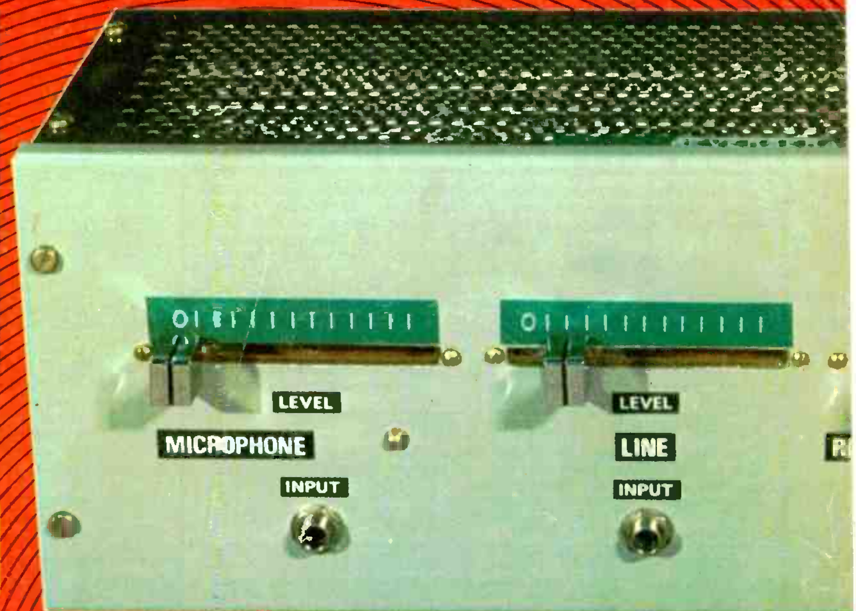
PRACTICAL WIRELESS

NOVEMBER 1972

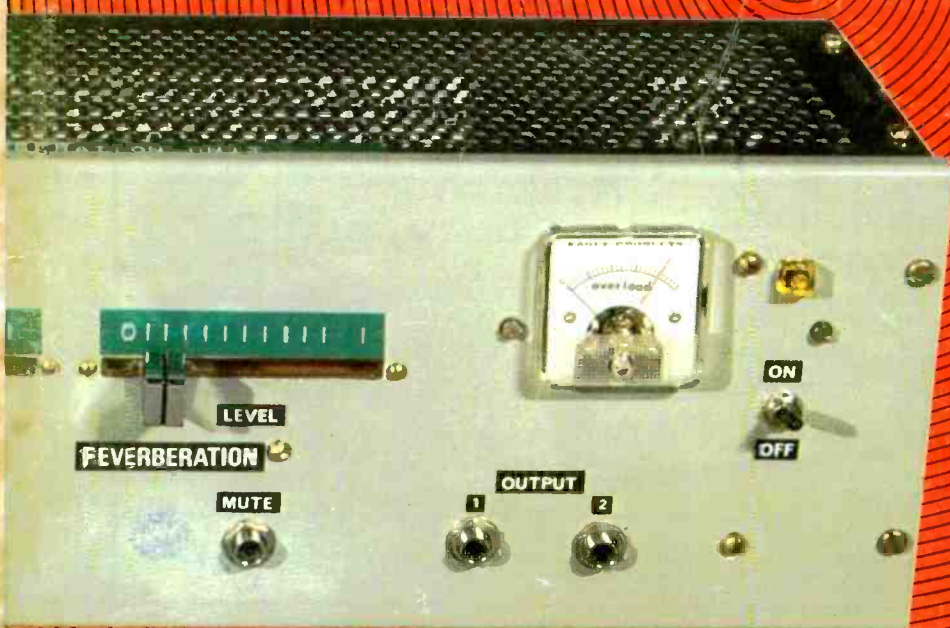
20p

EXTRA

THE abc OF hi-fi SUPPLEMENT



PW Reverberation unit



Also:

8 WATT SILICON AUDIO AMPLIFIER

SIMPLE RF SIGNAL GENERATOR

RSC HIGH-FIDELITY STEREO PACKAGE OFFERS

Four fully wired units ready to 'plug in'.

★ SUPER 30 AMPLIFIER (15+15 watt) in veneered housing
★ GARRARD SP25 MK III Turntable on Plinth with cover
★ GOLDRING G850 Magnetic cartridge with diamond stylus
★ PAIR OF STANWAY II Speaker Units

Special Total Price **£87·95**

Terms: Deposit £12·77 and 9 monthly payments £9·39 (Total £97·28).

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

Special Total Price **£98·63**

Terms: Deposit £13·63 and 9 monthly payments £10·62 (Total £109·21).

★ TA12 AMPLIFIER 6·5+6·5 watt in veneered housing
★ GARRARD SP25 MK III Player unit on Plinth
★ SONOTONE 9TAHC Ceramic Cartridge (diamond stylus)
★ PAIR OF DORCHESTER Loudspeaker Units

Or Deposit £8·40 and 9 mthly. payments of £6·32 (Total £65·28).
Trans. Plastic Cover £3·15 extra.

Special Total Price **£59** Carr. £1·25.

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

Or Deposit £7·50 and 9 monthly payments £5·64 (Total £58·26).
Trans. Plastic Cover £3·15 extra.

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

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ **Moderate size only 25×14×10in. approx.**
★ **Response 30-20,000 c.p.s.**
Impedance 15 ohms

COMPLETE KIT **£23** Carr. 65p

★ **Performance comparable with units costing considerably more.**

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

DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUDSPEAKER UNITS

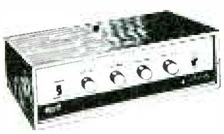
Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

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 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**

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 facia plate and matching control knobs.

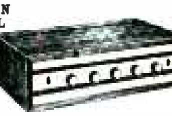


COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11·50** Carr. 40p

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

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

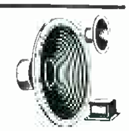
FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL



Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. −2dB ★ Harmonic Distortion 0·3% at 1,000 c.p.s. Hum and Noise −70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS **£15·50** Carr. 40p. **Factory built with 12 mths. guarantee £19·50**
Deposit £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing **£23**
Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet.

AUDIOTRINE HI-FI SPEAKER SYSTEMS

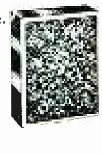


Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5·95** Carr. 30p

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

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

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



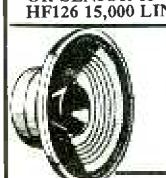
JE8 Size 16 × 11 × 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

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

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

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

AUDIOTRINE HIGH FIDELITY SPEAKERS

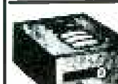


Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. **PLEASE STATE CHOICE.**

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

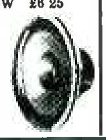
R.S.C. BATTERY/MAINS CONVERSION UNITS



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**

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.
PLEASE STATE IMPEDANCE WHEN ORDERING **£3·85**

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, 9¼×2¾×5¼in. Attractive brushed silver finish facia plate 10¼×3½in. 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

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

FULLY GUARANTEED. Impregnated and Interleaved where necessary. Primaries 200-250v. 50c/s. Screened

MIDGET CLAMPED TYPE 2⅜×2⅜×2¼in.

250v., 60mA, 6·3v. 2a	99p
250-0-250v., 60mA 6·3v 2a	£1·05

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·40
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 130mA, 6·3v. 4a. c.t., 6·3v. 1a. For Mullard 510 Amplifier	£2·65
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	£3·30

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. Mk III SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

A completely new design further improved in both appearance and performance. Representing value far higher than the prices suggest.

X

Only high grade components by leading manufacturers.
COMPLETE KIT OF PARTS **£25** Carr. 65p =2W 3A

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

Or **FACTORY BUILT** in cabinet as illustrated. Dep. £7 and 9 monthly payments £3·99 (Total £42·91) **£38·75**

Printed Circuitry
Twenty Silicon Transistors, Four Diodes, Four Rectifiers

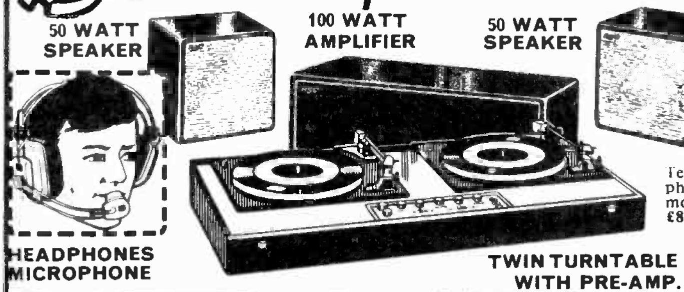
★ **SATIN SILVER METAL FACIA** with black lettering. Black edged knobs with bright silver centres.
★ **PUSH-BUTTON SELECTOR SWITCHING**
★ **NEON INDICATOR**
★ **JACK SOCKET FOR HEADPHONES**
★ **CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE CERAMIC or MAGNETIC, REGARDLESS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

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

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

RSC STEREO F.M. TUNER NOW AVAILABLE. Visually matches Super 30 MkIII **ONLY £44·95**

RSC GROUP/DISCO UNITS



PACKAGE OFFER
Units listed below
(a) 100w POWER AMPLIFIER
(b) PAIR OF HI-FI HEAD-PHONES
(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**

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 styli. 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 £80·62).

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

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

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

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). Carr. £1 **£65**

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 — 18" 100 Watt, 14,000 gauss, 8/15Ω **£22·95** Dep: £6 and 9 mthly payments £2·20 (Total £25·80)

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

'POP' 50 — 12" 50 Watt, 13,000 gauss, 15Ω **£10·90** Dep £2 and 9 monthly payments £1·20 (Total £12·80)

FOR BASS GUITAR, ELECT. ORGAN, ETC. PAIR SUITABLE ALL PURPOSES

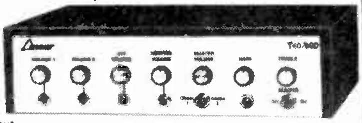
R.S.C. A10 30 WATT ULTRA LINEAR HI-FI AMPLIFIER

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.

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).

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

Terms: Deposit £7·50 and 9 monthly payments £5·37 (Total £55·83) **£40·50** Carr. free
Simulated black rexine, plastic bonded metal case

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER £34·95
PR. FANE POP 25/2 25W L/SPEAKERS £13·50
£48·45
Terms: Deposit £6.50 and 9 monthly payments of £4.92 (Total £50.78)
PACKAGE PRICE **£45** carr. £1

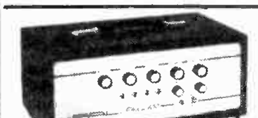
F.A.L. PHASE 50 MK.III AMPLIFIER £34·95
PR. FANE POP 50 L/SPEAKERS £21·80
£56·75
Terms: Deposit £10 and 9 monthly payments of £5·37 (Total £58.33)
PACKAGE PRICE **£52** carr. £1

F.A.L. PHASE 50 MK.III AMPLIFIER £34·95
PAIR L12/25 25W L/S in cabinets £23·90
£58·85
Terms: Deposit £10 and 9 monthly payments of £5·88 (Total £62·92)
PACKAGE PRICE **£56** carr. £1·25

LINEAR T40/60D AMPLIFIER £39·75
PAIR L12/25 L/S in cabinets £23·90
£63·65
Terms: Deposit £8·65 and 9 monthly payments of £6·56 (Total £67·69)
PACKAGE PRICE **£59·95** carr. £1·50

F.A.L. PHASE 100 AMPLIFIER £61·95
4 FANE POP 50 L/SPEAKERS £43·60
£105·55
Terms: Deposit £15·95 and 9 monthly payments of £10·73 (Total £112·52)
PACKAGE PRICE **£99·95** carr. £2

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.

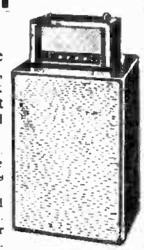
HIGH QUALITY LOUDSPEAKER UNITS

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 **£33·50**
Or deposit £4·50 and 9 monthly payts. of £3·70. Total £37·80

L12/25 12" 25 WATT 10,000 lines 15 ohms. Carr. 50p. **£11·95**

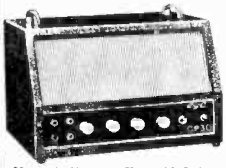
L13 13" × 8" 10 Watt 10,000 lines 3 or 15 ohms. State impedance required. Carr 40p **£5·25**

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 optional horizontal or vertical mounting.
★ Two extra heavy duty 12in. 50w L'spkrs.
★ 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 pyts of £6·25 (Total £71·25) Carr. £2 **£65** Send S.A.E. for leaflet.

RSC GP30 HI-FI AMPLIFIER



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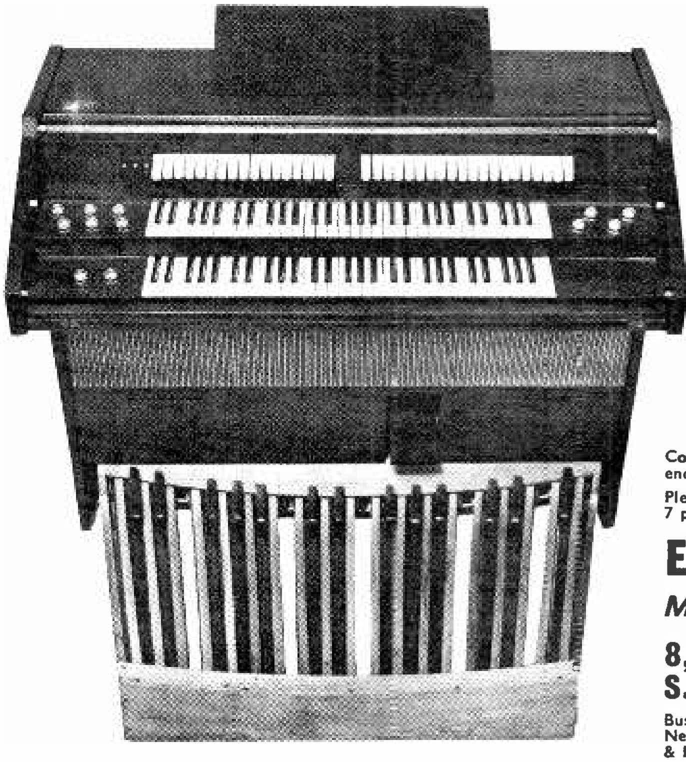

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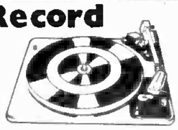

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4 speed
Automatic Single Player

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

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210 Complete with plinth, cover & BSR cartridge
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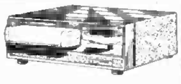

8 TRACK STEREO CARTRIDGE PLAYER
The TD8S is suitable for use with most modern stereo amplifiers and delivers a pre-amp output of 125mW. C & P 35p
Power requirements: 210/250V AC, 50Hz. Frequency response: 50Hz-10KHz. 4 pole dynamically balanced synchronous motor. Black and woodgrain plastic cabinet. Size: 8¼(W) X 3¾(H) X 10¼ (D) in.
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P & P 5p extra per reel, 4 reels and over Post Free.
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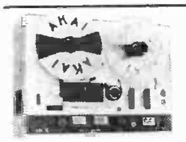
C & P: each 7p, 5—25p, 10—40p, 20—68p.



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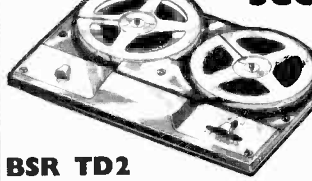

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FANTASTIC VALUE, ONLY Lasky's can offer you a tape deck at such an amazing price. The BSR TD2 tape deck operates by a simple reliable mechanism. Available with ½ track or ¼ track mono or stereo heads. Incorporates fast wind and fast rewind, records at 3¾ ips, giving up to 3 hrs playing time, takes up to 5¾in. spools. Size 13in. x 8¾in. front to rear, 2$\frac{13}{32}$in. below plate, 1$\frac{11}{32}$in. above plate.

ALSO SUITABLE FOR USE AS A TAPE TRANSPORTER

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Incorporates varicap diodes, printed circuit, coils, squelch circuit I.C. Decoder, etc., supplied completely built and tested and ready to be mounted into any cabinet you choose. It may be used with any High Fidelity Amplifier. Power requirements 25/30V DC. Size 8¼" x 1¼" x 3¾".

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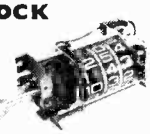
NEW DIGITAL CLOCK



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The clock measures 5¾ W x 2¾ H x 3in D (overall from front of drum to back of switch). SPEC.: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions. ● **COMPLETE WITH KNOBS. FEATURES: ● MAINS OPERATION ● 12-HOUR ALARM ● AUTO "SLEEP" SWITCH ● HOURS, MINUTES AND SECONDS READ-OFF ● FORWARD AND BACKWARD TIME ADJUSTMENT ● SILENT OPERATION ● SHOCK AND VIBRATION PROOF ● BUILT IN ALARM BUZZER**

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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.

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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.

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SPECIFICATION R 101

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

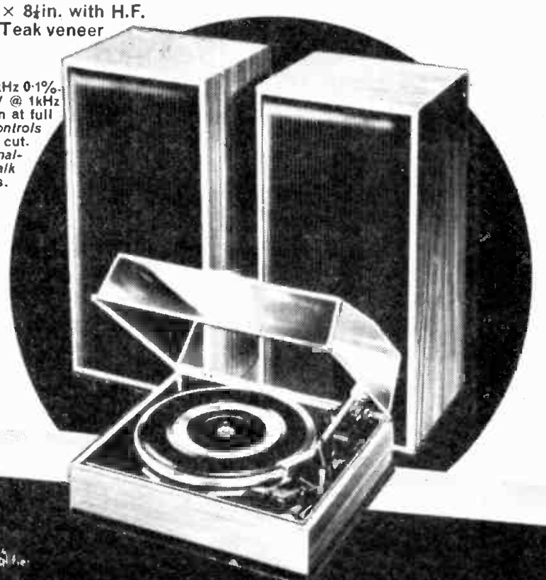
Viscount III R101 amplifier	£22·00+90p p&p
2 × Duo Type II speakers	£14·00+£2 p&p
Garrard SP25 Mk. III with MAG. cartridge plinth and cover	£23·00+£1·50 p&p
Total	£59·00

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

Available complete for £69 + £4 p&p



–ONLY FROM US

MUSIC MAKERS

UNISOUND FOR THE NEW SOUND

AT £25

The whole system is complete *including superb cabinets in simulated teak*—just simply screw together the components and you save pounds!
Amplifier is based on the famous Mullard Unilex system. Garrard 2025TC turntable complete with stereo ceramic cartridge, teak simulated plinth and tinted acrylic cover. Plus the big 13" x 8" EMI Twin-cone speakers ready for mounting in their elegant cabinets, which simply need screwing and glueing together. All glue and screws supplied.
Easy to follow step-by-step instructions guide you quickly and effortlessly to taking the wraps off truly realistic stereo sound.
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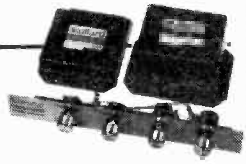
Diamond Stylus £1·25 extra.
Power output: 4 watts per channel into 8 ohms.
Inputs: 120 mV (for ceramic cartridges).
Stereo headphones with adaptor £4·00



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.
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AN R T V C EXCLUSIVE DESIGN

A 'NATURAL' ONLY FROM R T V C

THE TOURIST PB CAR RADIO KIT

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.

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.

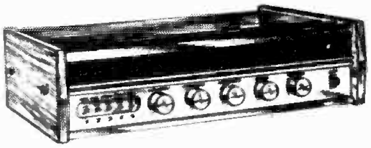
The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles. It covers the full medium and long wave bands. Four push-buttons for medium wave, one for long wave. It is permeability tuned and sturdily constructed. Output is a full 2·5 watts into an 8 ohm speaker. But the 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. Chassis size is: 7in. wide, 2in. high and 4 11/16in. 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.

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:**—12¼" × 6" × 3¼".

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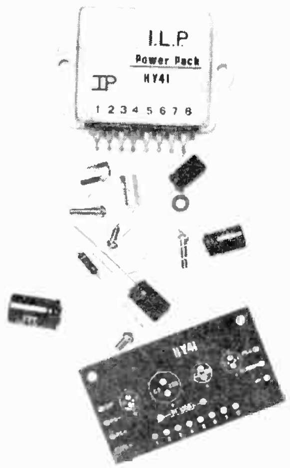


THE HY41

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

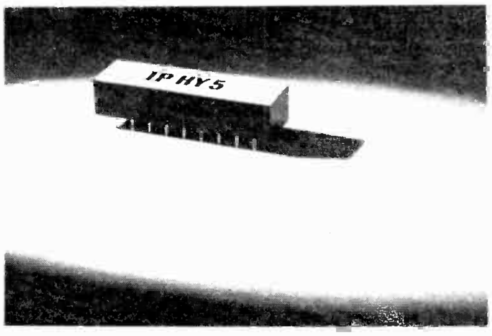
The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an integrated pre-amplifier circuit.

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. 47K Ω
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 (Baxendall)
Treble ± 12db.
Bass ± 12db.

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

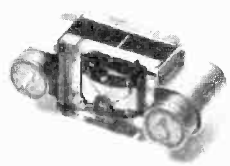
SUPPLY VOLTAGE
16–25 volts

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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SA25-SA35-SA100

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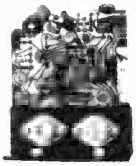

THESE THREE MODULES HAVE ENJOYED UNPARALLELED SUCCESS DURING THE FIRST FEW MONTHS OF THEIR BEING MADE AVAILABLE TO THE GENERAL PUBLIC. WE ARE PLEASED TO ANNOUNCE THAT WE CAN NOW OFFER FAST DISPATCH ON MOST OF OUR ADVERTISED ITEMS, INCLUDING THESE THREE MODULES.

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25 WATTS RMS. 7 transistors 7 diodes

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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	£6·75 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

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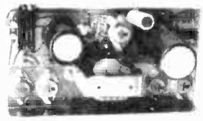
120 WATT HEAVY DUTY MODULE £13·90 + 20p carr. or with supply £18·95 + 40p carr.

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

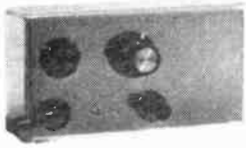
Power output	120 watts into 8 ohms
Freq. response	30-30,000 HZ ± 2dB
Input sensitivity	200 mV into 10K
Construction	Fibreglass board
Size	8" x 4" x 4" (5" with supply)

Low distortion parallel push-pull output stage.

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 mis-range notes by the addition of components costing less than 5p.



£8·90 carr. free

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 le ads, etc. Supplied in tough white steel case with a blue stelvetite hooded cover. Fully guaranteed.

£19·75 carr. 30p

SAXON STEREO CONTROL UNIT

£15·80 carr. 30p

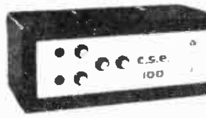
MONO VERSION £6·50 carr. 20p (As illustrated left S.A.E. details 9 volt operation) Outputs up to 1 volt RMS

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.**

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 sine wave 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.

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12" 25 watt 8/15 ohms £4·95 carr. 30p. 15" 50W.8/15 ohm £14·50 carr. 50p.
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CARTRIDGES—continued

	Rec. Retail Price	Comet Price
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SHURE M75EJ	15·40	9·25
SHURE M75E	19·00	11·50
SHURE M75 ED	19·00	11·50
SHURE M75E/95G	20·80	12·95
SHURE V15-11	39·40	27·95
*SONOTONE 9TAHC Diam/Saph.	3·75	1·45

Starred cartridges above are ceramic. All others are magnetic.

BASES AND COVERS

GARRARD WB1 Base	3·78	2·95
WB4 Base	5·60	4·25
SPC1 Cover	3·68	2·75
SPC4 Cover	4·38	3·25
Special offer of Base and Cover to fit SP25, SL55, SL65B and 3500 Special Price		3·60
WB4 base Mk IIZ to fit Zero 100 and Zero 100S	6·55	4·80
GOLDRING Plinth 75	4·77	6·75
GOLDRING Plinth 72	9·42	6·50
GOLDRING Covers for 72P	4·71	3·25
Cover for 75P De luxe	5·23	3·60
Cover for 85P	6·98	4·95
THORENS TX25 (for TD125AB)	8·85	6·95
THORENS TX11 Cover	4·49	3·60
SME Plinth System 2000 with motor-board	46·20	34·50
MOTORBOARDS only	5·85	4·45
SME P1 Spacer	0·98	0·75

BLANK TAPES

SCOTCH DYNARANGE CASSETTES		
C60	0·71	0·40
C90	0·99	0·50
C120	1·49	0·75
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1·10	0·65
C90	1·45	0·85
SCOTCH Low Noise 8—TRACK BLANK CARTRIDGES		
40 mins	1·50	0·90
80 mins	1·80	1·10
SCOTCH LONG LIFE SPOOLED TAPES		
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7" L.P. 1800	2·52	1·50
SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
5¾" L.P. 1200	2·20	1·30
7" L.P. 1800	2·95	1·80

Postage—Tapes, cassettes and 8T cartridges 1-9 items 5p per order. Packs of ten post free.

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ALBA UA552	47·75	29·95
BUSH A1005	69·89	53·25
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DANSETTE 4005	71·45	53·25
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PHILCO FORD M1500	97·96	66·75
PHILIPS 808	105·00	71·95
PHILIPS GF824	65·30	49·65
PHILIPS 825	49·50	38·95
PHILIPS 826	75·00	52·95
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BUSH TP 70 battery/mains	28·13	19·95
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EKCO 350 Bt./Mns. VHF/MW Radio	37·42	28·75
EKCO 351 Battery/Mains	23·23	18·45
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PYE 9118	29·11	22·95
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AMSTRAD 8000 Mk II amplifier 7 watts. RMS per channel, McDonald MP60 turntable with plinth, cover and Goldring G800 magnetic cartridge, fully wired, and 2 Amstrad 138 twin cone teak speakers.	86·96	46·95
SOLARVOX TAM 1105 2 x 5 watts. RMS output. AM/FM Multiplex Tuner/Amplifier plus Matrix 4 channel. McDonald MP60 deck with plinth, cover and Shure M44/7 cartridge, plus two Solarvox speakers	67·20	49·45
H.L. Audio Phoenix 707 amp. McDonald MP60 turntable, complete with base, cove and Shure M44/7 cartridge. Fully wired plus 2 Thorpe Grenville 100 loudspeakers	86·65	53·40
CARLTONE M4000 AM/FM tuner amp. with 8 track stereo player, 2 speakers. Garrard 2025/TC turntable, base, cover and Sonotone 9TAHC cartridge	Sp. Price	52·90
SINCLAIR 2000 amp. with McDonald MP60 turntable, plinth, cover and Shure M44/7 plus 2 Sinclair Q16 loudspeakers	81·66	56·00
ROTEL RA210 amplifier with McDonald MP60, base cover and Goldring G800 magnetic cartridge. Plus two Linear 10 watts. Speakers (Teak).	88·91	56·40
METROSOUND ST20E. amp. 10 watts RMS per channel, with McDonald MP60, plinth cover and Goldring G800 cartridge, plus 2 Metrosound HFS103 Speakers	101·72	66·40
TELETON 206B amp. with McDonald MP60 turntable, plinth, cover and Shure M44-7 cartridge. Plus two Wharfedale Denton Mk II speakers	103·70	66·95
SOLARVOX AM108 2 x 8 watts RMS output plus Matrix 4 channel amplifier. McDonald MP60 deck plinth and cover with Shure 44/7 Cartridge and four Amstrad 138 Speakers	109·15	67·35
AMSTRAD IC2000 integrated circuit amp. 20 watts per channel, with McDonald MP60 turntable, plinth, cover and Goldring G800 cartridge. Plus two Wharfedale Denton Mk II speakers.	117·96	74·40
TELETON F307 amp. with McDonald MP60 turntable, plinth, cover and Shure M44-7 cartridge. Plus 2 x Goodmans Minister speakers.	112·32	75·95
SINCLAIR 3000 amplifier, with McDonald MP60 turntable, plinth, cover and Shure M44-E cartridge. Plus two Thorpe-Grenville 200 speakers.	116·35	75·70
PIONEER SA500A amp. with McDonald MP60 turntable, plinth, cover and Shure M44-E cartridge. Plus two Wharfedale Denton speakers.	118·50	81·15
TELETON GA202 amplifier, 15 watts. per channel, RMS with McDonald MP60 turntable, plinth, cover and Shure M44-E cartridge, plus two Wharfedale Linton Mk II speakers	124·15	86·15

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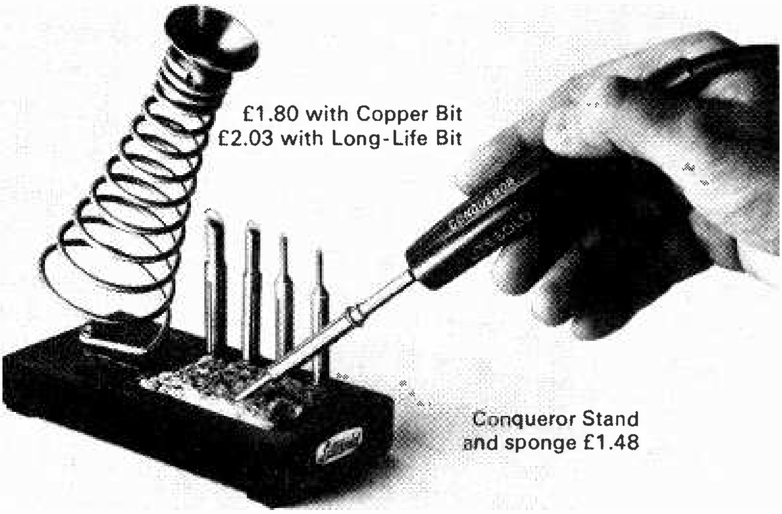

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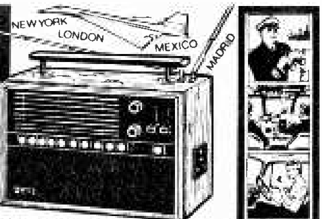

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6F23	·64	DL92	·24	ECL80	·35	EZ81	·21	PCL85	·36	UCH42	·56
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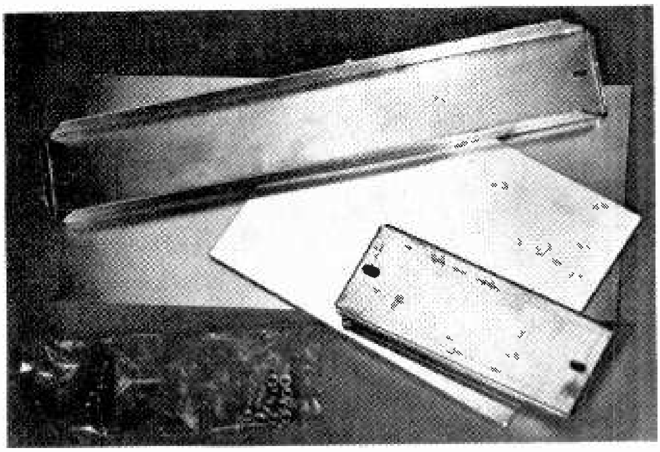

> **Problems**
>
> Now to try and deal with some of the problems. We have had a number of reader's asking where the universal chassis parts that we have specified for some projects are available, the answer is Home Radio Components Ltd., who advertise their catalogue in our pages regularly.

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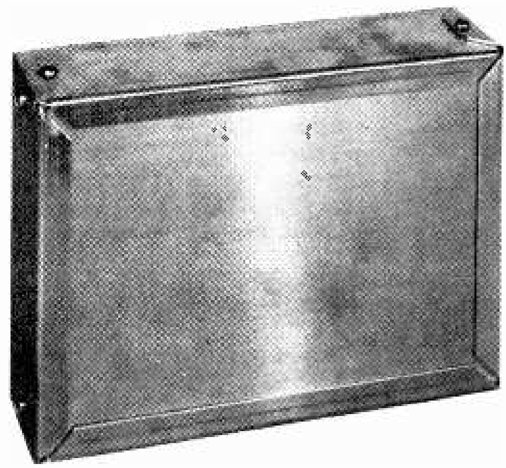

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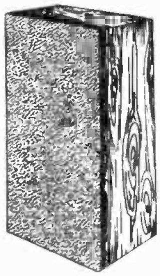

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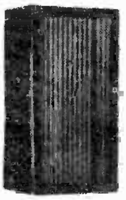

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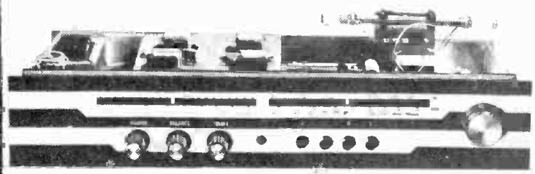

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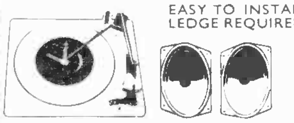

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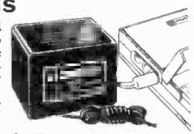

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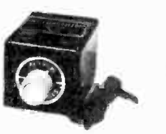

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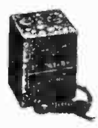

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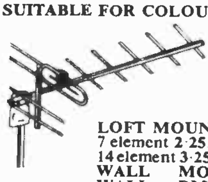

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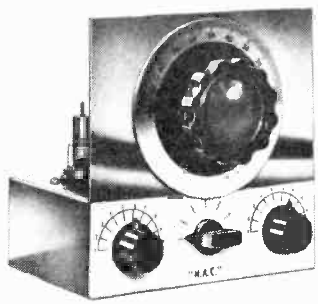

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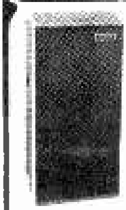

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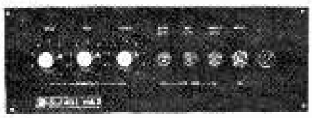

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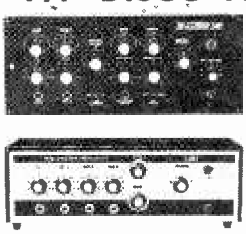
DISCO-IMP. The latest addition to the Discosound Range of discotheques. Even smaller and more compact than the Disco-Mini, it contains all the necessary features for the smooth running of a mobile unit. Size 29" × 18½" × 7". **£79·00**
DISCO-MINI. Complete portable Disco with built-in full function preamplifier/mixer. For use with any power amplifier such as "Discmaster". Size 30" × 20" × 8". **£98·50**
DISCO-STANDARD. Has all the facilities of the Disco-Mini with the addition of a built-in 100 watt power amplifier making it a completely self contained disco unit. A V.U. meter gives visual indication of output levels. Size 32" × 27" × 7½". **£180·00**
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". **£224·00**
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". **£261·00.**

PA—DISCO AMPLIFIERS



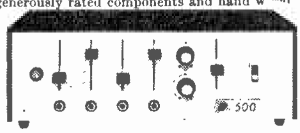
DISCO-AMP. 100 watt rms. output for 8-16 ohms, 4 channel inputs, 2-mic, 2 decks. Separate volume control plus masters. Response 30Hz –30KHz, distortion less than 1%. Treble/Bass/PFL/Mic over-ride etc. Panel size 16½" × 7".

