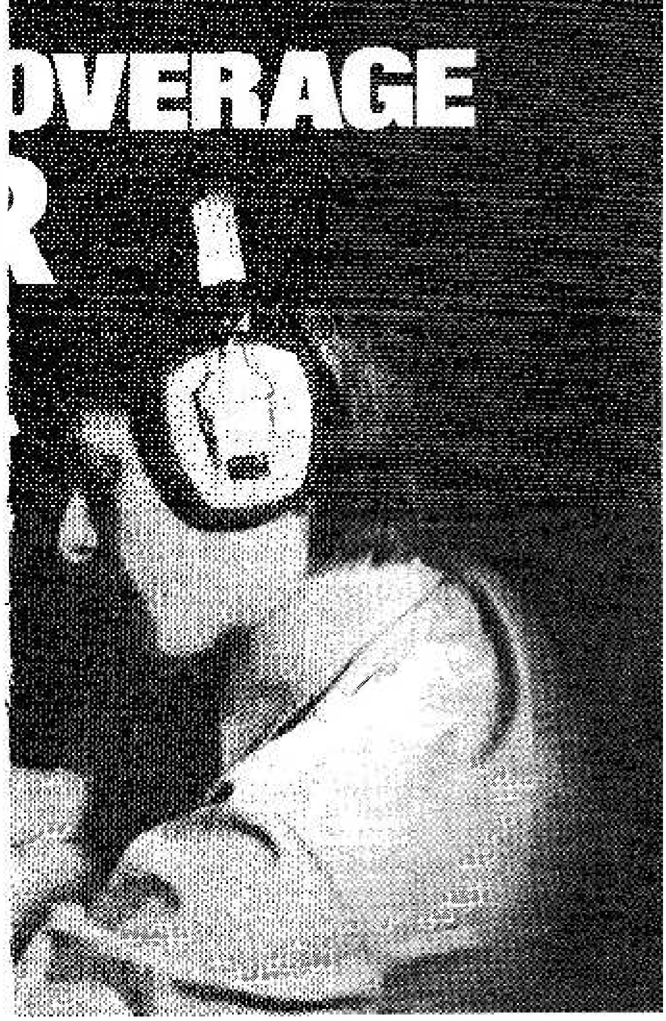


◀ *Fig. 1: Circuit of the mixer-oscillator board.*





▲ *Fig. 2: Intermediate frequency amplifier circuit.*



a 50pF capacitor directly across the tuned section of Range 1 coils. Such capacitors must not be fitted at the holder because of their effect on other ranges.

Range 2 is for medium waves, while the remaining ranges are for the higher frequencies. Actual coverage can be modified somewhat by adjusting the cores.

Plug-in coils as used at L1 for aerial tuning and at L2 for the oscillator have several advantages. Construction and wiring are simplified when compared with the permanent fitting of all coils and a multiway bandswitch. With plug-in coils, it is also a simple matter to obtain only those coils for the bands required. Coils for other bands can always be obtained later and no changes have to be made to the receiver to allow them to be used.

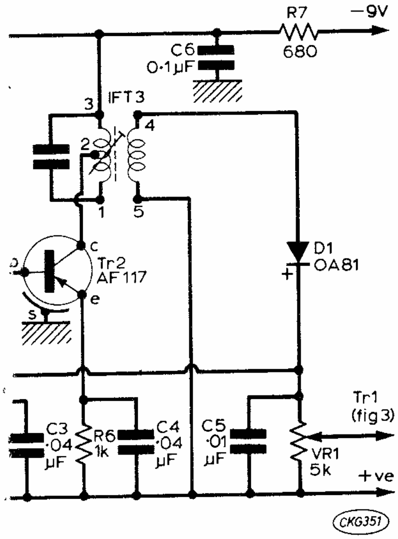
A panel aerial trimmer VC2 is fitted which has the advantage that the aerial circuit can be peaked up for best results with any aerial, on any frequency. Tuning on the higher frequencies becomes critical, so the bandspreading capacitor VC4 is provided for fine tuning. No additional bandspreading capacitor is necessary for the aerial coils.

Ranges 1, 2, 3 and 4 have their own oscillator coil padders, 110pF for Range 1, 350pF for Range 2, 1100pF for Range 3, and 3000pF for Range 4. No padder is used for Range 5. These padders go respectively to tags 5, 2, 3, 4 and 6, as in Fig. 1. The coils are so made that the correct padder is automatically in circuit when a coil is inserted.

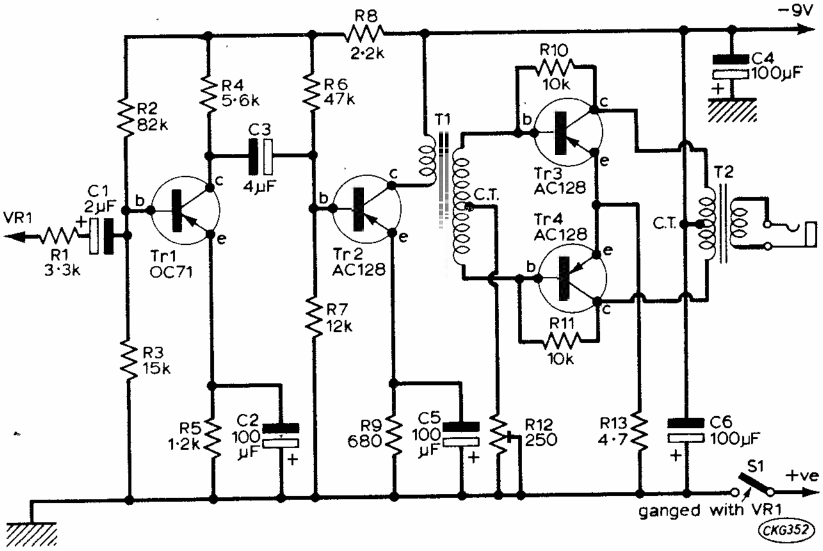
IF AMPLIFIER

Fig. 2 shows the intermediate frequency amplifier which has two double-tuned i.f.t.'s and one single tuned i.f.t. This results in good selectivity and gain.

Diode D1 is the demodulator which also provides automatic gain control bias through R2 for Tr1. Audio signals are taken from the volume control VR1 to the a.f. amplifier.



▲ *Fig. 2: Intermediate frequency amplifier circuit.*



▲ *Fig. 3: Circuit of the audio amplifier and output stages.*

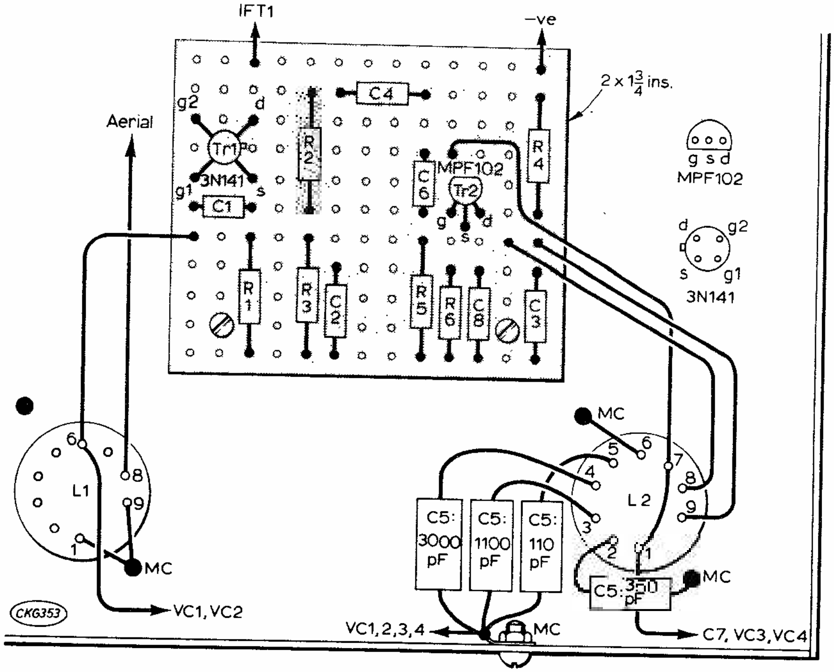


Fig. 4: Layout of the mixer-oscillator board and wiring of padding capacitors.

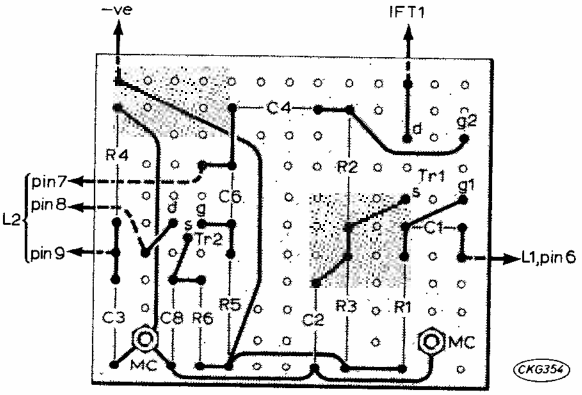


Fig. 5: Underside wiring of board shown in Fig. 4.

AF AMPLIFIER

The circuit for this section is shown in Fig. 3. Tr1 is the 1st a.f. amplifier, followed by the driver Tr2. The driver transformer T1 couples to the push-pull output pair Tr3 and Tr4 and T2 is the output transformer for a 2 or 3-ohm speaker. The pre-set R12 is adjusted for proper operating conditions in the output stage.

This type of circuit gives plenty of amplification and output. Its great advantage lies in the fact that the d.c. operating conditions of each stage are isolated from other stages, so it is not necessary to use matched sets of transistors. Some simplification would be possible by omitting Tr1 and taking C1 to the base of Tr2, though the extra stage of amplification is useful with weak signals.

MIXER-OSC BOARD

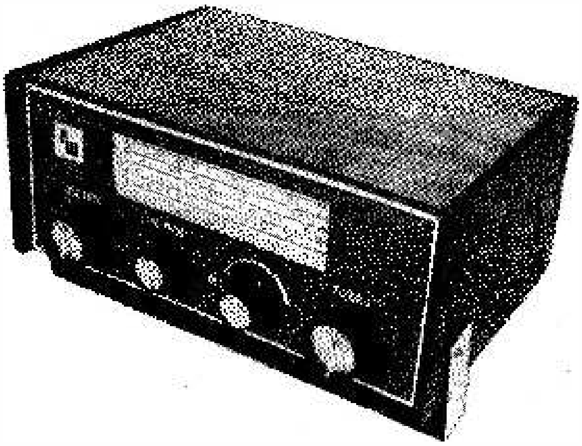
This section is wired on a piece of plain Veroboard 2 x 1¾in. **Do not remove the shorting ring from Tr1 until the transistor is fitted in the way explained.**

Two ½in. 6BA bolts with tags are secured in the positions in Figs. 4 and 5. Extra nuts on these space the board from the metal chassis to clear wiring. These bolts also provide a chassis return when the board is fixed to the chassis.

Resistors and capacitors are positioned as in Fig. 4. The board is turned over and wired as in Fig. 5. Place sleeving on leads where necessary. Veropins can be inserted for external connections, or flying leads can be left for this purpose and cut down to length later. Leads run from C1 to pin 6 of L1, from Tr1 drain to pin 1 of i.f.t.1, from C6 to pins 1 and 7 of L2, from Tr2 drain to pin 8 on L2 and from C3 and R4 to pin 9 on L2. These pins or leads are identified by locating them as in Fig. 4. A pin or black lead is also required for the negative connection, which runs to a pin provided on the i.f. board.

Tr1. This should be supplied with a shorting collar, spring or ring, which is left in position until Tr1 is fitted. With an insulated gate transistor, static charges from the fingers, or a metal or plastic tool, can damage the unprotected transistor. Spread the wires with a matchstick or piece of wood so that they can be inserted in the holes shown in Figs. 4 and 5. Solder drain and source leads. Solder the G1 lead by keeping the iron in contact with the R1 side of the joint, and the G2 lead by keeping the iron against the R2 side of the joint.

Once the transistor is fitted, it is protected by R1, R2 and R3, and the shorting spring can be pulled off. If it is necessary to unsolder this transistor, bind thin wire round the leads in advance. Do not touch the



General view of completed receiver with metal strap fitted to lift front edge.

unprotected G1 or G2 wires with the soldering iron, fingers or metal plastic tools.

Tr2. This transistor can be soldered in the usual way. A 3-lead holder was fitted for it primarily as a simple means of testing various transistors in the oscillator position.

When this section is finished, it is fixed with extra nuts as in Fig. 4, and the leads for L1 and L2 are cut and soldered. The $\frac{1}{2}$in. bolts should leave enough clearance between the chassis and joints, but a piece of card or other insulating material about $2 \times 1\frac{3}{4}$in. in size can be put under the board.

Fig. 4 also shows how the padders are wired. Do not forget the lead 6 to chassis for Range 5. Leads from pin 8, L1 and the chassis run to sockets at the back of the case for aerial and earth.

IF AMPLIFIER BOARD

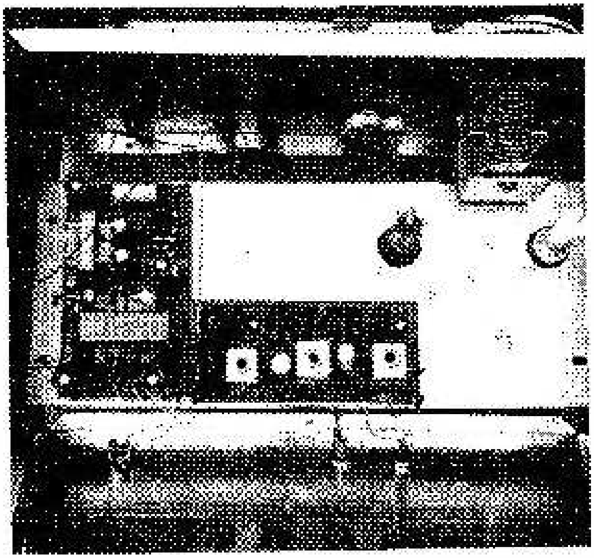
This is $3\frac{7}{8} \times 1\frac{3}{4}$in. and the components are placed as in Fig. 6. Holes are drilled for the pins and screening can tags of the i.f.t.'s with a central hole so that the lower cores can be reached with an adjusting tool. A very small round file is useful here if some of the holes are not in quite the correct positions.

Two bolts MC with tags are fitted in the same way as with the mixer-oscillator board, to mount the i.f. amplifier and provide the positive chassis return.

When fitting the transistors bring them down to within about $\frac{3}{8}$in. of the board so that leads are reasonably short. Wires can be identified and short circuits prevented by putting $\frac{3}{8}$in. pieces of sleeving on them—green for emitter, blue for base and red for collector. Connections underneath are shown in Fig. 7. It may be found helpful to put red sleeving on positive circuits, black on negative circuits and some other colour on other wires.

Pins are inserted for the external connections—negative supply from R1 to the mixer-oscillator; mixer to i.f.t.1, pin 1; from R7 to negative on the a.f. amplifier and battery; and from D1 positive to VR1.

The i.f. amplifier is fixed $3\frac{1}{4}$in. from the end of the chassis, level with the back of the chassis, with i.f.t.1 towards the mixer-oscillator section. Fig. 4 is the underside of the chassis, but i.f. and a.f. sections are on top of the chassis.



View of receiver with sides and back removed to show placement of the i.f. and audio boards.

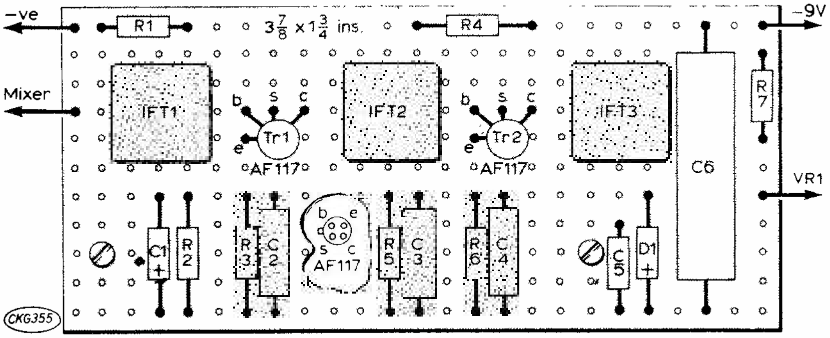


Fig. 6: Layout of components on the i.f. amplifier board and lead-out connections for the AF117 transistors.

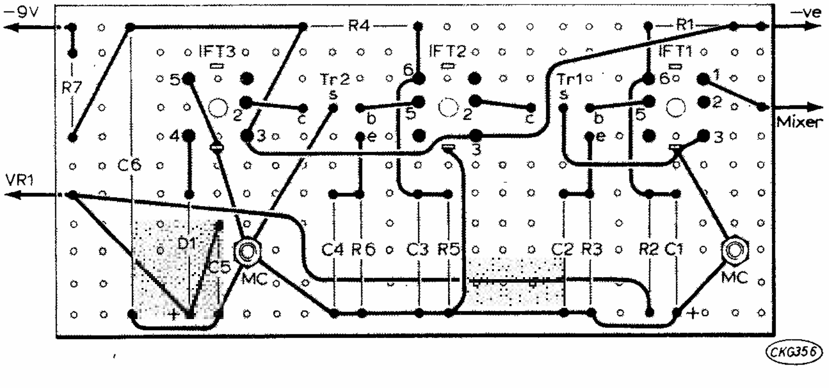


Fig. 7: Wiring details under the i.f. amplifier board. Points marked MC are the bolts fixing the board to the chassis.

AF AMPLIFIER BOARD

Components are placed as in Fig. 8, using a board 3¾ x 2¼in. in size. Bolts with tags are again used for chassis return and mounting with pins fitted for the junction of R1 with C1, for battery negative and for leads which will run from the secondary of the output transformer T2 to the loudspeaker.

Wiring should be straightforward as shown in Fig. 9. Coloured sleeving can be used to identify transistor and other leads, as already mentioned.

When this board is complete, it can be mounted in the space to the right of the chassis. Joints must be clear of the metal, or protection provided against shorts by placing card under the board, as described earlier.

CHECKING THE AF

The **a.f. section** may be checked by connecting a loudspeaker and providing a signal to R1 from a radio tuner, audio oscillator, pick-up or other source. VR1 should be in circuit to avoid overloading.

Initially set R12 so that little resistance is in circuit. With a 9V battery connected and the amplifier working, increase the value of R12 by moving the slider until the current is some 8mA to 10mA or so with no signal. Current peaks will be very much higher than this, increasing as the volume is increased.

Alternatively, R12 can be set to a position which results in clear reproduction with plenty of volume, though battery drain is increased if R12 is too high in value.

IF ALIGNMENT

The **i.f. amplifier** can be checked and aligned by itself or in conjunction with the a.f. section. VR1 must be connected and R1 of the a.f. section is connected to VR1; or phones may be connected to VR1, with an isolating capacitor in one lead to avoid upsetting the a.g.c. circuit.

As the i.f.t.'s are supplied pre-aligned, only a little adjustment of the cores should be necessary. If a signal is being obtained from the mixer-oscillator section, tune in a medium wave BBC or other stable transmission. Keep signal strength low by using a short piece of wire as an aerial, or by looping an insulated wire round the lead from pin 8 of L1. A proper tool is then used to rotate each core in turn, for best results. VR1 should be at maximum. A strong signal is avoided because it will operate the a.g.c. circuit and so make the correct core settings less precise. In any case, little or no adjustment of the cores may be needed, as explained.

If a signal generator is used, proceed in the same way, but couple the generator to the primary of i.f.t.1 by placing an insulated lead near pins 2 or 3. In this case, the mixer-oscillator section need not be in use.

★ components list

MIXER/OSCILLATOR

Resistors

R1	100kΩ	R3	2·2kΩ	R5	1MΩ
R2	100kΩ	R4	5·6kΩ	R6	2·7kΩ

Capacitors

C1	100pF SM	C5	*
C2	0·01μF	C6	100pF SM
C3	0·01μF	C7	18pF SM
C4	5pF SM	C8	0·01μF

* Padders:—110pF, 350pF, 1100pF and 3000pF

All silver mica

VC1/3 2 x 365pF gang (Jackson Type 02)
VC2 50pF variable (Jackson Type C804)
VC4 5pF variable (Jackson Type C804)

Semiconductors

Tr1	3N141	Tr2	MPF102

Inductors

L1	Denco "Blue" **valve** type for ranges required
L2	Denco "Red" **valve** type for ranges required

Miscellaneous

Valveholders B9A (2). Veroboard, plain, 0·15in. matrix 2 x 1¾in.

IF AMPLIFIER

Resistors

R1	68kΩ	R4	22kΩ	R7	680Ω
R2	8·2kΩ	R5	4·7kΩ	VR1	5kΩ pot.
R3	680Ω	R6	1kΩ		with switch S1

Capacitors

C1	8μF 4V	C4	0·01μF
C2	0·04μF	C5	0·01μF
C3	0·04μF	C6	0·1μF

Semiconductors

Tr1	AF117	Tr2	AF117	D1	OA81

Miscellaneous

IFT1/2 (Denco IFT18/465). IFT3 (Denco IFT14/465)
Veroboard, plain, 0·15in. matrix 3⅞ x 1¾in.

AF AMPLIFIER

Resistors

R1	3·3kΩ	R6	47kΩ	R11	10kΩ
R2	82kΩ	R7	12kΩ	R12	250Ω pre-set
R3	15kΩ	R8	2·2kΩ	R13	4·7Ω
R4	5·6kΩ	R9	680Ω		
R5	1·2kΩ	R10	10kΩ		

Capacitors

C1	2μF 6V	C4	100μF 10V
C2	100μF 6V	C5	100μF 6V
C3	4μF 6V	C6	100μF 10V

Semiconductors

Tr1	OC71	Tr2-3-4	AC128

Miscellaneous

T1, driver transformer 3·5 : 1 + 1. T2, output transformer 3 + 3 : 1. Veroboard, plain, 0·15in. matrix 3¾ x 2¼in.

All Resistors ¼W 10%

Cabinet, etc.

Universal chassis sides, flanged 10 x 4in. (3), DL44 2¾in. drum, DL34 Type G cord drive, DL31 tension spring, DL36A pulley wheels (2) drive cord. (All Home Radio). Perspex 10 x 4in. 3-ply wood, 10 x 7½in., 10 x 7in., 7½ x 4½in. (2), knobs, etc.

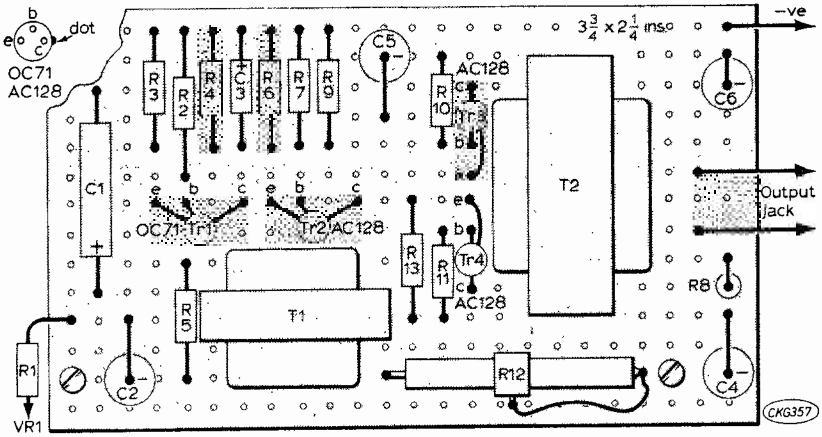


Fig. 8: Components on the audio stages board are placed as shown. Observe correct polarity of the several electrolytic capacitors.

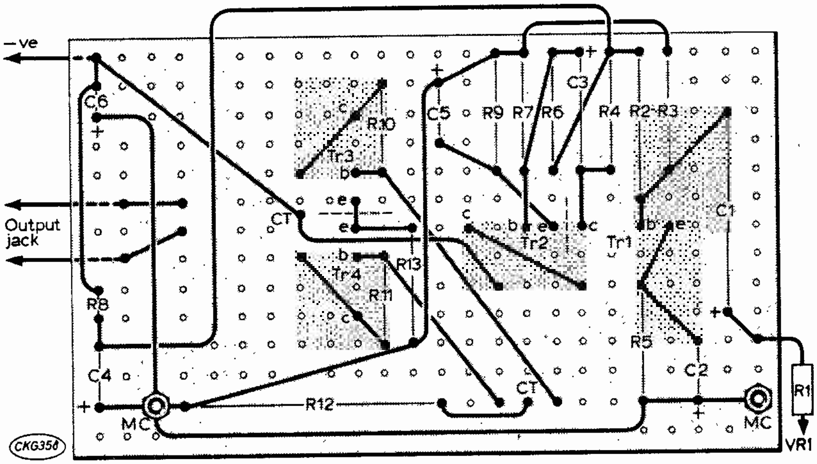


Fig. 9: Wiring underneath the audio amplifier board. Again points MC are "earth" returns, via the fixing bolts, to the chassis.

MIXER-OSC ADJUSTMENT

The **mixer-oscillator** is most easily tested and aligned when the receiver is otherwise completed. The coil adjusting screws are screwed in by the makers so that the coils can be placed in the cans in which they are supplied so initially all the cores have to be unscrewed several turns from this position.

Deal with each pair of coils separately. The cores can be locked with 6BA nuts when they are correctly adjusted.

Band coverage at the low frequency end of the band is adjusted by moving the core of L2. The core of L1 is adjusted so that near the low frequency end of the band signals peak up with VC2 nearly half closed. In these circumstances, it should be found that VC2 can be peaked for best results throughout the whole band. If it becomes necessary to close VC2 more and more, as the receiver is tuned from the h.f. end of the band towards the l.f. end, this shows that the core of L1 needs screwing in slightly. On the other hand, if when tuning in this way VC2 has to be opened more and more for best results, the core of L1 is too far in.

With the tuning capacitor VC1/3 fully closed, the frequency reached is lowered by screwing in the core of L2 and raised by unscrewing this core. This allows ranges to be adjusted so that there is some overlap between bands. A corresponding adjustment has to be made to the core of L1.

It should be found that alignment is not difficult, either by tuning in transmissions, or by using a signal generator. Maximum results will in any case be obtained if VC2 can be peaked for best volume throughout the whole of any range and is then seen not to be either fully open or fully closed.

R4 on Tr2 is the lowest value which does not result in strong spurious oscillations marring reception. The best value depends somewhat on Tr2 and is likely to be between about 1·2kΩ and 8·2kΩ.

CASE ASSEMBLY

Three 10 x 4in. flanged universal chassis members are used, one as the case front, one as the back and the third as a chassis to carry the three circuit boards and coil holders.

The sides are 3-ply, sanded and varnished, each 7½ x 4½in. The top is similar 3-ply, 10 x 7½in. while the bottom is 10 x 7in.

A piece of ⅛in. perspex, 10 x 4in. backed by card, except for a window over the tuning scales, is also required for the front.

Fig. 10 shows how the case is assembled. Mark through the holes punched in the flanges of the 10 x 4in. members so that the wooden sides can be drilled. The back is flush. The 10 x 4in. member forming the chassis is set forward about ⅞in. and is 1⅜in. above the lower edge of the back so that there is clearance for the mixer-oscillator board below, as well as for VC1/3 above.

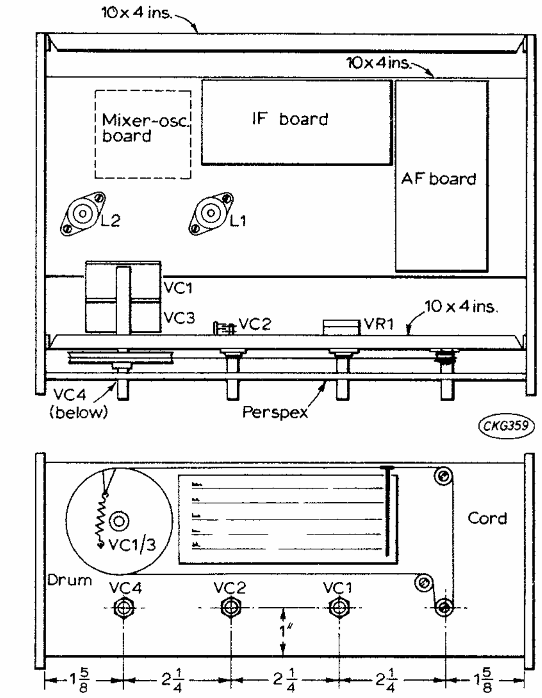


Fig. 10: Positioning of the major components on the chassis and front panel with details of the dial drive mechanism.

The front is set in 1in. from the front edges of the side pieces as in Fig. 10. Drill the front for VC4, VC2, VR1 and the cord drive bush. Mark the same hole positions on the perspex, and drill clearance holes for the operating spindles. Also drill four holes to match with those punched in the front near the flanges.

When assembly is otherwise complete, the perspex is put in place and held with four 1in. 6BA bolts, each with three nuts, so that it covers the drum and cord drive. A piece of card, with a cut-out through which the scales can be seen, fits behind the perspex.

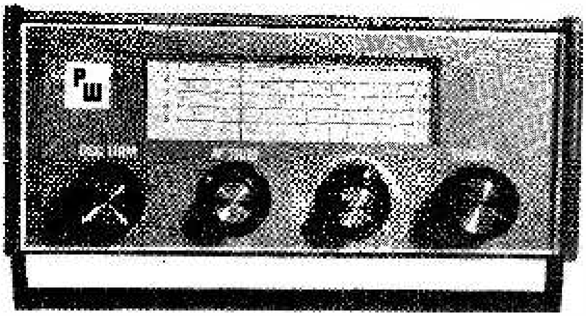
Drill the front for VC1/3, fixing this with countersunk head 4BA bolts with extra nuts or spacers behind. The two wheels for the cord run on bolts as in Fig. 10. The cord has one complete turn round the driving spindle and is held taut by the spring in the drum.

The card for the scales is brought forward by means of a piece of wood about ¼in. thick fixed to the 10 x 4in. member. A small piece of tinplace is cut and folded so that it can be clipped to the cord with pliers and a vertical wire pointer is soldered to this, the pointer and drum being as shown in Fig. 10 with the ganged capacitor fully closed.

The receiver can be wired and tested with the back, top and bottom completely removed, so that all units can be reached easily. The bottom is attached with three or four self-tapping screws. The top requires to be hinged, or provided with strips to hold it in place, so that it can be lifted off the case to change coils.

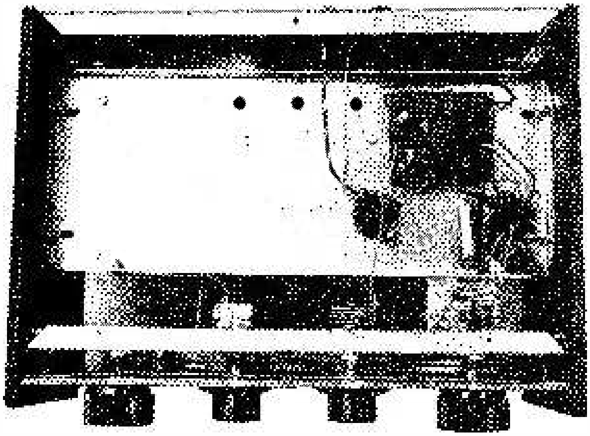
CALIBRATION

Markings are made before fitting the perspex. If the scales are to be calibrated in frequency first check coverage and ganging and fix the coil cores with 6BA nuts. Calibration is then most easily done with a signal generator. This is set to various frequencies, the signal is tuned in on the receiver, and the appropriate scale is marked. Take care to avoid harmonics and second-channel responses, in the usual way.



The markings of the four controls and dial calibration can be seen in this view of the receiver.

An alternative is to tune in various bands, such as 19 or 31 metres, and mark these. Another possibility is to fit a 0-100 or similar horizontal scale, against which stations tuned in, or known frequencies can be logged. A rule calibrated in mm. will act as an easily obtainable ready-made scale.



Only the mixer-oscillator board and associated coil holders are mounted underneath the chassis.

AERIAL AND EARTH

Remember that conditions on the various frequencies vary enormously according to the time of day and other factors. Quite a large number of transmissions should be received with some 5ft. to 20ft or so of wire as an indoor or outdoor aerial. For weak signals in the 1·5-5MHz region, a longer aerial will make a great difference by improving signal strength. For good results on these frequencies, some 50ft. to 150ft. or so of wire as high as possible and clear of earthed objects, can be worth while.

Though many signals are sufficiently strong with no earth the use of an earth connection will give a worthwhile improvement in volume on some frequencies and often allow the reception of weak signals which cannot otherwise be received. An earth lead can be an insulated wire taken to an earth spike or other metal object buried in the ground. Where this is impossible, a counterpoise earth consisting of an insulated wire running near the ground or in an opposite direction to the aerial can be helpful. ■

CQ!CQ!CQ!CQ!

ISSUES WANTED

..P.E. Aug. 1965, Sept. 1966, Nov., Dec., 1698, Jan., Feb., April, June, Aug., Sept., Oct., Nov. 1969. P.W. Jan., Feb., Mar. 1967.—A. G. Hodgett, 3, Ely Way, Fellgate, Jarrow, Co. Durham.

..P. E. Mar., May 1972.—G. Barraclough, Rustic Gables, Waterhill Lane, Sowerby Bridge, HX6 2UA.

..Jan., Feb., Aug., 1970;—Dec. 71;—July 1972; of P.W. Nov. 1969;—Sept. 70:—July 1972, P. E. July 72:—E.E.—G. D. Llody, 28 Underhill, Bolham Road, Riverton, Devon. EX16 6SF.

..buy, loan, exchange P.W. April, May, June, 1969—W. L. Brunsdon, 28 Meadfoot Road, Wallasey, Wirral, Cheshire.

..wanted—March & April 1970 to P.W. containing articles on 'General Coverage RX'. buy or loan.—C. MacAddhabhui, Machaire Gathlan, Derrybeg, Co. Donegal, Ireland.

..November 1971 edn. 'Everyday Electronics' Cover price and postage paid.—T. C. Rickard, 10, Berridge Road, Sheerness, Kent.

..P. W. Nov. 1969, Dec. 1969, Jan. 1970.—R. P. Moore, 'Caton'. Furnham Crescent, Chard, Somerset.

..Radio Constructor Aug. 1968, Jan. 1969, March 1969, April 1969, May 1969, June 1969, Aug. 1969.—R. J. McBride, 37, Border Street, Greenock, PA15 2EF. Renfrewshire.

..P.E. Sept. 1970 (Guitar pickup Construction).—A. D. Black, 16 Rosebury Avenue, Worthing, Sussex.

..Any W.W. or P.W. before 1930.—P. Kemmis, 92 Wildwood Road, London, N.W.11 6UD.

..Buy or borrow the May 1972 issue of "Television".—F. D. M. Wilson, 83, Marshal's Drive, St. Albans, Herts.

..P.E. 1969, containing the articles by A. Douglas on building an Electronic Organ, about March onwards I think.—E. Robinson, 171 Allendale Avenue, Aspley, Watlingham.

..Mar. and April issues (1972) P.W.—D. Mooney, 85 Audhineurk Road, Glenanne, Co. Armagh, N. Ireland.

..P.W. August—November 1967, willing to pay full price, or borrow to photocopy;—D. F. Boughey, 4 Milton Road, Birkenhead, L42 OJU.

..Wanted Practical Wireless for Jan., Feb., March 1972. I am ready to pay for them. M. Ilyas, 214 Golders Green Road, London, N.W.11 9AT.

..June 1971 P.W. to borrow or buy.—W. Kyle, 23, Lammermuir Drive, Potterhill, Paisley.

..March 1971, May 1971, October 1971.—E. McCaughey, 132 Foley Street, Dublin 1, Eire.

..May 1972 edition of P.W.—A. K. Bissett, 2 Brynteg Avenue, Bridgend, Glamorgan.

..Wanted issues of P.W. dated September and October 1971, willing to pay full price.—C. North 29 Kent Road, Harrogate, Yorks. HG1 2LJ.

..Practical Wireless: May 1971 to Sept. 1971 inclusive. Practical Electronics: Jan. 1971 to April 1971 inclusive and July 1971.—A. M. Cash, S. Codrington Road, Bristol, B27 8ET.

..pre 1972 P.W.; P.E.; P.TV.; Radio Construction.—N. Vaswaney, 28 Angus House, New Park Road, London, SW2 4LB.

..P.W. Feb. 1972 containing Part 1 quality Hi Fi System by C. R. Bradley.—P. Parker, 31 Fairview Handsacre, Nr. Rugeley, Staffs.

..Practical Wireless Vol. 46. (May 1970—April 1971). Also May and June 1971. Practical Electronics Vols. 5, 6, and 7 (Jan. 1969 to Dec. 1971). Also March 1972. Radio Constructor November and December 1968, August 1969 and May 1970.—M. Ridge, 25 Broomfield Crescent, Leeds LS6 3DD.

..January 1971 issue of Practical Wireless as I would like to build the stereo tape recorder described in that issue.—J. F. Heath, P.O. Box 355, Florida, Transvaal, South Africa.

..Practical Wireless for January 1968.—D. How, 25 Hillcote Avenue, Norbury, London, S.W.16 3BH.

..Practical Wireless Feb. and March 1972 (containing the transistorised oscilloscope) and the April 1972 issue. Also for the following: Handbook or any information on the Cossor Oscillograph Model 1049 Mk III.—B. S. Bainbridge, 7 Montclair Drive, Liverpool. 18.

..1971 December issue of Practical Wireless.—K. Avery, 22 Palington Grove, Cantley 2, Doncaster, Yorks. DN4 6LP.

..August 1968 P.W. or plans for Portable Keyless Organ, also P.E. August to November 1968 containing Sound Light and Colour series.—W. Kelly, Cairns Cottage, Memsie, Fraserburgh, Aberdeenshire.

..Wanted P.W. Sept. and Dec. 1971.—C. Jones, 45 Currock Park Avenue, Carlisle, CA2 4DJ.

..P.W. May to August 1970 inclusive.—M. Hollamby, 310 Ifield, Crawley, Sussex. RH11 OEW.

..April 1971 P.W. also June, July editions P.W.—O. Wilson, 57 Bellevue Road, Berea, Durban, South Africa.

..wanted P.W. September 1971—March 1972.—R. A. Leigh 416 Birmingham Road, Bromsgrove, Worcestershire.

INFORMATION WANTED:

..supplier of E3016 i.c.—B.P. Hellebone, 44 Gorring Valley Road, Lower Willingdon, Eastbourne, Sussex.

..any details, date of manufacture, circuit etc., of my Marconiphone Model No. 347, Serial No. C/1 12214, approx. 20 years old. Will photocopy and return or buy.—R. J. Stone, 53 Burleigh Road, West Bridgeford, Nottingham, NG2 6EQ.

..any info. dealing with modifications to the No. 19 set (March 1966).—W. Bryant, 50 New Road, Stokenchurch, H. Wycombe, Bucks.

..any info. on where I could purchase parts of P.E. Mercury 6 (one I.F.T.).—J. Baw, Esq., 2 Beatle Avenue, Hanstenton, Hereford.

..info. wanted on the AT.V No. 6. and also on the BC906 field strength meter.—A. Salisbury, 28 Dyke St., Brumbo, Wrexham, N. Wales.

..any info. on circuit etc. for Halicrafter S40A receiver.—J. E. Ford, 68c East Hill, Dartford, Kent.

..circuit and details of Admiralty B28 receiver (Marconi CR100?).—A. G. Jones, 6 Gower View, Llanelli, Carms, SA15 3SN.

..info. on building Fluorescent 12V lights for Caravan 12" and longer.—E. Dale, 2 Fordham Square, Sunderland, SR4 OBB.

..circuit for a simple portable 2m Rx with banspread and BFO if poss.—S. Fletcher, G-14003, 35 Elm Grove, Norton, Bromsgrove, Worcs.

..info. regarding receiver type R4187, ST.C. ie. mods., for mains, manual, etc. loan or buy. J. Warrillow, 52 Lochdochart Road, Glasgow, G34 0BH.

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..Loan of handbook and circuit for Eddystone 680X.—H. Vance, 13 Abbey Road, Enfield. Middlesex.

..any info on my old set, MW, LW, S1, S2, valve line up UU6, TH41, PEN45, HL4100, and YA11? Sockets for PU.A.E.LS. Transformer type 2ER N5 B2012, 1 think.—B.P. Tolley, 36 Northumberland Avenue, Cleveleys, FY5 2LH.

..instruction manual and/or any gen regarding Ex-R.A.F. Communications receiver type R1155(a)—G.P.C. Low, 117, Andover Road, Newbury Berks.

...Details of a Music Synthesizer.—S. Sudarsono, Garstang Flats, Room 3–13. Mt. Preston, Leeds, LS2 9JT.

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...Gen on Treco Scope (Serial S748) made by the "Range" Electronics Co., London —S. Franklin, 200 City Road, London, EC1V 2PH.

..any gen on English equivalents of Jap transistors in a Tech. Tradiper model TE15 grid dip meter. The numbers are: Toshibra 2(SB)54.—H. Britton, 14 Kennet-Green, Kings Heath, Northampton.

..a circuit for the construction of a simple musical rhythm unit.—G. Smith, 13 Dean Park Road, Plymstock, Plymouth, PL9 7NY.

..the address of "Viking Electronics" Ltd., of London. I have one of their "Viking Bass 40" amp, which has gone wrong and needs a circuit diagram.—D. Durrant, Puzzle Trees, Punnetts Town, Heathfield, Sussex.

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Power For Ever!

9V BATTERY ELIMINATOR

M.WALLIS

HAVE you ever worked out how much it costs you using batteries rather than the mains supply for operating your equipment? Obviously it depends on the type of battery you use, what current you are drawing and how often the equipment is used but a quick calculation shows that the current costs about *2,000 times* as much as operating through a power supply. Certainly a power supply costs rather more than a battery but this is rapidly recovered by savings in battery costs.

The unit described here is a replacement for the popular PP9 type of battery that is fitted in a number of the larger types of transistor portable radios. This battery is also very popular with amateur constructors. Although designed to replace the PP9 type, the circuit of course holds good for any 9V battery with a maximum current supply of about 80mA but the size of the unit described here may be too large to act as a direct replacement.

The cost of our battery eliminator is about £1, appreciably less than the commercial units available. In addition our unit is exactly the same size as the battery that it replaces—it is built inside the old battery casing—and so it will neither be too large, or too small, when in place.

THE CIRCUIT

The theoretical circuit is shown in Fig. 1 and is absolutely standard. The transformer (the type number and suppliers are mentioned in the components list) has a 7-0-7V secondary and this is connected to the rectifier diodes D1 and D2 giving full-wave rectification; this is then smoothed by the capacitor C1. The reason for the resistor R1 is to act as a bleeder, when the unit is on it will then be drawing at least 20mA and ensures that the peak voltage that may be present is never applied to the unit. With no load at all connected to the power supply, the voltage reaches well over 10V and this is not desirable as damage may result. As shown, with no load other than R1, the prototype measured 9·2V and with 80mA being drawn about 8·5V.

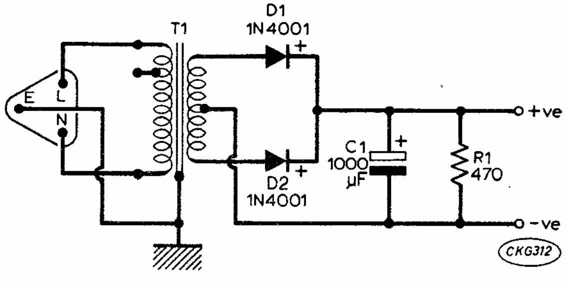


Fig. 1: The circuit of the battery eliminator.