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".

DJ.105S. 30 watt rms. version. Size 11¾" × 5" × 6".
DISCMASTER SLAVE AMPLIFIER. 100 watt rms. for 8-16 ohms. **£59·50**

NEW D.J. 500 SERIES P.A. AMPLIFIERS 50 WATT, 70 WATT & 100 WATT MODELS

This new range incorporates many features that make them ideal for the professional user, clubs, discotheques, factories etc. Fibre glass P.C. Boards are used throughout with low noise silicon transistors, high stability resistors, generously rated components and hand wired assembly to ensure reliability and quality.



- ★ Exclusive "Fail Safe" Electronic Protection circuit.
- ★ Fault Condition warning lamp.
- ★ Built in bass boost below 30 Hz.
- ★ 4 channel mixer with slider controls.

All three amplifiers have a built in emitter follower output socket for connecting a slave amplifier to enable the power output to be increased up to 1000 watts or more if required. A matching range of slave power amplifiers and a separate matching 100v line transformer is available

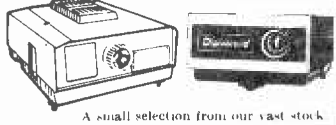
SPECIFICATION

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.	**£56·25**
	Model D.J.700	70 watts R.M.S.	**£67·50**
	Model D.J.1000	100 watts R.M.S.	**£79·00**

DISCO MINI

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". **£98·50.**

EFFECTS PROJECTORS



A small selection from our vast stock

DISCO COLT. 150 watt.
LIQUIMATIC MINI, 50 watt Q1 with 6" wheel.
DISCOWHEEL, 50 watt Q1 with quick change Cassette.
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
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Discosound
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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

CHECK WITH YOUR NEAREST STUDIO FOR LATEST PRICES AND DETAILS (TRADE AND RETAIL SUPPLIED)

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PROJECT 2 RADIO 2 TUNER	A fairly complex assembly making full use of the connection points on the Veroboard. A pre-tuned Radio 2 Tuner incorporating two transistors. Current consumption from the 9 volt battery is of the order of 2mA only.
PROJECT 3 INTEGRATED CIRCUIT AMPLIFIER	Designed around the readily available R.C.A. CA3020 i.c., this a.f. amplifier offers a high level of performance and relatively few components are needed – output in excess of 300mW, input impedance 50kΩ.

Copies may also be obtained direct from the Publishers, 26p. including postage. Published by Data Publications Ltd. 57 Maida Vale, London W.9.

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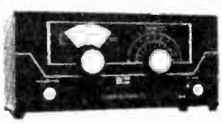
P.R.40

SOLID STATE R.F. PRESELECTOR

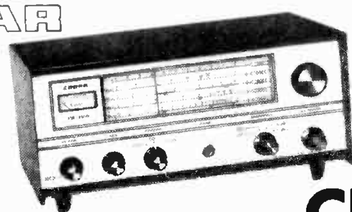
The PR40 R.F. Preselector is the solid state version of the world famous PR30 which it now supercedes.
It employs Silicon "N" Channel FET (Field Effect Transistor) front end, followed by silicon NPN Broad Band R.F. Amp., and will substantially improve receiver performance over the range 1·5 to 35 MHz, providing a considerable increase in gain up to an overall average of 30 dB, with improved image rejection and noise ratio.
Supplied complete with co-ax plug (less standard 9 volt PP6 Battery), 12 months Guarantee . . . £8·90 Carriage 30p.



MULTIBAND—6

SOLID STATE SHORT WAVE RECEIVER KIT

All transistor T.R.F. Receiver tunes 550 KHz to 30 MHz (540 to 10 metres) complete coverage—no gaps. Medium waves—Trawlers—Ship/Shore Telephone—All Six Amateur Bands 160–10 metres—International Broadcast from Australia, Far East, Russia, USA etc. using 4 miniature plug in Coils.
Hi-Gain FET Regen. Det./AF/AF Module giving full loudspeaker output to any external 2/3 ohm speaker. Receives AM/CW/SSB.
Separate Electrical Bandspread, Calibrated Main Tuning.
A Quality CODAR-KIT with 12 months Guarantee. No technical knowledge required, simple to build, printed circuit and Pictorial Instruction Manual, fully detailed step by step.
Complete Kit with 4 Coils (less standard PP6 battery). £13·20 Carriage 35p.
Stamp brings illustrated leaflets.



★

CR70A

COMMUNICATION RECEIVER

The CODAR CR70A is an outstanding general coverage communication receiver, ideal for the keen S.W.L.
It tunes from 540 metres medium through to 10 metres with no gaps. Covers shipping, coastguard and distress frequencies, all six amateur bands 160-10 metres, International broadcast, Met. stations etc. etc. giving world-wide reception. Exclusive features include Air-spaced CODAR-COIL Hi-"Q" Aerial input, illuminated Meter and Slide Rule Scale, Two Speed vernier tuning, Switched B.F.O. for CW/SSB signals. Separate output for Tape recorder.
Ready to plug in to 200/240 volts A.C. it only needs your aerial and a 2/3 ohm loudspeaker to bring the world to your finger tips. 12 months full guarantee.
Complete ready built £27·50, Carriage 70p.
Ask the chap who's got one, there's lots of them!

NOTE: These CODAR Receivers meet the B.R.E.M.A. specification for Communication Receivers and are FREE of Purchase Tax. Some portable receivers being advertised as Communication Receivers do not meet these requirements.

ON THE DESIGN STAFF— G3SZM G3IRE G8BBI

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THIS IS THE FIRST PAGE OF THE GREAT BI-PAK SECTION

BRAND NEW FULLY GUARANTEED DEVICES

Cut these 3 pages out and keep for reference

AC107	0·20	AD162	0·33	BC148	0·10	BD137	0·45	BF188	0·40	OC19	0·35	2G371	0·16	2N2219	0·20	2N3054	0·46	2N4059	0·10
AC113	0·20	AD161 &		BC149	0·12	BD138	0·50	BF194	0·12	OC20	0·63	2G371B	0·12	2N2220	0·22	2N3055	0·50	2N4060	0·12
AC115	0·23	AD162 (MP)		BC150	0·18	BD139	0·55	BF195	0·12	OC22	0·38	2G373	0·17	2N2221	0·20	2N3391	0·14	2N4061	0·12
AC117K	0·20		0·55	BC151	0·20	BD140	0·60	BF196	0·14	OC23	0·42	2G374	0·17	2N2222	0·20	2N3391A	0·16	2N4062	0·12
AC122	0·12	ADT140	0·50	BC152	0·17	BD155	0·80	BF197	0·14	OC24	0·56	2G377	0·30	2N2368	0·17	2N3392	0·14	2N4284	0·17
AC125	0·17	AF114	0·24	BC153	0·28	BD175	0·60	BF200	0·45	OC25	0·38	2G378	0·16	2N2369	0·14	2N3393	0·14	2N4285	0·17
AC126	0·17	AF115	0·24	BC154	0·30	BD176	0·60	BF222	0·95	OC26	0·25	2G381	0·16	2N2369A	0·14	2N3394	0·14	2N4286	0·17
AC127	0·17	AF116	0·24	BC157	0·18	BD177	0·65	BF257	0·45	OC28	0·50	2G382	0·16	2N2411	0·24	2N3395	0·17	2N4287	0·17
AC128	0·17	AF117	0·24	BC158	0·12	BD178	0·65	BF258	0·60	OC29	0·50	2G401	0·30	2N2412	0·24	2N3402	0·21	2N4288	0·17
AC132	0·14	AF118	0·35	BC159	0·12	BD179	0·70	BF259	0·85	OC35	0·42	2G414	0·30	2N2646	0·47	2N3403	0·21	2N4289	0·17
AC134	0·14	AF124	0·30	BC160	0·45	BD180	0·70	BF262	0·55	OC36	0·50	2G417	0·25	2N2711	0·21	2N3404	0·28	2N4290	0·17
AC137	0·14	AF125	0·25	BC161	0·50	BD185	0·65	BF263	0·55	OC41	0·20	2N388	0·35	2N2712	0·[illegible]	2N3405	0·42	2N4291	0·17
AC141	0·14	AF126	0·28	BC167	0·12	BD186	0·65	BF270	0·35	OC42	0·24	2N388A	0·55	2N2714	0·21	2N3414	0·15	2N4292	0·17
AC141K	0·17	AF127	0·28	BC168	0·12	BD187	0·70	BF271	0·30	OC44	0·15	2N404	0·20	2N2904	0·17	2N3415	0·15	2N4293	0·17
AC142	0·14	AF139	0·30	BC169	0·12	BD188	0·70	BF272	0·80	OC45	0·12	2N404A	0·28	2N2904A	0·21	2N3416	0·28	2N5172	0·12
AC1[illegible]K	0·17	AF178	0·50	BC170	0·12	BD189	0·75	BF273	0·35	OC70	0·10	2N524	0·42	2N2905	0·21	2N3417	0·28	2N5457	0·32
AC1[illegible]	0·15	AF179	0·50	BC171	0·14	BD190	0·75	BF274	0·35	OC71	0·10	2N527	0·49	2N2905A	0·21	2N3525	0·75	2N5458	0·32
AC154	0·20	AF180	0·50	BC172	0·14	BD195	0·85	BFW10	0·60	OC72	0·14	2N598	0·42	2N2906	0·15	2N3646	0·09	2N5459	0·40
AC155	0·20	AF181	0·45	BC173	0·14	BD196	0·85	BFX29	0·27	OC74	0·14	2N599	0·45	2N2906A	0·18	2N3702	0·10	2S301	0·50
AC156	0·20	AF186	0·45	BC174	0·14	BD197	0·90	BFX84	0·22	OC75	0·15	2N696	0·12	2N2907	0·20	2N3703	0·10	2S302A	0·42
AC157	0·24	AF239	0·37	BC175	0·22	BD198	0·90	BFX85	0·30	OC76	0·15	2N697	0·13	2N2907A	0·22	2N3704	0·11	2S302	0·42
AC165	0·20	AL102	0·65	BC177	0·19	BD199	0·95	BFX86	0·22	OC77	0·25	2N698	0·24	2N2923	0·14	2N3705	0·10	2S303	0·55
AC166	0·20	AL103	0·65	BC178	0·19	BD200	0·95	BFX87	0·24	OC81	0·15	2N699	0·35	2N2924	0·14	2N3706	0·09	2S304	0·70
AC167	0·20	ASY26	0·25	BC179	0·19	BD205	0·80	BFX88	0·22	OC81D	0·15	2N706	0·08	2N2925	0·14	2N3707	0·11	2S305	0·84
AC168	0·24	ASY27	0·30	BC180	0·24	BD206	0·80	BFY50	0·20	OC82	0·15	2N706A	0·09	2N2926 (G)		2N3708	0·07	2S306	0·84
AC169	0·14	ASY28	0·25	BC181	0·24	BD207	0·95	BFY51	0·20	OC82D	0·15	2N708	0·12		0·12	2N3709	0·09	2S307	0·84
AC176	0·20	ASY29	0·25	BC182	0·10	BD208	0·95	BFY52	0·20	OC83	0·20	2N711	0·30	2N2926 (Y)		2N3710	0·09	2S321	0·56
AC177	0·24	ASY50	0·25	BC182L	0·10	BDY20	1·00	BFY53	0·17	OC84	0·20	2N717	0·35		0·11	2N3711	0·09	2S322	0·42
AC178	0·28	ASY51	0·25	BC183	0·10	BF115	0·24	BPX25	0·85	OC139	0·20	2N718	0·24	2N2926 (O)		2N3819	0·28	2S322A	0·42
AC179	0·28	ASY52	0·25	BC183L	0·10	BF117	0·45	BSX19	0·15	OC140	0·20	2N718A	0·50		0·10	2N3820	0·50	2S32[illegible]	0·56
AC180	0·17	ASY54	0·25	BC184	0·12	BF118	0·70	BSX20	0·15	OC169	0·25	2N726	0·28	2N2926 (R)		2N3821	0·35	2S32[illegible]	0·70
AC180K	0·20	ASY55	0·25	BC184L	0·12	BF119	0·70	BSY25	0·15	OC170	0·25	2N727	0·28		0·10	2N3823	0·28	2S325	0·70
AC181	0·17	ASY56	0·25	BC186	0·28	BF121	0·45	BSY26	0·15	OC171	0·25	2N743	0·20	2N2926 (B)		2N3903	0·28	2S326	0·70
AC181K	0·20	ASY57	0·25	BC187	0·28	BF123	0·50	BSY27	0·15	OC200	0·25	2N744	0·20		0·10	2N3904	0·80	2S327	0·70
AC187	0·22	ASY58	0·25	BC207	0·11	BF125	0·45	BSY28	0·15	OC201	0·28	2N914	0·14	2N3010	0·70	2N3905	0·28	2S701	0·42
AC187K	0·20	ASZ21	0·40	BC208	0·11	BF127	0·50	BSY29	0·15	OC202	0·28	2N918	0·30	2N3011	0·14	2N3906	0·27	40361	0·40
AC188	0·22	BC107	0·09	BC209	0·12	BF152	0·55	BSY38	0·18	OC203	0·25	2N929	0·21	2N3053	0·17	2N4058	0·12	40362	0·45
AC188K	0·20	BC108	0·09	BC212L	0·11	BF153	0·45	BSY39	0·18	OC204	0·25	2N930	0·21						
ACY17	0·25	BC109	0·10	BC213L	0·11	BF154	0·45	BSY40	0·28	OC205	0·35	2N1131	0·20						
ACY18	0·20	BC113	0·10	BC214L	0·14	BF155	0·70	BSY41	0·28	OC309	0·40	2N1132	0·22						
ACY19	0·20	BC114	0·15	BC225	0·25	BF156	0·48	BSY95	0·12	P346A	0·20	2N1302	0·14						
ACY20	0·20	BC115	0·15	BC226	0·35	BF157	0·55	BSY95A	0·12	P397	0·42	2N1303	0·14						
ACY21	0·20	BC116	0·15	BCY30	0·24	BF158	0·55	Bu105	2·00	OCP71	0·43	2N1304	0·17						
ACY22	0·16	BC117	0·15	BCY31	0·26	BF159	0·60	C111E	0·50	ORP12	0·43	2N1305	0·17						
ACY27	0·18	BC118	0·10	BCY32	0·30	BF160	0·40	C400	0·30	ORP60	0·40	2N1306	0·21						
ACY28	0·19	BC119	0·30	BCY33	0·22	BF162	0·40	C407	0·25	ORP61	0·40	2N1307	0·21						
ACY29	0·35	BC120	0·80	BCY34	0·25	BF163	0·40	C424	0·20	ST140	0·12	2N1308	0·23						
ACY30	0·28	BC125	0·12	BCY70	0·14	BF164	0·40	C425	0·50	ST141	0·17	2N1309	0·23						
ACY31	0·28	BC126	0·18	BCY71	0·18	BF165	0·40	C426	0·35	TIS43	0·30	2N1613	0·20						
ACY34	0·21	BC132	0·12	BCY72	0·14	BF167	0·22	C428	0·20	UT46	0·27	2N1711	0·20						
ACY35	0·21	BC134	0·18	BCZ10	0·20	BF173	0·22	C441	0·30	2G301	0·09	2N1889	0·32						
ACY36	0·28	BC135	0·12	BCZ11	0·25	BF176	0·35	C442	0·30	2G302	0·19	2N1890	0·45						
ACY40	0·17	BC136	0·15	BCZ12	0·25	BF177	0·35	C444	0·35	2G303	0·19	2N1893	0·37						
ACY41	0·18	BC137	0·15	BD121	0·60	BF178	0·30	C450	0·22	2G304	0·24	2N2147	0·72						
ACY44	0·35	BC139	0·40	BD123	0·65	BF179	0·30	MAT100	0·19	2G306	0·40	2N2148	0·57						
AD130	0·38	BC140	0·30	BD124	0·60	BF180	0·30	MAT101	0·20	2G308	0·35	2N2160	0·60						
AD140	0·48	BC141	0·30	BD131	0·50	BF181	0·30	MAT120	0·19	2G309	0·35	2N2192	0·35						
AD142	0·48	BC142	0·30	BD132	0·60	BF182	0·40	MAT121	0·20	2G339	0·20	2N2193	0·35						
AD143	0·38	BC143	0·30	BD133	0·65	BF183	0·40	MPF102	0·42	2G339A	0·16	2N2194	0·35						
AD149	0·50	BC145	0·45	BD135	0·40	BF184	0·25	MPF104	0·37	2G344	0·18	2N2217	0·22						
AD161	0·33	BC147	0·10	BD136	0·40	BF185	0·30	MPF105	0·37	2G345	0·16	2N2218	0·20						

DIODES AND RECTIFIERS

AA119	0·08	BY133	0·21	OA10	0·35
AA120	0·08	BY164	0·50	OA47	0·07
AA129	0·08	BYX38/30		OA70	0·07
AAY30	0·09		0·42	OA79	0·07
AAZ13	0·10	BYZ10	0·35	OA81	0·07
BA100	0·10	BYZ11	0·30	OA85	0·09
BA116	0·21	BYZ12	0·30	OA90	0·06
BA126	0·22	BYZ13	0·25	OA91	0·06
BA148	0·14	BYZ16	0·40	OA95	0·07
BA154	0·12	BYZ17	0·35	OA200	0·06
BA155	0·14	BYZ18	0·35	OA202	0·07
BA156	0·13	BYZ19	0·28	SD10	0·05
BY100	0·15	CG62		SD19	0·05
BY101	0·12	(Eg) OA91		IN34	0·07
BY105	0·17		0·05	IN34A	0·07
BY114	0·12	CG651		1N914	0·06
BY126	0·14	(Eq) OA70·		1N916	0·06
BY127	0·15	OA79	0·06	IN414B	0·06
BY128	0·15	OA5	0·35	IS021	0·10
BY130	0·16	OA5SL	0·21	IS951	0·06

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx. count by weight	0·50
C 2	200	Capacitors mixed values approx. count by weight	0·50
C 3	50	Precision Resistors ·1%, ·01% mixed values	0·50
C 4	75	¼th W Resistors mixed preferred values	0·50
C 5	5	Pieces assorted Ferrite Rods	0·50
C 6	2	Tuning Gangs, MW/LW VHF	0·50
C 7	1	Pack Wire 50 metres assorted colours	0·50
C 8	10	Reed Switches	0·50
C 9	3	Micro Switches	0·50
C10	15	Assorted Pots & Pre-Sets	0·50
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Types	0·50
C12	40	Paper Condensers preferred types mixed values	0·50
C13	20	Electrolytics Trans. types	0·50
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·50
C15	4	Mains Toggle Switches, 2 Amp D/P	0·50
C16	20	Assorted Tag Strips & Panels	0·50
C17	10	Assorted Control Knobs	0·50
C18	4	Rotary Wave Change Switches	0·50
C19	3	Relays 6—24V Operating	0·50
C20	4	Sheets Copper Laminate approx. 10" × 7"	0·50

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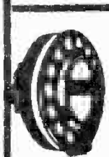

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PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
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100	0·25	0·33	0·47	0·47	0·50	0·58	0·63	1·40
200	0·35	0·37	0·49	0·49	0 57	0·61	0·75	1·60
400	0·43	0·47	0·56	0·56	0·67	0·75	0·93	1·75
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800	0·63	0·70	0·80	0·80	0·90	1·20	1·50	4·00

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PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·05	0·05	0·09	0·14	0·21	0·60
100	0·04	0·06	0·06	0·13	0·18	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
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200	50	60	90
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T2	8 D1374	OC75
T3	8 D1216	OC81D
T4	8 2G381T	OC81
T5	8 2G382T	OC82
T6	8 2G344B	OC44
T7	8 2G345B	OC45
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T9	8 2G399A	2N1302
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100 v RMS 37p ,,
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40PIV(Min.)	100	1·50
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U 3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·50
U 4	40	Germanium Transistors like OC81, AC128	0·50
U 5	60	200mA Sub-Min. Silicon Diodes	0·50
U 6	30	Sil. Planar Trans. NPN like BSY95A. 2N706	0·50
U 7	16	Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·50
U 8	50	Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·50
U 9	20	Mixed Voltages, 1 Watt Zener Diodes	0·50
U10	20	BAY50 charge storage Diodes DO-7 Glass	0·50
U11	25	PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·50
U12	12	Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·50
U13	30	PNP-NPN Sil. Transistors OC200 & 28 104	0·50
U14	150	Mixed Silicon and Germanium Diodes	0·50
U15	25	NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·50
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·50
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·50
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·50
U19	25	Silicon NPN Transistors like BC108	0·50
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U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·50
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U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·50
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·50
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	0·50
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U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·50
U32	25	Zener Diodes 400mW DO-7 case 3–18 volts mixed	0·50
U33	15	Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·50
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	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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Q4	6	Matched transistors OC44/45/81/81D	0·50
Q5	4	OC 75 transistors	0·50
Q6	5	OC 72 transistors	0·50
Q7	4	AC 128 transistors PNP high gain	0·50
Q8	4	AC 126 transistors PNP	0·50
Q9	7	OC 81 type transistors	0·50
Q10	7	OC 71 type transistors	0·50
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·50
Q12	3	AF 116 type transistors	0·50
Q13	3	AF 117 type transistors	0·50
Q14	3	OC 171 H.F. type transistors	0·50
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Q16	2	GET880 low noise Germanium transistors	0·50
Q17	5	NPN 2 × ST.141 & 3 × ST.140	0·50
Q18	4	MADT'S 2 × MAT 100 & 2 × MAT 120	0·50
Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·50
Q20	4	OC 44 Germanium transistors A.F.	0·50
Q21	4	AC 127 NPN Germanium transistors	0·50
Q22	20	NKT transistors A.F. R.F. coded	0·50
Q23	10	OA 202 Silicon diodes sub-min.	0·50
Q24	8	OA 81 diodes	0·50
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·50
Q26	8	OA95 Germanium diodes sub-min IN69	0·50
Q27	2	10A PIV Silicon rectifiers IS425R	0·50
Q28	2	Silicon power rectifiers BYZ 13	0·50
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7	Silicon switch transistors 2N706 NPN	0·50
Q31	6	Silicon switch transistors 2N708 NPN	0·50
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·50
Q33	3	Silicon NPN transistors 2N1711	0·50
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·50
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·50
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·50
Q37	3	2N3053 NPN Silicon transistors	0·50
Q38	7	NPN transistors 4 × 2N3703, 3 × 2N3702	0·50

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INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No. Contents	Price	Pak No. Contents	Price	Pak No. Contents	Price
UIC00 = 12 × 7400	0·50	UIC46 = 5 × 7446	0·50	UIC86 = 5 × 7486	0·50
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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
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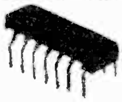

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SN7407	0·35	0·31	0·28
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SN7409	0·18	0·17	0·16
SN7410	0·15	0·14	0·12
SN7411	0·25	0·24	0·23
SN7412	0·35	0·31	0·28
SN7413	0·29	0·26	0·24
SN7416	0·43	0·40	0·38
SN7417	0·43	0·40	0·38
SN7420	0·15	0·14	0·12
SN7422	0·50	0·48	0·45
SN7423	0·50	0·48	0·45
SN7425	0·50	0·48	0·45
SN7427	0·45	0·42	0·40
SN7428	0·70	0·65	0·60
SN7430	0·15	0·14	0·12
SN7432	0·45	0·42	0·40
SN7433	0·80	0·75	0·70
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SN7491	£1·00	0·95	0·90
SN7492	0·67	0·64	0·58
SN7493	0·67	0·64	0·58
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SN7495	0·77	0·74	0·68
SN7496	0·87	0·84	0·78
SN74100	£1·65	£1·60	£1·55
SN74104	0·97	0·94	0·38
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SN74118	£1·00	0·95	0·90
SN74119	£1·35	£1·25	£1·10
SN74121	0·40	0·37	0·34
SN74122	£1·40	£1·30	£1·10
SN74123	£2·80	£2·70	£2·60
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SN74151	£1·00	0·95	0·90
SN74153	£1·20	£1·10	0·95
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BP 741—72741	75p	60p	50p
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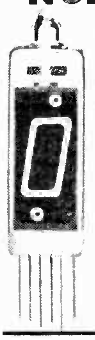
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
RP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP9093	40p	38p	35p
BP9094	40p	38p	35p
BP9097	40p	38p	35p
BP9099	40p	38p	35p

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
PRICE EACH	£1·70	£1·55	£1·90

All indicators 0-9 + Decimal point. All side viewing. Full data for all types available on request.

RTL MICROLOGIC CIRCUITS

Epoxy TO-5 case	Price each 1–24	25–99	100 up
uL900 Buffer	35p	33p	27p
uL914 Dual 2i/p gate	35p	33p	27p
uL923 J-K flip-flop	50p	47p	45p

Date and Circuits Booklet for IC's Price 7p.

DUAL IN LINE SOCKETS.

14 & 16 Lead Sockets for use with

DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	30p	27p	25p
TSO 16 ,, ,,	35p	32p	30p
LOW COST No.			
BPS 14	15p	13p	11p
BPS 16	16p	14p	12p

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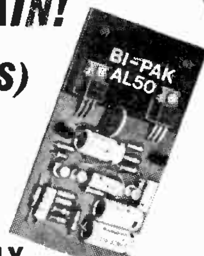
50W pk 25w (RMS)



0·1% DISTORTION!
HI-FI AUDIO AMPLIFIER

THE AL50

★ Frequency Response 15Hz to 100,000—1dB.

★ Load—3, 4, 8 or 16 ohms.

★ Distortion—better than ·1% at 1KHz.

★ Signal to noise ratio 80dB.

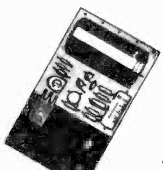
ONLY £3.25p each

★ 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.
FULLY BUILT — TESTED — GUARANTEED.

STABILISED POWER MODULE SPM80

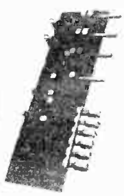


AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available, 10p **PRICE £2·95**

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 techniques. 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 controls.



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

ONLY £11·95

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £23·00 FREE p. & p.

All prices quoted in new pence *Giro No. 388-7006*
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Postage and packing add 7p. Overseas add extra for airmail. Minimum order 50p. Cash with order please.

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PRACTICAL WIRELESS

VOL 48 NO 7
Issue 789

NOVEMBER 1972

Is Ignorance Bliss?

MORE than £100,000,000's-worth of audio equipment, half of which is hi-fi, is being sold in the UK every year. But according to the findings of the commercial research department of Philips Electrical, who published details of a survey earlier this year, this buoyant industry thrives in a sea of appalling ignorance.

The report doesn't mince words. It says that "*the level of ignorance encountered in a number of shops was startling*". Many of them had inadequate audio facilities and expertise. When questioned, most dealers considered that the most important factor was the price, this being considered far ahead of design and performance.

This will come as no surprise to knowledgeable types who have had to buy goods from such shops. But the report goes on to say that the customers' largest single source of information is not from friends, magazines, sales literature or advertisements, but from dealers. It goes without saying, then, that in this classic example of the blind leading the blind, the average customer comes out of the ordeal in a state of mental fog.

To quote from the results of random samples: 44% did not know whether their cartridge was magnetic or ceramic; 75% did not know the frequency response of their amplifier; 60% could not give the audio output, and of those who could, 33% did not know if the figure was r.m.s. or music rating. Of more pertinent interest is that many people do not know whether or not they are listening to stereo. Many thought they were hearing stereo on Radios 1 and 2 and 75% of intending buyers interviewed thought they heard stereo on Radio 1!

It does not need a research team to expose the sad lack of competence (and, often, interest) in many shops, and it follows logically that many customers must be similarly ill-informed. However, we feel that there is a dividing line between the depth of knowledge a customer needs to use his equipment properly and the knowledge which is simply a technical luxury. In view of this, we were delighted to read that, despite the epidemic of ignorance, 64% of customers were "very satisfied" with their equipment.

One trade journal has suggested that we want a "*big effort to create more unsatisfied customers*". However, although we want people to appreciate good sound reproduction, is it ethical to unsettle people who are perfectly content with their equipment in order to gain a few more kHz and a little less distortion which they probably could not distinguish? In general we are against ignorance but sometimes, especially in audio, it can be bliss!

W. N. STEVENS—*Editor.*

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

SUPPLEMENT

THE DECEMBER ISSUE WILL BE PUBLISHED ON NOVEMBER 3rd

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

Mini calculator

Sinclair Radionics Ltd., annouce the world's smallest electronic calculator, just over $\frac{1}{4}$in. thick,

The Sinclair "Executive" performs all the functions of large desk machines although it is only 2 inches wide by $5\frac{1}{2}$ inches long. The total weight, including batteries, is $2\frac{1}{2}$ ounces. The illuminated display has a capacity of 8 digits and the machine will add, subtract, divide and multiply virtually instantaneously. Other features include automatic squaring, reciprocals, fixed or floating decimal point operation, and a memory for locking in instructions to repeatedly multiply or divide by a pre-determined factor.

This calculator uses a single MOS chip containing 7,000 transistors. Normally this type of I.C. consumes in the region of 350mW which alone would rule out a really slim pocket calculator because of the large batteries that would be required. The Sinclair calculator, however, includes a special circuit (patents applied for) which reduces the consumption to an average of only about 20mW. This is achieved in two ways; firstly by switching off the I.C. completely in between clock pulses, relying on the capacitance associated with the active elements to store the information, and secondly by reducing the clock rate considerably (and hence the "on" period) when the calculator is not actually performing a calculation.

Another factor contributing to the low overall power of the calculator is the way in which the display is driven. The battery voltage is chosen so that it is just sufficient to drive the monolithic gallium arsenide phosphide display directly so that no power is wasted in large dropper resistors. Indeed no such resistors are used at all as the display is driven directly from the chip. The batteries themselves are three tiny mercury cells of the type commonly used in hearing aids. These provide 20 hours of life.

The keyboard, another item which contributes to the thick-

ness of competitive machines, was specially developed for this calculator and is extremely thin, being only 4mm in depth. Price is £79 and every unit is guaranteed five years. *Sinclair Radionics Limited, London Road, St. Ives, Huntingdonshire PE 17 4HJ. St. Ives (04806) 4311.*

Texan Reprints

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

They may be obtained by sending 35p (30p + 5p postage/packing) to *Practical Wireless Editorial, Fleetway House, Farringdon Street, London, EC4A 4AD.* — Hurry the demand will be great!

Sheffield exhibition

Sheffield Education Committee will be holding an exhibition next month with the theme "Communications Today" at the Yewlands Comprehensive School, Creswick Lane, Grenoside, Sheffield, S30 3NN.

The dates of the exhibition are Friday and Saturday 3rd and 4th November and further information may be obtained from J. M. Nicholson, M.A., at the Yewlands School, telephone Ecclesfield 3778 (from London the code is 074 15 3778).

Record care

New from Bib is the Record Care Kit Ref. 43. Contained in a presentation 3-colour printed see-through box will be a new all-chrome finish Groov-Kleen Automatic Record Cleaner incorporating counterweight, arm-rest and all the features of the other two Bib Groov-Kleen's Models 42 and 50, turntable spirit level, plastic record dust-off, stylus & turntable cleaning liquid, right angle cleaning brush suitable for stylus and Groov-Kleen pad, and a turntable cleaning cloth. Recommended retail price for the Record Care Kit Ref. 43 is £2·49, including P.T.

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

Siemens equipment

The first Siemens record player to become available in the UK is announced by Interconti Electronics, who also announce the introduction of the RS303 tuner amplifier.

The RW346 stereo record player, comes complete with plinth and a protective dust cover. The arm is fitted with Shure magnetic pickup system and diamond stylus. The cabinet is available either in white or a light satinwood finish.

The recommended retail price of the unit is £100·66p.

The RS303 tuner amplifier to which the RW346 can be linked, is a stereo drive unit providing quadrosound reproduction. The receiver is equipped with built-in antennae covering all wave ranges. Station selection in the f.m. range is accomplished easily by using the five pre-set tuners each of which is tuned by a given control button. Price is £180. *Interconti Electronics Ltd., Albany House, Petty France, London, S.W.1.*

R.F. signal generator

Taylor Electrical Instruments have introduced the re-styled 68A/M Mk 11 signal generator which covers 100kHz to 240MHz in eight switched ranges with 30% internal amplitude modulation between 50Hz and 5kHz. All controls and sockets are panel mounted and include Set r.f. Level (with meter indication), Set a.f. Level, r.f. Output (switched 1-10), Attenuator (0 to −80dB.).

Stubec Radio

The above company have published a new catalogue which contains details and prices of radio components and special details of do-it-yourself loudspeaker components and grill fabrics.

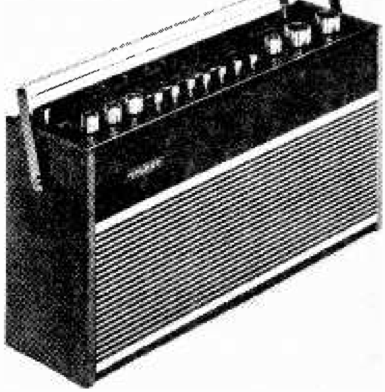
For your copy of this catalogue, send a stamped addressed foolscap envelope to: *Stubec Audio, 2 St. Faith's Street, Maidstone, Kent.*

Strobe unit

Dawe Instruments Limited announce stroboscope, Type 1209D. In addition to the many features of the well established Transistor Stroboflash, the new design provides a high sensitivity input (minimum external trigger: 200mV r.m.s.) which enables the Stroboflash to be triggered directly from such sources as vibration meters, vibration analysers or from an electromagnetic pickup.

The Stroboflash produces a high intensity white light and is capable of directly measuring the speed of any shaft or rotating part within the range 300 rev/min to 18,000 rev/min. The very short duration of the light flashes makes it possible to measure speeds up to 180,000 rev/min! *Dawe Instruments Ltd., Western Avenue, London, W3 OSD.*

"RP75"



The Super Sovereign RP75 covers medium, long, two short and f.m. bands and it's the latest in the Hacker range of portable radios, taking over from the well-known Hacker "Sovereign." Retail price is £69.