CONSTRUCTION

As can be seen from the photographs, the unit is built inside an old battery case. This has to be taken apart as follows:—

First, using a screwdriver, prise up the bent-over metal ridge that holds the top of the battery in place and work all around this, levering it up. Straighten this metal with pliers or the top will not come out easily and reassembly will be difficult. When this is done the entire contents of the battery will fall out.

The top panel with the snap-on contacts should be cut free of the connecting wires or bands of metal and put to one side. Just enough of the original metal on the underside should be left for making the connections later.

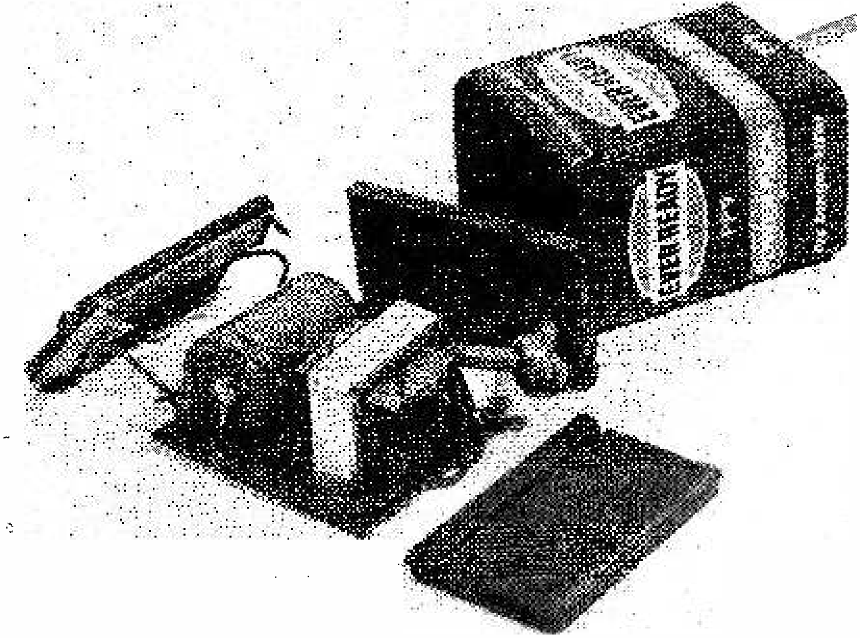
The circuit is built on a piece of drilled s.r.b.p. board with dimensions exactly $2\frac{1}{16}$ x $2^{1}{}_{2}$in. Holes will have to be drilled in this to take the transformer mounting lugs which are then fitted through and bent over. The remaining components are "threaded" through convenient holes and soldered together as shown in Fig. 2. C1 is shown here very much smaller than it actually is to make this drawing clear; in fact C1 will be so large that it probably overlaps the diodes and R1. Both sides of the transformer have three wires coming out, the secondary is that with two brown and one blue wire, the primary has brown, blue and a green. The mains wire should be connected to the primary side to the brown and blue, unless you live in an area where the mains supply is 230V or below in which case the mains should be wired to the brown and green.

The earth wire should be stripped back and a

★ components list

R1	470Ω ¼W, 10 per cent
C1	1000µF, 15V minimum
D1, D2	1N4001 silicon diodes
T1	Mains transformer with 7-0-7V secondary, type MT98 (Henry's Radio)

Hardboard, see text; Mains lead; Old PP9 battery; Drilled s.r.b.p. board.



The prototype just before final assembly.

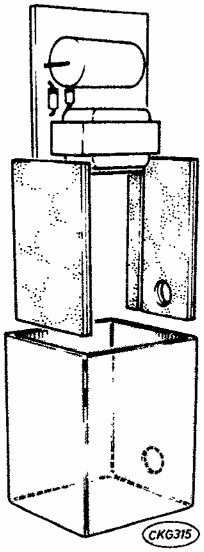


Fig. 4: How the unit fits together.

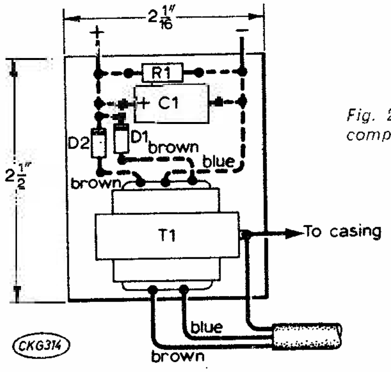


Fig. 2. The wiring of the components on the drilled s.r.b.p. board.

second short length of wire twisted with this and then both soldered to the case of the transformer. The reason for this is safety; this second wire will later be soldered to the battery case and if by any chance this solder joint breaks from the transformer, the battery case will still remain earthed.

Neither side of the 9V is shown earthed since it will depend on the design of the equipment which side requires earthing. If the equipment is negative chassis, the earth should run to the negative side and conversely for positive earth equipment.

The circuit board is held inside the battery case by means of two side fillets made up from hardboard, the dimensions for one of these is shown in Fig. 3; the other is of course identical. Three pieces are needed for each and these are then glued together.

When the side fillets are ready they should be fitted inside the case with the circuit board to ensure that everything is a tight fit and that they don't rattle about. If all is well, the bits should be taken out and one of the side pieces replaced to make the hole for the mains wire, both the piece of hardboard and case should be drilled together to ensure that the holes line up exactly.

It is important that the mains lead is fitted through one of the short sides with the hardboard fillets as this will prevent it chaffing on the sharp metal case; a grommet will be of little help as the metal sides will cut right through it in a very short while.

A knot should be made in the mains lead as close as possible to the transformer, as can be seen from the photograph, this will prevent it being pulled away from the unit with possibly disastrous results.

The unit is then reassembled as shown in Fig. 4. This should leave three wires coming out of the top: positive, negative and the earth wire from the transformer casing. The last should be soldered to the metal casing anywhere inside. The supply leads are then fitted to the snap contacts, remembering that for a battery the female contact is the negative and the male the positive. The original top can then be replaced and this should rest on the side fillets.

Before completing the assembly, the unit should be tested to ensure that it works; taking it apart again can be quite a job. If all is well the top metal, which is standing proud, should be bent down to hold the top in place.

The dimensions for the fillets are only applicable to the modern Ever Ready PP9 batteries. Other types of batteries have different inside dimensions and this will affect the length of the fillets; in this case the dimensions will have to be worked out. ■

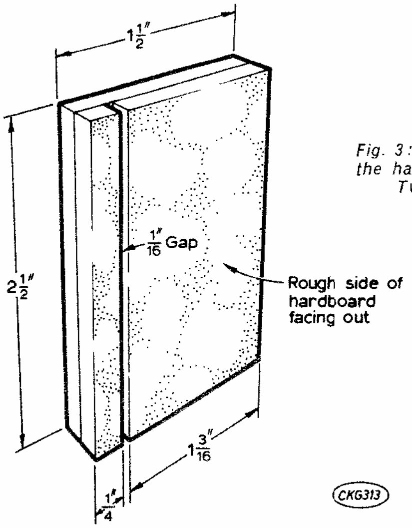


Fig. 3: The dimensions of the hardboard side fillets. Two are required.

TAKE 20

JULIAN ANDERSON

A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.

No. 45

SIGNAL INJECTOR/TRACER

ONE of the disadvantages of being interested in radio and electronics is that you act as a magnet for faulty transistor radios and the like. Certainly you can say "No!" to requests to "have a look at it," but if you take this attitude you will not be very popular. Your author usually agrees, on the condition that mechanical troubles are not handled (broken cabinets, dial mechanisms etc) and that if replacement components are required it is up to the owner to get the bits. If you stick by these principles, repairs can be done very quickly but *only* if you have the right equipment. The most useful item is a multimeter—it is hopeless trying to work without one—but running a close second is a signal injector/tracer and this forms the subject of our project this month.

Inject

The circuit of the signal injector/tracer is shown in Fig. 1; SW1 alters the function and is in the "inject" mode. The circuit is a multivibrator producing a square-wave output at C1 to which a probe can be attached. The square-wave is in the audio range but it is so full of harmonics (a square wave is a fundamental frequency plus all its harmonics) that these go up to several megahertz. If you place a transistor radio on the medium wave band even near this circuit, the output will be heard all over the band. If we inject this signal at the volume control we will be able to establish if the amplifier part of the set is O.K.; if it doesn't work then we can concentrate our efforts in this direction.

If this is O.K. we can work back along the i.f. section and we shall eventually discover where the fault lies.

★ components list

R1	1MΩ, ¼W, 5 per cent	1p
R2	2·7kΩ " "	1p
R3	1MΩ " "	1p
R4	2·7kΩ " "	1p
C1	3300pF disc ceramic	3p
C2	3300pF disc ceramic	3p
C3	3300pF disc ceramic	3p
C4	100µF, 10V minimum	5p
Tr1	BC109	10p
Tr2	BC109	10p
D1	1N914	7p
SW1	One-pole, 2-way slide switch	8p
SW2	On-off switch, toggle type	5p
	Crystal earpiece and jack socket	35p
		93p

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

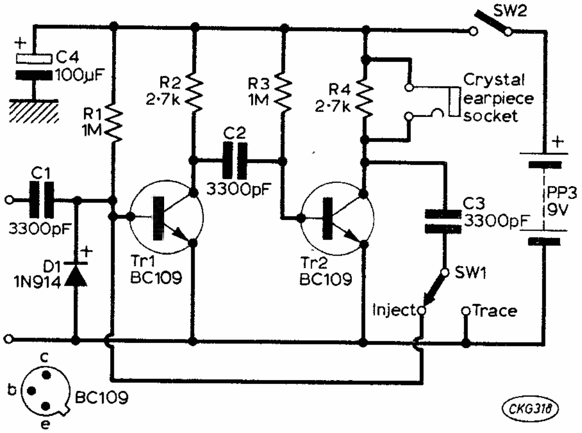


Fig. 1: The circuit.

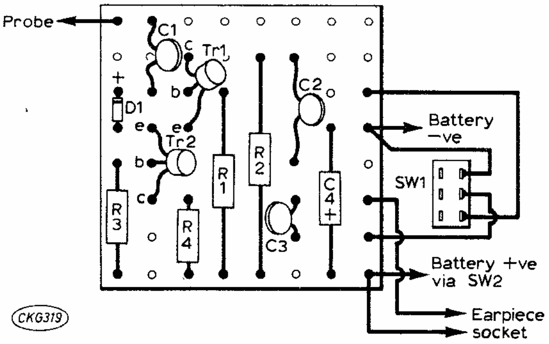


Fig. 2: Suggested layout on Veroboard.

Trace

When SW1 is switched to "trace", the circuit is no longer a multivibrator but becomes a highly sensitive amplifier. If the probe is fixed to an r.f. point the signal will be rectified by the diode D1 and amplified by both stages and fed to the crystal earpiece. It is smoothed by C3 which now, instead of coupling back to the base of Tr1, goes to the negative line.

The current drain of the unit is quite small and a PP3 battery is quite sufficient.

Two wires, fitted with crocodile clips, should be connected to the negative line and to C1 as these will be needed to couple the injector/tracer to the circuit under test. If using the injector at r.f. frequencies, the output is so high that the wire from C1 has only to be held near the aerial, it is not necessary to make a direct connection.

Construction

The components can be mounted in any convenient form but a suggested component layout is shown in Fig. 2; this is built on a small piece of Veroboard with 0·15in matrix, 8 x 8 holes; no breaks are necessary in the conductor strip. SW1 can be a small slide switch wired as shown; SW2 can take any convenient form. ■

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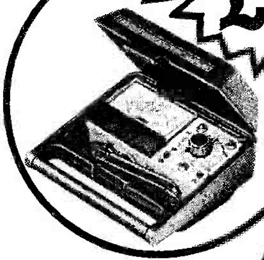

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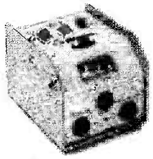

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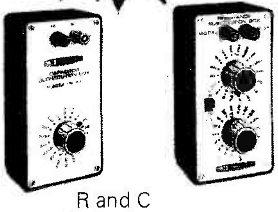

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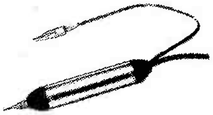

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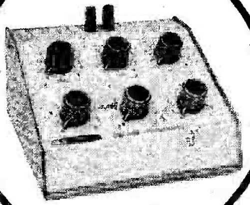

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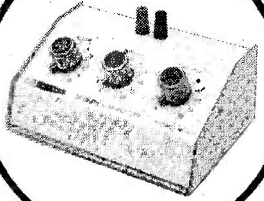

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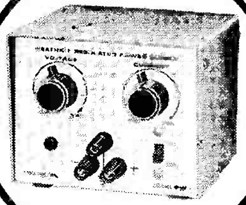

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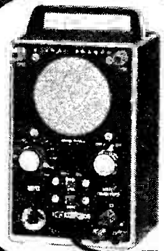

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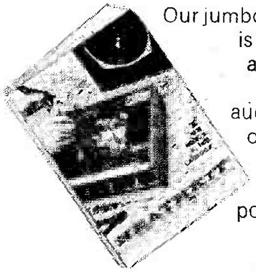

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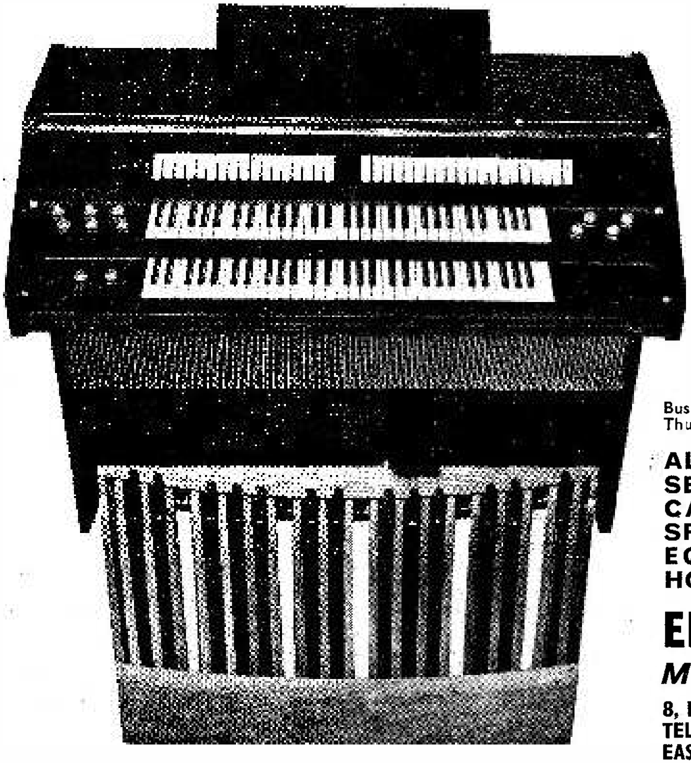

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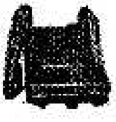

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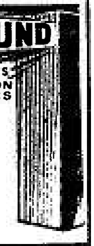

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MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

CHRISTMAS is over and here we are in another New Year. I know that many of my readers will have asked for presents of money so that they can save towards the new receiver that they want and many will write to me asking advice on the best set to buy.

Unless a second-hand purchase is anticipated the reasonably serious listener will have to pay around £50 for a good receiver. There are of course many sets on the market for much less and several which cost a lot more.

In this middle price range there are two receivers which stand out as being very good value for money and for this reason they are very popular with DXer's. The first is the Lafayette HA600 which is a general coverage receiver (550kHz to 30MHz) this set has the advantage of being all solid-state which means that it can be run from either the mains or from 12 volts d.c. The second is the Trio 9R59DS which is again general coverage but can only be operated from 240 volt mains.

Before anyone asks, my personal preference is for the Lafayette. There are two reasons for this, the first is that I have always owned Lafayettes and had no trouble with them at all. The second is that when I worked in an Electronics Laboratory, designing circuits, I only used transistors and integrated circuits, never valves. Consequently I feel more at home with a solid state receiver and if anything goes wrong I will be more able to repair it myself.

A great number of readers will, of course, not be lucky enough to afford one of these sets but they can increase their enjoyment of the hobby in many ways.

The 1973 edition of the World Radio TV Handbook has just been published and although it costs about £3 many experienced DXers will tell you that it is an invaluable text that they would never be without. The book lists all the Broadcasting Stations in the world with full details on each, including frequencies used, hours of transmission and the languages used. The book also contains a section on general information and a complete listing, by frequency, of all the stations.

A good New Year Resolution would be to erect a new and better aerial, about which much has been published in the past few months There is, however, a snag which was pointed out to me by Mr. **A. W. Lewington** of Bath. I also noticed the difficulty when I moved house recently and wanted to erect a new aerial. The problem is that nobody seems to sell good aerial wire any more. A few years ago Woolworths used to sell aerial wire which consisted of stranded copper wire with thick plastic insulation. This had the two important properties of being strong and flexible to withstand the ravages of our British weather. It is, however, no longer available.

If any reader knows of a good source of aerial wire I would be pleased to hear from him so that I can pass the information on to all our readers.

Yet another way of getting more enjoyment from the hobby is by joining a reputable DX Club. These clubs publish magazines for their members and these are used to exchange news and views about all aspects of the hobby. The membership fee is usually about £1·50 and the magazines alone make this outlay very well spent. The club that I would recommend is the World DX Club and the Secretary is Clive Jenkins, 11 Wesley Grove, Portsmouth, PO3 5ER.

In a recent article I published a specimen Reception Report. Mr. **A. J. Wills** of Elgin wrote to me to point out that the space devoted to programme details was not long enough. This was due to an error on my part when typing out the article. The most important part of the report is the section on programme details. All the other details on the report can be obtained from such sources as the World Radio TV Handbook.

The programme details are the only way in which the station can be sure that it was in fact their transmissions that were heard. The more complete the details are the greater is the liklihood of the station confirming the report with a QSL card.

All this chat has left me with very little space for your reports so I will start straight away with one from **James Pruden** of Sturminster Newton in Devon. James has a Skywood CX-203 receiver with a 15 metre end-fed aerial, this combination enabling him to hear:

6010 *RTB, Belgium* in French at 1510.
9545 *Radio Ghana* in English at 2120.
9610 *Radio Kiev,* USSR, in English at 1930.
11650 *Radio Bangladesh* in English at 1715.
15015 *Voice of Vietnam* in English at 2015.
15165 *Radio Denmark,* ID in English at 1330.
15170 *ELWA, Liberia* in Arabic at 2230.
15345 *Radio Norway* in English at 1615.
21570 *Radio Japan,* news in English at 0800.

Craig Tyson of Wembley in Western Australia used his Lafayette HA600 receiver and inverted 'L' aerial to hear the following stations:

6090 *Phnom Penh* in English at 1230.
7215 *AFN, Taiwan* in English at 1300.
7470 *R Liberation, N. Vietnam,* English at 1030.
9510 *Lakeland Radio, Malawi,* English at 1945.
9520 *VLT9, New Guinea* in English at 0730.
9580 *Voice of the Philippines,* English at 1300.
15170 *Radio Tahiti* in French at 0700.
15185 *Voice of Nigeria* in English at 0700.

Reports should arrive by the 15th of the month and be addressed to me at 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

HAPPY New Year. Now, how about a resolution to devote at least 30 per cent of your listening time to bands which you normally ignore? If you are an h.f. type, you could do no better than start off with top band transatlantics. These are tests carried out at certain times and on certain dates. The first ones in 1973 are as follows. January 14 and February 11 from 0500 to 0730 hours.

For something a little more difficult, how about the transpacific tests? These are to be held on January 13 and February 10 from 1330 to 1600 hours. The U.S. and Canadian stations will be transmitting between 1800 and 1807kHz. The D.X. stations will use 1825 to 1830kHz or 1800 to 1805kHz. It should be noted that stations in other countries are often restricted in choice of frequencies. For example, Japanese Amateurs may only use 1907 to 1912·5kHz while stations in New Zealand are restricted to 1875kHz. Doubtless we will get some Lid calling an endless CQ on these frequencies. How wonderful it would be for me to be proved wrong on this. How about it, Lids?

John Spacey (Devon) tells of A51PN putting in an appearance on 14MHz. He also mentions that Swan Island is active (listen for W6MTE/HR6) as is VU25FBZ on Andaman Island, both on 14MHz.

Two useful New Year presents you can treat yourself to. One is the latest countries list from the RSGB. Second is a good world atlas. For example, do you know where Swan Island or Andaman Island (mentioned above) are?

Which bands to listen on and at what time is really a matter of personal choice. However, the following remarks are based on readers' reports and personal observations by your scribe's ears.

The h.f. bands (14, 21 and 28MHz) become somewhat erratic during the winter months. By contrast, the three lower frequency bands (1·8, 3·5 and 7MHz) all improve compared to their summertime performance. Fifteen and twenty metres start to close down quite early now. Often, by 2000 hours there are no signals at all and this state of affairs remains until around 0600 hours.

On ten metres it is often a matter of luck. This band now opens at about 0800 hours and closes again at around 1700 hours. However, 28MHz is really a sort of lucky dip. If there is a high sunspot activity the band will suddenly burst into life.

Most of the winter D.X. activity migrates to 7MHz and this is particularly evident when the h.f. bands (14MHz and upwards) close down for the night. In theory, the sunspot activity should continue to decline in the coming months. This activity follows an 11-year cycle and we are currently on the way down towards a trough.

R. Kell (Northumberland) sends in a five-band log which includes earfuls of activity on 3·5 and 7MHz. Guilty parties aiding and abetting include a "modified" R109 with an a.t.u. and 150ft. end fed antenna. Goodies on 3·5MHz include; CN8HD, XV5AC, ZM4PG, 9H5D. Plundering forty metres brought the following r.f. jewels; CO3GS, CN8HD, HR1RF, KZ5PW, OA4SO, PY2ELX, PY2FKZ, TF1TP, VR2DE, XE1IIJ, YV4AGP.