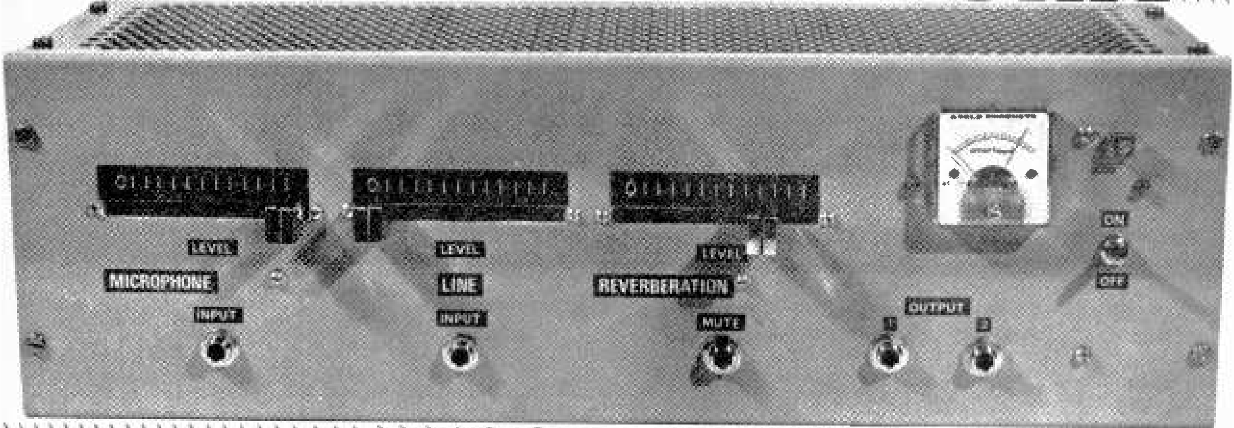
COME AND SEE US AT THE "AUDIO FAIR" . . .

Practical Wireless will be on Stand 18 (ground floor) at the International Audio Festival and Fair, Olympia from October 23rd-28th.

One of the highlights of our stand will be a display devoted to the "TEXAN" 20+20W Stereo Amplifier. You will also be able to get a reprint of the "TEXAN" for 30p.

Amongst other items featured, there will be a Reverberation Unit, Loud-Hailer, Buzz-Bar, Car Radio, Miniature Organ, Radio Transmitter, Receiver, Power Supply and Audio Test Instruments.

Reverberation Unit



F.C. JUDD

PART ONE

REVERBERATION is an acoustical effect caused by the reflection of sound from hard surfaces within an enclosed space such as a large room or hall containing little sound absorbing material such as carpeting and padded furniture etc. The reflections become multiplied as the sound bounces from surface to surface and reaches the ears as a series of echoes of very short duration. The overall effect however, is a sustained sound because the reflections may take a considerable time to die away completely, depending on the volume of the enclosed space. In a very large hall the dying away, or decay time, may be as much as several seconds. Reverberation is quite unlike the more distinct single echoes caused by sound reflection in the open air from a single surface, such as a large building, or the echo effect produced by feeding a recorded signal from tape back into the recording amplifier.

Specification

Microphone Sensitivity	0·5mV for 800mV output (without reverb)
Line Input Sensitivity	200mV for 800mV output (without reverb)
Microphone Input Impedance	Nominal 100kΩ
Line Input Impedance	Nominal 10kΩ
Output Impedance	Nominal 5kΩ
Frequency Response (without reverb)	20Hz to 20kHz, either input
Signal to Noise (without reverb)	Microphone: —60dB Line: —80dB
Distortion Factor (without reverb)	Less than 0·5 per cent
Reverb Delay Time	Approx 2 seconds maximum

Spring Line Reverberation

Reverberation is quite easy to produce artificially. All that is required is a) a means of obtaining a series of echoes of short duration, of a few milliseconds in fact, and b) a means of sustaining repetition of the echoes for at least two seconds. A length of coiled springy wire will do this if it is mechanically excited at one end; this can be done by using a simple electromagnetic sound transducer. The speed of sound vibration up and down the spring line is very slow when compared with the speed of electrical sound through wires. The spring line offers little resistance to vibration travelling along it and because of this the vibrations will continue to travel up and down the line for some time. The strength of the vibrations do, however, decrease slowly and eventually cease altogether.

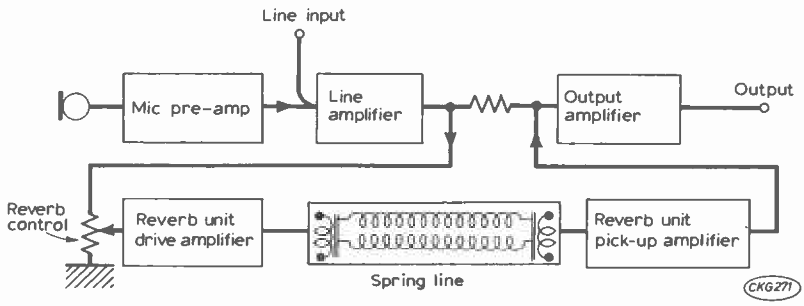


Fig. 1: Block diagram of the spring line reverberation unit.

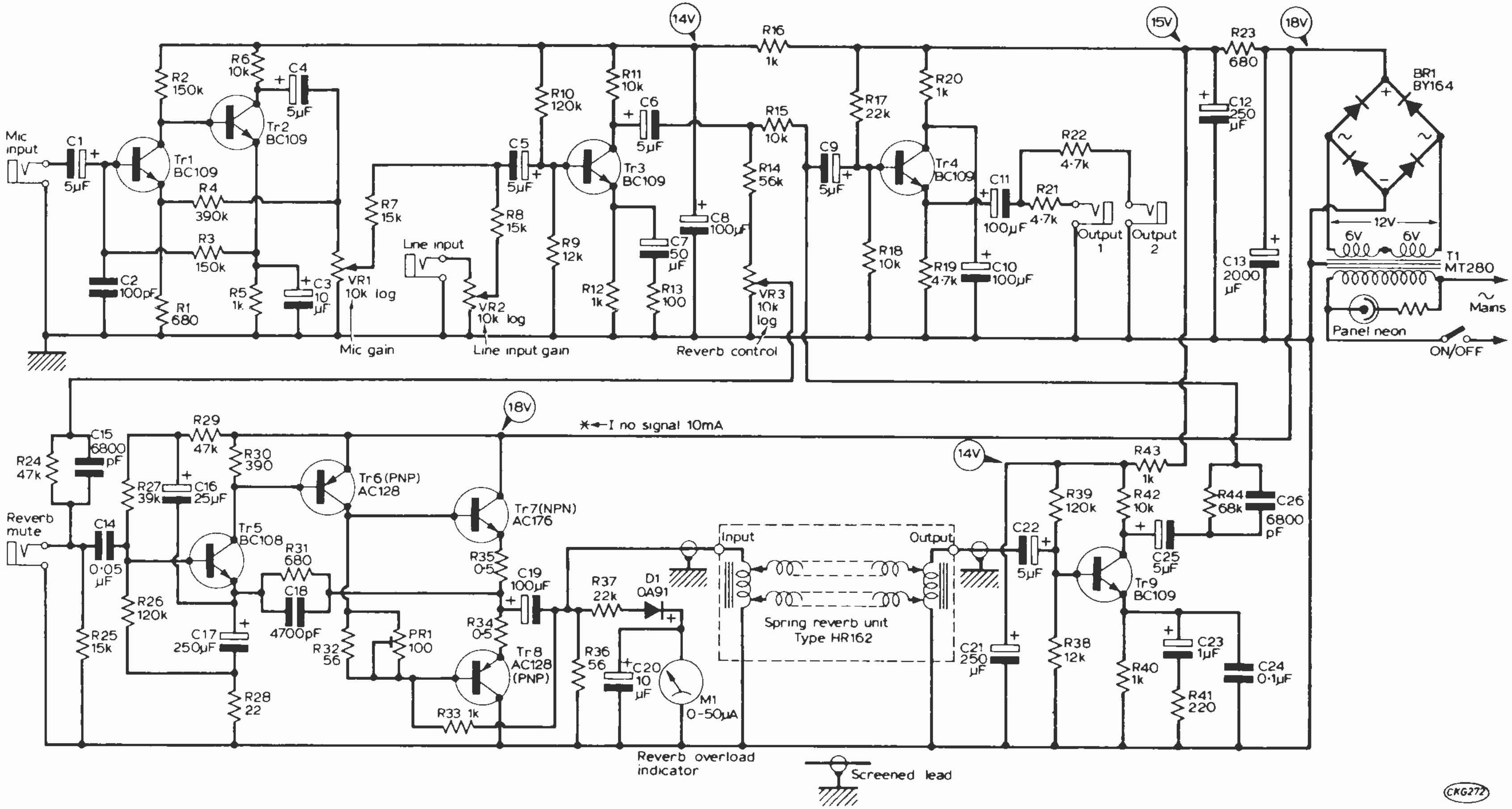


Fig. 2: Circuit diagram of the complete reverberation unit.

The complete reverberation unit

The block diagram in Fig. 1 will help to clarify the principle of a spring line reverb system. First the direct signals from a microphone or other external signal source are taken into the appropriate input. These are amplified and taken both to the output amplifier and to the spring line driving amplifier. The output from the latter drives the spring line and the reverberated signals are taken from the other end of the line, amplified and mixed with the direct signal. The output signal is therefore a mixture of both direct and delay signals. A control is inserted so that the level of signal from the reverberation circuit can be adjusted to provide different reverberation levels or it can be cut off altogether. One can simulate the short reverberation of a small room or the long sustained reverberation of a large hall.

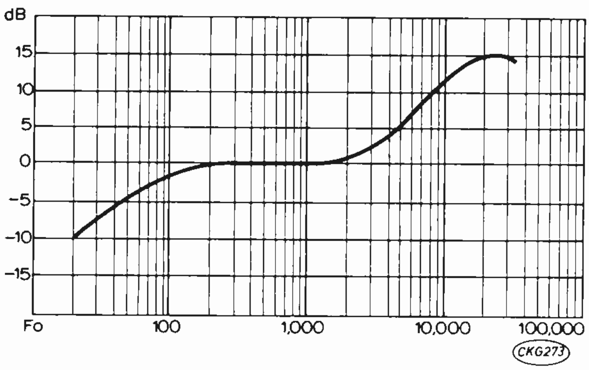


Fig. 3: Frequency response of the spring line driver amplifier.

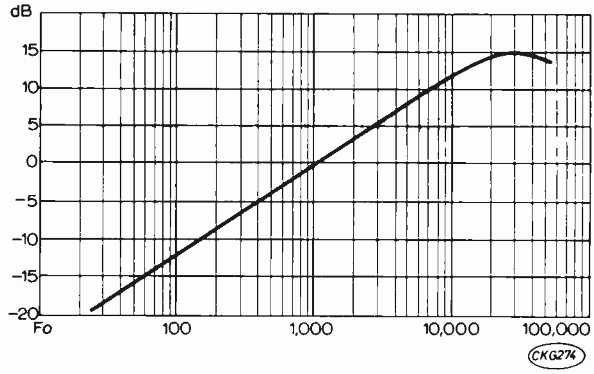


Fig. 4: Frequency response curve of the reverb output amplifier.

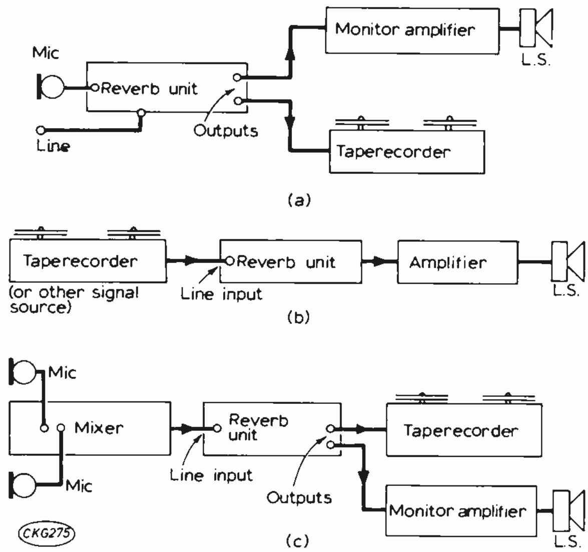
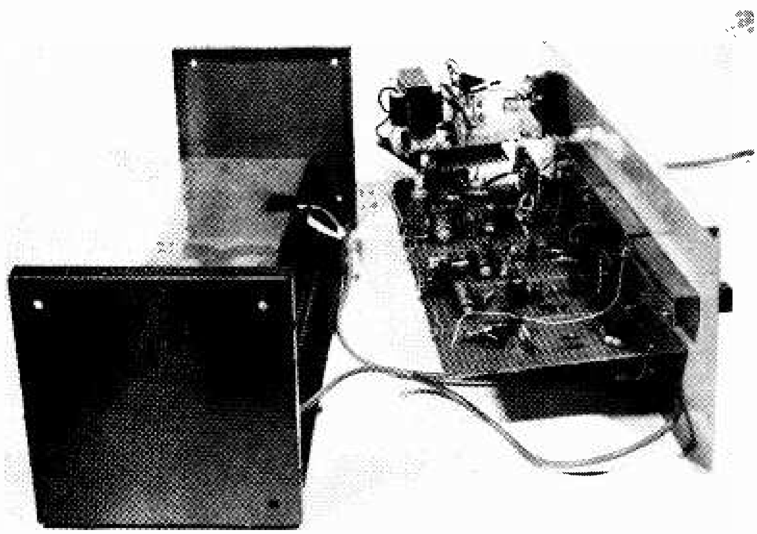


Fig. 5: Ways of using the spring line reverb unit.

The Circuit

The complete circuit is given in Fig. 2. The microphone preamplifier Tr1 and Tr2 is suitable for microphones of 200-600Ω, or low impedance microphones with a matching transformer, or with a crystal microphone. The output from this is taken to a passive mixing network via the microphone gain control VR1. The line level signal input, suitable for any linear signals from about 200mV upward, is taken via the line input gain control VR2 and thence to the passive mixing network R7 and R8.

The mixing network losses are recovered by the amplifier Tr3 and the output from this is taken via a passive network to a) the output emitter follower stage Tr4 and b) to the reverb unit driving amplifier Tr5, Tr6, Tr7 and Tr8. This amplifier delivers around 1W at full reverb i.e., with the reverb control VR3 at maximum. The amplifier also has a special frequency response as shown in Fig. 3 to suit the response require-



A view of the prototype showing the delay line at the bottom of the case with the electronic components mounted on the back of the front panel.

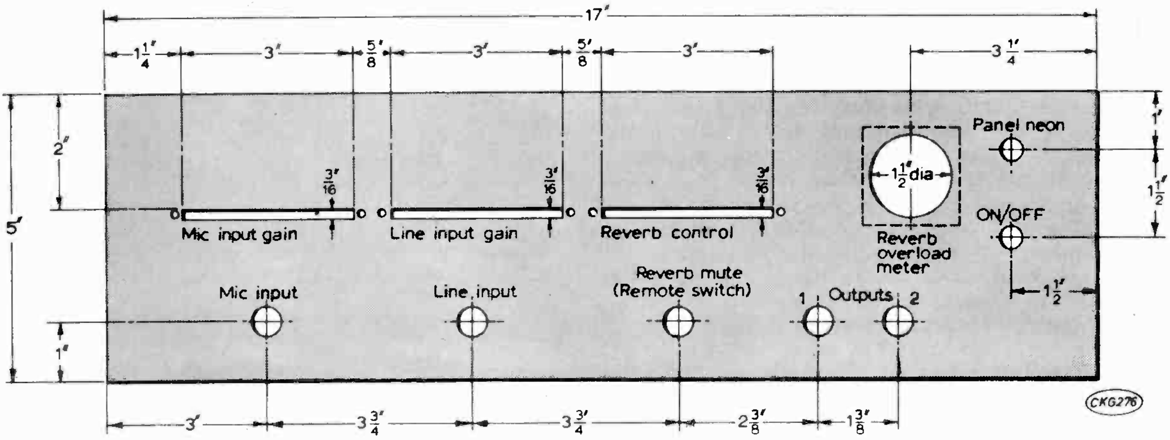


Fig. 6: Details of the front panel component positions and the drilling dimensions

ments of the spring line driving transducer.

The output from the driving amplifier is taken to the spring line unit socket marked 'Input' and also to the reverb overload meter circuit R37, D1, C20 and the 50μA meter. The use of the meter will be explained later.

The output from the spring line unit, from the socket marked 'Output', is taken to the amplifier Tr9 which also has a special frequency response as shown in Fig. 4. The signal from this amplifier is then taken to the emitter follower output stage Tr4.

The output from Tr4 is split to two output sockets, both of which can be used to feed a tape recorder and/or amplifier, or two tape recorders, or amplifiers as required and as shown in Fig. 5.

The reverb unit is mains operated by the transformer T1, bridge rectifier BR1 and smoothing network C13, R23, and C12. The supply rail at C13 is 18V positive and this goes direct to the spring line driving amplifier. Further smoothing is needed for the signal amplifier stages, hence the addition of R23 and C12 from which the supply rail is 15V positive. *Note that the transformer MT280 has two 6V secondary windings which are connected in series to provide 12V to the bridge rectifier BR1.*

Construction

The spring line reverb unit is a type HR162 (Henry's Radio Limited) and is 16⅞in long. This will just fit into a Lektrokit case (17in long) in which the prototype unit as shown in the photos was built

★ components list

Resistors

R1	680Ω	R16	1kΩ	R31	680Ω
R2	150kΩ	R17	22kΩ	R32	56Ω
R3	150kΩ	R18	10kΩ	R33	1kΩ
R4	390kΩ	R19	4·7kΩ	R34	0·5Ω
R5	1kΩ	R20	1kΩ	R35	0·5Ω
R6	10kΩ	R21	4·7kΩ	R36	56Ω
R7	15kΩ	R22	4·7kΩ	R37	22kΩ
R8	15kΩ	R23	680Ω	R38	12kΩ
R9	12kΩ	R24	47kΩ	R39	120kΩ
R10	120kΩ	R25	15kΩ	R40	1kΩ
R11	10kΩ	R26	120kΩ	R41	220Ω
R12	1kΩ	R27	39kΩ	R42	10kΩ
R13	100Ω	R28	22Ω	R43	1kΩ
R14	56kΩ	R29	47kΩ	R44	68kΩ
R15	10kΩ	R30	390Ω		

All resistors ¼W, 5 per cent tolerance except R34 and R35 which are 1W.

Capacitors

C1	5μF	C10	100μF	C19	100μF
C2	100pF	C11	100μF	C20	10μF
C3	10μF	C12	250μF	C21	250μF
C4	5μF	C13	2000μF	C22	5μF
C5	5μF	C14	0·05μF	C23	1μF
C6	5μF	C15	6800pF	C24	0·1μF
C7	50μF	C16	25μF	C25	5μF
C8	100μF	C17	250μF	C26	6800pF
C9	5μF	C18	4700pF		

All values above 1μF are electrolytic types and should have a working voltage of at least 25V, except C13 which should be at least 35V. Values below 1μF can be any type, Mylar, ceramic etc.

Semiconductors

Tr1	BC109	Tr5	BC108	Tr9 BC109
Tr2	BC109	Tr6	AC128	BR1 BY164 or similar silicon bridge rectifier (40V, 1·5A)
Tr3	BC109	Tr7	AC176	
Tr4	BC109	Tr8	AC128	

Miscellaneous

VR1, VR2 and VR3	Each 10kΩ log. Slider types Eagle RR11
PR1	100Ω preset carbon type
Spring Line Unit	Type HR162 (Henry's Radio Ltd.)
Transformer T1	240V primary, 6V+6V secondary, 280mA (Eagle Type MT280)
Neon	Panel type (prototype is Eagle RR30)
On-off switch SW1	Toggle type
Overload Meter M1	50μA, Eagle type MR2P
Jack Sockets	5-off required
Phono Plugs	2-off required
Case	Lektrokit, 17 x 5 x 5in. Made up from Front panel (1) LK401, Side Plates (2) LK311, Top, Back and Bottom Plates (3) LK501. Available from Home Radio
Circuit Board	Plain Veroboard, 0·15in. matrix, see text
Aluminium	16s.w.g. (for heatsink and power supply chassis); ⅜ x ⅜in. angle.

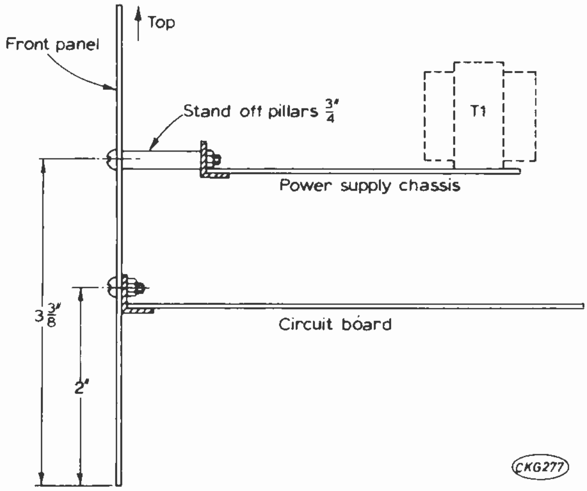


Fig. 7 (left): Location of the main circuit board and the power supply chassis behind the front panel.

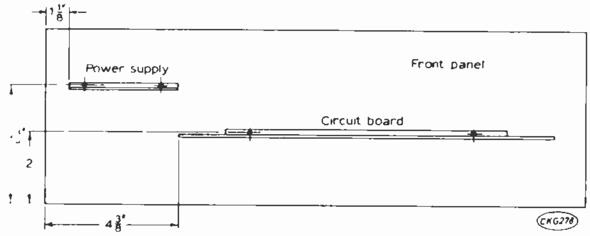


Fig. 8 (above): Rear view of the front panel showing the siting of the circuit boards.

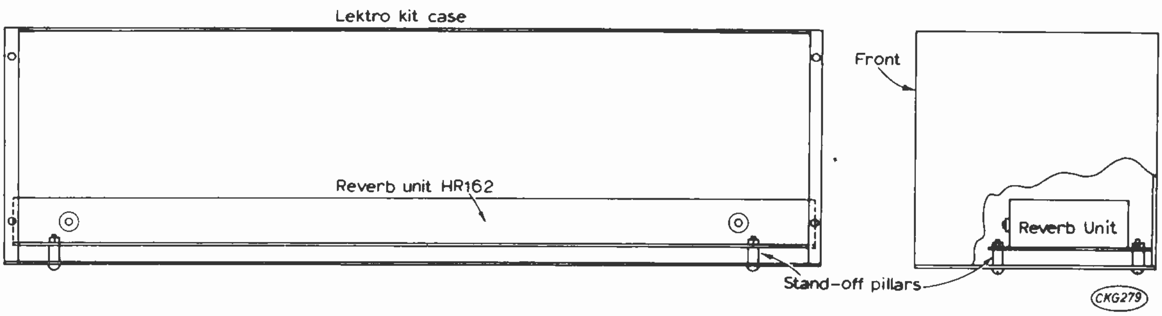
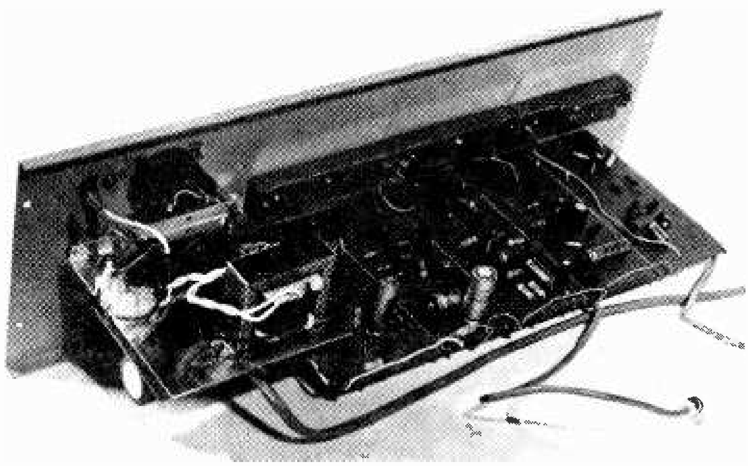


Fig. 9 (above): Siting of the spring line unit within the case.



On the left is shown a view of the prototype illustrating the siting of the component boards.

(see components list for details of the Lektrokit case which is 17×5×5in). A similar metal case of the same dimensions could of course be used.

Details for drilling the front panel to accommodate the slider type controls and signal sockets etc. are given in Fig. 6. The size of the hole for the overload meter will depend on the meter used but it must be a 50μA type.

The circuit board containing all the amplifier stages is mounted behind the front panel as shown in Figs. 7 and 8. The power supply is assembled as a separate chassis and this is mounted as shown. The spring line unit is mounted at the bottom and rear of the case and raised slightly on stand-off pillars as shown in Fig. 9 and with the output and input sockets facing towards the front.

The next stage is the circuit board which is $10\frac{7}{8}\times$ 5in. and is mounted on the front panel by means of $\frac{3}{8}\times\frac{3}{8}$in. aluminium angle and the stand-off pillars as in Fig. 7. Note that Tr7 and Tr8 must be mounted on a heatsink as in Fig. 10 which is made of 16 s.w.g. aluminium to the dimensions given.

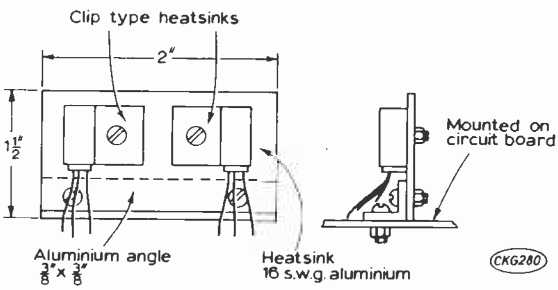
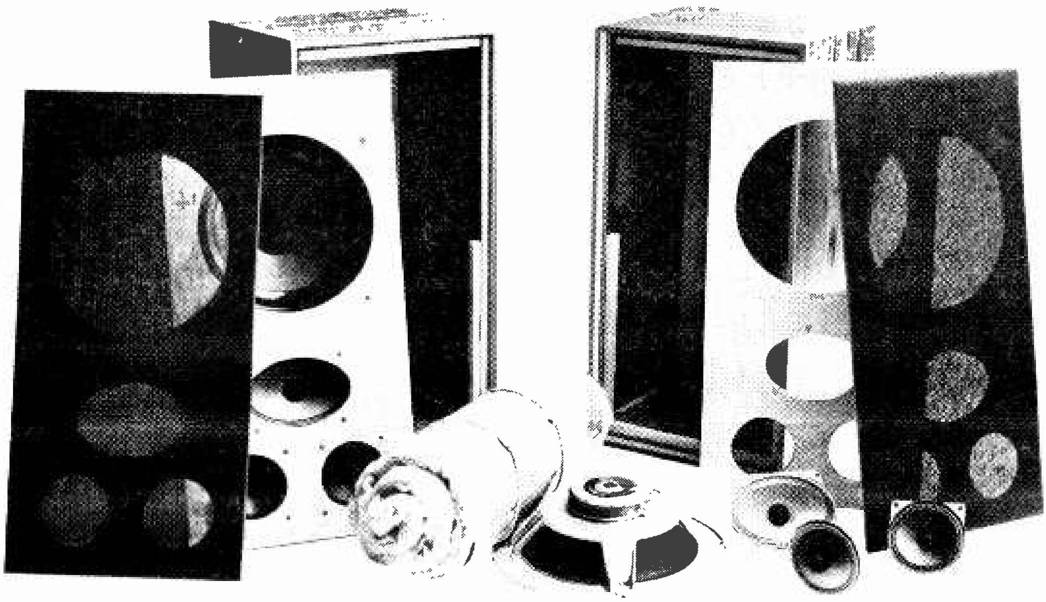


Fig. 10: Details of the heatsink for Tr7 and Tr8.

TO BE CONTINUED



If you want a job done properly, do it yourself.

Incredibly, almost half the money you spend on a speaker system simply goes to pay for the package it comes in: the cabinet.

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FR8	Dual Cone	8 90	CT5	Cone	1 20
Crossover Networks			CT10/8	Horn	2 40
CN23	2 way	1 10	CT10/16	Horn	2 40
CN28	2 way	1 10	HT15	Horn	3 50
CN216	2 way	1 10	MHT10	Horn	3 60
SN75	2 way	2 20	HT21	Horn	4 20
FF5	3 way	2 60	DT33	Dome	5 20

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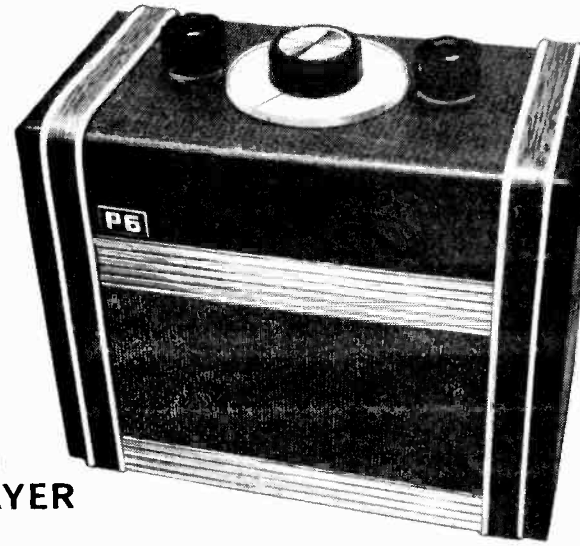
THE PROGRESSIVE SIX



F. G. RAYER

THIS portable receiver uses silicon n.p.n. epitaxial planar transistors in the first four stages, followed by a transformerless output stage employing germanium n.p.n. and p.n.p. complementary transistors. The circuit is relatively simple, while offering good sensitivity and adequate power output.

When completed, the receiver has three wavebands—long waves, medium waves and bandspreading of the h.f. end of the m.w. band (also sometimes termed Luxembourg Bandspread). However, though the switching associated with the provision of such bands is not very complicated, it does seem that it is sometimes a source of difficulty or wiring errors during building. So the receiver is first constructed with one band coverage, tuning m.w. only. When it has been found to give proper results in this form, the few additional items required to add bandspread tuning and l.w. coverage are incorporated. It would, in fact, be easy to limit coverage to l.w. and m.w. only, if the bandspread range is not required, or even to omit l.w. where this band is not wanted.

CIRCUIT

Fig. 1 is the circuit as constructed for one waveband, the m.w. ferrite rod winding L1 tuned by VC1, and the oscillator coil L3 tuned by VC2. VC1/2 is

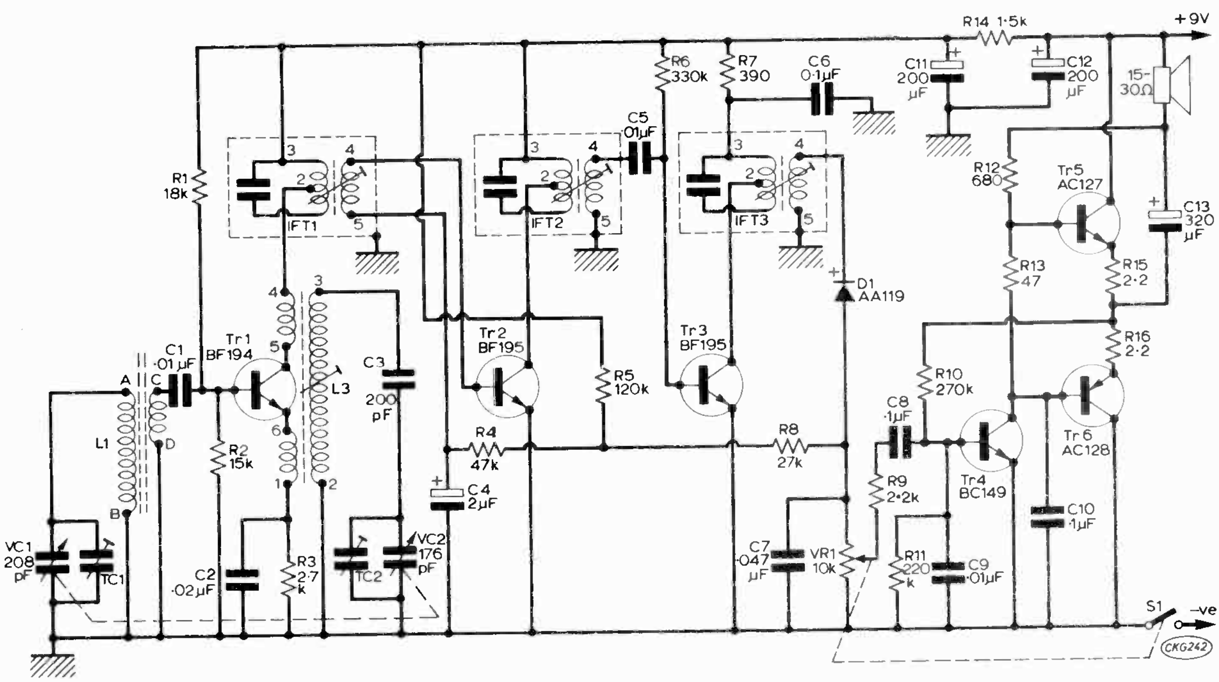
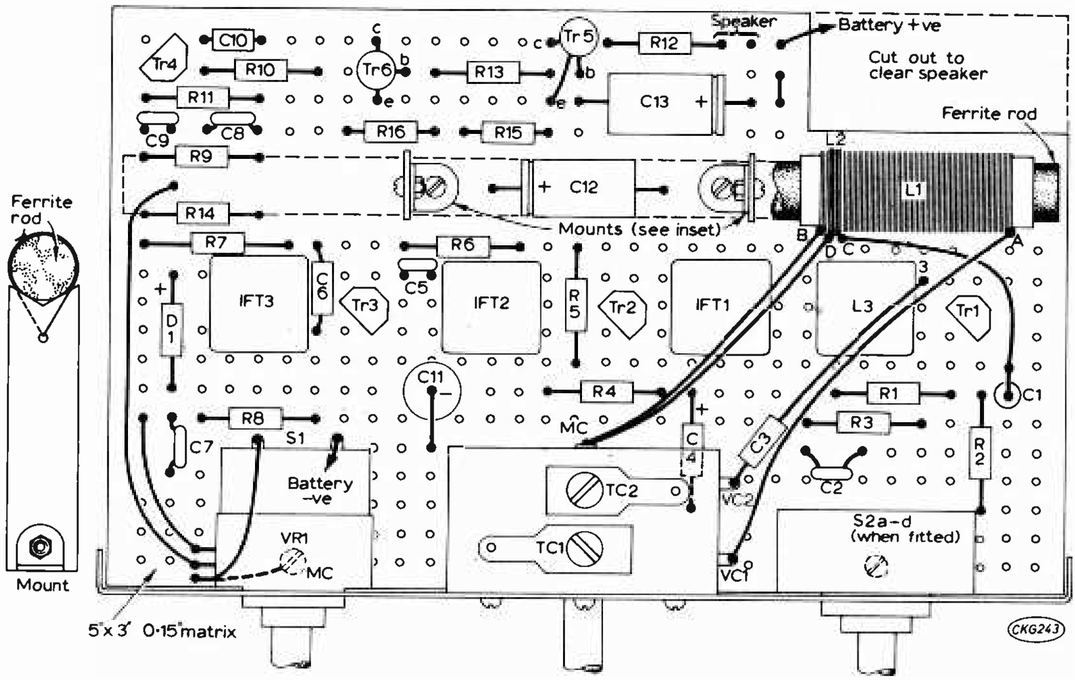
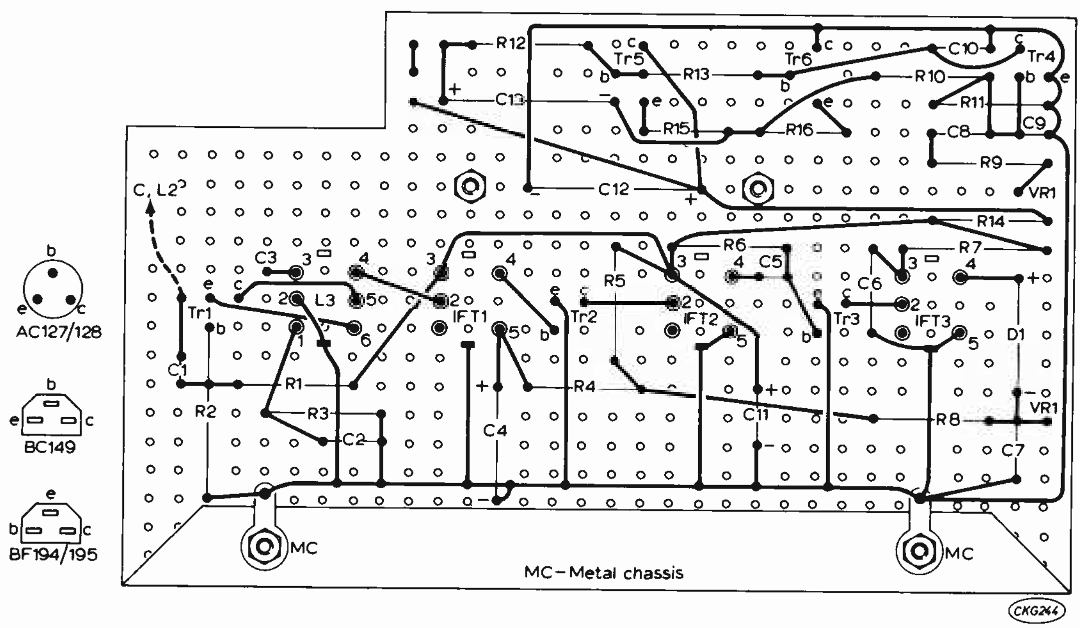


Fig. 1. Circuit of the basic receiver for normal medium wave reception. The additional bandswitching circuit is shown in Fig. 4.