John Hulse signing himself "Yours faithfully" and residing in Cheshire, tells of a sparkling new FR50B receiver. Duper squeaks on 28MHz from; CR6CN, CR7IC, CX2CF, ET3JH, KZ5PW, LU5DEK, LU5DTV, OY9LV, PY1AGC, ST2SA, VK6CF, VP7ND, VP9BO, XW8CN, YV4EBH, ZP5AQ, ZS6OS, 3B8CV, 3B8CZ. Down on 21MHz, the following menu was provided; CP1FU, CT2BG, EL4B, EP2TC, ET3DS, FP8DH, HI3XSJ, HK3CCO, HK3CLX, OD5FU, PZ1CU, VP1BH, VU25DK, XV5AC, YA1OS, YV5AK, ZD3X, ZE7JC. All stations using s.s.b. and the receiving aerial is described as a 66ft. dipole at 10m height.

Stefan Kaye (Oxon) made a brave attempt to break the habit. But the soulful look in the silent eyes of his AR88D got to him. Result of this joyous reunion was; CE3PY, CT2AC, LU3DTV, LU9DTQ, VQ9MC, ZS1WS—all on s.s.b. on ten metres. Down on eighty, a listen was rewarded by: FW8IA, HB0AIC, K3UQU/W1, ONONJ, TZ2AC, VE1ADV, VE1IE, VE3PT.

R. Iball (Notts.) uses a diamond aerial! Well, it's shaped like a diamond, is 7ft. long and hidden in the loft. The receiver is a JR500SE (not hidden in the loft) and the 14MHz c.w. signals were received by courtesy of: HS4AGN, UA0DV, VE7ZR, VE3ZT, ZL1ARV, ZL1MQ, ZL3GQ, ZM1AFW, ZM3ABC. Donald Duck mode of signals on the same band from: FP8DH, PZ1DR, VE6PP, VP8RA, VK1BF, VK6PG, VK6VW, VP9GA, VP9GE, VS9MB, ZL1AH, ZM4KM.

Trevor Thomsen (Bulawayo, Rhodesia) sends letters with pretty stamps and includes logs heard on his Hallicrafters S53A and 40ft. end fed. The list for s.s.b. on 21MHz reads: EL2CB, GR3NM, K3TGM, K4MQG, WA3GJZ, WB8JEY, W1AWE, W4SKO, W5RO, W8COG, 6W8AL, 6W8EM. Bernard Hughes (Worcester), JR310, 66ft. long wire, 28MHz s.s.b.

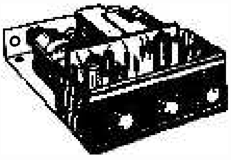
Logs, in alphabetical order please, to arrive by the 15th of the month to **12 Cross Way, Harpenden, Herts.**

TUT! TUT!!

AMATEUR BANDS RECEIVER DECEMBER 1972
Part 1. Fig. 2C, potentiometer (500 ohms) associated with S-meter should be marked VR2. Fig. 2D, power supply diodes should be marked D1 and D2. The OA2 voltage stabiliser should be marked V1. Amend Components List:—Fig. 2D, V1 OA2, V2 ECL86.

I.C. LINEAR CAPACITANCE METER JANUARY 1973
D3 should be a C5V6 5·6V (not 3·3V). This applies to both the circuit and the components list.

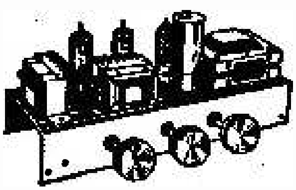
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz—30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8·15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7½" deep. AC 200/250V.

PRICE £10·50. P. & P. 25p.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **PRICE £8·92** P.&P. 45p.

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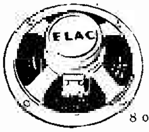

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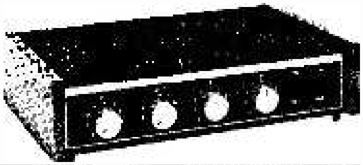

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Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

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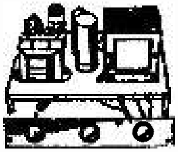

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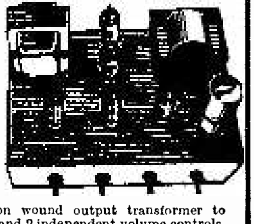

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier Simple instruction booklet 13p (Free with parts). **All parts sold separately.** ONLY **£7·97** P. & P. 55p. Also available ready built and tested **£10·97** P. & P. 60p.

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6F11	40
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6F32	25
6G6	25
6H6	23
6J5M	50
6J5G	20
6J5GT	30
6J6	20
6J7M	45
6J7G	30
6J7GT	45
6K6GT	60
6K7M	35
6K7G	35
6K7GT	35
6K8M	60
6K8G	40
6K8GT	50
6K25	75
6L6G	50
6L18	45
6Q7G	40
6Q7GT	43
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6SC7M	75
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6V6G	30
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6X4	35
6X5G	40
6X5GT	40
7B6	70
7B7	50
7C5	£1·13
7C6	75
7D5	60
7H7	50
7R7	75
7S7	£2·25
7Y4	65
9BW6	60
10C2	63
10F1	75
10F3	90
10F9	60
10F18	50
10LD11	65
10P13	60
11E3	£4·00
12AT6	30
12AT7	35
12AU6	35
12AU7	30
12AX7	30
12BA6	40
12BE6	40
12C8GT	35
12E1	£3·00
12J5GT	30
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12K7GT	40
12K8GT	50
12Q7GT	40
12SA7GT	50
12SG7	35
12SH7	35
12SJ7	40
12SK7	50
12SR7	40
14H7	50
19AQ5	50
20D1	50
20F2	70
20L1	£1·10
20P4	£1·10
20P5	£1·20
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25L6GT	50
25Y5	65
25Z4	30
25Z5GT	55
25Z6	65
30C1	30
30C15	80
30C17	90
30C18	80
30F5	85
30FL1	75
30FL12	£1·20
30FL14	85
30L15	85
30L17	80
30P4	£1·12
30P12	80
30P19	85
30PL1	75
30PL13	93
30PL14	90
35A5	75
35L6	50
35W4	35
35Z3	70
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35Z5	50
37	40
42	50
50B5	50
50C5	50
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75	50
78	45
80	55
85A2	50
150B2	60
150C4	60
801	60
807	50
813USA	£3·75
866A	75
954	60
1625	55
4022AR	£5·50
5763	70
7193	30
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A61	48
ATP4	45
ATP5	60
ATP7	60
AU2	£4·00
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CCH35	75
CL33	£1·30
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CY31	43
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DAF96	45
DCC90	£1·35
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DF70	45
DF91	30
DF92	20
DF96	45
DH3-91	£7·00
DH77	35
DK32	45
DK91	40
DK92	55
DK96	50
DL66	£1·25
DL92	35
DL93	40
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DL95	50
DL96	45
DM70	45
DY86	33
DY87	33
E88CC	65
EA50	20
EABC80	35
EAF42	55
EB91	20
EBC33	50
EBC41	55
EBC90	35
EBF80	40
EBF83	40
EBF89	30
EBL1	£1·00
EBL21	60
EBL31	£1·50
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ECC84	30
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ECC88	40
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ECH83	45
ECL80	45
ECL82	35
ECL83	70
ECL86	40
ECLL800	£1·65
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EF41	65
EF50	25
EF52	£1·25
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EF86	30
EF89	28
EF91	33
EF92	35
EF98	75
EF183	30
EF184	35
EL32	50
EL33	£1·75
EL34	50
EL41	60
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EL84	25
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EM81	60
EM84	35
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EY86	40
EZ35	40
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OC3	38
OZ4	40
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PC88	60
PC97	50
PCC84	40
PCC89	50
PCC189	55
PCF80	30
PCF82	35
PCF84	60
PCF86	60
PCF801	50
PCF802	50
PCF805	80
PCF806	70
PCF808	85
PCL82	35
PCL83	65
PCL84	45
PCL85	40
PCL86	45
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PEN45	75
PEN46	40
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PL83	45
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PL509	£1·10
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UAF42	55
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UBF80	40
UBF89	35
UCC84	43
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UCF80	55
UCH42	70
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UCL82	35
UCL83	60
UF41	60
UF89	40
UL41	65
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2N2147	75
2N2160	60
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2N2219	20
2N2369A	15
2N2444	£1·91
2N2646	45
2N2904	20
2N2926	10
2N3055	75
2N3702	10
2N3819	35
AAZ12	30
AC126	20
AC127	25
AC128	20
ACY20	20
ACY39	50
AD140	50
AD149	50
AD161	37
AF115	25
AF117	25
ASY26	25
BC107	10
BC108	10
BC109	10
BC169C	15
BFS98	28
BFY50	22
BFY51	20
BY100	15
BZY88	15
CRS1-40	47
DD003	15
GET102	30
GET882	25
GJ7M	37
KS100A	20
MJE520	87
MJE2955	£1·37
MJE3055	87
NKT212	27
NKT214	15
NKT223	33
NKT251	24
NKT713	25
OA70	10
OA71	10
OA81	08
OA85	12
OA91	07
OA211	30
OAZ201	50
OAZ207	47
OAZ210	32
OAZ222	45
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OAZ241	22
OAZ242	23
OAZ246	23
OC35	50
OC44	17
OC45	12
OC57	60
OC58	60
OC59	65
OC71	12
OC72	20
OC81	20
OC81D	20
OC82	25
OC82D	20
OC84	25
OC170	25
OC171	30
OC200	40
OCP71	97

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7400	20
7401	20
7402	20
7403	20
7404	20
7405	20
7406	30
7407	30
7408	20
7409	45
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7412	42
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7427	42
7428	50
7430	20
7432	42
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7438	65
7440	20
7441AN	75
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74110	80
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74118	£1·00
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74121	60
74122	£1·35
74123	£2·70
74141	£1·00
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74151	£1·10
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74157	£1·80
74170	£4·10
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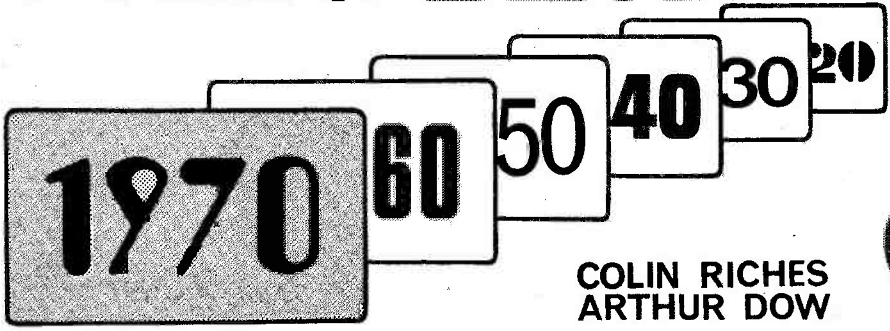
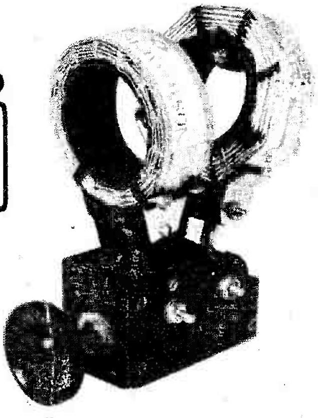
GOING BACK...





COLIN RICHES
ARTHUR DOW

MULLARD Limited, as their 50th Anniversary tribute to the BBC, staged a two month exhibition at Mullard House in London. It was opened on November 2 by Lord Hill, chairman of the BBC.

The Post Office gave its full support and co-operation to the exhibition which was complementary to the one organised by the BBC and held at the Langham Hotel, near Broadcasting House.

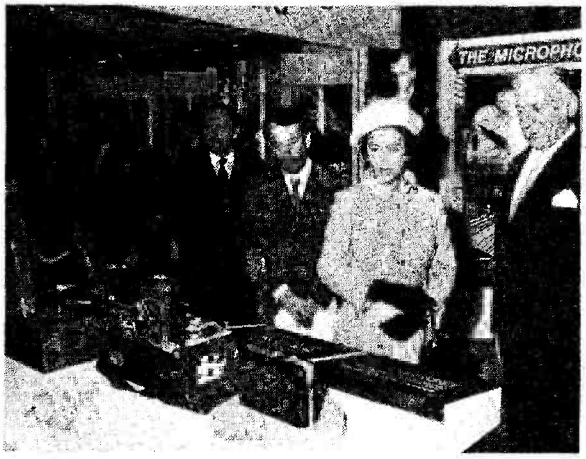
The Mullard exhibition was designed with a fourfold aim in mind—to show how technical innovation has contributed to the growth of broadcasting, to stress the pioneering effort that went into it, to enable the public to gain more of an insight into the technical aspects of broadcasting and to illustrate how development and research are continuing for the future.

The first part of the exhibition was entirely devoted to the development of broadcasting. It included a replica of the original Savoy Studio 1 of the early 1920s and a pictorial story showing how the microphone was evolved.

Two famous microphones exhibited were those used by Dame Nelly Melba and Sir Winston Churchill.

Visitors were also able to speak into one of the early "meat-safe" microphones and hear their voices reproduced on a tape machine. Also on display, was an early cylinder gramophone and one could, at the touch of a button, hear the kind of reproduction that could be obtained from such a machine.

The lip microphone: designed by the BBC Research Department to cut out background noise. It was first introduced in 1937.



Her Majesty the Queen compares vintage and modern tape recorders.

An early pianola was shown and it was difficult to realise that in the earlier days of broadcasting, the announcers actually had to pedal units like these as continuity between programmes!

On the same stand there was a recording machine of the type used by BBC War Correspondents and in one of the photographs shown in this article Her Majesty the Queen can be seen comparing this with a modern cassette tape recorder.

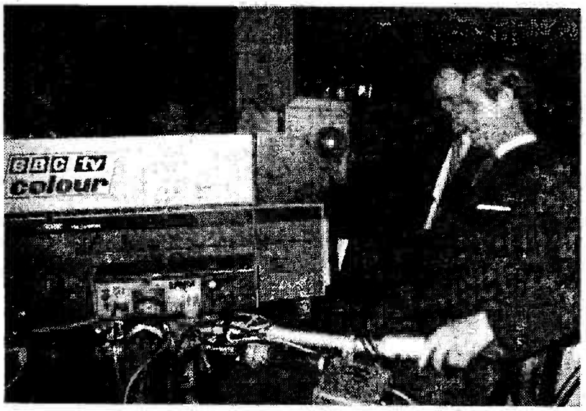
The section of the exhibition devoted to the story of television began with the actual first Emitron TV camera. Photos showed the various outstanding developments of television and the display was climaxed by a reconstruction of a live TV studio.

There was an audio/visual link with the BBC exhibition at the Langham, and Mullard House visitors were able to see themselves on colour TV and to read the news on closed circuit TV. From our picture it looked as though the BBC had taken on a new cameraman to demonstrate the colour camera—his face looked very familiar though!

Mullard themselves had a display showing the part their components had played over the five decades of sound and TV broadcasting.

They also had a "Colour TV Look-in", a six minute

The Queen shows interest in a horn loudspeaker and the "meat safe" microphone.



Prince Philip "has a go" at being a BBC cameraman.

The "Twenties" room setting at the Langham Hotel exhibition.

This picture shows the central display feature at the Langham exhibition. It reflects the development of the BBC over the years.

presentation telling the story of the Company's contribution to colour TV development.

Exhibits were also devoted to colour TV techniques and demonstrations in which the public could take part. Visitors could experiment with a BBC Radiophonics unit and see a demonstration of 3D television together with exhibits showing what the future may hold for transmission techniques.

The BBC held their own exhibition at the Langham Hotel, formerly one of London's most luxurious hotels and now offices and studios of the BBC.

Facing visitors, in the main area of the exhibition, was a multifaceted panoramic screen consisting of 20 separate screens. Forty-two slide projectors, with a total of 3,500 slides projected onto this screen. Scenes shown were chosen from a quarter of a million original BBC pictures and gave an extremely good visual impression of broadcasting in the past. present and future. These projectors, incidentally, were controlled by a simple computer which maintain the correct picture sequences.

Underneath this screen, which stood about 9ft. above ground level, there were mock-ups of room settings of different periods of broadcasting history.

Of particular interest to "Going Back" fans was a typical room of the '20s. The man is (see photograph) depicted hearing the first BBC broadcast on his home-made receiver on November 14, 1922.

In front of the stand was a row of buttons and excerpts from 1920s' type programmes could be heard by pressing any button. Famous voices heard included Flotsam and Jetsam, Tommy Handley and Jack Hylton.

Other room settings were shown depicting the broadcasting years rolling on. A large planographical map of the British Isles provided the basis of another exhibit and showed the growth of programme coverage from 1922 onwards, achieved by many miniature "transmitter" masts that lit up. Behind this stood a 20ft. high display reflecting the growth of the BBC's services at home and abroad.

Pictures kindly supplied by Mullard Ltd. and the BBC

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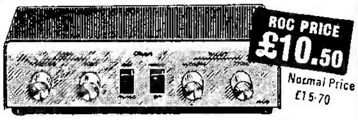
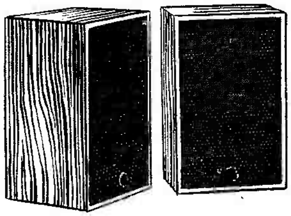


OLSON AM-400 4 WATT STEREO AMPLIFIER
Here's marvellous value for someone just starting to set themselves up in audio! At only £10·50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. 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, 2⅛" high, 4½" wide



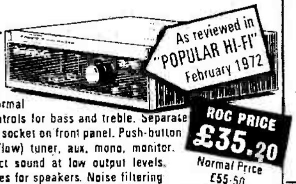
R.088 MATCHED STEREO LOUD SPEAKERS. Here's real value in stereo speakers! Each unit comes complete with 10-foot lead and phono plug, and look really smart. Power handling per speaker: 4 watts rms, 8 watts peak. Frequency range: 40-16,000 Hz. Flux density: 8,500 gauss. Impedance: 8 ohms. Dimensions: 9" high, 5½" wide, 4¾" deep. Finish: oiled walnut.
ROC PRICE £9·50 pair.
Normal Price £10·75

A-3000 36-WATT SOLID STATE STEREO AMPLIFIER
The A-3000 looks as good as it sounds! Giving you a big performance this superb audio amplifier has a full range of facilities on the front and rear panels. On the front – all the controls you're ever likely to need plus a headphone socket. On the rear – signal inputs, speaker outputs and a line fuse for circuit protection.
Specifications: 18 watts rms per channel into 8 ohms. Frequency response 20-35,000 Hz (± 2db) Inputs Magnetic, Ceramic, Tuner, Tape, Aux, Tape Play. Size: 345mm × 300mm × 130mm.

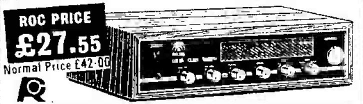
25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-5b

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.

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, 3½" high, 10½" deep.



PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16
This is one of the lowest priced stero 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, 4¼" high, 8" deep.

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 Sensitivites: FM, 3μV; AM, 250μV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11 1/16" wide, 4" high, 7½" deep.

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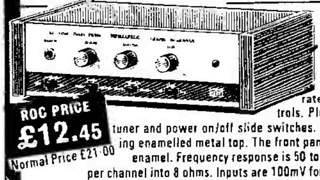
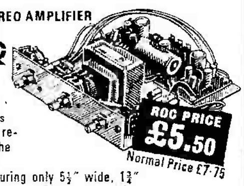


REALISTIC SA-100B 6-WATT STEREO AMPLIFIER
Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide × 3" high × 5¾" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/tuner and power on/off slide 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.



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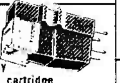

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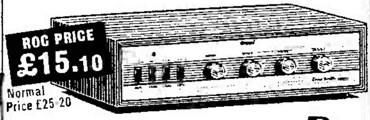

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Using Zener Diodes

J. N. WATT

THIS short article aims to bring to readers' attention some lesser known facts of zener diode operation—facts which are so useful when it comes to making the most of a voltage stabiliser or regulator.

Temperature

Almost all zener diodes, like other semiconductor diodes, have a temperature coefficient of voltage; that is, their exact voltage varies as their temperature varies. However, a study of manufacturers' literature shows that this temperature coefficient is by no means the same for all zener diodes and in fact varies with voltage as shown in Fig.1.

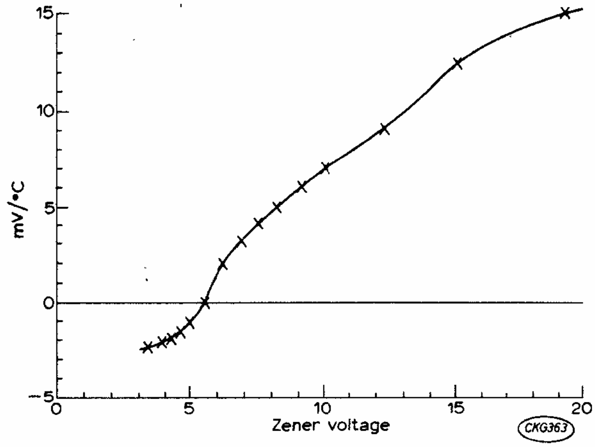

Fig. 1: Graph showing temperature coefficient for different zener voltages.

It can be seen that, at one particular zener voltage, namely 5·6V, this temperature coefficient is actually zero and that the coefficient becomes positive at higher voltages and negative at lower voltages. The values used to plot the graph were extracted from Mullard data but, in point of fact, all makes of zener diodes show this effect, which is presumably connected with the level of doping employed to obtain the various voltage ratings. Of what particular use is this information to the home experimenter?

Environment

Consider the environment in a motor-car. This could very easily range from 25°F to 85°F (−5°C to 30°C) and yet amateurs happily use a zener of any voltage thought appropriate, when, with a little further consideration, a higher performance could easily be obtained. For example, to stabilise a car battery supply at 10V for instrumentation, control or communication purposes, the use of 6·2V and 3·9V zeners in series will give an almost zero temperature coefficient, so contributing to the accuracy of any measurements and to the frequency stability of receiver local oscillators etc.

A further point of interest is that a forward biased silicon diode has a temperature coefficient of about −2·2mV/°C, so that such a diode used in series with a zener diode of 6·2V, see Fig.2, once again would give a zero temperature coefficient, this time with an output voltage of about 6·9V. Note that the forward biased diode can be the base-emitter junction of a silicon transistor if, for any reason, this is more convenient.