▲*Fig. 2: Plan view of components mounted on top of circuit board with details of the mounting for the ferrite rod aerial. NOTE: Speaker should be shown connected to centre and RIGHT-HAND pin.*

▼*Fig. 3: Wiring on reverse side of circuit board together with transistor lead-out connections.*



a ganged capacitor with the trimmers TC1 and TC2 incorporated.

L2 is the m.w. base coupling winding for the oscillator/mixer Tr1. Tr2 and Tr3 are the IF amplifiers using BF195's. Diode D1 is the detector or demodulator which also provides a.g.c. bias for Tr2. The collector circuit of Tr3 is decoupled by C6 and R7. Because of the very high gain of these transistors, it may be necessary to take certain steps to avoid squegging or instability, as described later. This depends to some extent on individual transistor characteristics.

VR1 is the volume control feeding Tr4. Tr5 and Tr6 are used in a directly coupled driver-output arrangement which will be found to give good results and plenty of volume with a 15Ω or 18Ω speaker.

CONSTRUCTION

The controls are mounted on a 5×2in. "universal chassis" flanged member, Fig. 2. The top flange is cut off, to clear TC1 and the variable capacitor. When mounting this item, with its spindle through a clearance hole, it is necessary to use very short bolts, or

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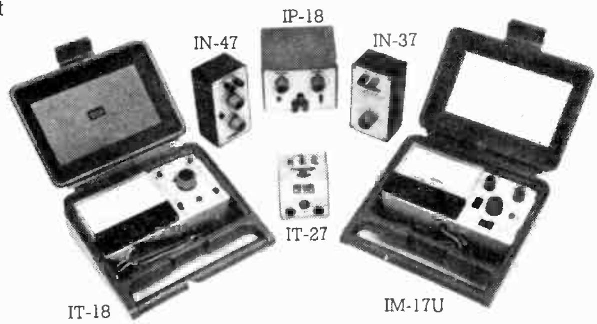

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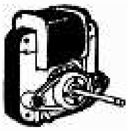

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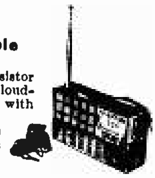

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RENITONE med. wave 7 transistors **£1·95**

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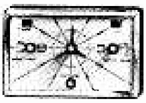

These units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set—also on the left is another time or alarm—this may be set in minutes up to 1 hour. At the end of the period a bell will sound. Offered at only a fraction of the regular price - £2·50, less than the value of the clock alone—post and ins. 15p.

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Model 1172 750m watt power output 85p.
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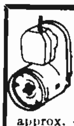
HONEYWELL PROGRAMMER

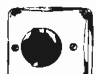
This is a drum type timing device, the drum being callibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price £5·75 plus 25p post and insurance. Don't miss this terrific bargain.

THIS MONTH'S SNIP



TIMAC 24 hour 15 amp Clock Switch. Self-contained unit for flex connection to the mains. Clock switches 2 on/offs per 24 hours. Operates a 15 amp switch. All neatly made up in an ivory moulded case with outlet socket. The only snag is that the outlet socket is the continental type. Plugs for these can be bought in this country alternatively you could fit a connector strip in place of the outlet socket. Overall size of this unit is approx. 4" × 2¼" × 3" and the clock has a clear perspex cover which is easily removable for reprogramming. Ideal for blanket controller etc. Price £2·75 each.

THYRISTOR LIGHT DIMMER



For any lamp up to 1kw. Mounted on switch plate to fit in place of standard switch. Virtually no radio interference. Price £2·95, plus 20p post and insurance.

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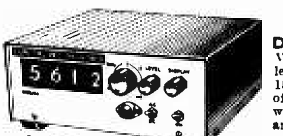

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MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up 9V battery operated. Size 2in long × 1½in wide × 1in high. SPECIAL SNIP PRICE 60p each. 10 for £5·40, 100 for £50.

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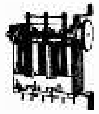

Made originally for Radiomobile car radios. This is a medium wave tuner with a frequency coverage 16kc—525kc. Aerial, RF and oscillator sections (long wave coil available) small size, only 2¼ + 2 + ½". Can be used with our IF module and AF modules and a few inter connection components to make a complete compact receiver. Circuit supplied. Price 65p. less 10% for 10.

Slide Switches. SP Change over spring return 250v 1 amp. 10p.

IMMERSION HEATERS BY REMPLOY

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BAKELITE INSTRUMENT CASE

Size approx. 6½" × 3½" × 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.

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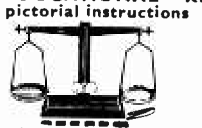
EDUCATIONAL KITS—all with pictorial instructions



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★ components list

Resistors

R1 18kΩ	R7 390Ω	R13 47Ω
R2 15kΩ	R8 27kΩ	R14 1·5kΩ
R3 2·7kΩ	R9 2·2kΩ	R15 2·2Ω
R4 47kΩ	R10 270kΩ	R16 2·2Ω
R5 120kΩ	R11 220kΩ	
R6 330kΩ	R12 680Ω	All ¼W 5%

VR1 10kΩ log. pot. with switch (S1)

Capacitors

C1 0·01μF	C9 0·01μF
C2 0·02μF	C10 0·1μF
C3 200pF 5%	C11 200μF 12V
C4 2μF 6V	C12 200μF 12V
C5 0·01μF	C13 320μF 6V
C6 0·1μF	C14 150pF 5%
C7 0·047μF	C15 30pF SM
C8 0·1μF	

VC1-2 208+176pF gang with slow motion and trimmers (TC1-2) (Jackson OO)
TC3-4-5 60pF compression trimmers.

Semiconductors

Tr1 BF194	Tr4 BC149	D1 AA119
Tr2 BF195	Tr5 AC127	
Tr3 BF195	Tr6 AC128	

Inductors

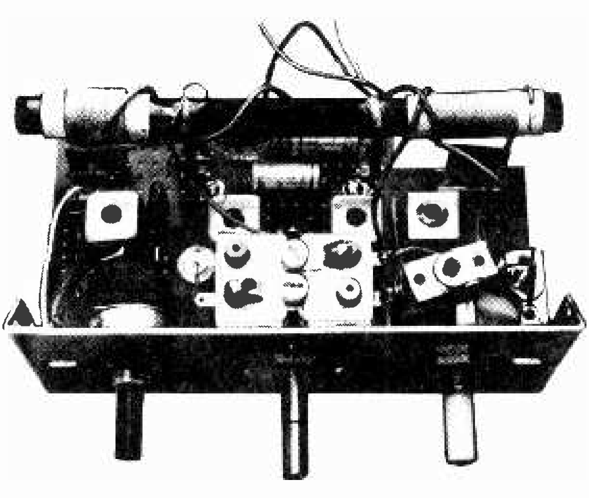
Ferrite rod aerial with m.w. and l.w. windings (Denco MW/LW/5FR)
L3 Oscillator (TOC1 Denco)
IFT1-2 (IFT13 Denco) IFT3 (IFT14 Denco)

Miscellaneous

Speaker 2¼in. dia. 15 to 30Ω. S2, 4 pole 3 way wafer switch. Veroboard 5 x 3in. 0·15in. matrix. Universal chassis members 6 x 3in. (2 off), 5 x 2in. (1) (Home Radio). Knobs, materials for case.

extra washers, to avoid shorting or damaging the front section. Two bolts through the circuit board and remaining flange hold these together, soldering tags being fitted for chassis connections, as in Figs. 2 and 3.

If the 0·15in. matrix board has 19 rows of holes one way and 32 rows the other, this will allow parts to be placed exactly as shown. The board is 5×3in.



View of completed chassis incorporating band switching.

Prepare it in advance by drilling holes for the bolts and for the pins and screening can tags of L3 and the i.f.t's. A very small round file can be very useful here if any holes are not quite correctly placed. Note that L3 has closer spacing between pins 1-2 and 5-6, and must be fitted as in Fig. 3.

A bare wire, such as 22 s.w.g. tinned copper, is soldered between the tags, as in Fig. 3, for earth returns. One screening can tag of L3 and each i.f.t. is connected to this.

Resistors and capacitors are inserted into the board as in Fig. 2, with their wire ends projecting. The wires are then bent over and connected as in Fig. 3, excess being snipped off. Insulated sleeving should be put on all leads which may touch each other or any metal part. In some places connecting leads have to be soldered on to reach to other components.

It is quite helpful to use black sleeving for the negative leads, red for positive wires and some other colour for other connections, as this makes it easier to check, if necessary.

Leads for the speaker and battery positive can be soldered to pins in these holes, or the wires may project a little and be used as soldering points.

TRANSISTORS

If Tr1, Tr2, Tr3 and Tr4 are placed as in Fig. 2, the pins will come as in Fig. 3. Leads to these pins should be soldered carefully so as to obtain proper joints, yet avoiding lengthy heating. Note that the BC149 pin connections differ from the BF194/195 types.

Place Tr5 and Tr6 so that their lead-out wires emerge as in Fig. 3. These transistors can be left with ½in. or so of lead above the circuit board. Fit diode D1 with the polarity correct as shown.

FERRITE AERIAL

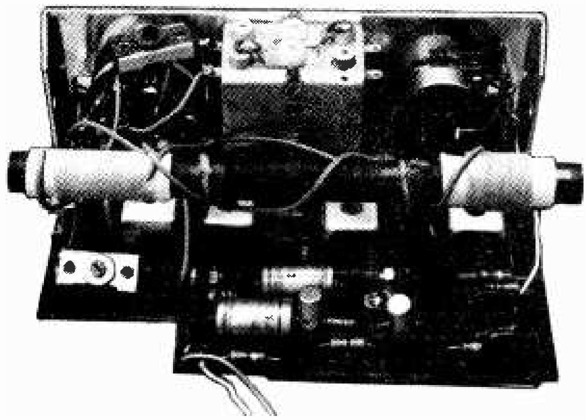
Two strips of paxolin or other insulating material are cut as in Fig. 2 to raise the rod about 1½in. from the circuit board. These strips are fixed with brackets, and the rod is held with string, thread or elastic through holes and round the rod.

For m.w., the m.w. section only is required, and is placed with the coupling winding L2 away from the rod end, Fig. 2. A and B are the ends of the long winding L1, and C and D are the ends of the smaller winding L2. Thin sleeving is put on the wires and enough slack left to allow the windings to be slid along the rod.

IF ALIGNMENT

The speaker should be connected to the points as shown. Core settings of the i.f.t's as supplied should be found to be approximately correct, but small adjustments are made for the best results, using a Denco TT5 tool or similar means of rotating the cores.

If a signal generator is available, tune it to 470kHz and couple it to the base of Tr1 through a small isolating capacitor, or place an insulated lead near C1. The i.f.t. cores are then adjusted for best volume. If this is done by ear, set VR1 at about maximum volume, and keep the generator signal input down so that the actual volume is quite low.



Rear view of receiver. Cut-out in veroboard to clear particular speaker used.

When no signal generator is available, tune in properly any stable transmission and adjust the cores for best results. Repeat with a weak signal.

Once the i.f.t. cores are adjusted for best results, they do not need any further attention and should be left.

MW ALIGNMENT

If a signal generator is used, band coverage can be set by adjusting TC2 at the h.f. end of the band and the core of L3 at the l.f. end of the band. A small adjustment of L3 core has considerable influence on band coverage.

A signal is then tuned in with VC1/2 nearly open and TC1 adjusted for best reception. VC1/2 is then adjusted to tune in a signal near the l.f. end of the band and the m.w. winding on the rod moved along to give best results. As these adjustments influence each other they are repeated until no further improvement can be obtained. If alignment is correct adjustment of TC1 or the winding on the rod should not give any important increase in sensitivity anywhere throughout the tuning range.

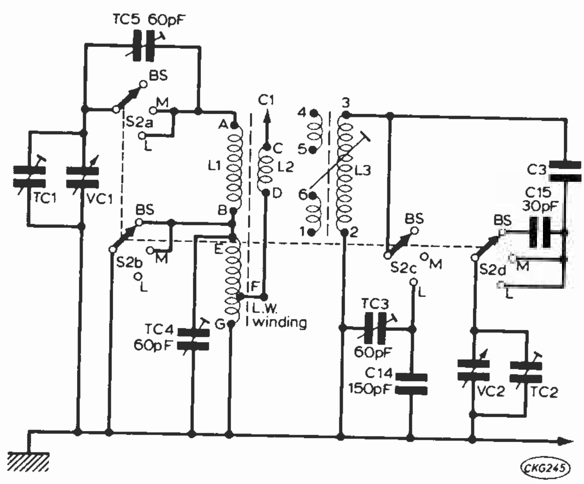


Fig. 4: Modification of Fig. 1 to permit reception on long waves plus bandspreading of h.f. end of medium wave band.

LW AND BANDSPREAD

Long waves and bandspreading are added by changing the aerial and oscillator circuit to that shown in Fig. 4. The 4-pole 3-way switch S2 has three positions BS, MW and LW.

In the BS position, S2d places C15 in series with C3, reducing the coverage obtained with the full swing of VC2. S2a leaves TC5 in circuit, to obtain a suitably reduced tuning coverage in the aerial circuit.

For m.w. reception, C15 and TC5 are out of circuit and S2b shorts the l.w. section of the aerial, giving m.w tuning as for the circuit in Fig. 1.

When l.w. reception is wanted, S2b places the m.w. and l.w. aerial windings in series, while S2c brings in the additional capacitor C14, with parallel trimmer TC3, to shift the oscillator coil coverage.

The tuning ranges obtained were as follows:

BS—1800-1425kHz.
MW—1525-560kHz.
LW—280-170kHz.

Any departure from this is not important, however, provided the circuits are adjusted for best results, as described.

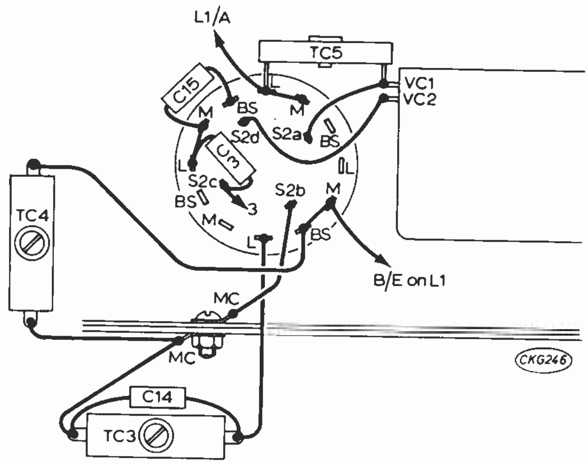


Fig. 5: Wiring of the components around the bandswitch shown in Fig. 4.

Fig. 5 shows the wiring of the bandswitch. TC5 is soldered directly from VC1 to the switch tag, while TC3 and TC4 occupy the space left on the circuit board.

Place the l.w. section of the aerial winding so that the end having two leads is towards the end of the rod. The twisted connection, consisting of two wires, is tapping F and D of the m.w. section is soldered to this. The single wire at the rod end, point G, is soldered to tag MC on VC1/2, Fig. 2. Ends B and E are soldered together and to the tags of S2b.

Note that the tapping F is electrically near point G. There are many more turns from E to F, than from F to G. The direction in which the turns are wound from A, through to B, to E and through to G, is the same. This will be so if the windings are connected as described. If one winding is reversed, l.w. alignment is impossible. Turns C to D and F to G should also be in the same direction throughout. If necessary leads C and D are reversed to secure this.

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AF186	0·20	2N1304-5	0·17
AF139	0·30	2N1306-7	0·20
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BC148	0·10		
BC169	0·12	OC20	0·40
BF194	0·15	OC23	0·25
BF274	0·20	OC25	0·25
BFY50	0·15	OC26	0·25
BSY25	0·13	OC28	0·30
BSY26	0·13	OC35	0·25
BSY27	0·13	OC36	0·37
BSY28	0·13	AD149	0·35
BSY29	0·13	AUY10	0·75
BSY95A	0·10	2S034	0·25
OC41	0·15	2N3055	0·40
OC44	0·13	**Diodes**	
OC45	0·10	AAY42	0·10
OC71	0·10	OA95	0·07
OC72	0·10	OA79	0·07
OC81	0·13	OA81	0·07
OC81D	0·13	OA95	0·07
OC83	0·18	IN914	0·06

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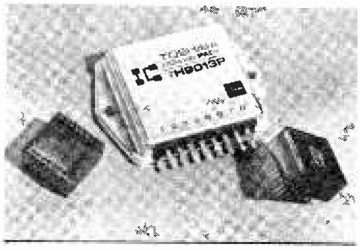

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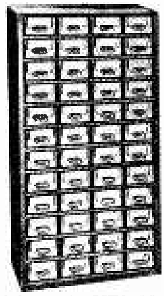

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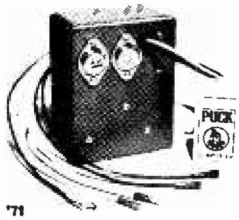

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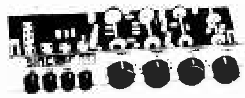

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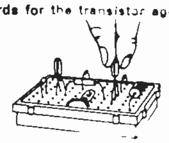

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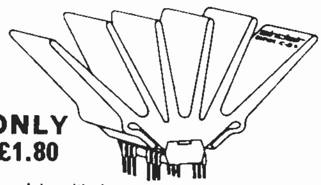

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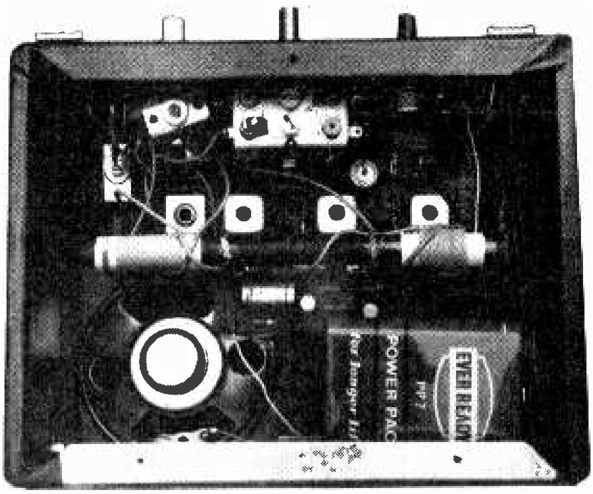
3-BAND ALIGNMENT

With the switch at MW align as previously described. A check can be made that coverage is about 560-1525kHz. If very much out, adjust L3 core and TC2 to correct this. Adjust TC1 at about 1450kHz and L1 on the rod, at about 625kHz for best results.

With the switch at BS, C15 is fixed, so no change of coverage can be arranged, except by altering coverage on m.w. Adjust TC5 at about 1500kHz for best reception. This adjustment should be found to remain substantially correct through this range but TC5 may be peaked on Luxembourg if wished.

With the switch at LW, adjust TC3 so that the BBC on 200kHz is about the middle of the band. TC4 may then be peaked at about 250kHz and the long wave aerial winding slid along the rod, at about 180kHz, for best results. The position of the core of L3 greatly influences l.w. coverage, so it is necessary either to set this for a m.w. coverage about as mentioned, or to adjust L3 until l.w. reception is suitable, afterwards moving L1 slightly to compensate so that m.w. reception is also satisfactory. All the adjustments can be repeated, in the order given, until no further improvement is possible.



Rear view of the completed receiver showing placement of the battery and speaker.

INSTABILITY

Commercially made receivers may employ individually selected sets of transistors or make provision for changes to some values, to suit individual transistors, in order to avoid instability.

In this circuit, where oscillation may arise due to particularly "good" transistors, a cure can be effected by adding a $\frac{1}{4}$W resistor between pin 4 of L3, and pin 2 of i.f.t.1. The lowest value which prevents oscillation is used, but it is not critical. A few spare resistors, such as 220Ω, 470Ω, 680Ω or 1kΩ can easily be tried. Should the trouble seem difficult to cure, a resistor of some 47 or 100Ω or so may be placed between point C of L2 and C1. Alternatively, a turn or so may be removed from L2, but this is less easy and difficult to replace.

COMPLETION

The completed receiver, with speaker and battery, can be fitted in any suitable wooden or plastic case. The case illustrated is quite easily made and is approximately 5in. high, $6\frac{3}{8}$in. wide, and $3\frac{3}{8}$in. deep.

Top and bottom consist of "universal chassis" flanged members 6×3in. The top is drilled so that the bushes of the bandswitch, VR1 and VC1/2 spindle, can pass through. Washers or spare nuts are put on the bushes of the switch and VR1 and the receiver is then secured in place by further nuts on these bushes, when the case is finished.

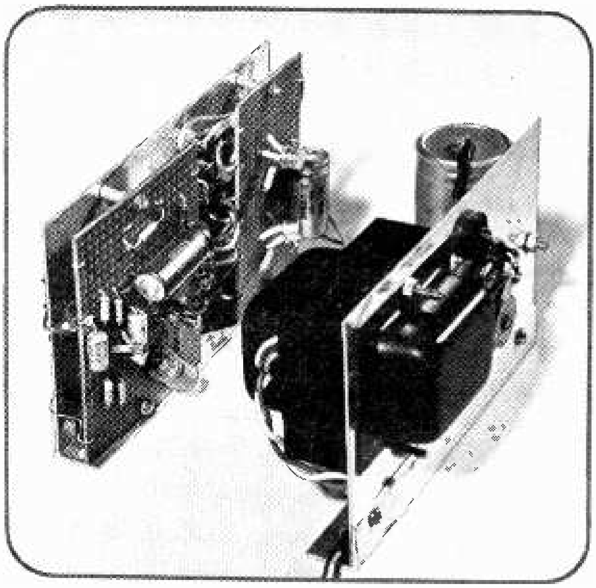
The case sides are $\frac{3}{16}$in. 3-ply, each 5×3in. They are fixed to the top and bottom by 6BA countersunk bolts through the end flanges. Front and back are similar 3-ply and are $6\frac{3}{8}$×5in.

An aperture is cut in the front panel to match the position and diameter of the speaker cone. Adhesive is spread on the case edges and the front fixed by countersunk bolts through the flanges with a few small panel pins driven through into the wooden sides. The back is held with self-tapping screws into the back flanges.

A piece of speaker material about $5\frac{1}{2}$×$3\frac{1}{2}$in. is glued across the front. The front was then covered with self-adhesive material, which can be obtained in many colours and styles. Top and sides are covered in the same way. Strips are cemented on to cover the junction between the speaker gauze and the case covering material. ■

8W silicon amplifier

F. C. JUDD



ALTHOUGH desirable for reliability in operation, silicon power transistors were, until recently, rather costly devices. They can now be obtained at prices comparable with germanium types and for this particular project the Newmarket type NKT 0033 have been chosen for the output stage, together with other small signal silicon types for the driver and input stages and for a recommended signal preamplifier.

The power amplifier, the circuit shown in Fig. 1, will deliver 8W r.m.s. into an 8Ω load for a THD factor of not greater than 0·2 per cent. The input sensitivity can be varied between 250mV and 1V depending on the value of Rb which sets the amount of negative feedback. The output pair are controlled against temperature rise by diodes D1 and D2 although it is most unlikely that any problem in this direction would occur, providing the heatsink for the output pair is of sufficient area.

The signal input is taken via Tr1 to the initial driver Tr2 which is in series with the bias pre-set PR1 for setting the d.c. condition of the driver and output stages. The drivers (Tr3 and Tr4) are a complementary NPN-PNP pair. Overall feedback is controlled

Table 1. Main Amp Specification

Frequency Response	30Hz to 30kHz ± 1dB
Max. Power Output	8W into 8Ω load
Signal-to-Noise	Better than −90dB
Distortion at 1kHz	8W less than 0·2 per cent 1W less than 0·3 per cent 500mW less than 0·4 per cent

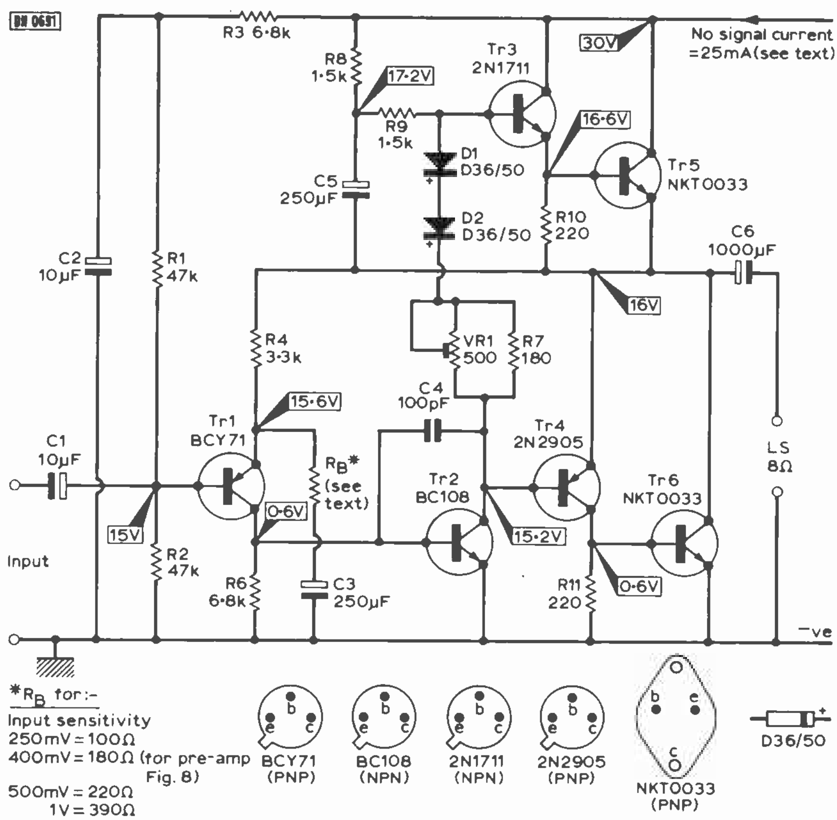


Fig. 1: The circuit of the main amplifier which uses all silicon transistors and gives an output of 8W r.m.s.

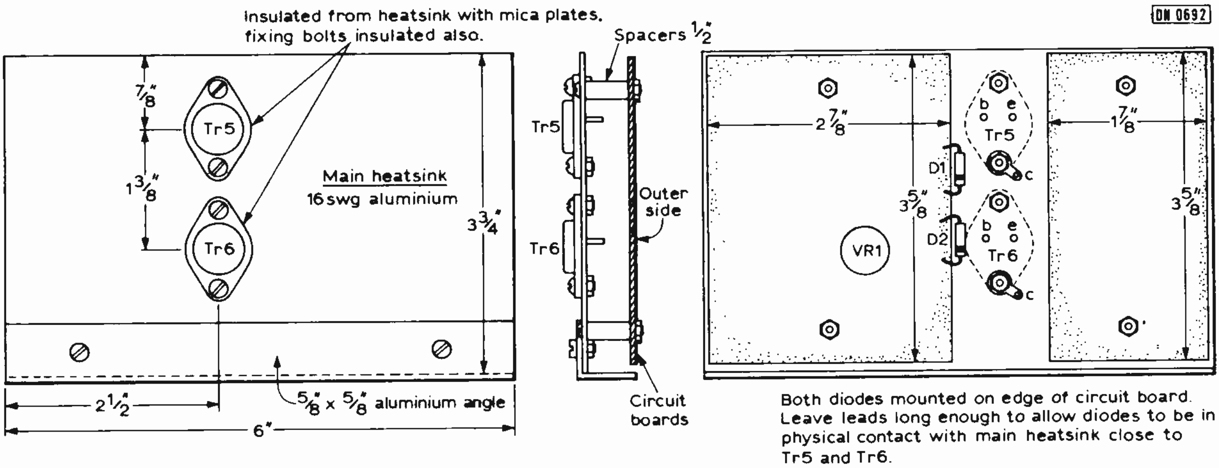


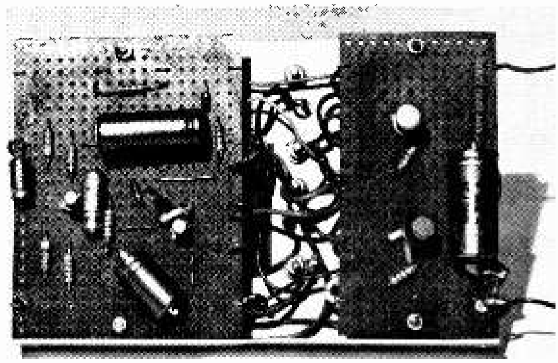
Fig. 2: (a) The heatsink for the output transistors. (b) An edge view showing the mounting of the circuit board. (c) The siting of the two circuit boards.

by the value of Rb and this also determines the required input sensitivity. The table shows the overall performance obtained with the prototype.

The amplifier is stable on loads down to 4Ω and will operate at reduced power output (approx 6W) into a 15Ω load. The quiescent (no signal) current is approximately 25mA for a supply rail of 30V. Total current at maximum power output (8Ω load) is about 400mA at which the supply voltage falls to about 26V to 27V.

CONSTRUCTION

The construction and assembly of the prototype is shown in Fig. 2. The heatsink must not be less than the area specified, even if an alternative layout and construction is adopted. The assembly shown makes a quite compact unit with the two circuit boards backed onto the main heatsink.



A view of the prototype illustrating the arrangement shown in Fig. 2c.

The layout and wiring are shown in Fig. 3a but note that the components are as seen from the outer side of the boards and the wiring from the inner side. The power transistors Tr5 and Tr6 must of course be completely insulated from the heatsink with mica spacers and fixing bolt insulators as shown in Fig. 3b. Note also that the two diodes D1 and D2 must be wired so that they can be pushed down to make physical contact with the heatsink. The complementary pair drivers Tr3 and Tr4 do not require heatsinks.

★ components list - Main Amplifier

R1	47kΩ	R7	180Ω
R2	47kΩ	R8	1·5kΩ
R3	6·8kΩ	R9	1·5kΩ
R4	3·3kΩ	R10	220Ω
R5	Rb—see text	R11	220Ω
R6	6·8kΩ		

All resistors ¼W, 5 per cent types.
VR1 500Ω (or 470Ω) carbon pre-set type

Capacitors

C1	10μF 20V min.	C4	100pF
C2	10μF 35V min.	C5	250μF 10V min.
C3	250μF 20V min.	C6	1000μF 35V min.

Semiconductors

Tr1	BCY71	Tr5	NKT0033
Tr2	BC108	Tr6	NKT0033
Tr3	2N1711	D1	D36/50 or IN4001
Tr4	2N2905	D2	D36/30 or 1N4001

The semiconductors are available from either Electrovalue Ltd., 28 St. Judes Road, Englefield Green, Egham, Surrey or Arrow Electronics, 7 Coptfold Road, Brentwood, Essex.