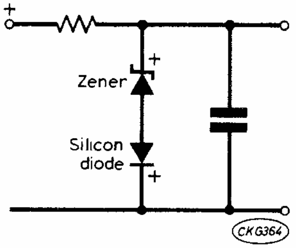

Fig. 2: Circuit illustrating the use of a forward biased diode and a zener diode in series.

So far, we have considered the effect of temperature on the actual voltage of a zener diode, using car applications as an example, but it should be remembered that almost any situation will experience temperature variations and the effect of these on any voltage regulators should not be overlooked. Steps to reduce any such voltage changes can then be taken, as described.

Stability

A further cause of disappointment in the voltage stability of zener diodes arises from the finite value of dynamic slope resistance of the zener. For example, in Fig.3a for a load of up to 20mA and a zener current of 5mA, resistance R is:—

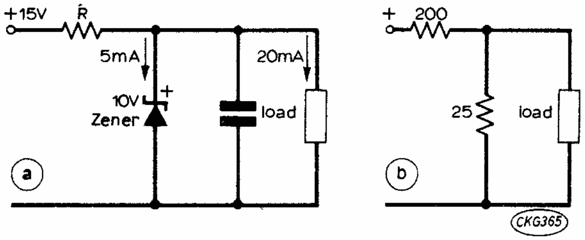

Fig. 3a: A typical zener diode application with Fig. 3b showing the effective dynamic equivalent circuit.

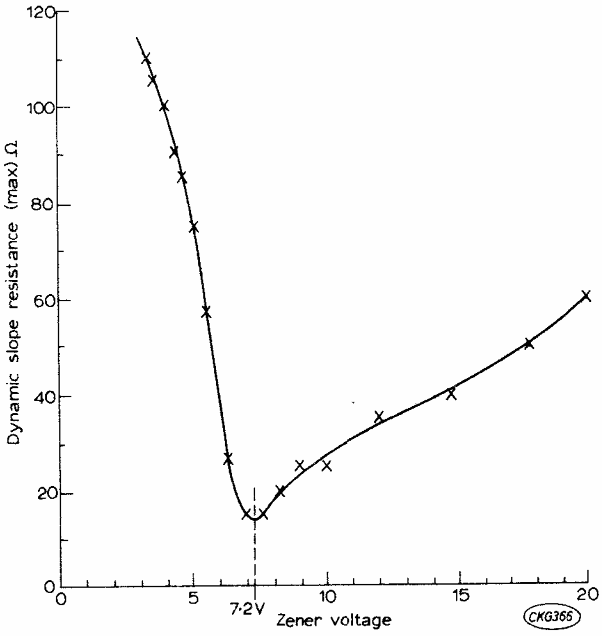

Fig. 4: Dynamic slope resistance of a range of zener diodes.

$$R = \frac{(15\text{-}10)10^3}{20+5} = 200\Omega$$

Now, a 10V 400mW zener can have, again according to Mullard data as plotted in Fig.4, a dynamic slope resistance of 25Ω. Thus, the effective *dynamic* equivalent circuit is as shown in Fig.3b. This leads to the result that, for a change in supply voltage Vi of 1V, the change in output voltage, Vo, will be:—

$$Vo = 1 \times \frac{25}{200+25} = 0{\cdot}11V$$

which is surprisingly high. A quick measurement confirmed such a value.

Output stability

A dramatic improvement in output voltage stability, as the input voltage varies, can be brought about by the use of a constant current circuit, provided that the load current to be supplied is almost constant. This is usually so where the zener diode is used to supply a reference voltage in a voltage regulator, and in supplies to receiver local oscillators, for example.

At very low zener voltages and, to some extent at the higher voltages also, quite large values of dynamic slope resistance are noted e.g. 85Ω at 4·7V and 60Ω at 20V so the constant current circuit of Fig.5 will greatly assist in providing voltage stability.

In this example, there is a load current of 10mA with 8mA zener current. Now, with a constant potential difference between transistor base and input voltage, due to the use of forward biased silicon diodes, and thus a constant difference between emitter and input voltage, a constant current *must* flow through the zener diode and load in parallel. Therefore, as the input voltage varies, the current through the zener hardly varies and we have *largely eliminated the effect of its dynamic slope resistance.*

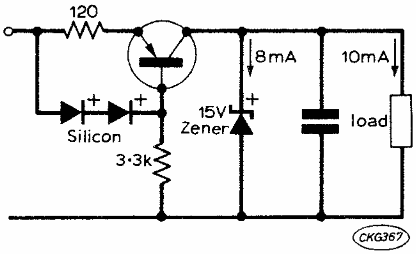

Fig. 5: In this circuit a constant current feed is provided for the zener diode.

Results

A series of measurement was made of the output voltage of the circuit of Fig.5, and of a simple resistance of 620Ω plus zener diode combination, as the input voltage was varied. The results are plotted in Fig. 6, where the remarkable improvement given by the constant current circuit is clearly seen.

A reduction of output voltage variation by a factor of about 30 over the range of 18V to 26V input voltage is surely well worth the additional complexity.

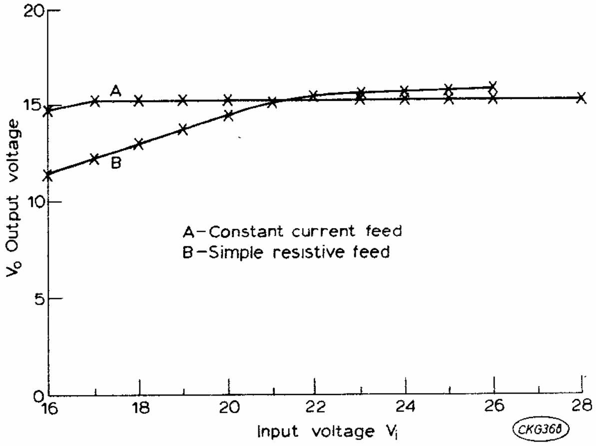

Fig. 6: Performance of zener stabilisers with constant current feed (A) and simple resistive feed (B).

It would doubtless have been possible to have extended the flatter part of curve B down to, say, 18V input voltage, but this would have required a very much smaller value of series resistor than the 620Ω actually employed in obtaining the curve of Fig.6. This would have probably called for the use of a zener diode of greater power rating, and yet it still would not have led to as good a performance as the constant current circuit.

If the zener diode so driven is employed to supply a reference voltage in a series stabilised power supply hum rejection is also greatly improved, for the constant current transistor has a very high output resistance, and this, together with the (relatively) low impedance of the zener diode, gives attenuation of ripple. This offers the chance to use smaller smoothing capacitors. A saving of space and money is the result, as well as improved performance.

One final point. In all the circuits given here a capacitor is shown across the zener diode. This is done since zener diodes are quite effective noise generators! The capacitor also helps to lessen any hum present if a poorly smoothed mains source of power is used with the simpler zener diode circuits. ■

THE Medium Wave Column

CHARLES MOLLOY

PETER WRIGHT of Formby, Lancashire has tried his PCR2 receiver and 50ft outdoor aerial on the medium waves at 0030hrs and he logged WINS 1010kHz located in New York City. Ian Geddes who lives in Dumbarton, Scotland reports CJON 930kHz in St John's Newfoundland; CHER 950kHz in Sydney Nova Scotia; CKBW 1000kHz Bridgewater N.S; CFRB 1010kHz Toronto; WOR 710kHz New York City; WOWO 1190Hz in Fort Wayne, Indiana; WABC 770kHz New York City; WKBW 1520kHz in Buffalo N.Y; WCKY 1530kHz Cincinatti, Ohio; WWVA 1170kHz Wheeling, West Virginia; WNEW 1130kHz New York City. Ian writes "CJON is the most consistent signal from midnight until 0200hrs". Others to listen for from midnight onwards are CBM 940kHz in Montreal; CBA 1070kHz Moncton, New Brunswick; WHN 1050kHz in New York City. A weak French-speaking station can often be heard on 1375kHz after the close down of Lille, France 1376kHz at 2300hrs. This is Radio St Pierre in the French Territory of St Pierre et Miquelon which lies a few miles to the south of Newfoundland. Radio St Pierre verifies readily and is the sole broadcaster on the islands which form a 'medium waves only' DX country.

Kevin Peel (Hornchurch Essex) has an 8 transistor Astrad receiver and a 100ft outdoor aerial and he heard the following broadcasts in English on the medium waves. Radio Portugal 755kHz at 2245hrs; Radio Tirana, Albania on 1394kHz at 2030hrs and Vatican Radio 1529kHz at 2045hrs. J. Cesarczyk (South Croydon) used his Grundig Elite Boy receiver with internal ferrite aerial to hear Radio Jerusalem 737kHz at 2230hrs (with interference from Warsaw and Madrid); Radio Bucharest, Romania 755kHz at 2050hrs; the Voice of America Kavalla, Greece 791kHz (in English at 2300hrs); VOA Rhodes 1259kHz (in English at 0300hrs); BBC World Service, Berlin on 809kHz (in English at 2315hrs after the close down of BBC R4).

During the evening quite a few distant stations can be found in the gaps between European channels. Baghdad, Iraq on 760kHz can be heard between West Germany on 755kHz and Sottons, Switzerland 764kHz and is usually on the air all evening with programmes in Arabic. Riyadh, Saudi Arabia is on 588kHz between Madrid 584kHz and Frankfurt 593kHz; Ovazim, Iran 841kHz is often strong when it signs-off at 2030hrs, listen between Nancy, France on 836kHz and Rome on 845kHz; Ahwaz, Iran can be found on 1394kHz in between Radio Centro Madrid 1385kHz and Albania on 1394kHz; the BBC relay on Masirah Island in the Persian Gulf (heard in English at 2040hrs) is on 1410kHz between the French network on 1403kHz and the Spanish channel on 1412kHz.

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

Electronotes..

S. GINSBERG

THE calculator market is flooded with many different types, each claiming some unique feature(s). Of particular interest to the buyers —us—is the price. News has now arrived from a semiconductor manufacturer that i.c. chips are currently in production which are so cheap that an electronic calculator could easily be manufactured and sold at a market price of less than £20.

There are four versions of the chip which are four-function (add, subtract, multiply and divide), eight-digit units with a seven segment output circuit. The entire electronics are housed on a chip area of only 166 x 162 millimetres.

In the United States these chips are already in production and coming off the line at the rate of some 75,000 every four weeks. The Company also reports that orders for the chips in the U.K. have already exceeded £100,000.

Heat sinks are comparatively uninteresting items of electronic hardware. Usually, they consist of a piece of metal often with fins protruding. Their purpose in life is to conduct heat and to dissipate it.

A new introduction is a hollow heat sink which spreads the heat evenly. The difference in temperature between the heat-producing element (say, a power transistor) and the furthest point on the heat sink is only around 1°C.

The heat sinks are fabricated rather like a hot water radiator. The hollow section is evacuated to a virtual vacuum. Water is then fed in. Because the air pressure is so low, the water boils. It then starts to lose heat and also gives off steam which condenses and turns back into water again. Eventually, equilibrium is established and the heat sink cools to room temperature.

The spread of heat on these sinks is extremely fast and the fins may be connected to the heat source by a pipe which has also been evacuated and filled with water. The fins may thus be located remotely from the heat source and the difference of 1°C holds over any part of the heat sinking system.

The cry still goes on about pollution, and electronics has come up with some useful ideas for monitoring. One research laboratory is busily engaged on producing an infra red diode which will emit radiation in the 3 to 6μm band. Carbon monoxide, carbon dioxide and hydrocarbons all absorb radiation strongly in this band and thus the amount of absorption of the radiation gives a measure of the pollution of these chemicals. Infra red diodes already exist, but they radiate at around 0·9μm and hence the need to design a new diode with radiation in the required region.

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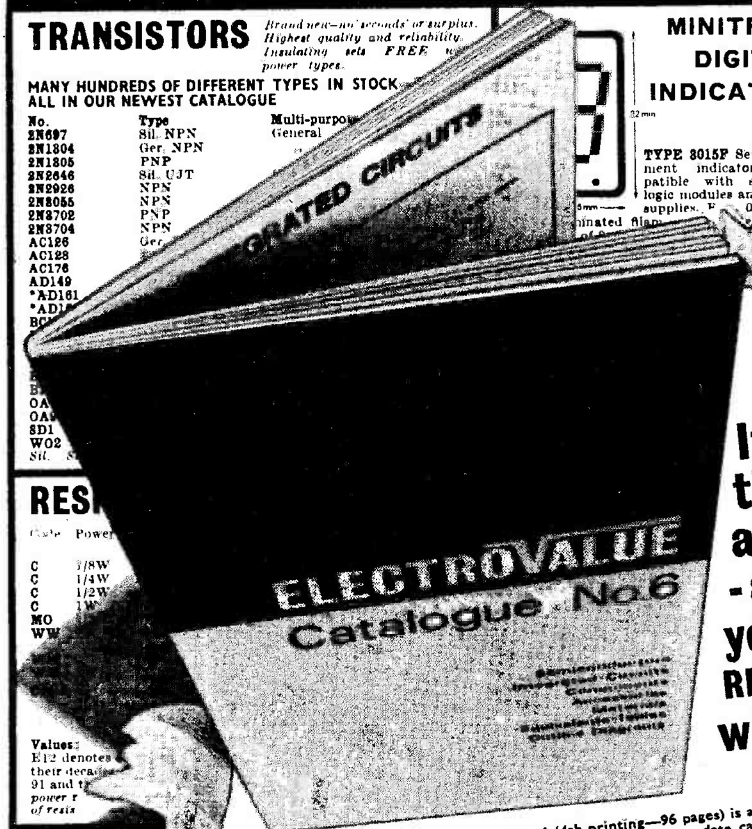

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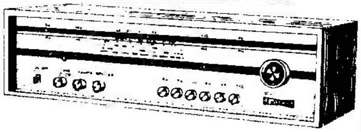

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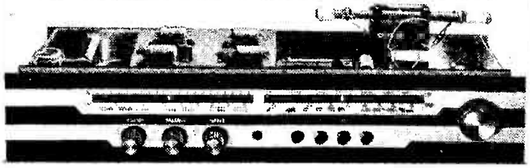

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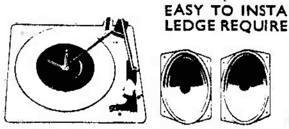

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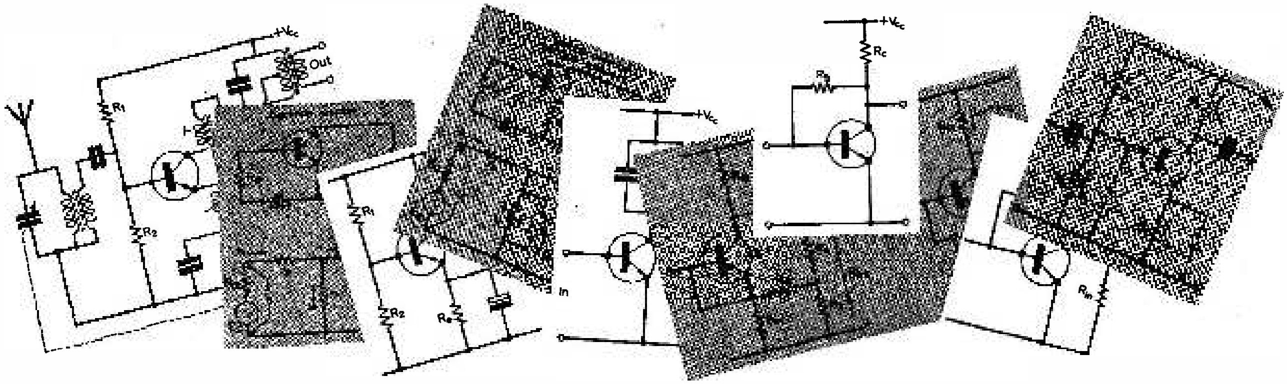

TRANSISTOR CIRCUITRY for beginners

PART 14

H.W. HELLYER & MICHAEL HOLLIER

Feedback etc.

Queries have arisen about our use of the term 'feedback' and its relation to equalisation. This month, while, at the time of writing, colleague Mike Hollier basks in holiday sunshine, seems as good a time as any to indulge myself in a little explanation of the terms we are using and why.

First, feedback. This is simply, as explained last month, a method of picking off part of the output from an amplifier and 'feeding it back' to the amplifier's input section. The feedback can be a simple resistor from collector to base of a single stage amplifier Fig. 67 (a), can be in series with the source signal (b) or in shunt with it (c).

Note that I have deliberately reverted to p.n.p. transistors in these examples. One reason is to remind you of the opening of this series of articles, where the precise examples were quoted; the other is to be able more easily to explain the action of the feedback. Here, I must insert the warning that people, like me, who were brought up on valves began to find difficulties with the revision of feedback concepts as applied to transistors, principally because the operation of transistor circuitry depends on the relationship of the 'circuit blocks' to each other. One has to consider the input and output 'loads' very much more than one did when dealing with valved circuits. So I use the germanium transistor circuits to lead into my subject—don't worry, it will get more complicated later on. . . .

The three examples of Fig. 67, are all of negative feedback. That is, the re-applied signal tends to reduce the gain of the amplifier. Its purpose, of course, is not *just* to reduce the gain but also to stabilise the circuit, help reduce noise and internally generated distortion. The feedback can be applied over several stages, not just the simple sub-circuit shown. And here it is shown as resistive feedback, i.e., effectively d.c. But we shall later be concerned with a.c. feedback, with capacitors in the loop, so that the amount of gain reduction varies as the frequency the circuit is handling also changes. Which will bring us to equalisation: which I would define as the application of frequency-dependent feedback.

Taking Fig. 67 in detail, (a) combines both a.c. and d.c. negative feedback if we insert a series capacitor (shown dotted) with the collector-base resistor R_F and retain the d.c. conditions by the negative feedback across the emitter resistor R_E. Apart from the emitter resistor effectively increasing th

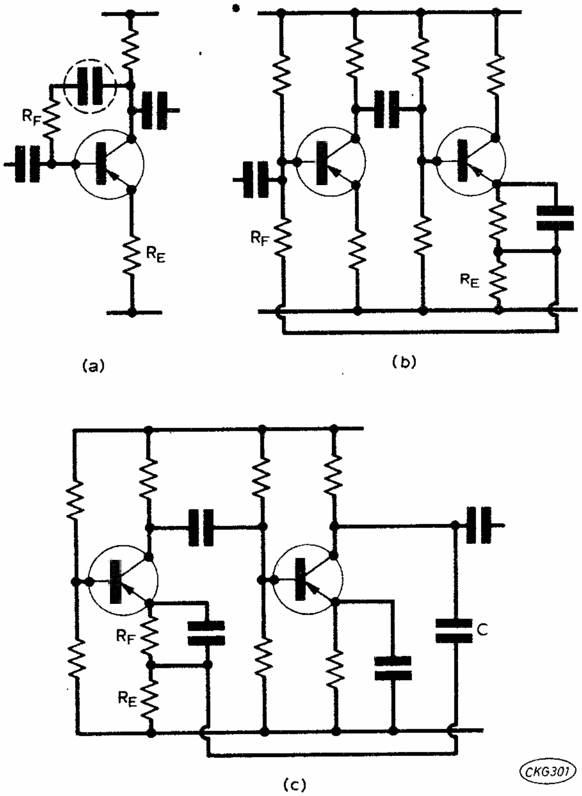

Fig. 67 (a): Simple collector/base negative feedback with d.c. blocking capacitor ringed. Change in value here affects a.c. feedback. (b) series feedback. (c) shunt feedback, from collector of second stage to emitter of first.

input resistance to the transistor, which is an advantage, it reduces the gain by being added to the denominator of the formula for voltage gain.

In the sub-circuit (b), the voltage developed across R_E is fed back in series with the lower part of the base bias potentiometer, the latter becoming R_F, and in (c), which is voltage feedback rather than current feedback, as before, R_E does its job in the first emitter while R_F picks off a portion of the amplified signal, the amount dependent on C, and modifies the reduction of gain which R_E is already effecting.

All this has been discussed before, and the relative figures and formulæ given in detail. It does not do us any good going over the same ground, but keep the above three examples in mind as basic 'styles' of feedback when we come to consider the action of equalising circuits. In talking of the virtual resistance circuits during Parts 11, 12 and 13 the point of relative gain with and without feedback, and the change in effective resistance should have been made clear.

Corrective feedback

Why do we want equalisation? If the source itself was 'linear', there would be no need of more or less gain at special frequencies. But there are reasons of plain mechanics and basic magnetics that demand the 'tailoring' of response curves of the input circuits of an amplifier.

Consider the case of a magnetic pick-up cartridge. Because of its construction—virtually a coil in which a moving metal piece causes a changing voltage by altering a magnetic field—and is therefore an inductance, not a pure resistance. The formula for the reactance (an a.c. term for resistance, no more) of a coil is $X_L = 2\pi fL$, where X is the reactance, f the frequency the coil is handling and L its inductance. We will neglect the small resistance of its windings in the case of the pick-up cartridge.

From this, we can see that the higher the frequency, the greater the reactance. So it would seem that our corrective feedback to handle an input from a cartridge need only reduce the gain in proportion to the frequency of the signal—which, in fact, it does.

But the problem is worse than this. To get the dynamic range on to the disc and to maintain as good a signal-to-noise ratio as possible, the bass is attenuated and the treble enhanced. By international agreement, the way in which this is done conforms pretty closely to a standard. This is the RIAA characteristic, Fig. 68.

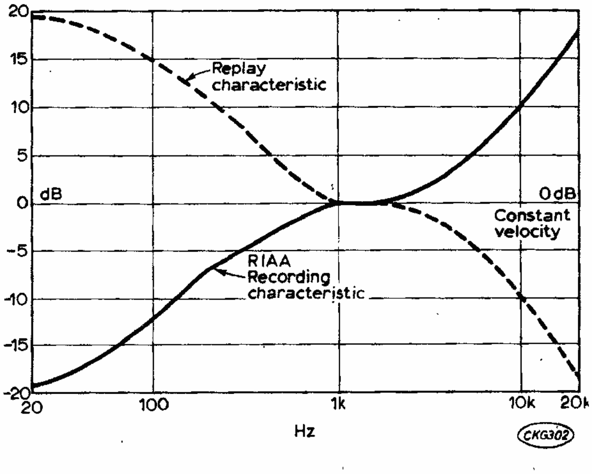

Fig. 68: RIAA recording characteristic as practically employed. Mirror image replay characteristic dotted. Note the short 'plateau' around 1kHz.

Modern discs are supposed to be recorded to this characteristic, although any enthusiast will tell you that there are some suspicious variations, difficult to prove except by comparison.

Unfortunately, a magnetic cartridge produces an output (voltage) proportional to its stylus movement. That is to say, it should. So if the characteristic is level, the output should be constant. Over a small portion of that given curve in Fig. 68 the characteristic is level, so testing only at this one frequency cannot give a true picture of the performance of either cartridge or pre-amplifier.

If we now consider how a disc is made, we shall see that the RIAA bass attenuation means that at frequencies below about 1kHz the velocity of the stylus will be reduced, although the amplitude remains constant, just as it very nearly remains constant at the higher frequencies, where the velocity now rises. In fact, the 'average' slope of the given curve is around 4dB per octave, instead of the more generally regarded 6dB per octave, which would be the ideal slope over the two nearly straight portions of the curve. (See also Fig. 71.)

To put matters in perspective, 6dB per octave means that the output voltage doubles for each octave upwards. So a bass note, say A4, the lowest of the white keys, whose frequency is 27·5Hz, giving, say, 1 millivolt at a certain loudness, would be compared with the top A on the piano 'third white note from the top, Joe', at a frequency of 3250Hz, would give 64mV if the original sound had been at the same level.

In fact, this circumstance would not so often apply, and our correction curve can be a replica of the original, mirrored, as shown dotted in Fig. 68 and the dynamic range could be left to take care of itself if the input sensitivity of the pre-amplifier and its overload characteristic are both in order. Too often, one or other is not.

As intimated in Part 11, one reason for the Cambridge style of virtual earth pre-amplifier was to achieve a very much better than usual overload performance. The average output of a magnetic cartridge is between 5 and 8mV (from a voltage output of between 1 and 1·5mV per centimetre per second of recorded velocity). But therein lies the rub.

Bass end overload

We have already seen that it is advisable in the interests of best signal handling to keep our variable controls (volume, tone and balance) after the input circuits. So our magnetic pickup circuit has to be able to handle signals from a couple of millivolts or less to 60mV or more. In practice, because there is bass boost applied during replay to make up for that attenuation during recording, the problem arises at the bass end, and we find that most pre-amplifiers will handle modern records if they have within a 3-30mV input sensitivity ratings. A 30dB overload rating is sometimes specified. If you consider that maximum velocity at 1kHz could be around 25cm/sec and that a cartridge with an output as

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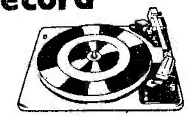

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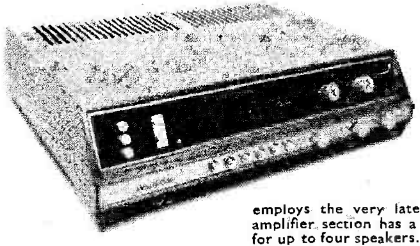

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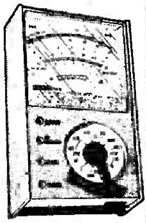

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1·5mV/cm/S would give 38mV from such a recorded groove, you can see that distortion on signal peaks would be inevitable, as this would require an overload rating of some 38dB.

So the overload safety margin diminishes toward the lower end of the frequency spectrum, and this is where mains hum, disc rumble, turntable rumble and other problems can rear their ugly heads. Hence the need, when we design our 'front-end' amplifiers to ensure that we get good gain figures before applying our feedback—and, what is more, a stable amplifier without (or with minimum) feedback, for it is precisely at this dangerously low end of the spectrum that the feedback will be least.

This is not the place to go on about cartridges, but I hope I have helped clear up a few of those queries about the need for good basic pre-amplifier design as well as the application of very precise feedback. And perhaps dropped a few hints about choice of pickup: if you have an amplifier with a sensitive magnetic pickup pre-amplifier and shove a high output cartridge into it, you can expect a bit of bass overload. As this occurs before any control you can apply, there is no real cure except correct matching.

In practice

One could quote extensively from commercial circuits to prove a point, but to combine our previous talk about virtual earth circuits and to use a design which has been proven by constructors, let me cite the modular pre-amplifier by John L. Linsley Hood, which appeared first in *Wireless World* in July 1969, and which, although parts have been modified since, happens to suit our purpose. Mr. Hood has kindly consented to allow us to quote him.

Fig. 69 shows his basic concept of a stage used to obtain the RIAA replay characteristic. Looking at it carefully, we see that it is again a virtual earth design, with point X the null point, provided the gain of the amplifier is high enough. The input impedance of the circuit will be approximately equal to that of the input network R1/C1. The load resistance of a magnetic cartridge is around 47kΩ at 1kHz, and provided C2 is large enough and R2 equal to R1, C3 relatively small in relation to R2 (at 1kHz), stage gain can be given approximately by R4+R5/R5.

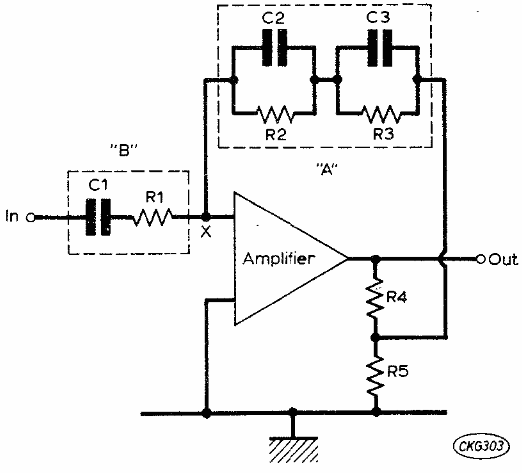

Fig. 69: Frequency selective feedback to achieve the RIAA replay characteristic, applied around a virtual earth amplifier.

The designer aimed at a gain of 10, this being deemed sufficient to deal with outputs between 4 and 10mV. The frequency response is determined by the two networks 'A' and 'B', shown in dotted 'boxes' in Fig. 69. In this idealised state, the circuit is not entirely practical, of course. Fig. 70 shows the actual circuit, drawn so that these frequency corrective components are at the front.

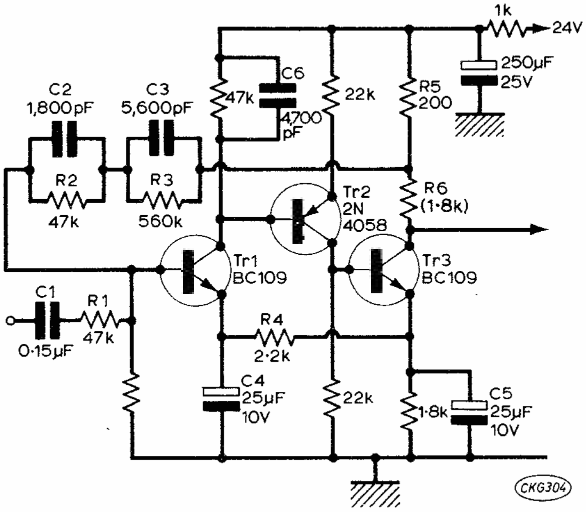

Fig. 70: The redrawn circuit of Fig. 69, part of the J. L. Linsley Hood modular pre-amplifier.

But we must also consider the effect of C4 and C5, which, in conjunction with C1 and R4, give a steep-cut rumble filter (18dB/octave) with an attenuation of more than 40dB at 8Hz and a turnover point of 25Hz. The results can be seen in the RIAA replay curve, measured from the pre-amp, in Fig. 71.

Two things remain to be mentioned. C6 is put across the collector load of the first transistor to sharpen up the transient response: the dotted curve

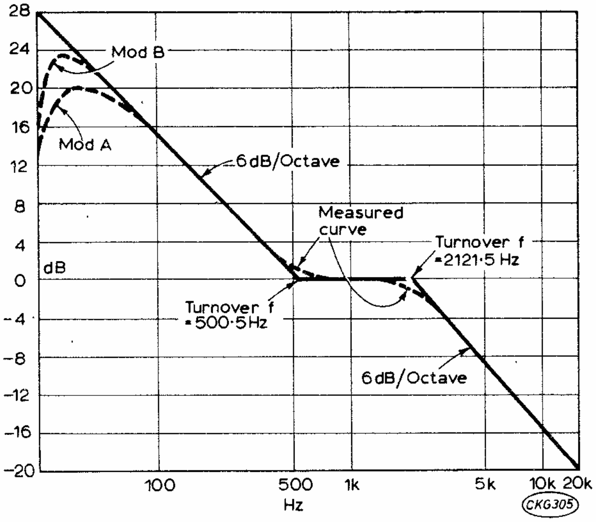

Fig. 71: Theoretical RIAA replay response curve with measured deviations. Bass roll-off is deliberately obtained by component changes.

at the bass end of this curve is in two parts. The lower is for the circuit shown; the higher, for a modified circuit. The last because the author (Mr. J. L. Linsley Hood), suspects that sufficient recording bass lift is not always given to accord with RIAA standards, and he consequently changed some values of his feedback components to get a flatter response down to 25Hz with a steeper roll-off as a protection against rumble.

These changes were as follows: R5—470Ω, R6—1·5kΩ, C1—0·47μF, C3—6,800pF and C6—6,800pF.

These modifications reduce the gain, and he has thus added a sub-circuit that we can now include in our armoury—the floating emitter, collector-follower. We show his addition in Fig. 72.

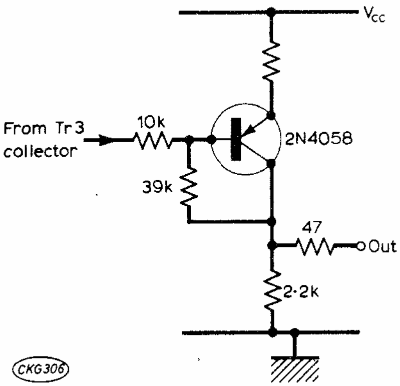

Fig. 72: A floating emitter collector-follower stage added to compensate for loss of gain.

Coping with the outputs of both magnetic and ceramic pick-up cartridges may seem a bit ambitious and, as done commercially, is not always very effective. But one can do it by switching those networks, 'A' and 'B' of our Fig. 69.

A ceramic cartridge normally likes to 'see' an impedance of a megohm or more at the amplifier input and as it is a capacitative device will suffer from low-frequency loss if this input is reduced. Hence the poor performance of many cheap record players, which have to suffer the design constrictions of transistor amplifiers with high input impedance, while retaining the best possible gain and noise performance. By using the virtual earth configuration, one gets over this problem neatly and the three suggested sub-circuit alterations by Mr. Hood are shown in Fig. 73. Here we have (a) a network that will retain the curve sensibly level down to about 30Hz, with the bass roll-off now made better by halving the values of C4 and C5 as well. And (b), a change to network 'B', while 'A' is as in the first modification. This is a suggestion by the author to obtain a 6dB/octave rise, followed by a level response, making a 'platform' over the portion of the replay curve of Fig. 68 that is fairly level from around 1kHz to around 2kHz.

To get even more treble response, without nasty peaks, i.e., to give this same 'platform' effect to a 12dB level after about 4kHz, (c) is suggested. The reason for these changes is to equalise for the 12dB drop in voltage anticipated when an RIAA recording (having velocity characteristics) is replayed with a displacement-sensitive device, such as a piezo-electric cartridge. As you can see, the modification entails shunting part of the input resistor with a small capacitor.

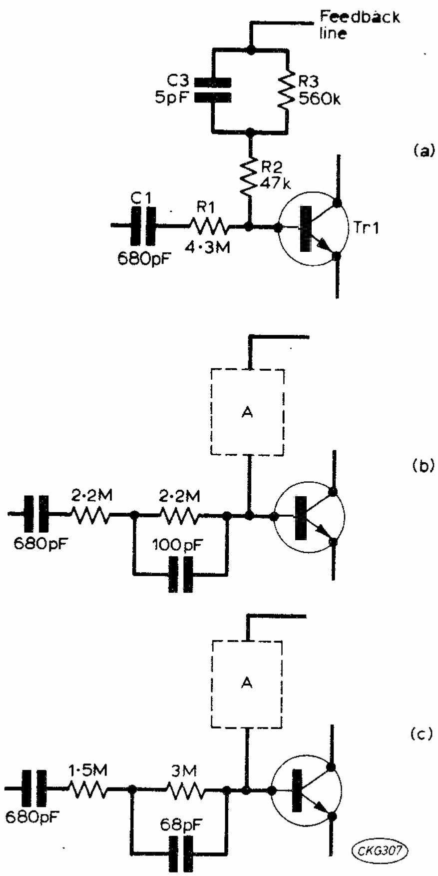

Fig. 73: Circuit changes to permit a ceramic cartridge to be fed into the same amplifier with (a) level response above 35Hz (b) a 6dB lift from 1 to 2kHz and (c) a 12dB lift at 6dB/octave, followed in each case a level response.

This, finally, brings me to the point that Mike asked me to make after last month's contribution had made its way irrevocably to the printers, viz., a capacitor shunted across the feedback resistor will give treble reduction while if it is across the input series resistor it gives treble lift, as in this previous example.

Just thought you'd like to know . . . !

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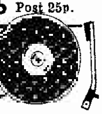

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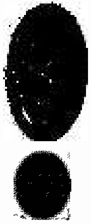

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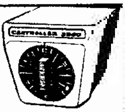

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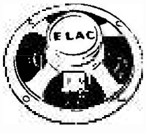

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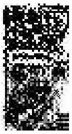

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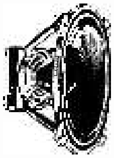

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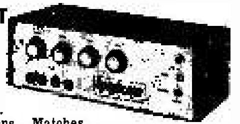

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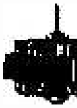

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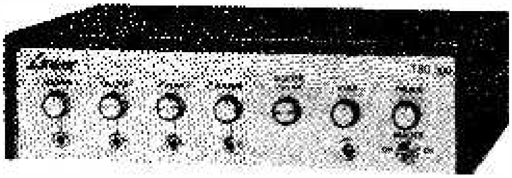

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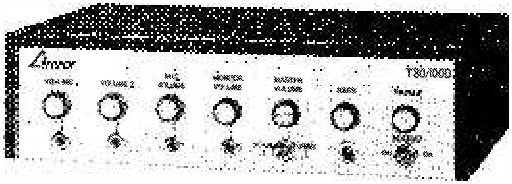

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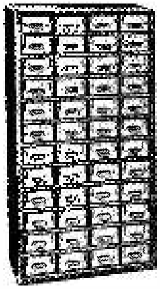

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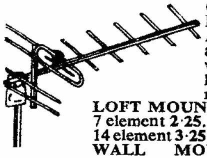

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AC168	0·24
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AC179	0·28
AC180	0·17
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AC181K	0·20
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ACY29	0·35
ACY30	0·28
ACY31	0·28
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AF179	0·50
AF180	0·50
AF181	0·45
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ASY54	0·25
ASY55	0·25
ASY56	0·25
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BC108	0·09
BC109	0·10
BC113	0·10
BC114	0·15
BC115	0·15
BC116	0·15
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BD198	0·90
BD199	0·95
BD200	0·95
BD205	0·80
BD206	0·80
BD207	0·95
BD208	0·95
BDY20	1·00
BF115	0·24
BF117	0·45
BF118	0·70
BF119	0·70
BF121	0·45
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BF259	0·85
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BF263	0·55
BF270	0·35
BF271	0·30
BF272	0·80
BF273	0·35
BF274	0·35
BFW10	0·60
BFX29	0·27
BFX84	0·22
BFX85	0·30
BFX86	0·22
BFX87	0·24
BFX88	0·22
BFY50	0·20
BFY51	0·20
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BPX25	0·85
BSX19	0·15
BSX20	0·15
BSY25	0·15
BSY26	0·15
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BSY39	0·18
BSY40	0·28
BSY41	0·28
BSY95	0·12
BSY95A	0·12
Bu105	2·00
C111E	0·50
C400	0·30
C407	0·25
C424	0·20
C425	0·50
C426	0·35
C428	0·20
C441	0·30
C442	0·30
C444	0·35
C450	0·22
MAT100	0·19
MAT101	0·20
MAT120	0·19
MAT121	0·20
MPF102	0·42
MPF104	0·37
MPF105	0·37
OC19	0·35
OC20	0·63
OC22	0·38
OC23	0·42
OC24	0·56
OC25	0·38
OC26	0·25
OC28	0·50
OC29	0·50
OC35	0·42
OC36	0·50
OC41	0·20
OC42	0·24
OC44	0·15
OC45	0·12
OC70	0·10
OC71	0·10
OC72	0·14
OC74	0·14
OC75	0·15
OC76	0·15
OC77	0·25
OC81	0·15
OC81D	0·15
OC82	0·15
OC82D	0·15
OC83	0·20
OC84	0·20
OC139	0·20
OC140	0·20
OC169	0·25
OC170	0·25
OC171	0·25
OC200	0·25
OC201	0·28
OC202	0·28
OC203	0·25
OC204	0·25
OC205	0·35
OC309	0·40
P346A	0·20
P397	0·42
OCP71	0·43
ORP12	0·43
ORP60	0·40
ORP61	0·40
ST140	0·12
ST141	0·17
TIS43	0·30
UT46	0·27
2G301	0·09
2G302	0·19
2G303	0·19
2G304	0·24
2G306	0·40
2G308	0·35
2G309	0·35
2G339	0·20
2G339A	0·16
2G344	0·18
2G345	0·16
2G371	0·16
2G371B	0·12
2G373	0·17
2G374	0·17
2G377	0·30
2G378	0·16
2G381	0·16
2G382	0·16
2G401	0·30
2G414	0·30
2G417	0·25
2N388	0·35
2N388A	0·55
2N404	0·20
2N404A	0·28
2N524	0·42
2N527	0·49
2N598	0·42
2N599	0·45
2N696	0·12
2N697	0·13
2N698	0·24
2N699	0·35
2N706	0·08
2N706A	0·09
2N708	0·12
2N711	0·30
2N717	0·35
2N718	0·24
2N718A	0·50
2N726	0·28
2N727	0·28
2N743	0·20
2N744	0·20
2N914	0·14
2N918	0·30
2N929	0·21
2N930	0·21
2N1131	0·20
2N1132	0·22
2N1302	0·14
2N1303	0·14
2N1304	0·17
2N1305	0·17
2N1306	0·21
2N1307	0·21
2N1308	0·23
2N1309	0·23
2N1613	0·20
2N1711	0·20
2N1889	0·32
2N1890	0·45
2N1893	0·37
2N2147	0·72
2N2148	0·57
2N2160	0·60
2N2192	0·35
2N2193	0·35
2N2194	0·35
2N2217	0·22
2N2218	0·20
2N2219	0·20
2N2220	0·22
2N2221	0·20
2N2222	0·20
2N2368	0·17
2N2369	0·14
2N2369A	0·14
2N2411	0·24
2N2412	0·24
2N2646	0·47
2N2711	0·21
2N2712	0·21
2N2714	0·21
2N2904	0·17
2N2904A	0·21
2N2905	0·21
2N2905A	0·21
2N2906	0·15
2N2906A	0·18
2N2907	0·20
2N2907A	0·22
2N2923	0·14
2N2924	0·14
2N2925	0·14
2N2926 (G)	0·12
2N2926 (Y)	0·11
2N2926 (O)	0·10
2N2926 (R)	0·10
2N2926 (B)	0·10
2N3010	0·70
2N3011	0·14
2N3053	0·17
2N3054	0·46
2N3055	0·50
2N3391	0·14
2N3391A	0·16
2N3392	0·14
2N3393	0·14
2N3394	0·14
2N3395	0·17
2N3402	0·21
2N3403	0·21
2N3404	0·28
2N3405	0·42
2N3414	0·15
2N3415	0·15
2N3416	0·28
2N3417	0·28
2N3525	0·75
2N3646	0·09
2N3702	0·10
2N3703	0·10
2N3704	0·11
2N3705	0·10
2N3706	0·09
2N3707	0·11
2N3708	0·07
2N3709	0·09
2N3710	0·09
2N3711	0·09
2N3819	0·28
2N3820	0·50
2N3821	0·35
2N3823	0·28
2N3903	0·28
2N3904	0·30
2N3905	0·28
2N3906	0·27
2N4058	0·12
2N4059	0·10
2N4060	0·12
2N4061	0·12
2N4062	0·12
2N4284	0·17
2N4285	0·17
2N4286	0·17
2N4287	0·17
2N4288	0·17
2N4289	0·17
2N4290	0·17
2N4291	0·17
2N4292	0·17
2N4293	0·17
2N5172	0·12
2N5457	0·32
2N5458	0·32
2N5459	0·40
2S301	0·50
2S302A	0·42
2S302	0·42
2S303	0·55
2S304	0·70
2S305	0·84
2S306	0·84
2S307	0·84
2S321	0·56
2S322	0·42
2S322A	0·42
2S323	0·56
2S324	0·70
2S325	0·70
2S326	0·70
2S327	0·70
2S701	0·42
40361	0·40
40362	0·45

DIODES AND RECTIFIERS

AA119	0·08
AA120	0·08
AA129	0·08
AAY30	0·09
AAZ13	0·10
BA100	0·10
BA116	0·21
BA126	0·22
BA148	0·14
BA154	0·12
BA155	0·14
BA156	0·13
BY100	0·15
BY101	0·12
BY105	0·17
BY114	0·12
BY126	0·14
BY127	0·15
BY128	0·15
BY130	0·16
BY133	0·21
BY164	0·50
BYX38/30	0·42
BYZ10	0·35
BYZ11	0·30
BYZ12	0·30
BYZ13	0·25
BYZ16	0·40
BYZ17	0·35
BYZ18	0·35
BYZ19	0·28
CG62 (Eg) OA91	0·05
CG651 (Eq) OA70-OA79	0·06
OA5	0·35
OA5SL	0·21
OA10	0·35
OA47	0·07
OA70	0·07
OA79	0·07
OA81	0·07
OA85	0·09
OA90	0·06
OA91	0·06
OA95	0·07
OA200	0·06
OA202	0·07
SD10	0·05
SD19	0·05
IN34	0·07
IN34A	0·07
1N914	0·06
1N916	0·06
IN414B	0·06
IS021	0·10
IS951	0·06

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C 8	10	Reed Switches	0·50
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C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·50
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C16	20	Assorted Tag Strips & Panels	0·50
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R.M.S.
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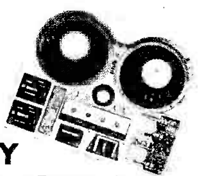

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PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·23	0·25	0·35	0·35	0·47	0·50	0·53	1·15
100	0·25	0·33	0·47	0·47	0·50	0·58	0·63	1·40
200	0·35	0·37	0·49	0·49	0·57	0·61	0·75	1·60
400	0·43	0·47	0·56	0·56	0·67	0·75	0·93	1·75
600	0·53	0·57	0·68	0·68	0·77	0·97	1·25	—
800	0·63	0·70	0·80	0·80	0·90	1·20	1·50	4·00

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·05	0·05	0·07	0·14	0·21	0·60
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·25	0·34	0·45	1·86
800	0·10	0·17	0·11	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·14	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·38	0·57	0·75	—

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VBOM	2A TO-1	6A TO-66	10A TO-88
	£p	£p	£p
100	30	50	76
200	50	60	90
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T5	8	2G382T	OC82
T6	8	2G344B	OC44
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Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

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2-33V. 400mV (DO-7 Case) **13p** ea. 1½W (Top-Hat) **18p** ea. 10W (SO-10 Stud) **25p** ea. All fully tested 5% tol. and marked. State voltage required.