Power Supply

Transformer T1	240V/17W Type TS 18/2 (Henry's Radio)
Bridge Rectifier MR1	Type LT119, 30V, 1A (Henry's Radio)
Capacitor C1	5000μF 50V

POWER SUPPLY

The circuit and layout are given in Figs. 4 and 5 respectively. The construction of the prototype is on the same lines as the power module with the transformer and rectifier etc. mounted on a piece of aluminium 6in × 3¾in. The transformer and rectifier specified will only supply sufficient current for one power amplifier module and a signal amplifier. If two power modules are to be used for stereo operation then the power supply must be able to deliver at least 1A with a maintained voltage (under maximum

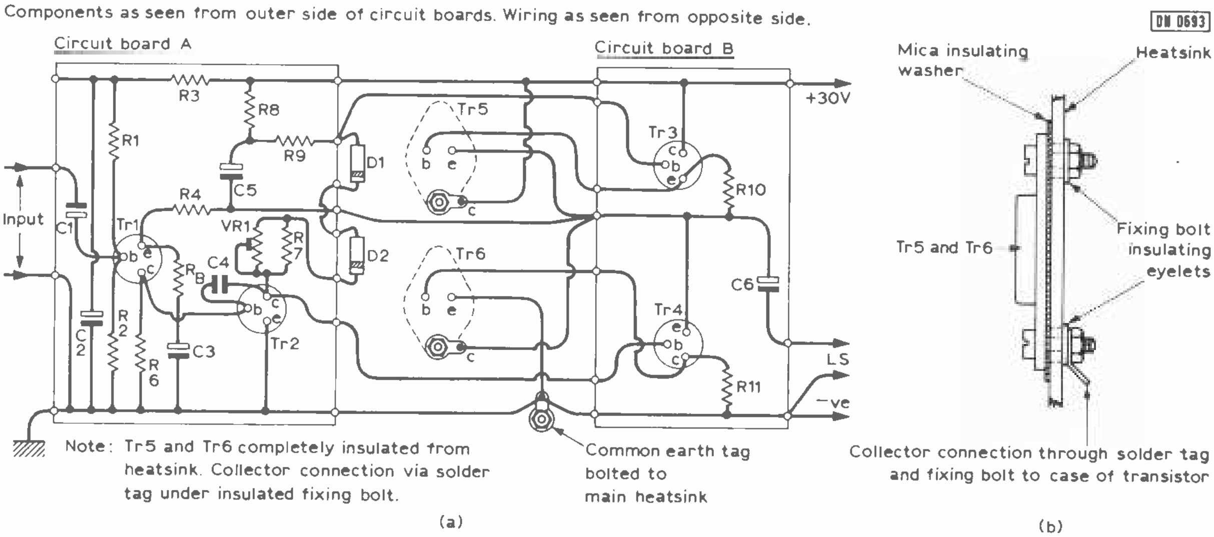
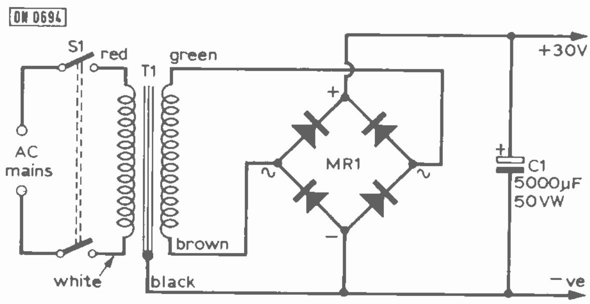
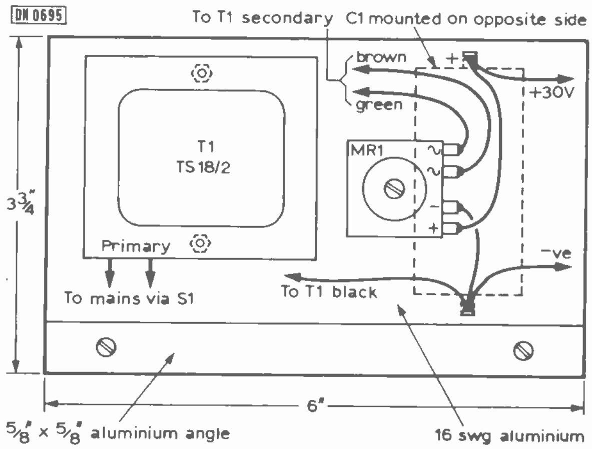


Fig. 3: (a) The component wiring of the main amplifier.
(b) The mounting of the output transistors.

Fig. 4 (below): The circuit of the power supply.

Fig. 5 (right): The wiring of the power supply.





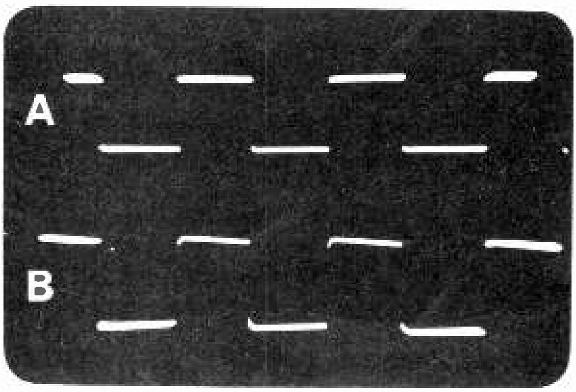


Fig. 6: Square wave results on the main amplifier.

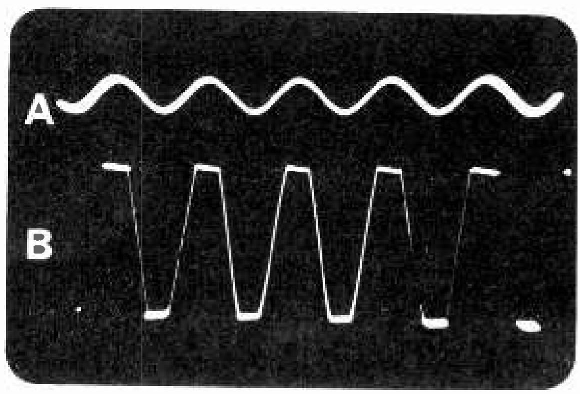
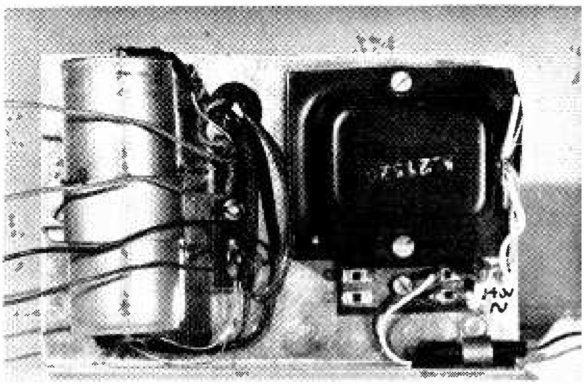


Fig. 7: Oscillogram showing symmetrical clipping.

power load) of 26-27V. The same rectifier may be used, as this is rated for 1A at 30V but a transformer capable of supplying the higher current will be required.

POWER AMPLIFIER PERFORMANCE

Before connecting the supply voltage, set PR1 to midway travel. Connect a milliamp meter in series with the positive line and reset VR1 to obtain a reading of 25mA. At maximum power, (just before clipping) the total current should not exceed 400mA. The input sensitivity can be adjusted by the value of Rb and typical settings for this are given in Fig. 1. The overall performance should be as given earlier but square-wave tests will further prove the performance. The result of the usual 1kHz square-wave test on the prototype is shown in Fig. 6 in which the input is the oscillogram A and the output from the amplifier is oscillogram B. Symmetrical clipping should be obtained at just over maximum (sine-



The prototype power supply.

Table 2. Preamplifier Specification

Frequency Response	Linear: ± 1dB, 10Hz to 100kHz Tape Head: CCIR plus treble lift Mag.P.U.: RIAA
Tone Controls	Bass ± 14dB at 50Hz Treble ± 12dB at 10kHz
Distortion Factor	Less than 0·2 per cent
Signal-to-Noise	—60dB ref. 400mV output
Inputs (for 400mV out)	Tape Head: 68kΩ, 5–10mV Mag. P.U.: 56kΩ, 5mV Cer. P.U.: 820kΩ, 80mV Radio: 200kΩ, 80mV

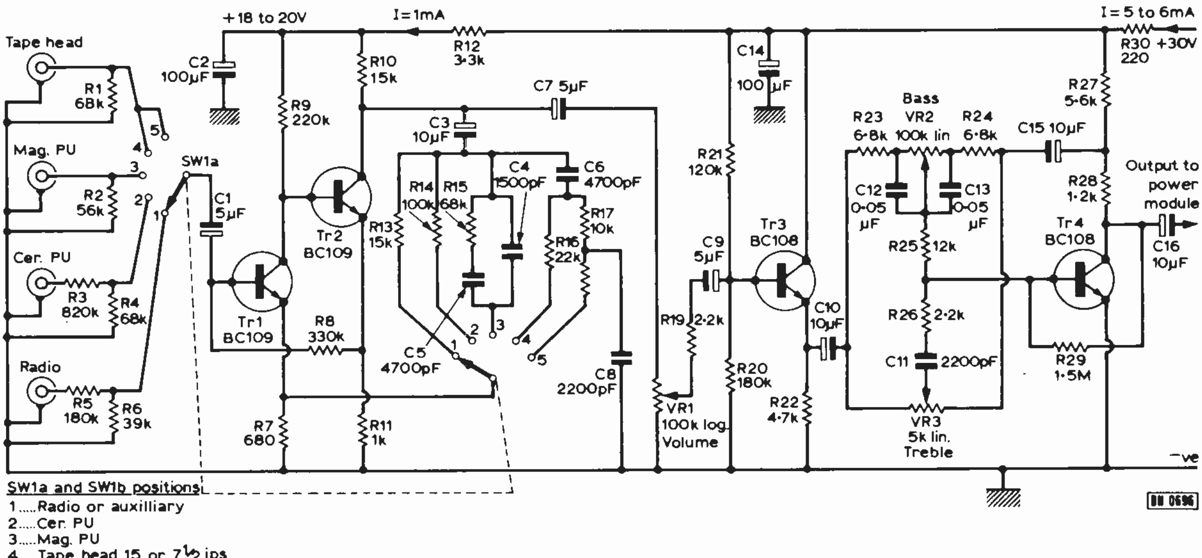


Fig. 8: The circuit of a suitable preamplifier; no constructional details are given.

wave) power output as shown in Fig. 7 in which A is a 1kHz sine-wave input and B the clipped output.

The average d.c. potentials that should be obtained with a 20,000 ohms per volt meter at various points in the amplifier are marked on the circuit; all with respect to common negative.

PREAMPLIFIER

A circuit for a suitable preamplifier is given in Fig. 8 and this caters for magnetic or ceramic pick-up cartridges, tape head and audio. The radio input can be used for tape replay from a unit with built-in preamp. The performance of the preamplifier is shown in Table 2.

The overall gain has been adjusted to provide 400mV output to match the input requirements of the power amplifier with Rb (as in Fig. 1) a value of 180Ω. The input circuit Tr1/Tr2 is quite conventional with selective feedback to provide equalisation for tape head and/or magnetic pick-up. The tape head response has been adjusted to comply with the recording characteristic most frequently used on domestic tape recorders; one which has less treble

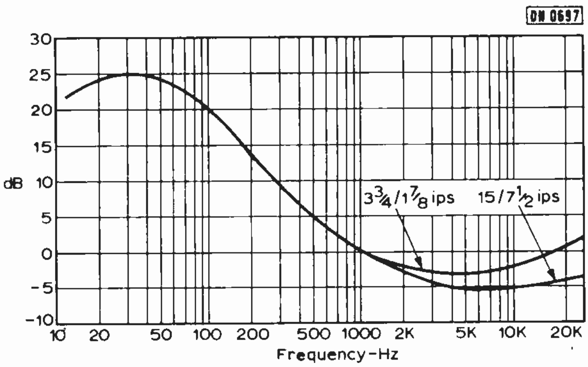


Fig. 9: Preamplifier response when switched to Tape Head.

lift than the original C.C.I.R. characteristic. The replay response obtained with the preamplifier is shown in Fig. 9 and provides what is effectively treble lift towards 20kHz but which is adjusted accordingly for tape speeds of 15 and 7½ or 3¾ and

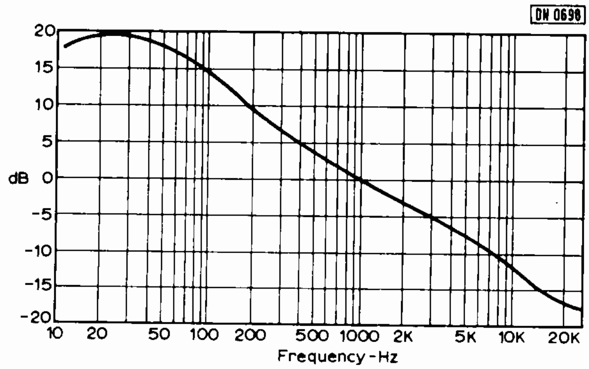


Fig. 10: The preamp response on Mag. P.U. showing R.I.A.A. curve.

★ components list - Preamplifier

RESISTORS

R1	68kΩ	R16	22kΩ
R2	56kΩ	R17	10kΩ
R3	820kΩ	R18	12kΩ
R4	68kΩ	R19	2·2kΩ
R5	180kΩ	R20	180kΩ
R6	39kΩ	R21	120kΩ
R7	680Ω	R22	4·7kΩ
R8	330kΩ	R23	6·8kΩ
R9	220kΩ	R24	6·8kΩ
R10	15kΩ	R25	12kΩ
R11	1kΩ	R26	2·2kΩ
R12	3·3kΩ	R27	5·6kΩ
R13	15kΩ	R28	1·2kΩ
R14	100kΩ	R29	1·5MΩ
R15	68kΩ		

All resistors ¼W, 5 per cent types
VR1 100kΩ log. pot. (volume)
VR2 100kΩ lin. pot. (bass)
VR3 5kΩ lin. pot. (treble)

Capacitors

C1	5μF 25V min.	C9	5μF 25V min.
C2	100μF 25V min.	C10	10μF 25V min.
C3	10μF 25V min.	C11	2200pF
C4	1500pF	C12	0·05μF
C5	4700pF	C13	0·05μF
C6	4700pF	C14	100μF 35V min.
C7	5μF 25V min.	C15	10μF 25V min.
C8	2200pF	C16	10μF 25V min.

Semiconductors

Tr1	BC109	Tr3	BC108
Tr2	BC109	Tr4	BC108

SW1 Double pole, five way rotary switch

$1\frac{7}{8}$ i.p.s. The response for magnetic pick-up is to R.I.A.A. characteristic as shown in Fig. 10.

The output from the first stage (Tr1/Tr2) is taken via the volume control to an emitter follower Tr3 and then via the active (feedback) tone control network to Tr4.

Care should be taken to prevent hum pick-up in the first stages, particularly in view of the high gain when the tape head or magnetic p.u. inputs are in use. The preamplifier can of course be duplicated for stereo use, in which case a balance control could be included between the ouput and the power amplifier. The insertion of a balance control will of course reduce the overall output signal in which case the feedback resistor Rb in the power amplifier should be about 100Ω. ■

CHARLES MOLLOY

THE Medium Wave Column

D. MAYHEW who lives in Littlehampton asks for information about English broadcasts beamed from abroad. As the medium waves are mainly used for local broadcasting there are not many special broadcasts in English to be heard, but the few known to the writer include Radio Sweden on 1178kHz, Radio Portugal on 755kHz and 1161kHz, Deutschlandfunk (West Germany) on 1268kHz, Radio Pyrgos (Greece) on 1349kHz, Radio Montecarlo 1466kHz.

Radio Sweden is on the air nightly at 2245hr GMT in English and it features a special programme "Sweden Calling DXers" every Tuesday. Radio Portugal transmits the English version of the "Voice of the West" at 2245hrs, its programme for DXers appearing on a Monday. Deutschlandfunk can be heard every evening at 1745hrs and there is a fort-nightly DX broadcast on a Wednesday. In spite of rumours of a closedown, Radio Pyrgos is still on 1349kHz. It can be heard in English at 0100hrs on Mondays and its DX broadcast is on the last Friday of the month at midnight. The Vatican Radio's 250kW outlet on 1529kHz is received well in this country and there is a short broadcast in English every evening at 2100hrs. Trans World Radio uses the Radio Montecarlo transmitter on 1466kHz for religious broadcasts which can be heard at 2100hrs.

Harold Emblem of Mirfield in Yorkshire reports reception of the new Voice of America transmitter at Kavalla in Greece which is on 791kHz. The time of reception was 0300hrs GMT. At the moment this station is only using 150kW but it will soon be on full power of 2500kW when it will become the most powerful medium wave broadcaster in Europe. Harold also mentions the Voice of America at Rhodes on 1259kHz; Omdurman, Sudan on 960kHz with the call "Huna Omdurman"; the BBC Central Mediter-ranean Relay at Point Delimara, Malta on 1511kHz at 0345hrs with Big Ben and "Huna London" at the start of the Arabic service.

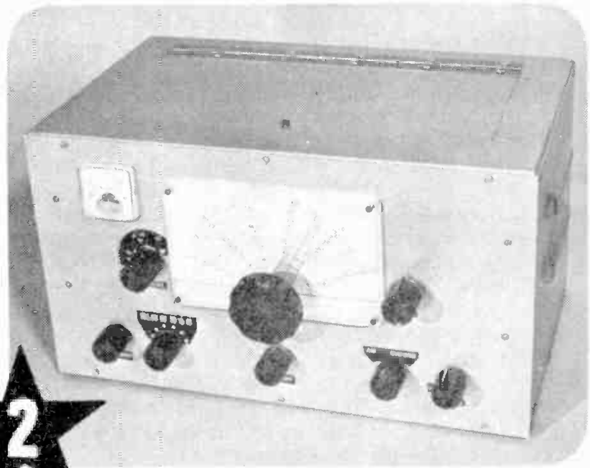
An interesting letter comes from Norman Burton who lives in Revesby N.S.W. in Australia. He is a keen MW DXer and he says "This place is good for MW DX. I've copied KFSO (560kHz, 1kW) in San Francisco at midnight, 8500 miles away. At this hour it is 6 a.m. in Frisco as it is across the international dateline." Norman is constructing the PW MW loop antenna which was described in the November 1966 edition of Practical Wireless. Although this issue is now out of print, copies are available in public reference libraries.

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

4 OF THE GREAT FEATURES IN NEXT MONTH'S PW!

1

10 'scopes to be won!



2

3

4

1 FREE COMPETITION!

A great, free competition, open to all readers of P.W. Ten (yes, TEN!) Heathkit Oscilloscope Kits Type OS-2 MUST be won. All you have to do is list eight of the excellent features in their order of importance and you could be the winner of a fabulous 'scope. Watch out for the entry forms which will appear in both the December and January issues.

2 AMATEUR-BANDS RADIO

By employing a double conversion circuit, this 6-band receiver provides good adjacent channel selectivity, utilising a crystal filter at 455kHz, while the tuneable first i.f. stage, covering 3·5 to 4MHz, virtually eliminates image interference. The project can be built in easy stages, initially as a receiver for the 80m band, later adding a product detector, BFO and crystal controlled front end converter.

3 THE 'MUSIC-MAKER'

The Music Maker will be one of the most popular features of the year; a portable, keyless, electronic organ which can be built for a song! The prototype has given the P.W. staff endless hours of fun . . . and it couldn't be easier: we have arranged for the supply of a special printed circuit board, the case and all unusual components at favourable prices.

4 LOUDHAILER & SIREN

You'll certainly be able to stir up the atmosphere with our combined loudhailer and siren . . . it has all the facilities of commercial models with a lot of extras. Operated from dry batteries inside the main case and using a ready built power module, this is not a complex project. No difficult metalwork is an added attraction to this unusual feature.

PLUS MANY OTHER FEATURES ALL IN THE DECEMBER ISSUE ON SALE 3rd. NOV.

TAKE 20

JULIAN ANDERSON

No. 42
"HUNT THE BLEEPER"

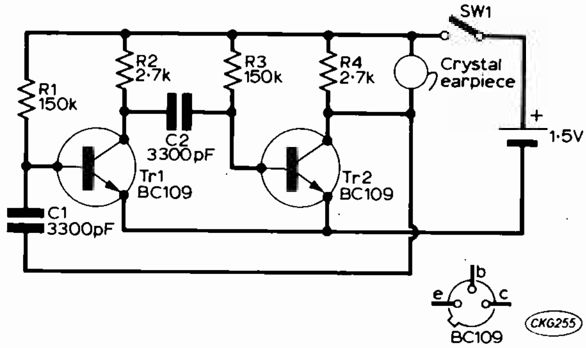


Fig. 1: The circuit is a simple a.f. multivibrator feeding a crystal earpiece.

THOSE readers of this column who are blessed with offspring will not need reminding that children *love* noise. Most of the time they will be discouraged but at parties there is no harm in allowing them to let off a little steam. Our project this month makes an excellent, if noisy, children's party game; it is a variation on the time-tested "Hunt the Thimble" game. Instead of a thimble, we use a small "bleeper" which gives off a high-pitched whistle but at very low level so that it can only be heard in quiet surroundings. The idea is to divide the children into two teams; the organiser chooses the hiding place and when this is done the two teams are set loose. They can either concentrate on finding the bleeper or on making so much noise that the other team will not be able to hear it. Teams can of course divide their forces and have "searchers" and "noise-makers"; it doesn't take much imagination to predict which most children will opt for!

The bleeper, if built up as shown, is very robust and should stand up to the rough handling to which it is bound to be subjected. As with all our projects the cost is low, in this case even new components will set you back only about 50p plus the battery cost, well worth it for a popular party game.

The circuit is shown in Fig. 1. It is a simple multivibrator working at about 2kHz although the exact frequency will depend on the particular transistors used.

The sound output is taken to a very cheap crystal earpiece which is wired in parallel with R4. The circuit works perfectly well with a 1·5V single cell battery but space is a bit limited and a mercury cell Type RM401H may be better. The current drain of the circuit using the specified components is only about 600μA—less than a milliamp—and mercury cells will easily give this.

The operation of the multivibrator is not as simple as many people believe but we have described the operation before and no doubt will do so in the future; for this reason we shall not go into the actual theory. All that you need to know is that it is very easy to build and very reliable.

The prototype was built into a 35mm film can. A hole can be made in the lid and the crystal earpiece fitted through it. All the crystal earpieces that I have seen are of the same type, though there may be others. In the commonest (if not only available) type the plastic part which fits into the ear screws off and if the hole is made just large enough to take this thread, the lid of the can may be trapped when the earpiece is reassembled. This is illustrated in Fig. 2.

There is no room for a circuit board but there are very few components and these can be wired to each other as shown in Fig. 3. When this has been completed and tested the components can be wrapped in insulating tape to prevent shorting to the can. A switch is shown in the circuit but once again room precludes the use of a conventional type and a wander plug and socket can be used or even wires twisted together and untwisted after use.

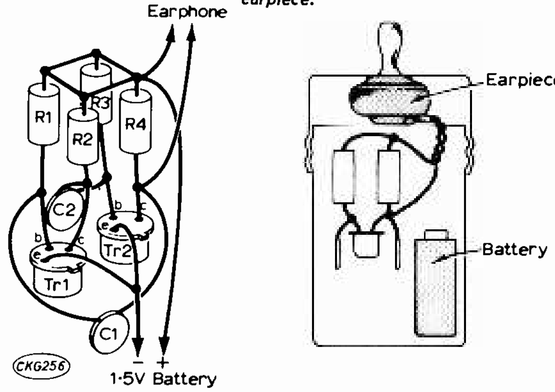


Fig. 2 (left): The components should be wired to each other as shown.
Fig. 3 (right): Shows how the components fit into the can.

★ components list

R1	150kΩ 5%, ¼W	1p
R2	2·7kΩ 5%, ¼W	1p
R3	150kΩ 5%, ¼W	1p
R4	2·7kΩ 5%, ¼W	1p
C1	3300pF ceramic or polystyrene	3p
C2	3300pF ceramic or polystyrene	3p
Tr1	BC109	10p
Tr2	BC109	10p
Crystal earpiece		20p
35mm film can		—
		50p

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 carefully checked before ordering.

Contacts to the mercury cell will have to be made by soldering wires directly to it and this operation should be performed with care. I don't know too much about the chemistry of mercury cells but if the soldering operation is not done quickly the cell appears to discharge almost instantly making the case extremely hot and destroying it, so do take care not to heat the cell up too much. ■

PW THE abc OF hi-fi NOV. 1972 SUPPLEMENT

With Hi-Fi now a booming industry the potential purchaser of audio equipment for home entertainment is faced with a mountain of shiny brochures often describing the merits and specifications of equipment in a jargon he finds difficult to understand. This supplement, compiled by Gordon King, the well-known writer on all types of electronic equipment, is aimed at clarifying the more commonly used terms in the field of Hi-Fi.

NEW terminology is being introduced by the progressing art of hi-fi and it is the purpose of this supplement to explain the more important terms used by manufacturers in their specifications as well as some of the established ones found in abundance in the hi-fi literature.

The terms and their definitions, along with sometimes revealing comment, are classified under three headings to which they most appropriately relate. These are **Amplifiers, Tuners** and **Ancillary,** the third dealing chiefly with those terms applicable to equipment other than amplifiers and tuners. Sometimes, of course, a term, such as distortion, will be equally applicable under the three headings.

AMPLIFIERS

AMPLITUDE DISTORTION

This distortion is present when the amplitude of the output signal fails to follow exactly any increase or decrease in the amplitude of the input signal. It results from non-linearity of the transfer function and gives rise to harmonic and intermodulation distortion. No amplifier is completely free from the effect because its transfer function is slightly curved.

The nature of the curvature determines the order of the distortion produced, but negative feedback and other artifices used in hi-fi amplifiers minimise the curvature within the dynamic range and hence keep the distortion at a very low level.

ATTACK

This term describes the 'responsiveness' of the amplifier to signals with a fast rise-time, such as produced by percussive sounds of a transient nature. See under Rise-Time.

CHANNEL SEPARATION

This refers to the 'leakage' of signal from one channel of a stereo amplifier into the other channel. The separation is greatest when the signal leakage is the smallest. The leakage signal is commonly expressed as a decibel ratio referred to the full output of the amplifier when the channel in which the leakage signal is measured is correctly terminated both at the input and output. Thus a separation of 40dB means that the voltage of the leakage signal at the output of the channel tested is 100 times below that of the voltage of the signal at the output of the talking channel.

Owing to capacitive effects, the channel separation sometimes falls with increasing frequency, while impairment at the l.f. end can indicate a common impedance coupling between the two channels. One cause of poor separation is the common impedance presented by the wiper of the balance control on the track of the potentiometer.

CLASS A

This implies biasing the valves or transistors to the middle parts of their transfer characteristics so that the device is driven upwards on one half cycle and downwards on the other half cycle. In a push-pull power amplifier, one of the device pair is driven upwards on negative half cycles while its partner is driven downwards, the mode reversing on the positive half cycles. The stage thus draws a constant current at all drive levels within the dynamic range of the amplifier. A class A power amplifier has an efficiency of almost 50 per cent.

CLASS AB

One type of power amplifier of this class is engineered so that at low drive level the stage operates class A, while at increasing drive level the mode changes to class B.

PW THE abc OF hi-fi

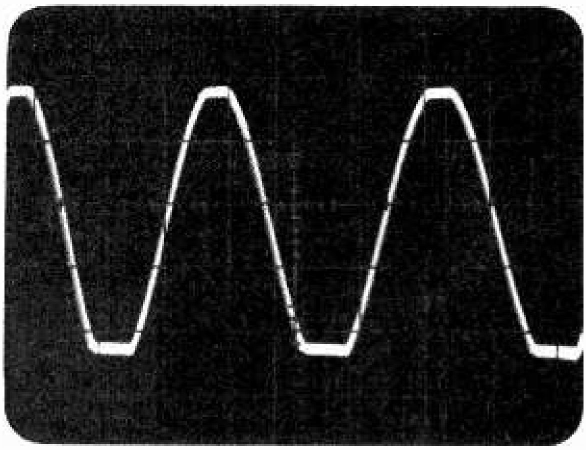
The Mullard Pi-Mode class AB power amplifier design is arranged so that the actual biasing changes from class A to class B with increasing drive.

CLASS B

The majority of transistor amplifiers adopt this class of power amplifier. The biasing is adjusted such that the push-pull transistors (could be valves) operate at a low no-drive current (called quiescent current). When drive is applied the current in one of the pair rises while the partner is pushed into cut-off on one half cycle, the mode reversing on the other half cycle. Maximum efficiency of a class B power amplifier is 78·5 per cent. Current increases with drive.

CLIPPING

This is the term used to express the clipping of the peaks of a waveform when an amplifier is driven beyond its power capacity.



Clipping. *The flattening of the tips of a sine wave due to clipping.*

COMPLEMENTARY PUSH-PULL

A power amplifier where the output transistors are of complementary polarities (i.e., **p-n-p** and **n-p-n**). In some amplifiers of this kind the driver transistors also constitute a complementary pair.

CROSSOVER DISTORTION

The type of distortion resulting from class B push-pull power amplifiers owing to the lack of coincidence of the two transfer characteristics at the crossover point. The effect is reduced by applying a critical value of biasing to optimise the quiescent current (see under Class B and Quiescent Current) and hence 'linearise' the middle portion of the transfer characteristic. The situation is further improved by heavy negative feedback and by circuit design, such that the crossover distortion from hi-fi amplifiers is very small.

DAMPING FACTOR

This is the ratio of load or speaker impedance to the amplifier's output impedance. Thus the smaller the output impedance the greater the damping factor. The damping factor increases with increase of voltage negative feedback, and with the large amounts of feedback applied to transistor hi-fi amplifiers the source or output impedance can be as low as 0·1 ohm, giving a damping factor of 80 referred to an 8-ohm load.

Such a small value of output impedance is 'seen' by the speaker as a virtual short-circuit, excluding the resistance of the speaker connecting cable, and this has the effect of damping the cone movement electromagnetically, thereby minimising the speaker output at the resonance frequencies. The bass resonance is important from this respect, so the damping factor should remain desirably high down to 40Hz or less.

DERIVED CENTRE CHANNEL

Some amplifiers are now appearing with a centre channel output derived from the addition of the left and right signals by a matrix. This output can be fed to a single-channel power amplifier operating a speaker for location between the left and right stereo speakers.

DIRECT COUPLING

This refers to interstage couplings or the speaker coupling being direct with no intervening transformer or capacitor. To the speaker it ensures that the damping factor remains high at l.f. (but increasing power supply impedance at l.f. can influence this), while direct coupling generally minimises l.f. phase shift and encourages enhanced bass performance.

DYNAMIC RANGE

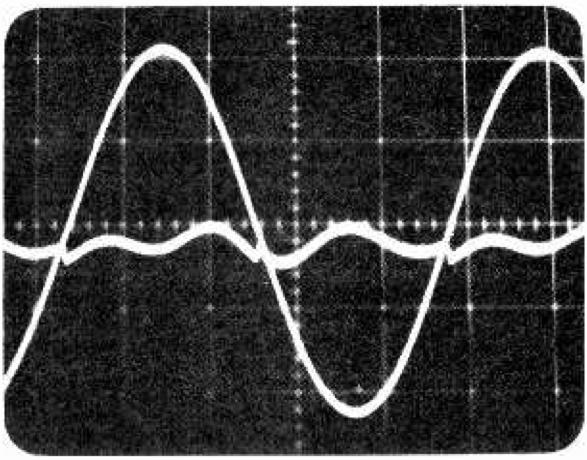
This is the range of reproduction limited on the one hand by the intrinsic noise of the amplifier (see under Noise) and the ambient background noise level of the listening environment and on the other by the power capacity of the amplifier and speaker system. In many cases the dynamic range is limited by the programme signal, but well recorded gramophone records are capable of a dynamic range approaching 60dB, which is 10^6:1 power ratio (one million).

EQUALISATION

When emphasis is given to a range of frequencies during processing or recording (or transmitting), the correction required to normalise the signals during reproduction is called equalisation. Typical is the RIAA recording characteristic which, apart from ensuring that the recording amplitude is reduced from about 800Hz downwards, boosts the recording level with increasing frequency so that the required de-emphasis (equalisation) during reproduction not only 'flattens' the overall response but also reduces the record noise at the same time.

FEEDBACK

This refers to the feedback of the output signal (or a portion of it) to the input. When the feedback signal is negative it subtracts from the input signal and thus reduces the effective output and when it is positive it adds to the input and increases the effective output. Positive feedback produces sustained oscillation or howl. One example is acoustic feedback where sound from the speaker causes



Crossover Distortion. *Artifacts on the distortion residual produced by very mild crossover distortion.*

response at a gramophone pickup or microphone, a feedback loop then being completed through the amplifier. Howl or oscillation develops at the frequency corresponding to a major resonance in the loop.

FREQUENCY DISTORTION

This is the unequal amplification of all frequencies over the passband of the amplifier (also see under Frequency Response).

FREQUENCY RESPONSE

The range of frequencies over which an amplifier responds within defined limits of amplification (or signal output). A parameter expressed as 20Hz to 20kHz is the frequency range and is of limited value, while the parameter expressed as 20Hz to 20kHz $\pm$ 1dB is the frequency response which means that the deviation of amplification from 20Hz to 20kHz is a mere +1dB or −1dB, which is much more meaningful.

HARMONIC DISTORTION

The voltages of harmonics resulting from amplitude distortion expressed as a percentage of the voltage of the fundamental. A common measurement is total harmonic distortion (THD) where the fundamental of a very low distortion sinewave test signal is removed by a steep notch filter, the summed harmonics remaining then being measured as a voltage and expressed as a percentage (or dB value) of the voltage of the fundamental at the required test power of the amplifier.

When measured in this manner the term THD is not really correct since the distortion also has the amplifier noise added to it within the test passband. The correct term is **distortion factor.**

HEAT SINK

A metal 'radiator' used in transistor amplifiers to conduct the heat away from the power transistors, thereby allowing them to be used for the delivery of greater power.

HIGH-PASS FILTER

A filter which, above a critical frequency, allows the unrestricted passage of high-frequency signals. Reciprocally, a bass-cut filter.

HUM

Spurious signal at the mains frequency (50Hz in the UK) and its harmonics. It is sometimes expressed with noise (see under Noise), so that the total effect is hum and noise.

HUM-LOOP

A condition arising from the connection of two or more 'earths' to an amplifier system whereby circulating currents of low value at mains frequency and harmonics are added to the programme signals, causing hum to appear in the background.

INPUT IMPEDANCE

The effective impedance at the input circuits of an amplifier across which the signal source is connected. In this respect the source is loaded by the input impedance. A load sensitive source is a magnetic pickup, most of which are designed for optimum treble response connected to a load of about 47kΩ. A higher resistance will cause a rise in treble, and a lower one a fall in treble.

INTEGRATED AMPLIFIER

An amplifier which embodies in a common housing the preamplifier and control section and the power amplifier. Some early amplifiers of large power were in two separate units, one the control unit with preamplifiers and the other the power amplifier.

INTERMODULATION DISTORTION

Resulting from amplitude distortion (i.e., non-linearity) two or more signals passing through an amplifier intermodulate and hence produce spurious signals, known as intermodulation distortion. Since the distortion components are inharmonious they are subjectively disturbing, more so than low order, even harmonic distortion. Discontinuity in the crossover function of class B amplifiers is responsible for intermodulation distortion and, sometimes, the listening fatigue resulting therefrom. Measurement in based on the voltage of the intermodulation components expressed as a percentage of the voltage of one of the test signals, when two signals are applied to the amplifier in a 4:1 amplitude relationship at a low (100Hz) and high (5kHz) frequency.

LINE INPUT

Input channel of an amplifier designed to accept signal at a given level from a line at a specific impedance, usually 600Ω.

LINE OUTPUT

Output channel of an amplifier designed to deliver signal at a given level to a line at a specific impedance, usually 600Ω.