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 90p each

NEW LINE

Plastic Encapsulated
2 Amp. BRIDGE RECTS.

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100 v RMS	37p ,,
400 v RMS	46p ,,

Size 15 mm × 6 mm.

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ORP60, ORP61 **40p** each

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100	For	1·75
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POWER TRANS BONANZA!

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2N3055

115 WATT SIL POWER NPN 50p EACH

AD161/162 *PNP*

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U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·50
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U33	15	Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·50
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 2S302/4	0·50
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·50
U36	25	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·50
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Code No's. 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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UIC01	=12×7401	0·50	UIC47	=5×7447	0·50	UIC90	=5×7490	0·50
UIC02	=12×7402	0·50	UIC48	=5×7448	0·50	UIC91	=5×7491	0·50
UIC03	=12×7403	0·50	UIC50	=12×7450	0·50	UIC92	=5×7492	0·50
UIC04	=12×7404	0·50	UIC51	=12×7451	0·50	UIC93	=5×7493	0·50
UIC05	=12×7405	0·50	UIC53	=12×7453	0·50	UIC94	=5×7494	0·50
UIC06	=8×7406	0·50	UIC54	=12×7454	0·50	UIC95	=5×7495	0·50
UIC07	=8×7407	0·50	UIC60	=12×7460	0·50	UIC96	=5×7496	0·50
UIC10	=12×7410	0·50	UIC70	=8×7470	0·50	UIC100	=5×74100	0·50
UIC13	=8×7413	0·50	UIC72	=8×7472	0·50	UIC121	=5×74121	0·50
UIC20	=12×7420	0·50	UIC73	=8×7473	0·50	UIC141	=5×74141	0·50
UIC30	=12×7430	0·50	UIC74	=8×7474	0·50	UIC151	=5×74151	0·50
UIC40	=12×7440	0·50	UIC75	=8×7475	0·50	UIC154	=5×74154	0·50
UIC41	=5×7441	0·50	UIC76	=8×7476	0·50	UIC193	=5×74193	0·50
UIC42	=5×7442	0·50	UIC80	=5×7480	0·50	UIC199	=5×74199	0·50
UIC43	=5×7443	0·50	UIC81	=5×7481	0·50			
UIC44	=5×7444	0·50	UIC82	=5×7482	0·50	UICXI	=25 Assorted 74's	1·50
UIC45	=5×7445	0·50	UIC83	=5×7483	0·50			

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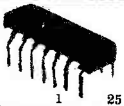

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SN7409	0·18	0·17	0·16	SN7475	0·45	0·43	0·42	SN74157	£1·90	£1·80	£1·70
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SN7432	0·45	0·42	0·40	SN7494	0·77	0·74	0·68	SN74182	£2·00	£1·80	£1·60
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SN7448	£1·00	0·97	0·95	SN74122	£1·40	£1·30	£1·10				

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BP 709P—µA709C	36p	34p	30p
BP 710—72710	44p	42p	40p
BP 711—µA711	45p	43p	40p
BP 741—72741	75p	60p	50p
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TAA 350	170p	158p	150p

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Type No.	Price 1–24	25–99	100 up
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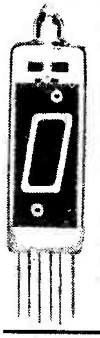
BP945	25p	24p	22p
RP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

NUMERICAL INDICATOR TUBES



MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
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All indicators 0·9 + Decimal point. All side viewing. Full data for all types available on request.

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Epoxy TO-5 case	Price each 1–24	25–99	100 up
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THE AL50

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- ★ Distortion—better than ·1% at 1KHz.
- ★ Signal to noise ratio 80dB.

ONLY £3.25p each

- ★ Supply voltage 10–35 Volts.
- ★ Overall size 63mm × 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.F. amplification needs.
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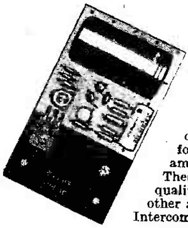

STABILISED POWER MODULE SPM80

AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
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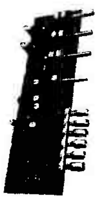
TRANSFORMER BMT80 £1·95 p. & p. 25p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market. the PA100 stereo pre-amplifier has been conceived from the latest circuit tecniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100. which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble oontrols.



SPECIFICATION

Frequency Response	20Hz — 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs : 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters : Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than — 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

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U	5½x4½x4½"	£1·15	Y	13x7x9"	£3·15
U	8x6x6"	£1·45	Y	15x9x7"	£3·35
U	9¼x7½x3½"	£1·55	Z	17x10x9"	£4·15
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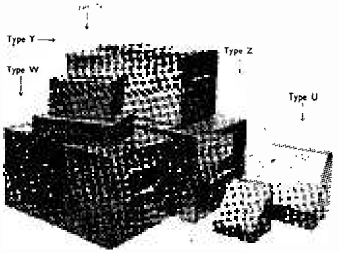

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8x4x2"	38p	19p	13x8x2½"	76p	38p
8½x5½x2"	44p	21p	14x7x3"	80p	36p
9x7x2"	50p	26p	14x10x2½"	88p	47p
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EBF83	.38
EBF89	.26
EBL21	.60
EC86	.59
EC88	.59
EC92	.34
ECC33	1.50
ECC35	·95
ECC40	.60
ECC81	.16
ECC82	.19
ECC83	.21
ECC84	·28
ECC85	.32
ECC88	.35
ECC189	.48
ECC807	1.70
ECF80	.27
ECF82	.25
ECF86	.64
ECF804	2.10
ECH21	.68
ECH35	.50
ECH42	.57
ECH81	.25
ECH83	.38
ECH84	.34
ECL80	.28
ECL82	.28
ECL83	.52
ECL84	.54
ECL85	.54
ECL86	.33
EF22	.63
EF40	.49
EF41	.58
EF42	.33
EF73	·75
EF80	.21
EF83	.54
EF85	.25
EF86	.27
EF89	.23
EF91	.17
EF92	.28
EF98	.65
EF183	.25
EF184	.27
EH90	.34
EL32	·18
EL34	.44
EL35	1.00
EL37	·74
EL41	.53
EL81	.50
EL83	.38
EL84	.21
EL85	.40
EL86	.38
EL91	.23
EL95	.32
ELL80	·75
EM80	.37
EM81	.37
EM83	.75
EM84	.31
EM85	1.00
EM87	.34
EY51	.29
EY81	.35
EY83	.54
EY84	.50
EY87/6	.27
EY88	.40
EZ40	.40
EZ41	.42
EZ80	.19
EZ81	.20
GY501	.75
GZ30	.33
GZ32	.39
GZ33	.70
GZ34	.47
GZ37	.67
HABC80	.44
HL23DD	.40
HL41DD	.98
HL42DD	.50
HN309	1·40
HVR2	.53
HVR2A	.53
KT2	.25
KT41	.98
KT44	1.00
KT66	·80
KT81	2.00
KTW61	.63
KTW62	.63
KTW63	.50
MHLD6	.75
P61	.44
PABC80	.32
PC86	.44
PC88	.44
PC95	.53
PC97	.36
PC900	.29
PCC84	.27
PCC85	.24
PCC88	.39
PCC89	.42
PCC189	.46
PCF80	.26
PCF82	.30
PCF84	.40
PCF86	.44
PCF200	.67
PCF801	.28
PCF802	.37
PCF806	.55
PCH200	.62
PCL82	.29
PCL83	.54
PCL84	.32
PCL805/85	.37
PCL86	.36
PD500	1.44
PEN4DD	1.38
PEN45	.40
PEN45DD	.75
PEN46	.20
PEN453DD	.98
PENDD-4020	.88
PFL200	.50
PL33	.38
PL36	.46
PL81	.42
PL81A	.48
PL82	.28
PL83	.30
PL84	.28
PL504/500	·60
PL505	1.30
PL508	.90
PL509	1.30
PL802	.75
PM84	.31
PY33/2	.50
PY80	.33
PY81	.24
PY82	.23
PY83	.26
PY88	.31
PY500	.95
PY800	.31
PY801	.31
PZ30	.48
QQV03/10	1.20
QS75/20	.63
QS95/10	.49
QV04/7	.63
R19	.28
SP61	.33
TH233	.98
TP2620	.98
UABC80	.30
UAF42	.49
UBC41	.45
UBC81	.40
UBF80	.28
UBF89	.28
UBL21	.55
UC92	.35
UCC84	.33
UCC85	.33
UCF80	.31
UCH21	.60
UCH42	.57
UCH81	.29
UCL82	.30
UCL83	.48
UF41	.50
UF42	.60
UF80	.35
UF85	.34
UF86	.63
UF89	.27
UL41	.54
UL84	.28
UM80	.33
UY41	.38
UY85	.23
U10	.45
U12/14	.38
U19	1.73
U25	.62
U26	.53
U191	.56
U251	.62
U301	·40
U403	.33
U404	.38
U801	.76
U4020	.38
VP23	.40
VP41	.38
VT61A	.35
VU111	.44
VU120	.60
VU120A	.60
VU133	.35
W107	.50
W729	.60
X66	.50
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2N966	·53
2N1756	·50
2N2147	·85
2N2297	.23
2N2369	.22
2N2613	·39
2N3053	.33
2N3121	2·50
2N3703	·19
2N3709	.20
2N3988	.50
2S323	.50
AA119	·15
AA120	·15
AA129	·15
AAZ13	.18
AC107	.15
AC113	.25
AC126	.13
AC127	.17
AC128	.20
AC132	·20
AC154	.25
AC156	.20
AC157	.25
AC165	.25
AC166	.25
AC168	.38
AC176	.55
AC177	.28
ACY17	.25
ACY18	.20
ACY19	.19
ACY20	.18
ACY21	.19
ACY22	.15
ACY28	.18
AD140	.36
AD149	.50
AD161	.45
AD162	.45
ADT140	.63
AF106	.50
AF114	.25
AF115	.15
AF117	.19
AF121	.30
AF124	.25
AF125	.17
AF126	.18
AF139	.65
AF178	.68
AF180	.48
AF186	.55
AF239	.38
BA102	.45
BA115	.14
BA116	.25
BA129	.13
BA130	.10
BA153	.15
BC107	.13
BC108	.13
BC113	.25
BC115	.15
BC116	.25
BC118	.23
BCY10	.45
BCY12	.50
BCY33	.20
BCY34	.23
BCY38	.23
BCY39	.25
BCZ11	.38
BF158	29
BF159	.25
BF163	.20
BF173	.38
BF180	.30
BF181	.40
BF185	.40
BF194	.15
BFY50	.23
BFY51	.19
BFY52	.20
BY100	.18
BY105	.18
BY114	.18
BY126	.15
BY127	.18
BYZ10	.25
BYZ11	.25
BYZ12	.25
BYZ13	.25
CG12E	.20
FSY11A	.23
FSY41A	.23
GD9	.20
GET113	.20
GET118	.20
GET119	.20
GET573	.38
GET587	.43
GET873	.15
GET887	.23
GET897	.23
GET898	.23
M1	.15
OA5	.28
OA9	.13
OA10	.43
OA47	.10
OA70	.15
OA73	·15
OA79	.09
OA81	.09
OA85	.08
OA90	.13
OA91	.09
OA95	.09
OA200	.09
OA202	.10
OC22	.38
OC23	.38
OC24	.38
OC25	.38
OC28	.60
OC29	.63
OC35	.32
OC36	.43
OC42	.63
OC44	.10
OC45	.11
OC46	.15
OC70	.13
OC71	.11
OC72	.11
OC74	.23
OC75	.11
OC76	.15
OC77	.27
OC78	.15
OC78D	.15
OC81	.11
OC81D	.11
OC82	.11
OC82D	.11
OC83	.20
OC84	.24
OC123	.23
OC139	.23
OC140	.95
OC169	.23
OC172	.35
OC200	.22
OC201	.38
OC202	.43
OC203	.30
OC204	.30
OC205	.43
ORP12	.53

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Carr. 40p **PS 50/50** Supply **£9·68**. Carr. 65p

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Hum & Noise: Better than −70dB.
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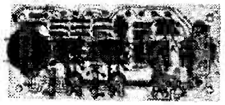

These exceptional units are constructed on glass fibre P.C. board. Triacs are used giving full wave control. Operating sensitivity only ¼ Watt! Full interference suppression.

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AC176	**15p**	BC108	**10p**	OA91	**7p**
AD161	**30p**	BC109	**10p**	BY100	**15p**
AD162	**30p**	BC113	**10p**	IN914	**6p**
AF115	**20p**	BC148	**10p**	IN4001	**6p**
AF116	**20p**	BF195	**15p**	IN4007	**12p**
AF117	**20p**	2N2926g	**10p**	ORP12	**50p**
		2N3055	**50p**		

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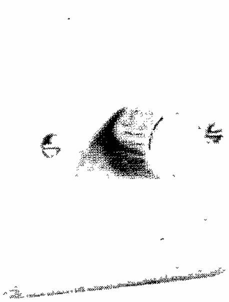

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12V × 2	1A × 2	MT 71 AT‡	£1·48	24p
12V × 2	2A × 2	MT 18 AT	£2·06	30p
12V × 2	3A × 2	MT 70 AT	£2·59	32p
12V × 2	4A × 2	MT 108 AT	£2·92	34p
12V × 2	5A × 2	MT 72 AT	£3·33	42p

30 volts. All tapped at 0-12-15-20-24-30V

Output Amps.	Ref. No.	Price £	P.P.	Output Amps.	Ref. No.	Price £	P.P
500 mA	MT 112 CT‡	1·12	16p	3A	MT 20 AT	2·64	32p
1A	MT 79 AT‡	1·55	29p	4A	MT 21 AT	3·10	40p
2A	MT 3 AT	2·23	30p	5A	MT 51 AT	4·31	42p

50 volts. All tapped at 0-19-25-33-40-50V.

500 mA	MT 102 AT‡	1·45	24p	3A	MT 105 AT	3·91	41p
1A	MT 103 AT	2·00	32p	4A	MT 106 AT	5·06	41p
2A	MT 104 AT	3·10	32p	6A	MT 107 AT	7·47	50p

60 Volts. All tapped at 0-24-30-40-48-60V.

500 mA	MT 124 AT‡	1 46	30p	2A	MT 127 AT	3·16	41p
1A	MT 126 AT	2·24	32p	3A	MT 125 AT	4·59	41p

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75 VA	,, ,,	MT 64 AT	£1·72	30p
150 VA	0-115-200-220-240	MT 4 AT	£2·15	32p
200 VA	,, ,,	MT 65 AT	£3·00	32p

	Price	P. & P.
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9-0-9 V.	100 mA	MT 13 CS*†	£0·91	8p
12-0-12	50 mA	MT 239 CS*†	£0·91	8p
20-0-20	30 mA	MT 241 CS*†	£0·91	8p
0-20 × 2	300 × 2	MT 214 CT*‡	£1·21	16p
0-8-9 × 2	500 mA × 2	MT 207 CT*‡	£1·46	19p
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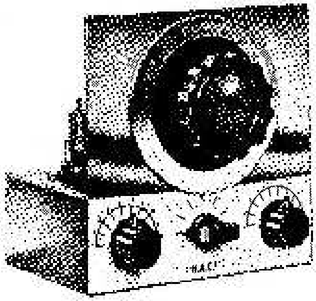

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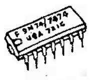

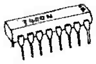

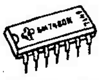

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SN7417	0·30	0·27	0·25
SN7420	0·20	0·18	0·16
SN7422	0·48	0·44	0·40
SN7423	0·48	0·44	0·40
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SN7427	0·42	0·39	0·35
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SN7430	0·20	0·18	0·16
SN7432	0·42	0·39	0·35
SN7433	0·70	0·61	0·44
SN7437	0·65	0·60	0·50
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SN7440	0·20	0·18	0·16
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SN7442	0·75	0·72	0·70
SN7443	1·00	0·95	0·90
SN7445	2·00	1·75	1·60
SN7446	2·00	1·75	1·60
SN7447	1·75	1·60	1·45
SN7448	1·75	1·60	1·45
SN7450	0·20	0·18	0·16
SN7451	0·20	0·18	0·16
SN7453	0·20	0·18	0·16
SN7454	0·20	0·18	0·16
SN7460	0·20	0·18	0·16
SN7470	0·30	0·27	0·25
SN7472	0·30	0·27	0·25
SN7473	0·40	0·37	0·35
SN7474	0·40	0·37	0·35
SN7475	0·55	0·52	0·50
SN7476	0·45	0·42	0·39
SN7480	0·80	0·75	0·67
SN7481	1·25	1·15	1·10
SN7482	0·87	0·80	0·70
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SN7492	0·75	0·70	0·65
SN7493	0·75	0·70	0·65
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SN74154	2·00	1·75	1·55
SN74155	1·55	1·47	1·35
SN74156	1·55	1·47	1·35
SN74157	1·80	1·70	1·50
SN74160	2·60	2·40	2·25
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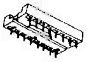

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IN4005	600	10
IN4006	800	12
IN4007	1000	15
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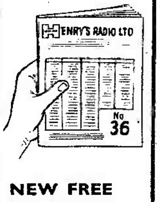

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ONE AMP ¼ × ⅜ H TUBULAR		
B1/05	50	25p
B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
ONE AMP (G.I.) TUBULAR		
W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
TWO AMPS ½ H × ½ L × 3/16		
B2/05	50	35p
B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
B2/1000	1000	60p
FOUR AMPS ½H × ½L × 3/16		
B4/100	100	60p
B4/200	200	65p
B4/400	400	70p
B4/600	600	75p
B4/800	800	£1·00
SIX AMPS ½H × ½L × 3/16		
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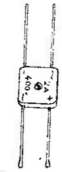
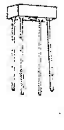
B6/200	200	75p
B6/400	400	90p
B6/600	600	£1·00



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Type	Volts P.I.V.	Price 1-11
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CRS 1/10	100	30p
CRS 1/20	200	30p
CRS 1/40	400	35p
CRS 1/60	600	45p
THREE AMP (T048)		
CRS 3/05	50	30p
CRS 3/10	100	30p
CRS 3/20	200	35p
CRS 3/40	400	45p
CRS 3/60	600	55p
FIVE AMP (TO66)		
CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
SIXTEEN AMP		
SCR 16/100	100	65p
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1 Amp T05

3 Amp T048

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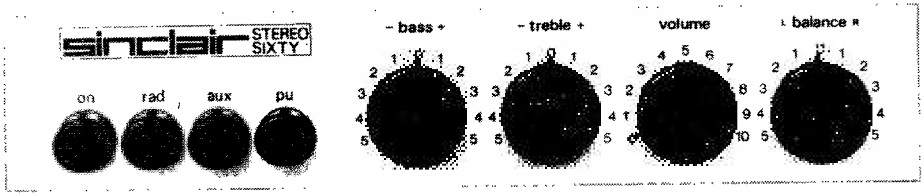
Sinclair Project 60

Stereo 60



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pre-amplifier/control unit

The versatility of Project 60 high-fidelity modules is well demonstrated in this excellent unit. It provides the facilities essential to good stereo and will enhance the quality of any system it is used with, whether Project 60 or any any other top line power amplifiers. Compact, yet robustly constructed, the unit is easily panel mounted and will operate satisfactorily from 18 to 35 volts supply. Silicon epitaxial transistors are used throughout to achieve a very high signal to noise ratio with excellent separation between channels. Distortion at maximum output is barely 0·02% with magnetic p.u. input. Accurate equalisation is provided for all inputs, which are selected by push buttons. For maximum effectiveness, the Sinclair A.F.U. is recommended for use with the Stereo 60 pre-amp/control unit. A comprehensive manual supplied with Project 60 modules makes installing and connecting easy and ensures best possible results from your system.

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 ±12 to —12dB at 10KHz; BASS +12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 × 40 × 207mm.

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SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8Ω. **Frequency Response:** 5Hz to 100KHz±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0·1%) at all output powers and frequencies in the audio band (28V). **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 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 × 45 × 28mm including pins and heat sink.

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The easy way to buy and build Project 60

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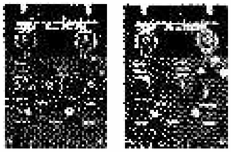
Built, tested and guaranteed with circuits and instructions manual. **Z.30 £4.48** **Z.50 £5.48**

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) 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 are intended for use principally with other units in the Project 60 range. Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

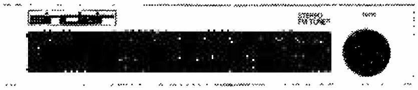


SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).*** **— Power Outputs:**
Z.30 15 watts R.M.S. into 8 ohms using 35 volts : 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts : 30 watts R.M.S. into 8 ohms using 50 volts.
Frequency 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 15w into 8Ω). For speakers from 3 to 15 ohms impedance. **Size:** 14 x 80 x 57mm.

Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

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 advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stero decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

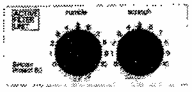


SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz. **Sensitivity:** 7µV for lock-in over full deviation. **Squelch level:** Typically 20µV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10Hz – 15KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2µV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum **Operating voltage:** 25–30VDC. **Indicators:** Stereo on; tuning. **Size:** 93 x 40 x 207mm.

A.F.U. High & Low Pass Filter Unit

Built, tested and guaranteed. **£5.98**

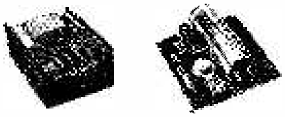
For use between Stereo 60 unit and two Z.30s or Z.50s. The unit is very easily mounted and is unique in that the cut-off frequencies are continuously variable. As attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. There are two filter sections – rumble (high pass) and scratch (low pass). 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. Operating voltage from 15 to 35V. Current 3mA. **Size:** 66 x 40 x 90mm.



Power Supply Units

Designed specifically for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 or PZ.8 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**



Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc.	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control, etc.	**£9.45**
12W. RMS continuous sine wave stereo amp. for average needs	**2 x Z.30s, Stereo 60; PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc	**£23.90**
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60; PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60; PZ.8, mains transformer**	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. **(£5.98)** may be added as required.

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Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1·00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

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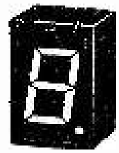

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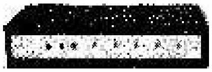

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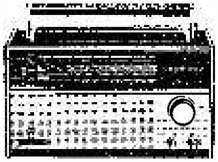

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AF115	15p	BC184L	8p	ME6102	15p	OC36	36p	2N3706	10p		
AF116	15p	BC212L	8p	MP8111	32p	TIP29A	48p	2N3707	10p		
AF117	15p	BC214L	8p	MP8511	34p	TIP30A	55p	2N3708	9p		
				MP8513	45p	TIP31A	58p	2N3709	10p		
				OC41	13p	TIP32A	69p	2N3710	10p		

DIODES

IN4001	4p
IN4002	4p
IN4003	5p
IN4004	7p
OA90	6p
OA91	6p
OA200	10p
OA202	8p
IS44	10p
IN4149	4p
WO2	32p

CAPACITORS

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF, **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF, **8½p.** 0·68μF, **11p.** 1·0μF, **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, **2½p.** 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **3p.** 0·047μF, 0·068μF, 0·1μF, **4p.** 0·15μF, **6p.** 0·22μF. **7½p.** 0·33μF, **11p.** 0·47μF, **13p.**

160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF **3½p.** 0·15μF, **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p·** 1·0μF, **13p.**

ELECTROLYTIC CAPACITORS—MULLARD C426 SERIES **6p each**

(μF/V) 10/2·5, 20/2·5, 80/2·5, 160/2·5, 320/2·5, 500/2·5, 8/4, 32/4, 64/4, 125/4, 250/4, 400/4, 6·4/6·4, 25/6·4, 50/6·4, 100/6·4, 200/6·4, 320/6·4, 4/10, 16/10, 32/10, 64/10, 125/10, 200/10, 2·5/16, 10/16, 20/16, 40/16, 80/16, 125/16, 1·6/25, 6·4/25, 12·5/25, 25/25, 50/25, 80/25, 1/40, 4/40, 8/40, 16/40, 32/40, 50/40, 0·64/64, 2·5/64, 5/64, 10/64, 20/64, 32/64.

MULLARD C437 SERIES

100/40, 160/25, 250/16, 400/10, 640/6·4, 800/4, 1000/2·5, **9p.** 100/64, 160/40, 250/25, 400/16, 640/10, 1250/4, 1000/6·4, 1600/2·5, **12p.** 160/64, 250/40, 400/2·5, 640/16, 2000/4, 1000/10, 1600/6·4, 2500/2·5, **15p.** 250/64, 400/40, 640/25, 3200/4, 1000/16, 1600/10, 2500/6·4, 4000/2·5, **18p.**

Miniature Fixed Ceramic Plate **3p** each.
Preferred values from 1·8pf to 10,000 pf.

MINITRON DIGITAL INDICATOR TYPE 3015F

Reads 0–9 and decimals
(Data Sheet on request)

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16 DIL Socket	**30p**
Driven by 7447	**95p**

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301A	To99	49p
301A	DIL	45p
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709C	DIL	30p
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723C	DIL	90p
741C	To99	35p
741C	DIL	34p
741C	8p in DIL	84p
747C	DIL	40p
748C	To99	38p

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Carbon track 500 Ω to 2·2M Ω
Log or Linear
Single **12p.** Dual gang (stereo) **40p.**
Single type with D.P. switch **12p** extra.

RESISTORS

¼ watt 5% carbon	**1p each**
½ watt 10% carbon	**1p each**

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240v or 110v 1–4 **5p,** 5 plus **4½p** each.

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3¾ × 3¾in	25p	25p
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(unmarked)
but tested

2N2646
(unmarked)
30p each

AC127 & AC128

1–9	13p
10 plus	11p
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Pack of 10
2N2926G **50p**
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Unmarked but fully
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1-9	30p
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Pack of 25
IN4148
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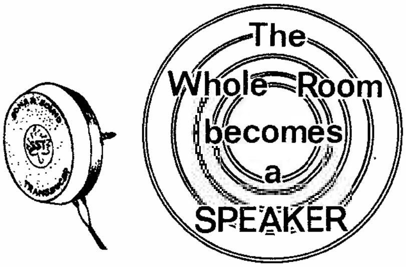

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F. 19v. ½A, **30p** (15p). G. 19v. 2A, **75p** (20p)
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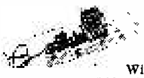

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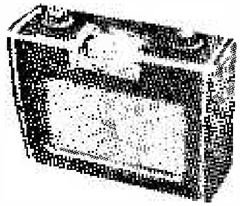

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6AL3	0.43
6AL5	0.22
6AM5	0.40
6AM6	0.37
6AQ5	0.42
6AQ6	0.70
6AR5	0.55

6AR6	0.65
6AR11	1.25
6AS5	0.50
6AS7G	0.85
6AT6	0.38
6AU6	0.30
6AV6	0.40
6AW8A	0.65
6BA6	0.28
6BE6	0.32
6BF6	0.55
6BH6	0.75
6BJ6	0.55
6BK7A	0.75
6BN5	0.43
6BN6	0.60
6BQ5	0.25
6BR8	0.75
6BS7	1.35
6BW6	0.90
6BW7	0.90
6BX6	0.25
6BZ6	0.45
6C4	0.35
6C5GT	0.55
6CB6	0.40
6CD6GA	1.30
6CG7	0.60
6CH6	0.60
6CL6	0.60
6CU6	0·80
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6CY5	0.50
6CY7	0.75
6D3	0.55
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6DK6	0.60
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6DS4	1.25
6EA8	0.65
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6EJ7	0.35
6EW6	0.70
6F1	0.75

6F5	0.75
6F6G	0.45
6F11	0.50
6F13	0.50
6F14	0.70
6F15	0.65
6F18	0.50
6F23	0.90
6F24	0.80
6F25	1.00
6F26	0.35
6F28	0.70
6GK6	0.60
6J4	0.60
6J5GT	0.40
6J6	0.30
6J7	0.45
6K4П	0.60
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6K7	0.43
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6P28	0.65
6Q7	0.50
6SA7	0.45
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6SL7GT	0.45
6SN7GT	0.45
6SQ7	0.50
6SR7	0.50
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6V6GT	0.45
6X4	0.40
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6X8	0.65

6Y6G	0.80
7Y4	0.75
9BW6	0.70
10C2	0.60
10D1	0.65
10D2	0.55
10F1	0.75
10F9	0.65
10F18	0.60
10L1	0.60
10LD11	0.70
10P13	0.75
12AB5	0.70
12AC6	0.60
12AD6	0.60
12AE6	0.60
12AL5	0.55
12AQ5	0.50
12AT6	0.40
12AT7	0.40
12AU6	0.45
12AU7	0.38
12AV6	0.45
12AV7	0.70
12AX7	0.38
12AY7	0.75
12B4A	0.65
12BA6	0.45
12BA7	0.50
12BE6	0.50
12BH7	0.50
12BY7	0.65
12K5	1·00
12K7GT	0.50
12Q7GT	0.45
12SR7	0.50
20D1	0.60
20L1	1.10
20P1	0.50
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30P19	0.95
30PL1	0.95
30PL13	1.10
30PL14	1.25
35A3	0.60
35A5	0.75
35B5	0.65
35C5	0.60
35D5	0.75
35L6GT	0.75
35W4	0.40
35Z3	0.75
35Z4G	0.40
35Z5GT	0.70
50A5	0.80
50B5	0.70
50C5	0.60

50CD6G	1.20
50EH5	0.65
50L6GT	0.60
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90C1	0.75
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6360	1.25
6939	2.25
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7360	2.20
7586	1.50
7895	1.50
A2293	2·20
AZ1	0.60
AZ31	0.55
CBL1	0.90
CBL31	1.00
CY31	0.50
DAF96	0.50
DF96	0.50
DK92	0.70
DK96	0.60

DL96	0.55
DM70	0.60
DM160	0.68
DY51	0.55
DY86	0.35
DY87	0.36
E88CC	0.70
E180F	1.00
E810F	2·90
EABC80	0.38
EAF42	0.60
EBC33	0.60
EBC41	0.65
EBC81	0.33
EBF80	0.40
EBF83	0.40
EBF89	0.32
EBL31	1·50
EC53	0.50
EC86	0.60
EC88	0.60
EC90	0.35
EC92	0.45
EC93	0.60
ECC35	1.00
ECC40	0.70
ECC81	0.40
ECC82	0.33
ECC83	0.33
ECC84	0.30
ECC85	0.40

ECC88	0.40
ECC89	0.50
ECC91	0.30
ECC189	0.65
ECC807	1.00
ECF80	0.35
ECF82	0.35
ECF804	1.65
ECH42	0.75
ECH81	0.30
ECH83	0.45
ECH84	0.45
ECL80	0.50
ECL81	0.50
ECL82	0.35
ECL83	0.70
ECL84	0.55
ECL85	0.55
ECL86	0.40
ECLL800	2·20
EF37A	1.00
EF40	0.50
EF41	0.65
EF42	0.70
EF80	0.30
EF85	0.35
EF86	0.30
EF89	0.28
EF91	0.37

EF92	0.35
EF95	0.40
EF97	0.65
EF98	0.75
EF183	0.30
EF184	0.35
EF804	1.25
EK90	0.32
EL33	1.50
EL34	0.50
EL36	0.50
EL37	1.70
EL41	0.75
EL81	0.55
EL83	0.50
EL84	0.25
EL85	0.43
EL86	0.40
EL90	0.42
EL95	0.35
EL821	0.60
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ELL80	0.75
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EM71	0.80
EM80	0.45
EM81	0.60
EM83	0.50
EM84	0.35
EM85	1.00
EM87	0.70
EN91	0.40
EY51	0.40
EY80	0.75
EY81	0.40
EY83	0.55
EY86	0.40
EY87	0.43
EY88	0.43
EZ40	0.50
EZ41	0.75
EZ80	0.28
EZ81	0.29
GT1C	3.00

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GZ30	0.45
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GZ32	0.50
GZ33	0.75
GZ34	0.60
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HK90	0.50
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KT88	2·25
N78	1·60
PABC80	0.40
PC86	0.60
PC88	0.60
PC92	0.05
PC97	0.50
PC900	0.48
PCC84	0.40
PCC85	0.40
PCC88	0.55
PCC89	0.55
PCC189	0.60
PCC805	0.95
PCC806	0.95
PCF80	0.30
PCF82	0.35
PCF84	0.60
PCF86	0.60
PCF87	1·10
PCF801	0.50
PCF802	0.50
PCF805	0.90
PCF806	0.75
PCF808	0.90
PCH200	0.70
PCL81	0.50
PCL82	0.35
PCL83	0.65
PCL84	0.45
PCL86	0.45
PCL88	1.25
PCL800	1.10
PCL801	0.95
PCL805	0.50
PD500	1.30

PF86	0.70
PF818	1.00
PFL200	0.65
PL33	0.40
PL36	0.55
PL81	0.50
PL82	0.45
PL83	0.45
PL84	0.40
PL302	0.95
PL504	0.75
PL508	0.90
PL509	1.10
PL801	1.00
PL802	0·95
PM84	0.60
PY31	0.35
PY33	0.63
PY80	0.40
PY81	0.30
PY82	0.35
PY83	0.38
PY88	0.40
PY800	0.47
PY801	0.50
PZ30	0.38
QQVO2-6	2.25
QQVO3-10	1.25
QQV03-20A	5.25
TT21	3.40
TT22	3.50
U18/20	0.75
U25	0.85
U26	0.85
U31	0.70
U37	6.50
U52	0.40
U76	0.40
U78	0.40
U191	0.75
U201	0.50
U281	0.55

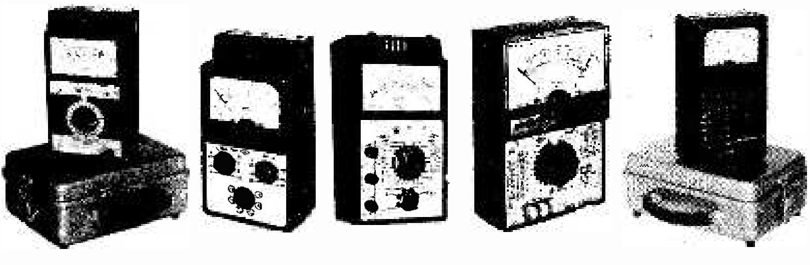
U282	0.55
U301	0.55
U403	0.70
U404	0.70
U801	0.80
UABC80	0.40
UAF41	0.70
UAF42	0.60
UB41	0·65
UBC41	0.55
UBC81	0.45
UBF80	0.40
UBF89	0.40
UBL1	0.70
UBL21	0.70
UC92	0.45
UCC85	0.45
UCF80	0.70
UCH21	0.60
UCH42	0.70
UCH81	0.40
UCL81	0.60
UCL82	0.35
UCL83	0.65
UF9	0.65
UF11	0.60
UF41	0.65
UF42	0.85
UF43	0.65
UF80	0.35
UF85	0.40
UF89	0.40
UL41	0·65
UL84	0.43
UM84	0.30
UY1N	0.50
UY11	1.00
UY41	0.48
UY82	0.50
UY85	0.40
W729	0.75
Y63	0·75
Z803U	1.35

TRANSISTORS

2N696	0.15
2N697	0.15
2N698	0.30
2N705	0.70
2N706	0.10
2N708	0.15
2N753	0.25
2N929	0.20
2N930	0.20
2N987	0.30
2N1131	0.25
2N1132	0.25
2N1184	1.25
2N1302	0.17
2N1303	0.17
2N1304	0.20
2N1305	0.20
2N1306	0.25
2N1307	0.25
2N1308	0.25
2N1309	0.25
2N1613	0.17
2N1711	0.20
2N1756	0.75
2N2147	0.75
2N2160	0.60
2N2217	0.25
2N2218	0.20
2N2219	0.20
2N2369A	0.15
2N2477	0.65
2N2646	0.40
2N2905	0.25
2N2923	0.12
2N2924	0.13
2N2926	0.10
2N3053	0.20
2N3054	0.50
2N3055	0.60
2N3133	0.25
2N3134	0.25
2N3391	0.17
2N3392	0.17
2N3393	0.15
2N3394	0.15
2N3395	0.20
2N3402	0.15
2N3403	0.15
2N3404	0.32
2N3414	0.20
2N3415	0.15
2N3417	0.25
2N3702	0.10
2N3703	0.10
2N3704	0.12
2N3707	0.12
2N3709	0.10
2N3710	0.10
2N3819	0.35
2N3906	0.25
2S702	0.50
2S746	0.25
AC113	0.15
AC125	0.30
AC126	0.20
AC127	0.17

AC128	0.15
AC132	0.35
AC153	0.20
AC154	0.15
AC157	0.17
AC169	0.10
AC176	0.17
AC187	0.25
AC188	0.25
ACY17	0.25
ACY18	0.20
ACY19	0.25
ACY20	0.20
ACY21	0.20
ACY22	0.10
AD140	0.50
AD149	0.45
AD161	0.35
AD162	0.35
ADZ11	1.25
ADZ12	1.25
AF114	0.17
AF115	0.17
AF116	0.17
AF117	0.17
AF118	0.30
AF125	0.20
AF127	0.20
AF180	0.35
AF181	0.35
AF186	0.40
AF239	0.36
AFZ11	0.45
AFZ12	1.00
ASY26	0.25
ASY27	0.30
ASY28	0.25
ASY29	0.30
ASY54	0.25
ASZ15	0.70
ASZ16	0.70
ASZ17	0.75
ASZ18	0.75
ASZ20	0.25
ASZ21	0.40
AUY10	1·00
BC107	0.10
BC108	0.10
BC109	0.10
BC113	0.10
BC118	0.20
BC134	0.20
BC147	0.10
BC148	0.10
BC149	0.12
BC152	0.15
BC158	0.15
BC175	0.20
BC186	0.25
BCY30	0.25
BCY31	0.30
BCY33	0.25
BCY34	0.30
BCY72	0.15
BCZ10	0.30
BCZ11	0.40

BD121	0.65
BD123	0.80
BD124	0.60
BD131	0.75
BD132	0.80
BF115	0.20
BF167	0.18
BF173	0.20
BF179	0.30
BF180	0.30
BF181	0.30
BF184	0.20
BF185	0.20
BF194	0.14
BF195	0.14
BF196	0.12
BF197	0.12
BF200	0.35
BFW87	0.25
BFW88	0.20
BFW89	0.20
BFW91	0.20
BFX88	0.20
BFY17	0.40
BFY19	0.25
BFY50	0.20
BFY51	0.20
BFY52	0.20
BSY26	0.17
BSY27	0.15
BSY28	0.17
BSY65	0.20
BSY95A	0.12
OC16	0.50
OC22	0.50
OC23	0.60
OC24	0.60
OC25	0.35
OC26	0.25
OC28	0.50
OC29	0.60
OC35	0.50
OC36	0.45
OC42	0.20
OC44	0.15
OC45	0.12
OC70	0.10
OC71	0.12
OC72	0.12
OC73	0.30
OC75	0.15
OC76	0.15
OC78	0.25
OC78D	0.20
OC81	0.20
OC81D	0.20
OC83	0.20
OC139	0.30
OC140	0.35
OC141	0.60
OC170	0.25
OC171	0.25
OC200	0.30
OC201	0.60
OC202	0.65
OC203	0.40
OC204	0.40



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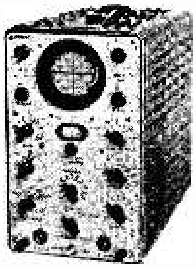

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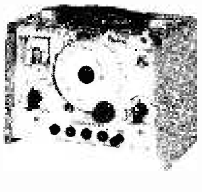

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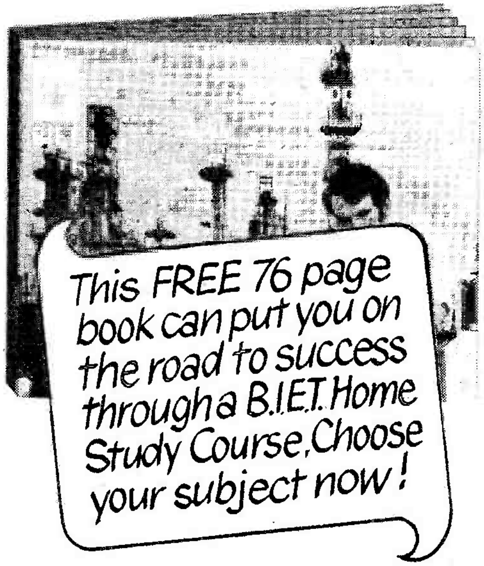

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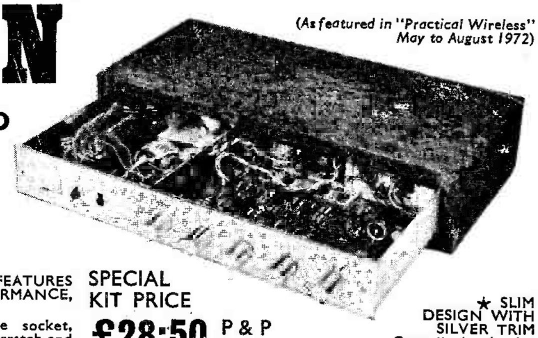

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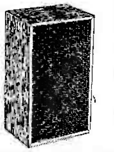

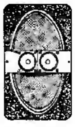

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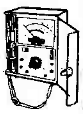

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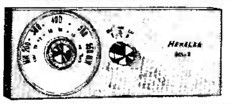

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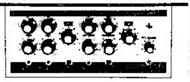

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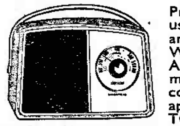

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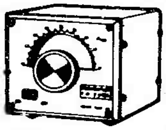

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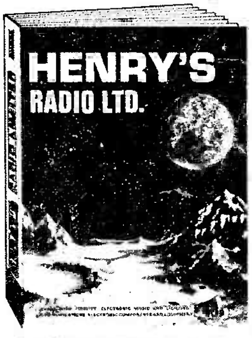

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