LOAD

The circuit or transducer (e.g., speaker) connected to the output of an amplifier. The source (e.g., pickup) is loaded by the amplifier's input impedance (see under Input Impedance).

LOUDNESS CONTROL

A control, often the volume control suitably switched, which boosts the bass and to a lesser degree the treble as it is retarded as a means artificially of compensating for the ear's loss of sensitivity at bass and treble frequencies at reducing loudness. A volume control which is permanently arranged to operate in this manner (i.e., loudness effect not switchable) is deprecated by some people and hi-fi enthusiasts.

LOW-PASS FILTER

A filter which, below a critical frequency, allows unrestricted passage of low-frequency signals. Reciprocally, a treble-cut filter.

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MATCHING

This commonly refers to the selection of the correct impedance to match the source or load and of the correct sensitivity of the input to match the source signal. If the source yields a signal substantially greater than the input sensitivity of the amplifier the volume control will have to be operated at a low setting and overloading of the input preamplifier may result.

MISMATCH

A condition whereby the coupled impedances inhibit optimum power transference or the source or output signal fails to match the amplifier sensitivity or the load's (i.e., speaker) power capacity.

MUSIC POWER

Sometimes called **dynamic power**, and refers to the power that the amplifier (with both channels working, when stereo) is capable of delivering on music type signal. Output is rated in watts into a specified load value and the test signal is sometimes interrupted sinewave signal (i.e., tone bursts). This method of power expression fails to take account of the power supply impedance and regulation and the efficiency of the power transistor heat sinks. The power obtained is always greater than that measured when the test signal is continuous wave (i.e., steady-state sinewave signal) and with both channels driven together (see under Output Power).

NOISE

Spurious signal resulting from the random electrical charges existing in conductors, components, valves and transistors. It is heard from the loudspeaker as a 'hiss'. Hum (see under Hum) is also sometimes included as general noise, but since the hum is sometimes filtered in certain measurements, hum and noise may be expressed separately.

OUTPUT IMPEDANCE

Effective impedance across the output terminals of an amplifier as reflected across the load (i.e., speaker). This impedance is generally much lower than that of the speaker (see under Damping Factor).

OUTPUT POWER

The maximum amount of power, limited by clipping or a specified value of distortion, the amplifier is capable of delivering to a load of given value (also see under Music Power).

Many transistor amplifiers yield increasing power with reducing load value, and the power is generally given at 4 and 8Ω (sometimes also at 16Ω). The power of stereo amplifiers is given per-channel with one channel only driven and/or with both channels driven together. The almost double demands on the power supply when both channels are driven together reduces the per-channel power significantly unless the supply is regulated or of a very low impedance when the power amplifiers are class B (see under Class B). However, this does not follow with class A amplifiers (see under Class A) because the power input remains constant within the dynamic range (see under Dynamic Range) of the amplifier.

The most meaningful power rating is that based on continuous wave (i.e., uninterrupted sinewave) signal with both channels driven to capacity together, referred to a specified level of distortion (0·5 per cent or 1 per cent), the power then being calculated by squaring the r.m.s. voltage across the load and dividing by the load value on ohms. This gives the **average power** per-channel, both running, **not** the r.m.s. power as often thought and, indeed, specified by many manufacturers!

The peak power on a continuous wave signal is equal to the square of the peak value of the sinewave divided by the load in ohms. Thus when the sinewave passes through zero the power is zero. Hence the average power is equal to half the peak power. The peak power is also equal to the square of the r.m.s. voltage across the load times the square of root-two divided by the load in ohms. Hence half of this, which is then equal to the square of the r.m.s. voltage divided by the load in ohms, is the **average power**. The power in r.m.s. watts can be obtained by calculation, and it works out to **1·225 times** the average power! This is almost 23 per cent higher than the average power. We often wonder whether the spec. writers are aware of this.

OVERLOAD

When an amplifier is driven beyond its capacity the waveform is clipped and overloading and hence heavy distortion results.

OVERLOAD MARGIN

It is desirable to have a margin prior to the onset of overload to avoid clipping on transients. This also enhances the reproduction, giving it a 'smoother' quality in many cases.

POWER BANDWIDTH

The bandwidth over which the full power does not drop below a specified value. The l.f. and h.f. points where the power is half that at 1kHz (i.e., full power) are often given. This is the **half-power bandwidth.** Expression is commonly such as '20Hz to 35kHz —3dB', the —3dB indicating a power drop to half the full value.

Sometimes the bandwidth is referred to the low and high terminal frequencies where the distortion fails to rise above a specified value, the DIN value being 1 per cent.

QUIESCENT CURRENT

The static current drawn by the valves or transistors of a push-pull class B output stage as determined by the biasing in the absence of drive signal. See also under Class B.

RADIO BREAKTHROUGH

The breakthrough of modulated radio signals into the channels of an audio amplifier owing to the presence of high-level radio signal fields. The effect is that the base/emitter junction of the low-level input transistor rectifies the signals picked up by the wiring or circuit components and the resulting audio is then handled by the amplifier in the ordinary way so that the radio programmes appear as a disconcerting background on the wanted source signal.

Since the pickup preamplifier has the lowest level input, this source is most troublesome, particularly when the volume control is well advanced. In many cases the trouble can be cured without affecting the amplifier's response or unduly changing the input impedance (when the preamplifier is in an equalising feedback loop) by connecting a 2000pF capacitor between the base and emitter of the pickup input transistor, using the shortest possible connecting wires. Both channels of a stereo amplifier must be processed.

RIAA
Standing for Record Industry Association of America and refers to the recording characteristic of gramophone records. The pickup equalising is a reciprocal of this characteristic.

RISE-TIME
Time taken by an amplifier for its output to rise from 10 per cent to 90 per cent of its final value when a perfect step (i.e., one with zero rise-time) is applied to the input. The rise-time is a function of the bandwidth.

The upper frequency response of most hi-fi amplifiers, with the treble filter off, is generally sufficient to give a rise-time well in advance of that of most programme material. (see also under Attack and Transient Distortion).

ROLL-OFF
The rate of attenuation of a filter at the bass end (high-pass) or treble end (low-pass). The crossover frequency is that frequency where the response is —3dB of the mid-frequency response. The roll-off of an amplifier is similarly defined but in terms of decrease in amplification.

RUMBLE
Infrasonic disturbance due to the electro-mechanical action of a record player.

SENSITIVITY
Input signal voltage (r.m.s.) at 1kHz required to produce maximum amplifier output when the volume control is at maximum and the tone controls and filters set for a 'flat' response and, in the case of stereo amplifiers, with the balance control at neutral.

SIGNAL/NOISE RATIO
Voltage or power output due to unwanted noise referred to the full power of an amplifier or to some other datum. A S/N ratio of 60dB implies that the unwanted noise is 10^6 below the full power or 10^3 below the full voltage of the amplifier. The noise may or may not include hum. This is sometimes made clear by the parameter being expressed such as 'hum and noise 60dB below full output'.

TRANSIENT
Signal component of fast rising leading side and usually of short duration.

TRANSIENT DISTORTION
Distortion of a transient signal component such as produced by resonance and lack of damping, the effect being overshoot or ringing following the fast rising leading side of the signal component.

WATTS RMS
A commonly incorrectly used term for continuous wave power (see under Output Power).

WEIGHTED
Often applies to the filtering of a disturbance signal (such as noise) to take account of its annoyance value rather than its absolute value. A weighted S/N ratio is always better than that obtained from the same amplifier (etc.) when unweighted.

TUNERS

AMPLITUDE MODULATION (AM)
Where the audio (or other) information applied to a radio wave causes changes in amplitude. Used generally in the long, medium and short wavebands but is not a hi-fi system as currently employed.

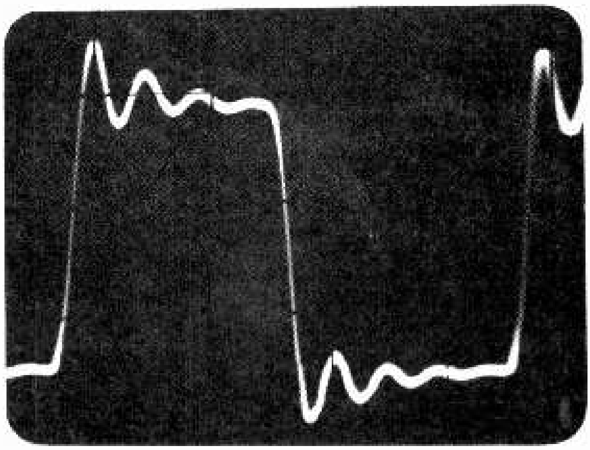
ATTENUATOR
Network for reducing signal level. Sometimes necessary in the aerial circuit of a tuner to avoid overloading by strong, local signals.

AUTOMATIC FREQUENCY CORRECTION (AFC)
Often termed automatic frequency control and is a circuit arrangement used in f.m. tuners to correct automatically for any initial, long or medium term tuning error. Currently based on a capacitor diode in the oscillator tuning whose reverse bias is adjusted by a potential delivered by the f.m. detector when the tuning is in error. In some applications it is desirable for the correction to be switchable to avoid the tuning pulling on to a strong station when it is required to receive an adjacent weaker one.

AUTOMATIC GAIN CONTROL (AGC)
Circuit arrangement which yields a gain reducing bias with increase in signal strength as a method of keeping the output of the tuner constant irrespective of the strength of the received signal.

BALUN
Usually a transformer designed to accept 75Ω unbalanced input (coaxial cable) and deliver the signal at 300Ω balanced (twin feeder). Usable in the converse sense, and sometimes necessary for matching a tuner with 300Ω balanced aerial terminals to 75Ω coaxial feeder.

CAPTURE EFFECT
Effect characteristic of the f.m. system whereby the stronger of two signals, even when in the same channel, 'captures' the tuner so that it responds mostly to this one, pushing the weaker unwanted one well into the background.



Transient Distortion. *Example of transient distortion where the fast leading edge of a squarewave initiates ringing.*

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CAPTURE RATIO

IHF term which refers to the power ratio of two signals in the same channel required to keep the signal/interference ratio to a value of 30dB referred to 100 per cent modulation and 1mV input signal level. The ratio of the powers of the two input signals is expressed in decibels, the smaller the dB number the better the capture ratio. Top-flight tuners have a value as low as 1dB.

DECODER

Device used in stereo tuners for yielding the left and right channel signals from the multiplex signal fed in from the f.m. detector.

DISTORTION

Harmonic distortion produced by tuners is generally given at 100 per cent or 30 per cent modulation and 1kHz. F.M. detector non-linearity may cause the distortion to rise with increasing modulation percentage. Owing to the attenuation of the higher-order harmonics, the THD may be less from tuners with the American 75μS de-emphasis than from those based on the British (and European) 50μS de-emphasis. Distortion on stereo is also usually higher than on mono.

FIELD EFFECT TRANSISTOR (FET)

Transistor whereby the current is controlled by electrostatic means. These devices have greater overload immunity than bipolar transistors and a square-law characteristic (minimising third harmonic components) and for these reasons are favoured by many designers for use in the r.f. amplifier and mixer stages.

FREQUENCY MODULATION (FM)

Where the audio (or other) information applied to a radio wave (i.e., carrier wave) causes changes in the instantaneous frequency of the wave at a rate determined by the modulation frequency and by an amount determined by its magnitude. 100 per cent f.m. corresponds to $\pm$75kHz deviation on the broadcasting system. F.M. is a hi-fi system of broadcasting also allowing the addition (in a subchannel) of stereo information. See under Decoder.

IMAGE REJECTION

This refers to the rejection by the tuner of a signal at the image (second channel) frequency, corresponding to the tuned (real) frequency **plus** twice the intermediate-frequency when the local oscillator is working above the signal frequency or **minus** twice the intermediate-frequency when the local oscillator is working below the signal frequency.

The IHF image rejection ratio refers to the ratio (in decibels) of the signal required for a 30dB S/N ratio to that required for the same ratio but at the image frequency. Front-end selectivity increases the ratio.

INTERMEDIATE FREQUENCY (IF)

The fixed frequency resulting from heterodyning (i.e., 'beating' or modulating to develop the sum or difference frequency signal) the incoming signal with a signal from the local oscillator. The i.f. used in f.m. tuners is commonly 10·7MHz and in a.m. tuners 470kHz. The i.f. signal is amplified in the i.f. channel and it is here where most of the selectivity is introduced by tuned bandpass couplings and/or crystal or ceramic filters.

INTERMODULATION

This can result in the tuner front-end owing to the application of two or more powerful signals. In the group of the three f.m. stations (Radios 2, 3 and 4), third-order intermodulation can put interference on Radio 3. The solution lies in reducing the strength of the signals by attenuation.

MULTIPATH DISTORTION/RECEPTION

Owing to reflection of the v.h.f. f.m. signal by large buildings, hills, etc., the tuner sometimes receives not only the direct signal but also a reflected signal slightly later due to the greater path distance travelled. This results in high-order harmonic distortion and impairment to the stereo separation and quality.

MULTIPLEX (MPX)

The name sometimes given to the stereo system of broadcasting and the complex signal delivered by the f.m. detector for application to the stereo decoder.

PILOT TONE

The signal included with the stereo information, and applied in a subchannel on the f.m. signal, which is used to reform the suppressed subcarrier and synchronise the switching of the detectors in the stereo decoder. Pilot tone frequency is 19kHz, and doubling this (38kHz) gives the subcarrier frequency. The pilot tone also activates the stereo indicator light switching.

QUIETENING (MUTING)

A muting circuit which 'quietens' the audio channel when tuning between f.m. stations and which is 'cancelled' when the incoming signal is of a pre-determined (preset) level.

QUIETING

The amount (expressed in decibels) by which the noise output of an f.m. tuner is reduced when the input signal is at a given level (see also under S/N Ratio and Sensitivity).

SELECTIVITY

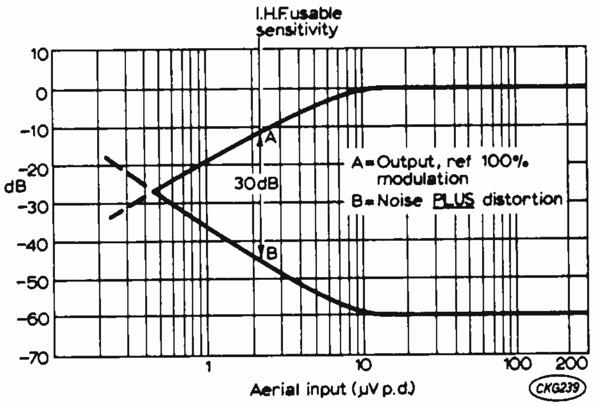
The ability of a tuner to select the wanted frequency without interference from signals at adjacent frequencies. Front-end selectivity enhances the image (and i.f.) rejection ratio, while good i.f. channel selectivity prevents interference from unwanted stations at frequencies near to the tuned frequency.

Good i.f. selectivity is required by f.m. tuners to minimise 'birdies' interference on stereo reception, coupled with low-pass filtering (critical frequency about 53kHz) between the f.m. detector and stereo decoder.

The IHF selectivity, given in many tuner specs., refers to the ratio of the level of a signal in the alternate channel (400kHz away from the required station) to the level of the wanted signal for a signal/interference ratio of 30dB when the wanted signal is applied at a level of 100μV. The signal ratio is given in decibels, and the larger the number the better the selectivity. Top-flight tuners with ceramic or crystal i.f. filters can have an IHF selectivity better than 50dB.

SENSITIVITY

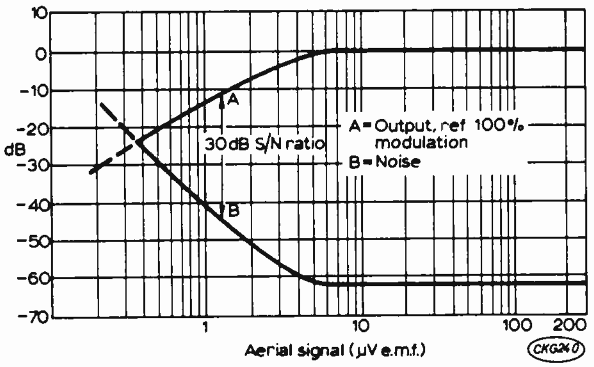
In general refers to the aerial input signal required for a given S/N ratio or quieting ratio (see S/N Ratio). The IHF **usable sensitivity,** frequently given in tuner specs., is the least aerial signal required across the tuner aerial terminals (p.d.) for a signal/noise **plus** distortion ratio of 30dB. Instead of the modulation being switched off it is notched out by a steep filter so that only the distortion and noise remains. The test is made with 100 per cent modulation.



Sensitivity. *Graphical representation of IHF usable sensitivity.*

SIGNAL/NOISE (S/N) RATIO

The ratio of the output signal to the noise at any given level of aerial signal. Signal modulation is either 30 per cent or 100, the latter giving an improvement over the former of about 9dB. A 0dB datum is established on the modulation, which is then switched off and the remaining noise measured. See also under Quieting and Sensitivity.



Signal/Noise Ratio. *Curve A is tuner output referred to 0dB and 100% modulation. Curve B is noise output without modulation. Max. S/N ratio about 63dB while input of 1·4μV results in S/N ratio of 30dB.*

SPURIOUS RESPONSE REJECTION

The ability of an f.m. tuner to reject spurious signals falling outside the tuned frequency or the immunity of the tuner itself to the production of spurious signals as the result of intermodulation, etc. (see under Intermodulation).

SUBCARRIER

The carrier used in stereo broadcasting to accommodate the subchannel stereo components. Frequency is 38kHz and is suppressed at the transmitter, leaving only the sidebands, but is reformed at the receiver for detection of the stereo components by doubling the synchronised 19kHz pilot tone (see under Pilot Tone).

TUNING INDICATOR

Often a meter which gives both an impression of the signal strength and the correct tuning point at maximum deflection. As maximum S/N ratio and least distortion occurs from an f.m. tuner only when the station is accurately tuned, a centre-zero meter might also be incorporated, and the tuning is carefully adjusted until this shows the correct condition of balance.

ANCILLARY

AMBIENCE

The term sometimes given to the 'colouration' of the signals due to the concert hall, etc. A kind of 'ambience' from stereo signals can sometimes be obtained by feeding the difference signals (appearing across the two 'live' terminals of the left and right channels) to a speaker sited behind the listener. More advanced matrices are necessary for full effect.

ANTI-SKATING BIAS

A bias force applied to a pivoted pickup arm to counteract the inward force (towards the centre of the record) resulting from the drag of the stylus in the groove and the offset angle of the head.

AUXILIARY BASS RADIATOR

A parastic (non-electrically-driven) unit resembling a bass speaker unit located in a loudspeaker enclosure, as if it were an ordinary unit, to increase the movement of air and hence enhance the bass performance at a given enclosure volume.

AZIMUTH

Referring to the vertical setting (alignment) of the head in a tape recorder.

CCIR

Short for International Radio Consultative Committee, responsible for certain audio standards and tape play characteristics, among other matters.

CERAMIC PICKUP

A pickup whose generator system is based on piezo electricity produced by the stressing of natural and man-polarised crystals.

COMPLIANCE

Opposite to stiffness. A mechanical unit whose electrical analog is capacitance. In gramophone pickups one 'compliance unit' is taken as 10^{-6} cm/dyne.

CONE BREAKUP

The inability of a speaker cone to work as a piston at high frequencies, the effect being that the cone is not under the complete control of the speech coil, certain parts of it moving in opposition to other parts like a 'rippled rope'. Responsible for uneven frequency response.

DE-EMPHASIS

A method of signal equalisation where pre-emphasis is used during recording or transmission. Such as the pre-emphasis of the treble modulation on f.m. and the equalising de-emphasis at the tuner. Used essentially as a noise reducing artifice.

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DOLBY SYSTEM
A noise reducing system whereby the recorded signal is 'compressed' and the replay signal 'expanded'. Originally used professionally, but a simplified version for domestic applications (for tape recorders, especially those based on cassettes) has recently been developed.

DROP-OUT
Short pause in tape replay due to bad tape coating.

DUAL CONE
Speaker unit containing a main cone for bass and middle frequencies and a smaller, stiffer inner cone for treble frequencies, sometimes called a 'full range' speaker unit.

DYNE
Unit of force equal to 1/980 gram at latitude 45° at sea level. Used in pickup mechanics especially.

ELECTROMOTIVE FORCE (EMF)
Electrical pressure at source. Not to be confused with potential difference (p.d.) which is the voltage developed across a resistance or impedance due to current flowing through it. Both are measured in volts.

FLUTTER
Cyclic speed variation of tape recorder (e.g. above about 10Hz) producing spurious signal related to the frequency.

HEADSHELL
The end of a pickup arm where the cartridge fits. Sometimes bonded to the arm, though often detachable.

INERTIA
Resulting from mass and inhibiting change in velocity. Important in pickup mechanics.

INFINITE BAFFLE SPEAKER SYSTEM
A speaker system where the bass driver is located in an almost airtight enclosure.

LABYRINTH
A type of speaker enclosure where a maze-like construction extends the air column. Resonances are tamed by heavy damping material.

MASS
The bulk of matter though not necessarily equal to its weight. A mechanical unit whose electrical analog is inductance.

OMNIDIRECTIONAL
Having no particular direction of maximum emission or sensitivity. Omnidirectional speaker is one which radiates theoretically equally in all directions.

PARALLEL TRACKING ARM
Pickup system which allows the cartridge to track on the true radius of the record, as the recording was made, thereby minimising lateral tracking error.

PINCH EFFECT
Slight variation in the width of the groove resulting from the mechanics of recording which cause the pickup stylus to vibrate vertically at twice the recorded frequency, giving second harmonic distortion.

PLAYING WEIGHT
The downward force required on the pickup stylus to keep it in the groove and to counter the mechanical reactions of replay.

PRE-DISTORTION
A scheme sometimes adopted during recording to nullify the effect of tracing distortion on replay. The distortion deliberately introduced is the reciprocal of that produced on replay.

PRE-EMPHASIS
Deliberate boosting of high frequency to allow attenuation on replay (or reception in the case of f.m.) as a noise reducing artifice. See also under De-Emphasis.

QUADRAPHONY
A scheme of extended 'stereo' whereby ambient and dimensional information is fed directly or via a matrix to a set of four speaker systems suitably orientated in the listening room. Two main systems are currently under development. One based on four discrete channels and the other on two channels into which are matrixed the information of the other two channels. In the latter system a reciprocal matrix at the reproducing end delivers a version of the original four channels for application to separate amplifiers and speaker systems.

REFLEX SPEAKER
This differs from an infinite baffle enclosure in that an air vent is incorporated which is tuned by its dimensions for the best bass performance in conjunction with the bass driver and the volume of the enclosure. The auxiliary bass radiator is a development of this technique.

TIP MASS
The effective mass at the tip of the stylus of a pickup cartridge. Modern techniques have reduced this mass towards 1 milligram or below.

TRACKABILITY
How well the pickup system will track high amplitude and velocity modulation at a given tracking weight.

UNIPIVOT PICKUP ARM
An arm which secures both the lateral and vertical movements from a single highly engineered pivot. Difficult to engineer, but characteristics (i.e., very low bearing friction) desirable when well engineered.

VELOCITY PICKUP
Magnetic pickup whose output increases with increase of recorded velocity. This differs from the ceramic pickup whose output is a function of amplitude or deflection of the stylus.

WOW
The complement of flutter, but at frequencies below about 10Hz.

IC STABILISED POWER SUPPLIES

D. J. SILVESTER

THE design and construction of a compact high stability power supply results in a number of difficulties when the use of a 4½in. x 3½in. x 2in diecast aluminium box is contemplated. This particular supply unit has obvious uses as a 9V battery replacement, and since output current limiting can easily be added, the supply unit can be used in radio repair work where a current overload would otherwise cause irreparable damage. There is a limitation to the size of the mains transformer due to the smallness of the box, resulting in large variations of unregulated d.c. voltage, a difficulty which can be overcome.

The simple transistor-assisted zener circuit proved to be unstable because of these large voltage variations and the usual multi-transistor feedback circuits needed to give a stable output required more space than was available. The next step was to examine the possibility of using an integrated circuit as the feedback amplifier, and after this was done successfully a second and more powerful supply was built.

PRINCIPLE OF OPERATION

The block diagram of Fig. 1 shows the basic circuit of the two power supplies. The principle of negative feedback requires that part of the output voltage be compared with a reference voltage, and the output regulator drive adjusted so that the two voltages become equal. The amount of correction applied to the output regulator is controlled by the gain of the amplifier. It can be shown that the stability of the regulated output depends upon:—

1. The gain of the amplifier.
2. The variations of the amplifier output with changes in the unregulated d.c. supply.
3. The stability of the reference voltage.

The integrated circuit has a very high gain (100,000 times) and has been designed so that a change of 1V in the unregulated supply will cause only a $30\mu V$ change in the output. The first two sources of design difficulty are eliminated in practice if an i.c. is used as the feedback amplifier. The third source of instability due to the internal resistance of the zener diode can be overcome by providing a stable bias current from the regulated output, and by choosing a diode with a low internal resistance.

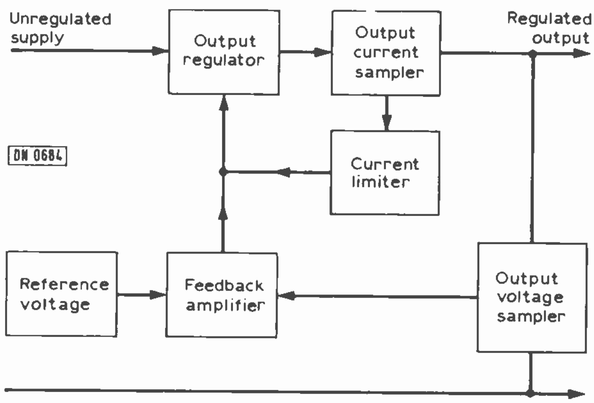
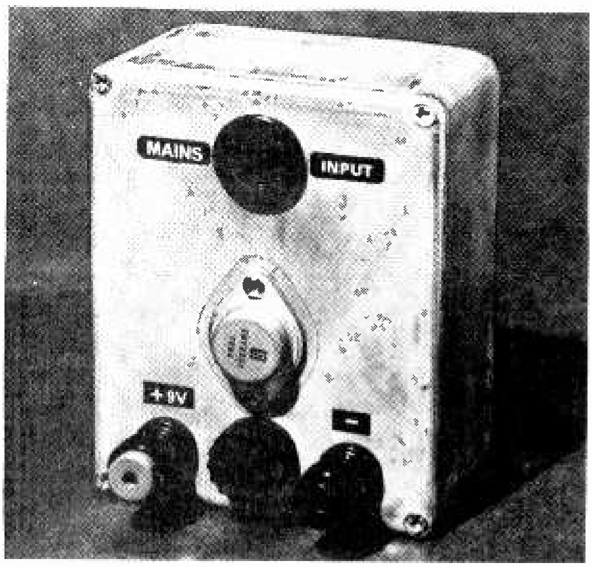


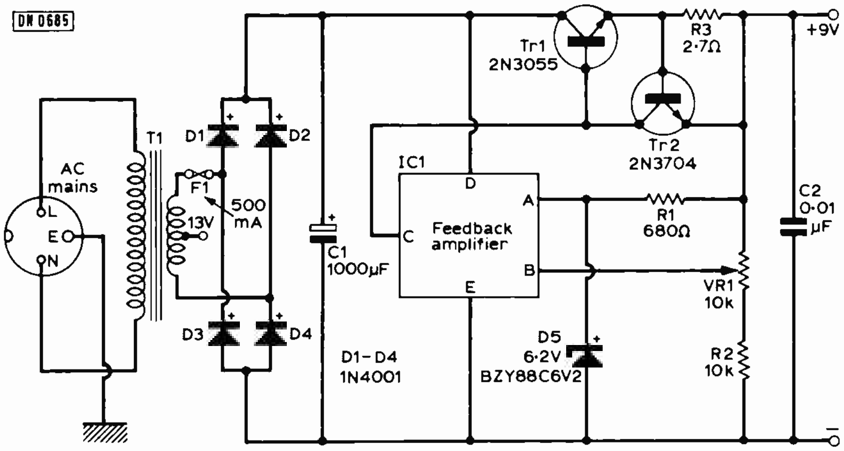
Fig. 1: Block diagram showing the various feedback paths of the stabilised supply.



Front view of the completed 9V supply.

FIXED 9 volts supply

The final circuit used for the smaller supply is shown in Fig. 2, the few changes required to give a higher output power will be discussed later. It is possible to use either a μA709C or μA741C integrated circuit as the feedback amplifier, and as five possible package alternatives exist, this component has been represented by the box with connections A to E. These alternatives, as well as the three extra frequency stabilising components required with the μA709C are shown in Fig. 3. It is preferable to use the μA741C integrated circuit since this device will be undamaged should the inputs or



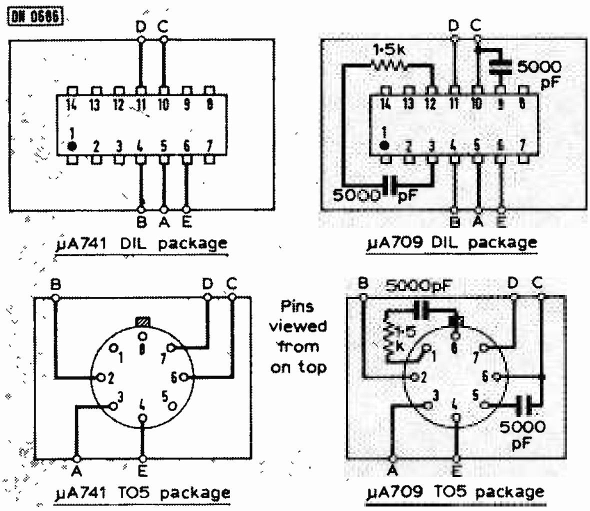


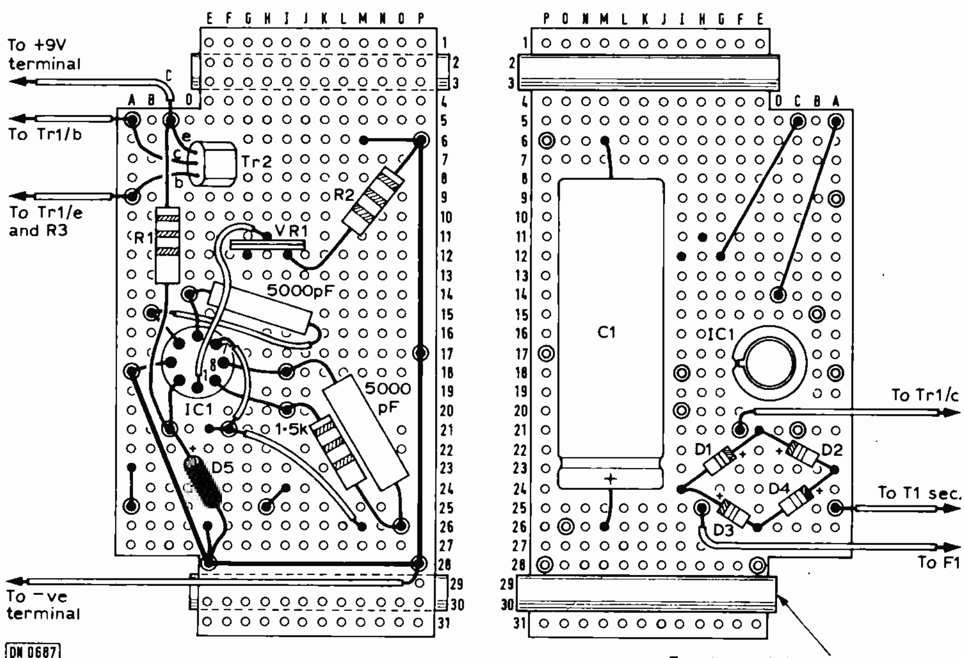
Fig. 2: Above, complete circuit of the fixed 9V supply. Fig. 3: left, connections of the various forms of the integrated circuit that can be used. Fig. 4: below, shows the veroboard layout for the smaller components. The 5000pF capacitors and 1·5kΩ resistor (see text) were fitted on the prototype.

★ components list

R1 680Ω ½W 5%	R2 10kΩ ½W 5%
R3 2·7Ω 3W wirewound	C1 1000µF 25VW
C2 0·01µF	VR1 10kΩ skeleton preset
Tr1 2N3055	Tr2 2N3704

D1–4 IN4001 or 1A bridge rectifier
D5 BZY88C6V2 (6·2V 400mW)
IC1 µA741C (µA709C may be used, see text)
T1 230V/12–13V 500mA

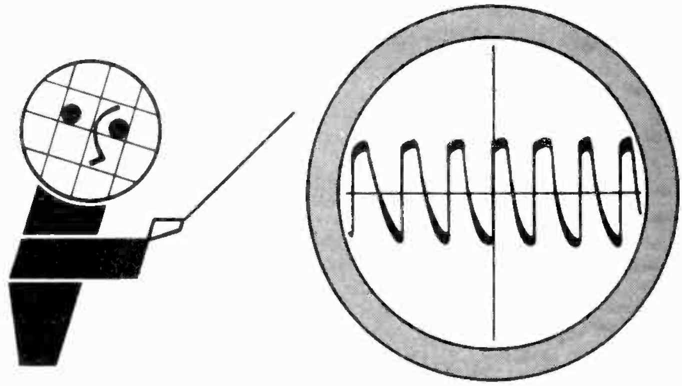
Red and black insulated terminals. Die cast box, 4⅜ x 3⅝ x 2¼in. Mains input plug and socket. Fuse 500mA and holder. Veroboard 3 x 1⅞in. 0·1in. matrix. insulating kit for 2N3055.



look! electronics really mastered

... practical
... visual
... exciting!

no previous knowledge
no unnecessary theory
no "maths"



RAPY

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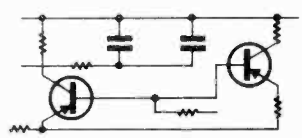

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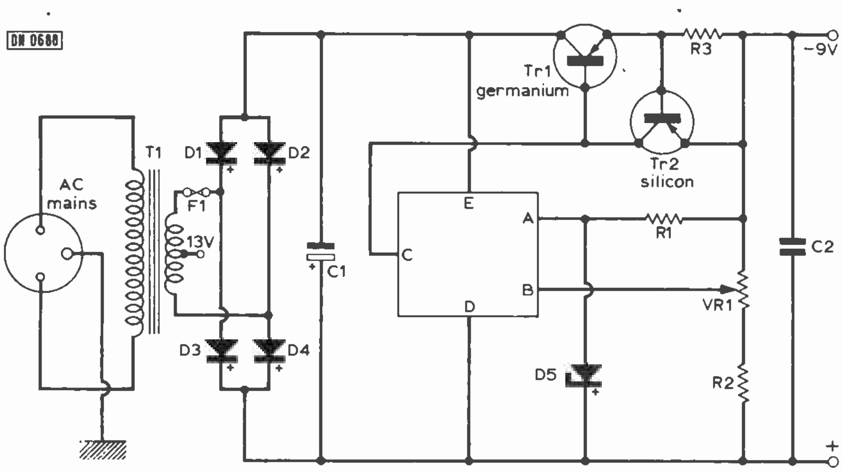


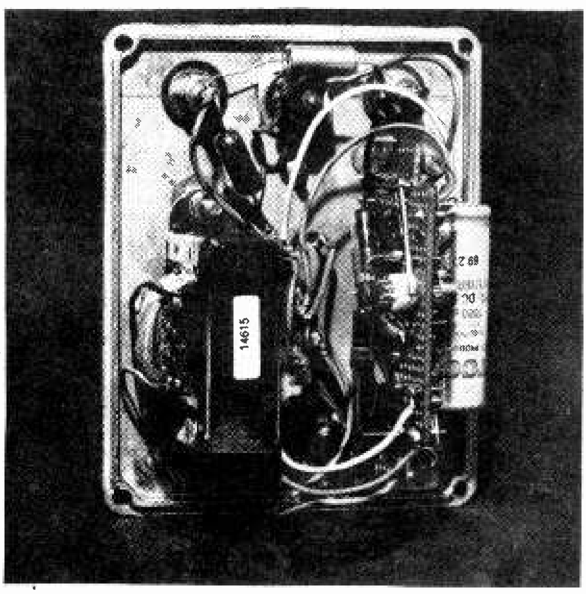
Fig. 5: Variation of circuit shown in Fig. 2 to permit the use of p.n.p. transistors such as may be found in an existing unstabilised supply.

output be shorted to either chassis or the unregulated d.c. supply.

The current limiting device consisting of R3 and Tr2 can be omitted if this facility is not required. The short circuit current with the components chosen is 250mA. The potentiometer VR1 is used in place of a single resistor in the output sampler, so that the output voltage may be set accurately to 9V when construction has been completed. It was not necessary to reduce the sensitivity of this control by using a three resistor potential divider.

CONSTRUCTION

Very little information is required on the layout of the circuit components, which, with the exception of Tr1, R3 and the transformer, can be assembled on a very small piece of veroboard (Fig. 4). One idea which greatly helps the final wiring is that all the components and board are mounted on the lid of the box. A neater appearance results if the larger components and the circuit board are stuck to the lid with epoxy resin adhesive.



Inside the fixed voltage supply unit. The transformer is fixed to the lid with epoxy resin as are short lengths of studding to locate the circuit board.

The power transistor uses the box as a heat sink but it must be electrically isolated with washers. The wiring should be thoroughly checked before switching on, after which the output can be set to 9V by adjusting VR1. A 47Ω resistor connected across the output should not cause any change in the output voltage.

VARIATIONS

It is possible to alter an existing power supply having germanium p.n.p. transistors, by using a variation of the original circuit, shown in Fig. 5. The unregulated d.c. supply must not exceed 36V or the i.c. will be damaged. If a different value of output voltage is required the values of R1, and VR1 and R3 must be recalculated.

If only a small current is required from the regulated output the power transistor can be replaced by a BFY51 or removed completely if an output of less than 10mA is required.

VARIABLE voltage supply

After the successful construction of the 9V fixed supply it was decided that a much more versatile supply could be constructed using the same basic circuitry. This new supply would be capable of powering small hi-fi amplifiers, and it was decided that in order to increase its usefulness the supply should be able to deliver a constant voltage in the range 10 to 25V at a maximum current of 1A. A few small design changes must be made to the circuit of the fixed supply, but one difficulty, the large variations in the unregulated d.c. supply, is to some extent overcome. The final circuit of the second supply is shown in Fig. 6.

The transformer used gave between 20 and 23V a.c. to the bridge rectifier consisting of four 3A 50V diodes, D1 to D4. These diodes produce a d.c. voltage of between 30 and 36V across the capacitor C1, the value of this component being increased to 5000μF by using two separate 2500μF electrolytics in parallel.

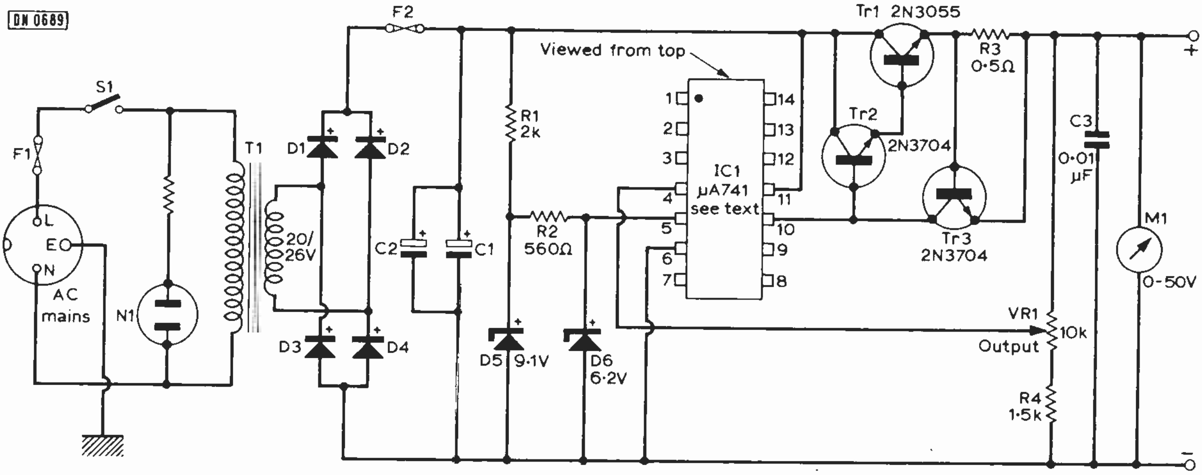


Fig. 6: Circuit of the variable voltage power supply which includes a meter to monitor the actual output voltage.

It should be noted that on no account, or under any load conditions, must the voltage across C1 exceed 36V or the i.c. will be destroyed.

OUTPUT CURRENT REGULATOR

The first transistor used for the current output stage is again a 2N3055 being the cheapest of a number of alternatives. The current gain of this transistor is about 20, which means that at maximum output current this transistor will require a base current of 50mA which is greater than the i.c. can supply. The final output current stage consists of a darlington pair Tr1, Tr2 using the 2N3055 and 2N3704/BFY51 transistors. It is calculated that the maximum current demand on the i.c. is now reduced to below 1mA. The value of the limited output current is 1·2A, obtained by reducing the value of R3 to half an ohm.

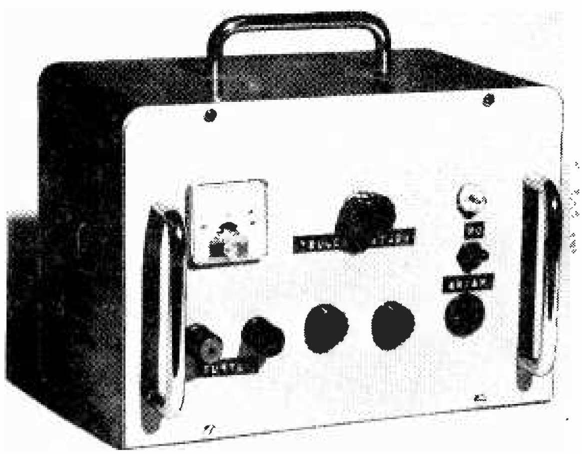
REFERENCE VOLTAGE

The reference voltage is derived from a zener diode D6, and as the stability of this component directly affects the stability of the output voltage some method of supplying D6 with a constant current must be found. The zener cannot be supplied directly from the regulated output so the most obvious alternative is to provide a stable d.c. voltage from a second zener diode, D5, biased from the unregulated supply. The amplifier chosen is the µA741C type used in the fixed supply but any of the alternatives given in Fig. 3 may be used if required.

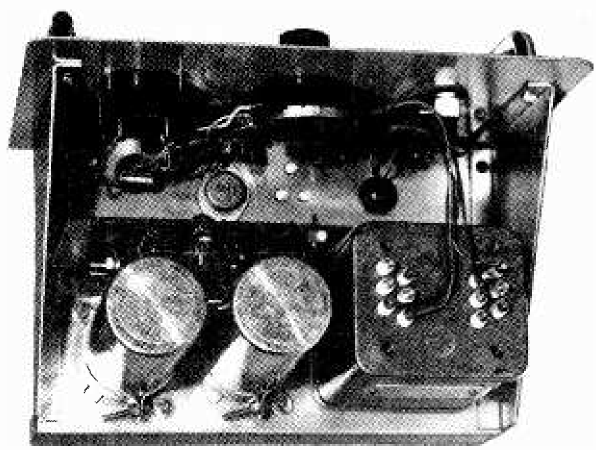
OUTPUT VOLTAGE SAMPLER

This part of the circuit consists of a resistor chain across the regulated output. The minimum output voltage occurs when the inverting input (lettered A in Fig. 3) is connected to the output rail, the output voltage being equal to the zener voltage of D6. The maximum output voltage is determined by the values of VR1 and R4. The value of R4 is calculated to be 1·3kΩ for an output of 30V. The preferred value nearest to this, 1·5kΩ, produced a drop in the maximum output voltage. There is a rapid increase in voltage with rotation of the potentiometer at the high voltage end, and although this causes some slight inconvenience it was not considered necessary to use separate resistor chains.

—continued on page 642



Front view of the larger unit contained in a standard instrument case.



The smaller components are mounted on a vertical board shown above the large capacitors C1 and C2.

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

Only knocks

I would like to comment on the correspondence regarding v.h.f. radio in your October issue.

Mr. James W. Robson's technical explanation for v.h.f. not having caught on is ingenious, but I fear, nonsensical. When f.m. was introduced in this country, and for several years after, only mains driven equipment was available for its reception. In those years, given suitable incentives, a large proportion of listeners could have been persuaded to buy f.m. radios. As it was, shackled by a monopoly broadcasting service, v.h.f. never stood a chance.

In the preface to "Radio & Television Servicing, 1955-56", a purely technical publication, the editors wrote: ". . . The outstanding feature of this period has undoubtedly been the inclusion, in the ranges of most manufacturers, of combined a.m./f.m. receivers for the reception of the BBC very-high-frequency (Band 2) transmissions . . ." In a subsequent edition it was stated that sales resistance to v.h.f. only sets was strong, and that the absence of Luxembourg on this band was partly to blame. And that is the situation in a nutshell. If only the opportunity had been taken at the time of the new channels becoming available to introduce independant radio stations, listeners would have clamoured for sets to receive them. Few saw the point of spending money to obtain carbon copies of existing programmes. A parallel may be drawn with the introduction of independent television on Band 3. In the two years following the opening of the Lichfield transmitter I supplied and installed upwards of 1,000 Band 3 converters. In the first two years of the BBC-2 625-line service I had orders for just two conversion kits. Even to this day I find customers with facilities for v.h.f. radio and 625 line television who have no intention of using them. What a monument to wasted opportunity!

One might have thought that the instant and overwhelming success of the so-called "Pirate" radio stations in 1965 would be construed as a clear indication that something was serioulу wrong with broadcasting in this country. Attempts to legalise the pirates were frustrated by the BBC, who solemnly announced that it was quite impossible to find space for any more stations on the medium wave band. No one appears to have though of offering the largely unused v.h.f. band. Now the BBC has done a complete about turn by foisting its local radio stations onto medium waves. Nothing could be a greater admission of failure on the part of monopoly broadcasting to attract listeners to v.h.f.

The promised commercial stations may inject some life into v.h.f. reception, if only because all will be capable of transmitting in stereo, but by and large I am compelled to admit that I am far from sanguine. Even Lord Hill, contemplating the prospect of medium-wave reception in the future, is quoted as saying, ". . . and may the Lord have mercy on you after dark!" Unfortunately, f.m. broadcasting missed the boat 17 years ago, and opportunity, as they say, only knocks once. — **Charles Miller** *(Uttoxeter)*.

Local radio

No doubt many readers will have noticed the additional interference caused in the m.w. band by the opening of local radio station m.w. transmitters recently, by the BBC. These transmissions, at night, can scarcely be described as local, with a range of over 200 miles. In my location, Radio London is very powerful, and has been received at night in Holland, France and Northern England. This rather defeats the BBC's good original object of a local radio service. Could not the BBC shut down the 206 metres Radio London m.w. outlet, and other outlets, at night, when local radio simply relays programmes carried by Radios One and Two. The v.h.f. outlets could of course remain, as they have done previously. This step would reduce the amount of interference with foreign services, and would bring BBC local radio in line with the proposed restrictions to be imposed upon local commercial radio stations.—**John Manners** *(Middlesex)*.

Quadraphonics

I am interested in building myself a Quadraphonic Hi Fi system.

The design of the preamplifiers and power amplifiers is relatively straightforward, but as yet I have been unable to find any details on how to design the four channel matrix decoder.

An article in your magazine on either the principle of operation or a practical circuit would be of considerable value to myself and I am sure to other people.— —**P. M. Cunnington** *(Essex)*.

Your letter has been forwarded to me by the Editor and I must comment, with a copy to the Editor, in the hope he may publish, for your letter raises one or two interesting points.

First, before we could contemplate publishing the circuit for a decoder, we must know something of the encoding. Quadraphonics is very much in a state of flux.

In April, there was a show at Osaka, and about half of the 38 exhibitors had some sort of four-channel exhibition. Few were convincing. Most annoying was the fact that few were mutually compatible—nor even tried to be!

There are, basically, three systems of stereo recording: the CD-4 of Matsushita and JVC-Nivico, with American backing from RCA; the SQ, with CBS and Sony throwing in their weight, to which EMI have now added their backing in this country. And last is what might be called a 'Regular Matrix' system, like the Sansui QS, and several related alternatives.

There is no 'universal' decoder, and until the vast commercial battle is won and there is a 'standard' method of encoding, we should play it very close to the chest. I would advise you, Mr. Cunnington, to forgo the pleasure of anything but purely discreet quadraphonics until your way ahead is sufficiently clear. In any case, you can go ahead with pre-amps and power amps—and, I hope, separated power supplies—with the knowledge that whatever decoder is appropriate to the software available to us (mostly SQ at present, will soon be made available to the constructor.— **H. W. Hellyer** *(Bristol)*.

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6K8GT	50
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6L6G	50
6L18	45
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6Q7GT	48
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35Z5	50
37	40
42	50
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75	50
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80	55
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807	50
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954	60
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4022AR	£5·50
5763	70
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EBC33	50
EBC41	55
EBC90	35
EBF80	40
EBF83	40
EBF89	30
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EBL31	£1·50
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ECC81	35
ECC82	30
ECC83	30
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ECH21	63
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AC127	25
AC128	20
ACY20	20
ACY39	50
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AD149	50
AD161	37
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AF117	25
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BC109	10
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OAZ224	45
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7423	48
7425	48
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SIMPLE R.F. SIGNAL GENERATOR

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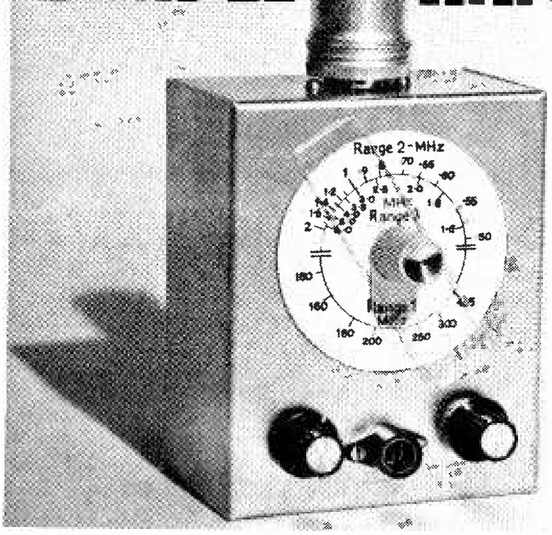


THE r.f. signal generator forming the subject of this article was designed for the alignment of superhet receivers as well as for general purpose usage. The cost should be low as the coils are of the Denco plug-in type and do not form a permanent part of the circuit. This has additional advantages in that range switching is not necessary and all r.f. leads and connections can be kept very short; construction is also simplified greatly by using this method. The coverage of the generator depends entirely on the reader. Two coils will cover the medium waves, long waves and the i.f. of 465kHz but the prototype also worked on the short waves up to at least 10MHz; this however is not so vital as the harmonics of the lower ranges will get up to this frequency and way beyond. The circuit used has proved very reliable and gives a good output.

THE CIRCUIT

The complete circuit is given in Fig. 1 and may be considered in two distinct parts, the r.f. oscillator and the a.f. modulator. The r.f. side is very simple and comprises a tuned circuit (VC1 and La) with base coupling (Lb) with a feedback winding (Lc). Base bias for the transistor is provided through R1 while C1 decouples the supply line with the take off point being C2 from the collector of Tr1. A BC169C is used, mainly because of the lead configuration; this is a plastic encapsulated version of the BC109. The supply for this stage is provided through a dropping resistor R2.

The a.f. section comprises Tr2 and associated components. This is a Hartley configuration using a transistor output transformer type LT700. This is a completely conventional arrangement, the primary of the transformer is tuned by C4 with C5 providing the feedback coupling and R3 the base bias to start the operation (this resistor may not be necessary as the feedback should be of sufficient level to maintain oscillation but it is as well to include it to make sure).

The output from the a.f. oscillator is at a fixed frequency—in the case of the prototype it is about 800Hz but the exact frequency will depend on the particular transformer and on component tolerances etc. The frequency can be increased by lowering the value of C4 or omitting it altogether, relying on the self-capacity of the windings to tune it. The frequency can be lowered by increasing the value of C4.

The waveform from the audio oscillator is far from a pure sine-wave but this is of no consequence and serves the desired purpose admirably.

FUNCTION SWITCH

Switch SW1 is the main function switch providing the on-off facility, r.f., modulated r.f. or a.f. at the output socket. In position A the battery is unconnected and so the circuit is off. In position B the

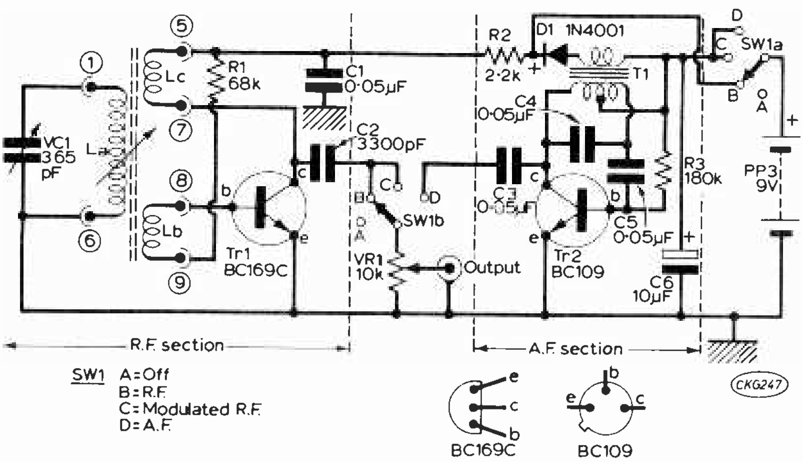


Fig. 1: The complete circuit of the R.F. Signal Generator. The required range is selected by plugging in the appropriate coil. SW1a and SW1b are ganged to give the required output.

positive supply is connected between D1 and R2. In this mode the diode will block any current to the a.f. oscillator and this will be inoperative. Current, however, is allowed to reach the r.f. stage and SW1b connects the output level control to the output of Tr1 via the d.c. blocking capacitors.

In position C, VR1 remains connected to the output of the r.f. section but SW1a applies current directly to the a.f. oscillator stage. In this mode D1 allows current to reach Tr1 but the positive supply is now connected via the secondary of the a.f. oscillator transformer. This creates a small, rapid change in the supply voltage in sympathy with the frequency of operation (800Hz in the case of the prototype) and so the output from Tr1 will also vary, modulating the signal. Normally it is not good practice to modulate an oscillator as this can cause both amplitude and frequency modulation but in practice some slight f.m. can be ignored. This arrangement gives a modulation depth of about 20 per cent.

In position D the positive supply is as for C but SW1b connects to the collector of Tr2 via the d.c. blocking capacitor C3 giving an audio output. If it is important that only pure a.f. is provided, the r.f. section can be made inoperative simply by unplugging the coil.

Capacitor C6 decouples the supply of the a.f. stage, the relatively low value is quite sufficient because of the audio frequency used.

The output of the r.f. section is about 500mV and that of the a.f. section about 400mV; in both cases this is more than adequate for normal usage and both outputs connect via the level control VR1 before connecting to the coax output socket.

CONSTRUCTION

The coils used are the Denco plug-in types, these fit into a B9A valve-holder. The leads can be kept very short by building the r.f. section directly onto

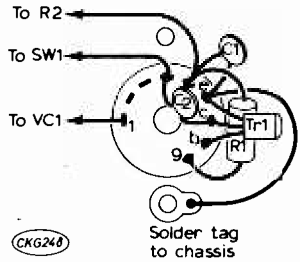


Fig. 2: The wiring of the r.f. section on the B9A valve base into which the coil is plugged.

the pins of the valveholder as shown in Fig. 2. To neaten the layout some changes have been made to the recommended Denco connections but the electrical result is the same. To bring the negative chassis connection to this part of the circuit a short wire runs to a solder tag fitted underneath one of the valveholder mounting screws.

Pin 4 of the valveholder does not connect to the coil and is only used as a convenient anchoring point for C2.

The layout and construction of the a.f. section is much less critical than that of the r.f. oscillator and can be built in any convenient form. In the prototype these components are mounted on a piece of Veroboard of standard $2\frac{1}{2}$in. width, 13 holes long. The layout of this section is shown in Fig. 3.

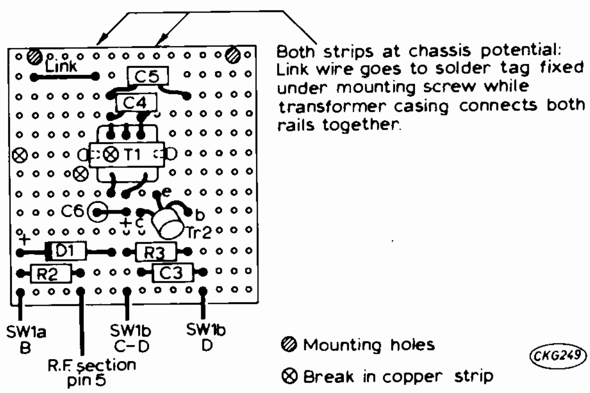


Fig. 3: The component layout of the a.f. section on Veroboard.

Holes should be drilled out to take the mounting screws and the lugs of the transformer. There are two strips on this board which are connected to chassis potential, these are linked together through the transformer casing, the lugs being bent inwards and soldered to the adjacent strip. One of these strips also connects to a link wire which runs to a solder tag fitted under one of the component board mounting screws.

There is no crowding of the components and construction should present no problems.

A few breaks are necessary in the conductor strip; one underneath the transformer is absolutely necessary, the other two will only be needed if the solder tag or the transformer lugs touch an adjacent strip.

Four take-off points are required; these are shown in Fig. 3 and Fig. 4, the latter shows the wiring not dealt with in the other drawings. A stiff wire should

★ components list

Resistors
R1 68kΩ — R3 180kΩ
R2 2·2kΩ — VR1 10kΩ lin. pot.
All fixed resistors ¼W, 5 per cent tolerance

Capacitors
C1 0·05μF ceramic disc
C2 3300pF ceramic, polystyrene or silver mica
C3 0·05μF ceramic disc
C4 0·05μF ceramic disc
C5 0·05μF ceramic disc
C6 10μF 12V electrolytic
(All 0·05μF can be 0·047μF)
VC1 365pF tuning capacitor, Jackson Type 00

Semiconductors
Tr1 BC169C — D1 1N4001 or similar
Tr2 BC109

Miscellaneous
Coils: Denco transistor range, Blue, 1T, 2T, 3T of to suit; T1: Eagle transistor output transformer type LT700; SW1: 4-way, 2-pole rotary type; B9A valve holder; Coax output socket; Veroboard 0·15in. matrix 16 x 13 holes; PP3 battery and battery clip; Terry clip for holding battery; Aluminium angle; Plastic sheet for pointer; Knobs to suit; Metal chassis 5 x 4 x 2½in.

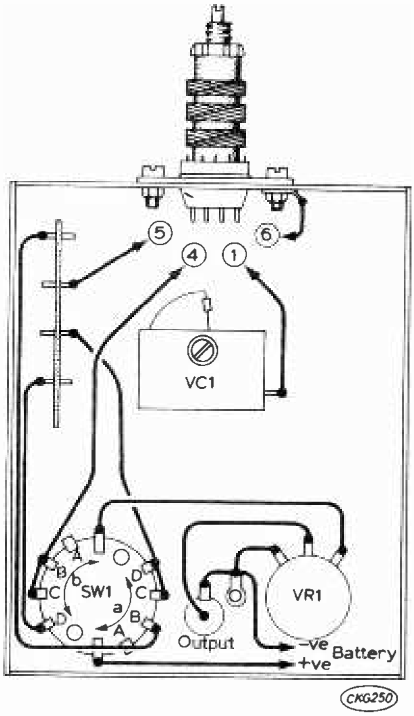


Fig. 4: The wiring between the controls and the two main operative sections.

be used from the fixed vanes of VC1 to pin 1 of the valveholder.

The rotary switch used is unlikely to look like that in Fig. 4, it is only shown in this way for clarity. The coax output socket used was of the insulated type and so a chassis connection has to be made to it; more conventional types will not need this.

It is very important that a good quality valveholder is used. Initially the author used rather a poor one and this later had to be replaced. The frequent plugging and unplugging of the coils demands a first rate quality component here.

The pointer can be made from any thin rigid clear plastic; the dimensions for this are given in Fig. 5a. A score mark should be made centrally on the underside, this can be inked in to make it clearer.

The component board is fixed to the chassis by means of an aluminium angle bracket as shown in Fig. 5b.

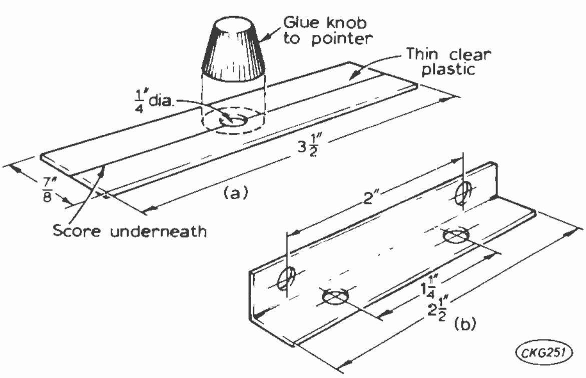
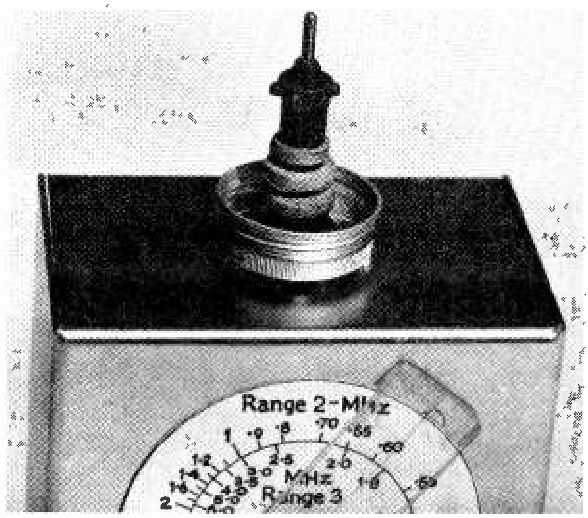


Fig. 5: (a) The construction of the frequency pointer. (b) The mounting bracket for the a.f. section component board.



The screening can lid should be fixed on top of the valve base, ensuring that there is an electrical connection.

The main case is a $5 \times 4 \times 2\frac{1}{2}$in. chassis—this is a fairly common size and the drilling of the face is shown in Fig. 6. The only part of this which may cause problems is the mounting of VC1; the dimensions of these holes and their siting are rather critical. It is best to first drill a $\frac{1}{2}$in. diameter hole, this will then accommodate the raised section around the ball race. The capacitor itself can then be used as a template for finding the exact locations of the two mounting screw holes. Very short screws must be used to mount this component, if they are too long they will foul the moving vanes of the capacitor.

The valveholder is mounted centrally on the top

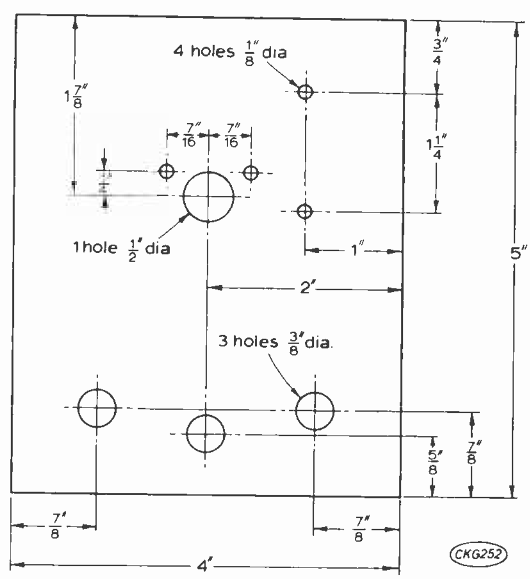
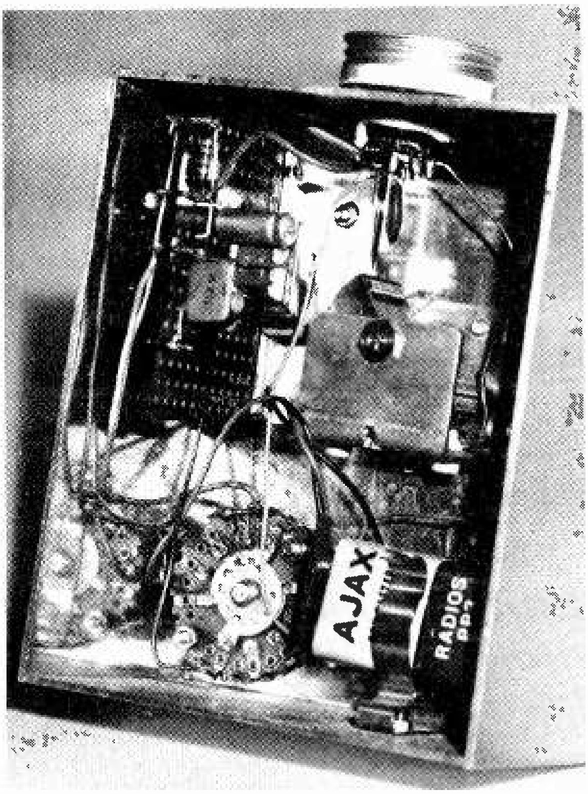


Fig. 6: The drilling details of the chassis face.



Rear view of the completed prototype.

of the case; no problems are likely to be associated with this and so dimensions are not given.

Battery mounting is often a problem; it has been solved in this case by using a Terry clip which grips the PP3 battery; this is fitted behind the level control.

To have control over the output level, the coil should be screened; if it is not it will radiate considerable power. The screening can supplied with the coils may be used for this. A ¾in. diameter hole should be cut in the lid and this glued over the valve base at the same time ensuring that there is an electrical connection to chassis. A hole should also be drilled in the top of the can to provide access to the coil core adjusting screw.

CALIBRATION

Articles on r.f. signal generators frequently make a lot of calibration, this however need present no problems if you have available an all-band radio. Radio stations maintain very accurate frequency control and by beating the r.f. of our signal generator with their carriers, we can obtain very accurate calibration.

A blank calibration panel is given in Fig. 7. This can be cut out and stuck onto the face of the case or copied.

It is best to calibrate the long wave band (range 1) first as this will also give us our i.f. frequency. Assuming that all is well with the circuit and wiring, when the range 1 coil is plugged in and the function switch is set to MOD, the output should be tuneable over the long wave band and this will be heard on a radio. A wire should be connected to the inner of the coax socket and placed near the radio, the level

Easily received MW/LW Radio Stations that can be used for calibration. Extra points can be found by interpolation

Range 1		Range 2	
Frequency	Station	Frequency	Station
151	Deutschlandfunk	529	Algeria
180	Europe No. 1	602	France
200	BBC Radio 2	647	BBC Radio 3
233	Luxembourg	701	Andorra
245	Denmark	746	Hilversum 1
		800	W. Germany
		908	BBC Radio 4
		1007	Hilversum 2
		1106	AFN Munich
		1196	VOA Munich
		1295	BBC European Service
		1403	France
		1502	Warsaw (Often English in late evenings)
		1594	BBC Radio Leicester

should be turned down as low as possible to prevent pulling in the receiver.

The receiver should be tuned to the German *Deutschlandfunk* programme on 151kHz—this is usually well received throughout Europe. With the vanes of VC1 fully closed and the pointer lined up with the end of the scale the core of the coil should be adjusted till the a.f. note, combined with a beat note, is heard. When this is done, tune VC1 to a point where the vanes are almost completely open. If the receiver is a superhet with an i.f. of 465kHz (or 455kHz for many imported sets) another note will be heard. Unlike the 151kHz point this note will be heard from the receiver irrespective of the band or frequency (though not on v.h.f.) the receiver is tuned to. When this point is found it should be

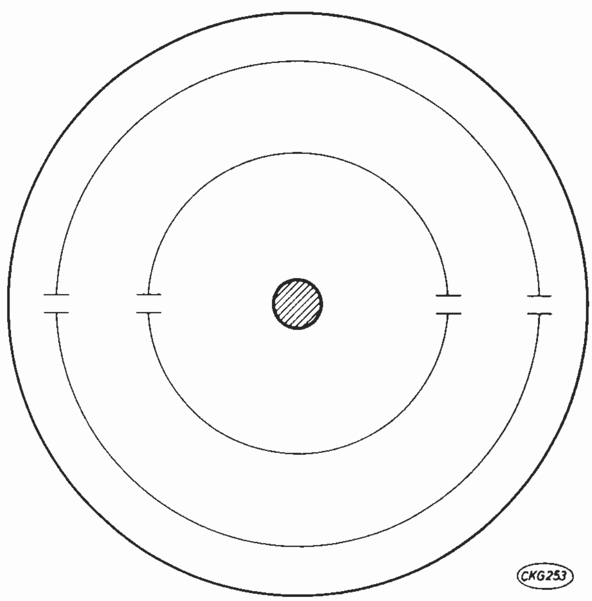


Fig. 7: This basic scale may be cut out and calibrated as described in the text.

carefully marked as this is the i.f. If possible, two positions should be marked, one for 455kHz and another for 465kHz.

Range 2 should be adjusted in a slightly different way. If we adjusted the core of the coil to operate on, say, 529kHz (*Algeria*), the high frequency end of the medium wave band would be badly cramped as this point would be reached before the vanes of VC1 reached their "extra spread" setting. For best results the core should be adjusted so that at a frequency of about 700kHz coincides with the vanes half open (pointer vertical). *Andorra* on 701kHz can be used for this. The range should then extend from 500kHz to over 2MHz, encompassing the complete medium wave band and the 1·6MHz i.f.

Range 3 should be adjusted so 1·6MHz coincides with the vanes fully closed. This range should then go up to about 6MHz.

The harmonics of range 3 can be used to give coverage of up to 30MHz though these are of less use and will be of lower level.

Various low level whistles may be heard on the wrong frequencies—these can be due to harmonics or receiver action but they should always be at a low level and there should never be any real doubt about determining the fundamental, it will be by far the strongest.

A table of useful stations for helping in the calibration are given; for a more complete list, reference books such as the "Guide to Broadcasting Station" or "World Radio TV Handbook" should be consulted. ■

CQ! CQ! CQ! CQ!

ISSUES WANTED

...P.W. January 1971, Feb. to Dec. 1971 (inclusive) and Jan. 1972.—G. A. Hunt, 38 Garrich Close, Ings Road, Hull, Yorkshire.

...P.W. Oct., Nov., Dec. 1971.—Alan Ward, 3 Cressbrook Avenue, North Wingfield, Nr. Chesterfield, Derbyshire, S42 5NL.

...P.W. March 1968 and June 1968 with items on "Clubman" receiver. Also required information on Lafayette HE 40 radio, including circuit diagram. Willing to loan or buy.—B. S. Smith, "Barnston", 58 Blackburn Road, Rishton, Blackburn, Lancs.

..."Beginner requires any back numbers of P.W. and P.T. particularly P.T. June/July 1970, June/July 1966.—L. Cooke, 21 St. Anthonys Road, Bournemouth, Hants.

...P.E. April 1970, for any information as to power supply for the 50+50 watt amplifier featured in that issue. Urgent.—P. Elliott, 4 Rowlands Avenue, Upton, Pontefract, Yorks.

...P.W. for Jan. and Feb. 1971 containing details of Stereo tape recorder construction.—M. Scott, 13 Upper Montagu St., London, W1H 1RR.

...P.E. Feb. 1968 containing I.C. tape recorder.—D. Hollis, 15 Merlin Close, Collier Row, Romford, Essex.

...Wanted P.W. October 1971 and April 1972. Postage and cost refunded.—K. Foster, 148 Malmesbury Road, Shirley, Southampton, SO1 5EY.

...Feb. and March issues of 1971 containing the P.W. Stereo Tape Recorder.—D. J. Thomas, 16 Western Road, Urmston, Lancs. M31 3LF.

...April and May 1960 copies of P.W. and any information on 19 set Mk. III.—T. Izard, 41 Clumber Drive, Radcliff-on-Trent, Notts.

...P.T. Feb. 1966.—J. S. Fairie, 5 Douglaston Crescent, Milngavie, Glasgow, Scotland.

...P.W. Jan. 1972 and Feb. 1972 issues.—C. W. Lo, 183 Lodge Avenue, Dagenham, Essex.

...P.W. Feb. to June 1967 and Aug. to Dec. 1970. P.E. Volumes 4, 5, 6 and Feb. 1971, All in very clean condition for binding.—E. Somerville, 2 Hillcrest Place, Killwinning. Ayrshire.

...Popular Hi-fi April, June and October 1971.—R. S. Wood, Preston Secondary School, Monks Dale, Yeovil, Somerset.

...wanted P.W. Feb 1972.—P. Ducker, 50 Cheshire Road, Leicester.

...P.W. Oct. 1971 to Feb. 1972 Transistor Circuitry for beginners required by.—David John Cullen, 7 O'Neill St., Clonmel, County Tipperary, Ireland.

...April 1968 issue of P.W.—C. Saylis, 60 Hardens Mead, Chippenham, Wilts.

...P.W. May and June 1971.—A. Duffy, 52 Glenbervie Drive, Whitehirst Park, Kilwinning, Ayrshire, KA13 6QH.

...Jan. 1972 issue of P.W.—S. Bouma, Wild Hoeflaan 31, The Hague, Netherlands.

...April 1970, May 1970 and June 1970 P.W.—J. Slim, 1 Whitehall Road, Smethwick, Warley, Worcestershire.

...P.W. Feb. 1972.—G. Burns, 31 Beechwood Drive, Eaton, Congleton, Cheshire, CW12 2NQ.

...P.W. Jan. 1972 and Feb. 1972.—B. A. Cotton, 15A, Thomas King House, Wellington St., Coventry.

...P.W. Aug. 1969 to September 1971 inclusive. Price please to.—P.O. Box 341, Hastings, New Zealand (Airmail).

...P.W. Feb. 1972.—P. Parker, 31 Fair View, Handsacre, Rugeley, Staffs, WS15 4DJ.

...April 1966 P.W. including '19' Set Mods. Article.—A. C. Arthur, Pinkworthy Farm, Pyworthy, Holsworthy, Devon, EX22 64Q.

Electronotes..

S. GINSBERG

THE art of sonar is not quite as simple as it sounds. In radar, an electromagnetic wave is transmitted in bursts and the energy from these which is reflected by surrounding objects is viewed on a cathode ray tube. Different objects cause different amounts of reflection and thus cause a pattern to be set up.

Sonar does the same sort of thing but with two major differences. First, it uses sound waves instead of radio waves. Secondly, it functions under water, the classic application being in ships.

Basically, sonar sounds simple until one considers it in greater depth—so to speak! A moving target generates acoustic energy, a form of noise, which can be detected. Thus no generated pulses would be needed in this passive mode. Perhaps, already I have stimulated anglers into thoughts of being able to actually "see" the big ones or shoals? Incidentally, professional systems do exist which can detect a single cod at 600ft!

In the case of sonar, the speed of data collection is limited mainly by the velocity of the propagation of acoustic energy through the water. In sea water, this is about 1,500 metres/second. Although this may sound (sorry!) fast, compare it with electromagnetic energy which has a velocity of propagation of some 3×10^8 metres/second. Thus radar would take only 1/1,000th. of a second to receive a reflection from a target nearly 100 miles away. For sonar, it would take something in the order of four seconds for a target about 3,200 yards away—barely two miles.

Like its r.f. counterpart, sonar has problems with noise. The surface of the sea is in a continual state of variation due to the weather. Marine organisms cause noise, so does seabed turbulence.

At u.h.f., microwave energy in the earth's atmosphere travels in a straight line tending to follow the curvature of the terrain. Unhappily, sonar's acoustic energy is very reluctant to follow any straight line in sea water.

To complicate matters further, water temperature has an affect. In the sea, there is a temperature gradient. One "layer" of water is a little warmer than the next one down which in turn is a different temperature to the one immediately below it. It is not until nearly a mile down that an almost constant temperature is reached.

It is interesting that the velocity of acoustic energy varies dependant upon the temperature, pressure, salinity etc. Thus the acoustic waves are bent or diffracted (like light waves in water and glass) the amount of diffraction depending upon

—continued on page 641

practically wireless commentary by HENRY

No. 93
Do you read me?

SOME while ago, Henry had the uncomfortable pleasure working beside a pedantic colleague who corrected every casual remark as if invested with the guardianship of the English language.

A favourite dampener was: in answer to a query, "What does the meter say?" "The meter doesn't. You have to read it!"

Recent forays into the world of instrumentation have convinced this traveller that we shall soon render Old Niggly out of date. We have lately been promised computer type voltmeters that will store a measurement and notify a comparison. A sort of digital poor cousin of the storage 'scope. It is but a small step to the meter that will shout: "Hey! Give over" when overloaded, or a prim: "Three-point-seven millivolts" at the appropriate moment. With, of course, a built-in recorder (opto-magnetic; I mean to invent it) so that Old Niggly cannot dispute the matter, though he is sure to contest the manner of its delivery.

Avid and persistent collectors of Henribilia will by now have gathered that the subject of digital read-out devices for the ordinary radio workshop occupies the upper layer of the author's (for want of a better word) mind.

The meter that will shout "Hey! Give over!"

It is true. I have recently come into proud possession of a digital multimeter.

Quite apart from a phenomenal accuracy, better than the thickness of a conventional pointer on the lowest voltage or highest resistance scale, the Digivom has the advantage of push-button range selection, and a read-out large enough to satisfy the most myopic niggler.

Mind you, it is not all plain sailing. There are one or two disadvantages the brochure omitted to mention. One is the tendency the Digivom has of sending out its own identifying signal—a series of chopped pulses that render its use as a measuring instrument for delicate audio (and some radio) purposes, about as valid as a Bobby Fischer unpaid checkmate.

The darned thing radiates all through the workshop. And if you enclose it in a tin box, leaving only the display tubes glowing through their visor like the Red Knight's menace, it still manages to jigger the f.m. band on the next-door engineer's rush job.

At the moment, I have a Solartron rival which uses diode display devices and these radiate only a mild hash, so, presumably there is hope for we humble servicemen yet. Except that this one has a read-out much smaller and of a style which, like the numbers my friendly, neighbourhood bank manager scrawls along the bottom of my cheques, defies analysis except by logical devices.

It is fascinating to watch the digivoms trundling down through the voltages when one reads off the h.t. line. Almost like a Cape Kennedy transmission!

Henry was happy with his push-buttons till Old Niggly sowed the seed of doubt in his mind. "Why not", he said, "do away with the push-button range selection?" After all, if you can read-off an overload indication and produce a flashing light, and do a similar service for the wrong d.c. polarity, why not build in a trigger circuit fed from a sensing device so that the meter must always switch itself to a range appropriate to the voltage applied to its terminals?

Throw one or two in the makers' faces.

Well, why not? I asked an electronics designer whose name you will have seen if you read the glossier audio journals or works on instrumentation. He said clamly: "It has been done," and quoted me one of his own patents.

Now Henry doesn't pretend to be a designer or an inventor, and his only claim to innovatory fame is a range of hook-up switch-boxes. But, fired by the ambition engendered by necessity—and not a little niggled by chagrin at spending over a hundred quid on a digivom before discovering its drawbacks—he has sworn to throw one or two modifications in the makers' faces before the year is out. Watch this space for details. . . .

The modifications will not, true, confound Old Niggly by making the machine shout its readings to all and sundry. I cannot hope to incorporate storage facilities. But the least that can be done for an instrument that boasts only one current scale, and that the "basic one", is a switched range of external shunts. *That* should not be beyond Henry's abilities—when he gets five minutes to spare.

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AD16	42p	8D4 ..	9p
AD162	40p		

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					(see note below)		
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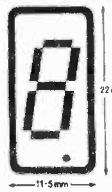
C	1/4W	10%	4·7-10M	E12	1	0·8	0·7
C	1/2W	5%	4·7-10M	E24	1·2	1	0·9
C	1W	5%	4·7-10M	E12	2·5	2	1·9
MO	1/2W	2%	10-1M	E24	4	3	2 nett
WW	1W	10% +1/20 Ω	0·22-3·9	E12	7	7	6
WW	3W	5%	1Ω-10K	E12	7	7	6
WW	7W	5%	1Ω-10K	E12	9	9	8

Codes: C = carbon film high stability low noise
MO = metal oxide Electrosil TR5 ultra low noise
WW = wire wound Plessey

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 72, 91 and their decades. Prices *are in pence each for same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1p on total value of resistor order).*

MINITRON DIGITAL INDICATOR



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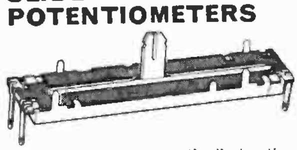

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FLH131	(7430)	20p	FLJ171	(7492)	85p
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FLH281	(7442)	1·16	FLJ191	(7495)	87p
FLH361	(7443)	1·45	FLJ261	(7496)	1·48
FLH371	(7444)	1·45	FLJ301	(74100)	1·64
FLH151	(7450)	20p	FLJ281	(74104)	43p
FLH161	(7451)	20p	FLJ271	(74107)	52p
FLH171	(7453)	20p	FLK101	(74121)	48p
FLH181	(7454)	20p	FLJ201	(74190)	1·80
FLY101	(7466)	20p	FLJ211	(74191)	1·80
FLJ101	(7470)	45p	FLJ241	(74192)	1·74
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ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

IT IS a generally accepted axiom that good shortwave reception is 50 per cent dependent on the aerial, the other 50 per cent accounts for the receiver and skill of the operator etc. I know many people who have bought expensive receivers and been disappointed with the results simply because they did not have an effective aerial system.

The simplest form of aerial is the long wire, and the longer the wire is the better the reception will be. The strength of the signal is measured in microvolts per metre; the longer the aerial is, the stronger the signal will be because the voltage induced in the aerial will be higher. All receivers have a certain sensitivity which is a measure of the voltage required at the aerial input to give a useful audio output.

A long-wire aerial of 50 feet will usually give adequate reception whilst one of 100 feet is very good. Other factors affect the performance of such an aerial, consequently the higher above ground it is the better it will perform. Care should also be taken to keep the aerial as far away as possible from buildings, trees and any other obstructions which may reduce the signal induced. It is also essential to keep the aerial as remote as possible from any sources of man-made interference.

A better type of aerial is the dipole. This type of aerial is restricted in use because it can only be tuned to a single band. The advantage of a dipole, however, is that being tuned its performance on the band of interest is superior to that of a long-wire.

The dipole aerial consists of a single length of wire which is cut in half, the two halves are connected via a coaxial cable to the two terminals at the rear of the receiver. The overall lengths for the various Broadcast Bands are as follows:

Frequency Band	*Length of aerial*
25 MHz.	5·60 metres
21 MHz.	6·65 metres
17 MHz.	8·00 metres
15 MHz.	9·30 metres
11 MHz.	12·10 metres
9 MHz.	14·80 metres
7 MHz.	20·00 metres
6 MHz.	23·40 metres

For the benefit of those who have not been converted to the metric system one metre is approximately equal to 3·28 feet (e.g. 20·00 metres = 65·6 feet).

An interesting feature of the dipole is that it is a directional aerial. If the wire is aligned North-South the best reception will be from due East and due West.

It is possible to use a dipole on all bands but without the same sensitivity as the band to which it is tuned. For example a 7MHz. dipole will be a sensitive, directional aerial on the band of interest. but on all other bands it will perform as a non-directional, 66 foot long-wire.

Most listeners have one band in which they are particularly interested, the ideal solution in this case would be to erect a dipole for this band and a long-wire for general listening on the other bands.

The first report this month comes from **Michael Berry** in Dewsbury, Yorkshire. Michael is still using his Eddystone EB35 receiver but has replaced his vertical aerial with a 20 foot long-wire in the loft. The stations logged included:

3960 *Baghdad, Iraq* in Arabic at 2310.
4800 *R. Lara, Venezuela* in Spanish at 0240.
4820 *Voz Evangelica, Honduras,* English at 0340.
4880 *R. Universo, Venezuela,* Spanish at 0330.
4990 *R. Barquisimeto, Venezuela* at 0230.
4995 *R. Brazil Central* in Portuguese at 0110.
5075 *R. Sutatenza, Columbia* at 0100.

Richard Keen of Hayes in Middlesex has just erected a long-wire of 120 feet which enabled him to hear:

4790 *R. Ondas Portenas, Venezuela* at 2055.
9510 *R. Barquisimeto, Venezuela* at 2015.
9595 *R. Cultura de Bahia, Brazil* at 2025.
9965 *R. Lisbon, Portugal* in English at 2050.
11875 *R. Nacional de Nicaragua,* Spanish at 2010.
12550 *R. Nacional, Tanganyika* at 2100.

John Adams of Sheffield returns to the column after a long absence. John has an Eddystone EC10 receiver, a Codar PR30X preselector and a 72 foot long-wire. His log included:

9570 *Radio Australia* with music at 0710.
9625 *Kol Israel,* English news at 2035.
11620 *AIR, Delhi* with news in English at 2008.
11650 *R. Bangladesh* in English at 1715.
13220 *R. Euzkadi* in Basque at 2135.
15018 *Voice of Vietnam,* Hanoi at 2005.
21495 *R. Portugal* with DX News at 0800.

Nigel Knowlman of Cullompton in Devon has sent in another good log which includes:

9570 *Radio Australia* in English at 0830.
9912 *All India Radio* in English at 2000.
15105 *Radio Japan,* English news at 0945.
15165 *R. Denmark* in English and Danish at 1200.
17655 *Radio Cairo,* 'Arabic by Radio' at 1800.
21535 *RSA, South Africa,* English news at 1400.
21545 *Radio Ghana* in English at 1440.

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

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

FIRST letter out of the postbag this month comes from **GW3ZSV**. He tells enthusiastically of an 80 metre contest to be run by the Sully & District Short Wave Club on October 22. First section from 0900-1100 and the second from 1700 to 1900. Great news—the contest is open to both licenced Amateurs and s.w.ls so there's no excuse for not having a go. Rules are just about the simplest and easiest to follow that I've ever seen. Why not send GW3ZSV a s.a.e. and get all the gen? Address is 3 Thorley Close, Cyncoed, Cardiff, South Wales. For local s.w.ls with no club at present, the Sully gang meet every Tuesday at 1930 at the Sully Bowls Social Club. Sully is about 6 miles from Cardiff on the coast road to Barry. They cater specially for the s.w.l., too.

Elated squeaks from **Bill Waldron** (Cwmbran) whose 144MHz score since April 1 this year has now topped 40 counties and six countries. Bill mentions the infuriating situation during a recent 2 metre opening when London and Midland stations could be heard calling LA, SM, ON, OZ, etc., but only the faintest of whispers and bits of EU callsigns detectable down in Wales. He also remarks on hearing many QSO's of, say, Dudley talking to Wolverhampton and other local natters. He again asks why these locals don't turn their beams round towards GW. Almost every night, GW3ZTH, GW3LEW and GW3TMM are active on the s.s.b. channel. How about it you northern types—or are those beams rusted in position from the habit of local gossips?

On 80 metres, Bill complains of high static levels but still managed to log some s.s.b. from; EL0H/MM, FP0BG, OA4AS, PY2RT, PY3CGP, VE3GCS, VO1GQ/M, VP7ND, VP9BK, WA2FCA, W4NJF, W8BT, 5Z4MO, 8P6SJ (Scout Jamboree station).

Pretty stamp and long epistle from **Victor Springer** (St. Lucy, Barbados) relates hair-raising tales of s.s.b. received on a receiver using battery valves and a 90V h.t. line. Modifications include items like half of a 12AU7 as an outboard tuneable b.f.o. whose signal is injected by winding a few turns of wire around the first DF96. (Transistor types will doubtless find all this way above their heads!). (No, a 12AU7 hasn't got a collector). Heard on 14MHz with the aid of 150ft of aluminium wire in an unspecified shape; CE3AJE, DJ1HP, DJ2WF, DJ8EG, F3OX, G3KTJ, G3XJN, G4OO, G6GA, GB3MKT, HB9KM, HC2JX, HK5ACP, I5MLI, JA1BRK, JA4YAR, OA4AEH, PY1AGO, VXVK2SG, VK3JW, VK9JW, XE1LAG, YK1AA, ZD3A, ZK2DX, 4Z4JX, 5V2AT, 5V4GE, 5V8AR, 7X7Y.

Chance to get yourself a nice QSL from the land of GC. **Ken, GC3GPL** (ex G3GPL) is now active on c.w. between 14·000MHz and 14·050MHz most evenings between 1900 and 2230 plus Sunday mornings. He has put up a special antenna which, he hopes, will give reliable short skip signals into the UK. He will QSL any s.w.l. who sends him a useful report on his signals. Address for those useful (note that word, not just a "Heard you 579 pse QSL) reports is Haut du Pre, Fern Valley, St. Helier, Jersey, Channel Isles.

Patrick Funnell (Nottingham) has an 8-element Yagi on two metres. This feeds a dual-gate m.o.s.f.e.t. converter which in turn feeds a PW Clubman receiver used as a tuneable i.f. covering from 2-4MHz. He comments that the Clubman is a very good receiver and includes a 2 metre log which mentions stations like; OZ1EP OZ4HW, PA0KOK, PA0LSG (using n.b.f.m.), PA0PMQ, PA0TLX (n.b.f.m.) plus numerous G stations. It is interesting to note the number of stations using narrow band frequency modulation (n.b.f.m.).

Log from the quill of **Alan Smith** (Lancs.) using a JR310, 60ft. long wire plus a E-ZEE Match a.t.u. He complains of ". . . a combination of night starvation and v.f.o. tuners cramp". (Wait till you get knob nippers gout, that's when we really separate the men from the boys). Alan's log for 14MHz reads; CE3AQW, CE3OE, CO8GL, CP1JV, EA8EN, EP2TW, FC9VN, FM7WN, FY7AE, HC4BS, HK6CBS, HP1XIS, MP4TDM, OA4LV, OA4WJ, OD5AU, OX3HV, OX3JW, PJ2CC, PJ9AD, PZ5CW, TI2AS, VE1TB, VE7BNJ, VE8RCS, VK2QM, VK3DO, VK4CZ, VK5ID, VK6FD, VK7AK, VK0RC, VP2VAM, VP7MG, VS6DO, VU2ALU, VU2BX, XE1DO, XE1EH, XE3RE, ZL1VY, ZL2CB, ZL3JD, ZL4BC, ZM2ASJ, ZM4CR, 9K2AR, 8P6BC.

DX on ten metres is a GW, claims **Martin "Squiggle"** whose second name I can't decipher. (It's when your own g.d.o. is d.x. you start worrying!). Treasured possessions include a 640 receiver, a 20 metre dipole and a "flimsy bit of co-ax". Mr. Squiggle comments on the d.x. stations claimed by users of simple t.r.f. receivers, headphones made of draught excluders and coat-hanger aerials. He wonders if they use an SB303 receiver as a pre-amp and just forget to mention it. (Play fair lads, if you use a 30 transistor pre-amp, you gotta say).

A 9R59DE, 7MHz dipole and **B. Mainwaring** (Walsall) raised this lot on 21MHz; CE3OE, CP1HG, CR6CA, EA3VC, EA6BJ, EP2TC, JA1MTP, JA2MJ, JH1TMR, JH3ONP, OD5HF, OE6PN, PA0WF, PY1MT, SM4APD, 4Z4MO, 7X7Y. Interesting to note the European stations here (many haven't been included). Many s.w.ls commented on the short skip conditions which prevailed this past month. Effects like G stations on 20 metres being 5 and 9 were common. Wonder what things will be like next month, and how do you think the bands will fare this coming Winter? How about a line airing your views?

Logs, in alphabetical order please to arrive by the 15th of the month to 12 Cross Way, Harpenden, Herts.

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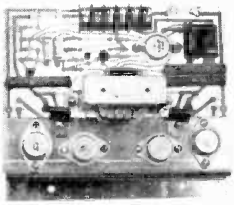

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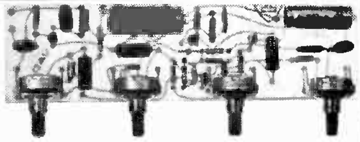

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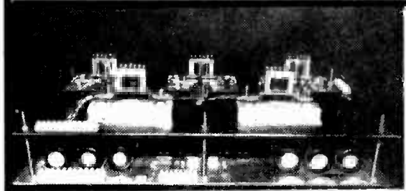

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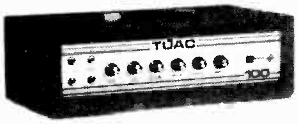

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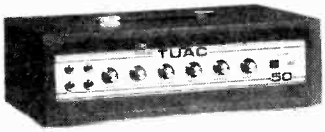

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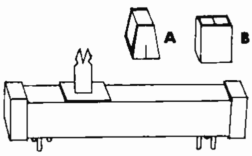

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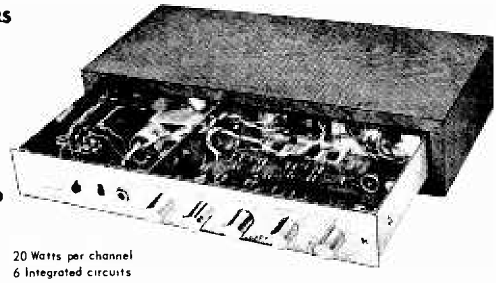

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6BE6	·21	35L6GT	·45	ECF82	·26	KT61	·55	PL83	·33	UL84	·30
6BJ6	·41	35W4	·25	ECH35	,55	KT66	·78	PL84	·30	UM84	·22
6BW7	·50	35Z4GT	·25	ECH42	·59	LN319	·63	PL500	·63	UY41	·39
6F14	·40	50CD6G	·68	ECH81	·29	LN329	·72	PL504	·63	UY85	·25
6F23	·68	807	·49	ECH83	·38	LN339	·63	PM84	·33	VP4B	·77
6F25	·53	AC/VP2	·77	ECH84	·35	N78	·87	PX25	·95	W77	·43
6J7G	·24	B349	·65	ECL80	·35	P61	·40	PY32	·52	Z77	·22
6K7G	·12	B729	·62	ECL82	·29	PABC80	·34	PY33	·52	**Transistors**	
6K8G	·17	CCH35	·67	ECL86	·35	PC86	·47	PY81	·25	AC107	·17
6Q7G	·35	CY31	·30	EF39	·38	PC88	·47	PY82	·25	AC127	·18
6SL7GT	·30	DAF91	·22	EF41	·57	PC96	·42	PY83	·26	AD140	·37
6SN7GT	·30	DAF96	·36	EF80	·23	PC97	·36	PY88	·33	AF115	·20
6V6G	·28	DF91	·16	EF85	·28	PC900	·29	PY800	·34	AF116	·20
6V6GT	·28	DF96	·36	EF86	·30	PCC84	·29	PY801	·34	AF117	·20
6X4	·23	DH77	·20	EF89	·26	PCC85	·23	R19	·30	AF125	·17
6X5GT	·28	DK32	·33	EF91	·13	PCC88	·38	R20	·70	AF127	·17
10P13	·53	DK91	·28	EF92	·27	PCC89	·43	U25	·73	OC26	·25
12AT7	·17	DK92	·50	EF98	·65	PCC189	·48	U26	·70	OC44	·12
12AU7	·20	DK96	·45	EF183	·28	PCC805	·70	U47	·73	OC45	·12
12AX7	·22	DL35	·40	EF184	·31	PCF80	·28	U49	·70	OC71	·12
19BG6G	·75	DL92	·26	EH90	·34	PCF82	·33	U52	·31	OC72	·12
20F2	·67	DL94	·47	EL33	·55	PCF86	·46	U78	·24	OC75	·12
20P3	·75	DL96	·38	EL34	·45	PCF800	·58	U191	·68	OC81	·12
25L6GT	·19	DY86	·24	EL41	·54	PCF801	·28	U193	·42	OC81D	·12
25U4GT	·57	DY87	·24	EL84	·23	PCF802	·40	U251	·64	OC82	·12
30C1	·28	DY802	·33	EL90	·26	PCF805	·58	U301	·38	OC82D	·12
				EL95	·33	PCF806	·56	U329	·66	OC170	·23

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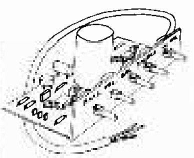

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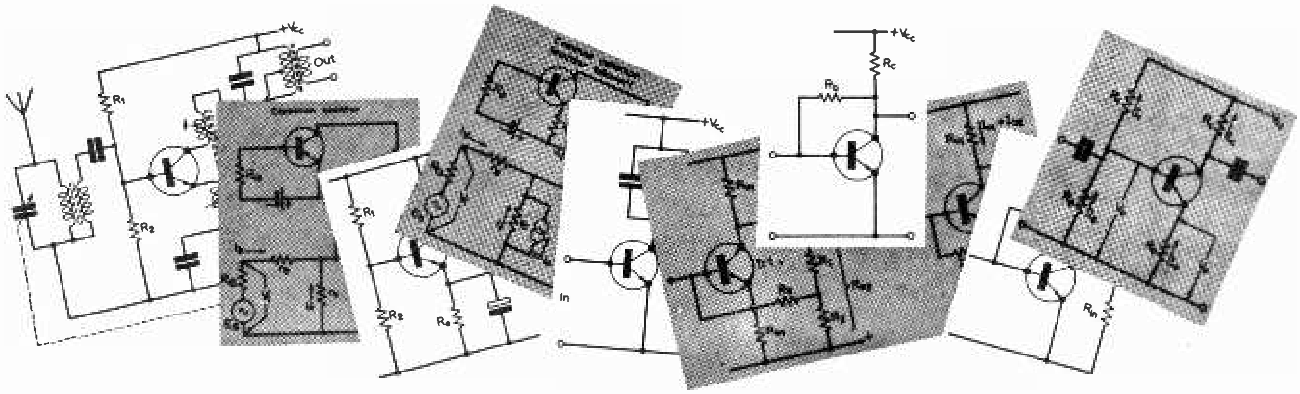

TRANSISTOR CIRCUITRY for beginners

H.W. HELLYER & MICHAEL HOLLIER

PART 12

Virtual Earth in practice

Theory is all very well; an interesting intellectual exercise. Sooner or later, we must put our theories to the test, our principles into practice, and it is then—as any constructor will tell you—that the moment of truth comes. When you switch on, hold your breath, tentatively measure, go back meticulously over every step you have made and find the snags. That feeling of utter elation when a self-designed, self-made circuit bursts into life has no parallel in the world of module-massing. Humble though our circuitry may be, we are tempted to say: 'A poor thing, but mine own . . .'

So this month, following a discussion of virtual earth principles that may have left some of you wondering what all the fuss is about, we put our theories into practice. Again, we shall proceed step by step, explaining *why* each component has to be its particular value, and what it does. Only this way is it possible to adapt ideas to your particular situation, i.e., to make your own design.

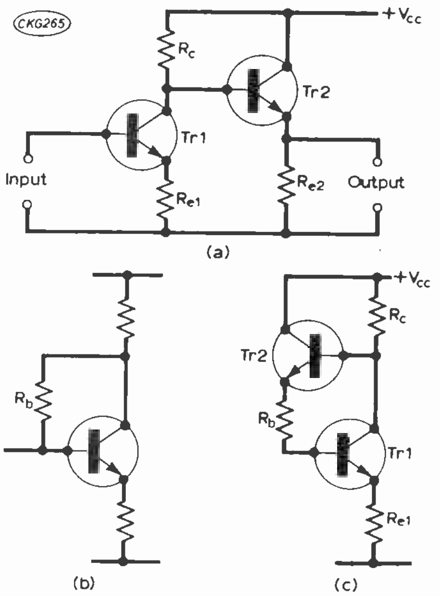

Fig. 61 (a): Redrawn circuit of Fig. 53 with some components omitted for simplicity. (b) base bias can be derived this way, included in (c) we have redrawn version of (a).

Part 10 in September *PW*, left us with a directly coupled pair of transistors, the first device acting as a collector-follower and with a potential divider for the derivation of its base bias. The second transistor operated in the common collector mode—that is, it was an emitter follower—and its base bias was derived from the collector of the first transistor, to which it is, (see Fig. 53, page 429, September *PW*) directly connected.

In the subsequent issue, under the guise of giving us all a breather, we talked about virtual earth circuitry, but you will have noted, in Fig. 60, that we again used a pair of transistors, intimately connected, directly coupled, so that their combined operation can be regarded, with some provisos, as that of a single unit.

Now let's take a look at a redrawn circuit of our earlier arrangement. Fig. 61 (a) is the redrawn circuit of our previous direct-coupled pair, this time with some components removed for simplicity. These are the base bias resistors, the input and the output coupling capacitors.

We still need base bias current, and this time we get it from the emitter of the second transistor. The important component is R_b. Take a look at another way of presenting such a circuit, Fig. 61 (b), which is really a redrawn Fig. 51 (*PW* Aug. 1972): now compare this with (c), which is, of course, a redrawn version of (a). The essential modification is that the base-emitter junction of the second transistor is included now in series with R_b. The similarity of the circuits is significant: similar spreads can be expected.

Gain

With this circuit, just as with the circuit of Part 10, gain is determined by the ratio of collector and emitter resistors of Tr1, which is to say, Rc1/Re1.

But this gain is before any feedback is applied. It is called the OPEN LOOP GAIN, and is denoted by the term G_o. As we shall see later, though it can be calculated fairly enough, it is not quite so easy to verify by practical measurement.

When we put a bit of negative feedback in circuit, conditions alter. We are now taking a portion of the output and applying it to the input of our amplifier in such a way as to reduce the gain in proportion to the growth of the signal. If we apply the same feedback another way, of course, we can cause the amplifier to increase its gain in accordance with the signal, and thus go haywire. We are concerned here with *negative feedback*, reducing the gain selectively. So we get CLOSED LOOP GAIN.

The determination now is from the value of that feedback and the source input. In plain symbols the ratio of feedback resistor to source resistance, or

$$\frac{R_b}{R_1 + \text{source resistance}}$$

That magical term (if you read the right brochures!) the 'Virtual Earth' occupied us last month and we shall now return to it, as in Fig. 62.

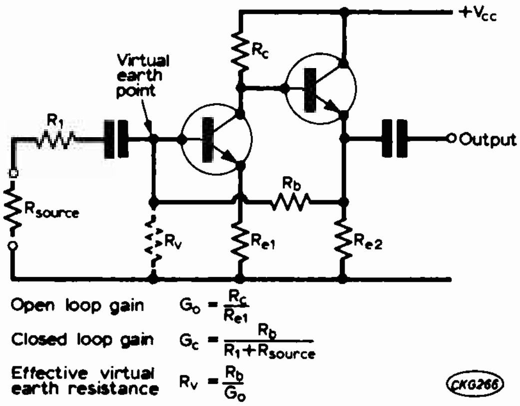

Fig. 62: Virtual earth amplifier with feedback emitter Tr2 to base of Tr1.

Here, the virtual earth point is indicated and we must remember that the *effective* resistance at this point is determined by the ratio of that feedback resistor R_b and the open loop gain of the stage. This is R_b/G_o. Take a close look at this circuit, study it so that it can be recognised immediately, for this virtual earth circuitry will not show R_v, even dotted, as we have, and it is very easy to miss the implication. So let's now start to calculate the component values, for a practical circuit that can be part of a mixer, a microphone pre-amplifier, a variable gain pre-amplifier for an oscilloscope, and several other things.

Calculations

In Fig. 63(a) we have the same circuit, again shorn of unnecessary frills, and now we have a 'rail voltage', or h.t. positive, of Vcc, whichever term your age group has committed you to using, of 20 volts. The point is that we want a reasonable voltage 'swing' and if a collector is going to go up and down like a yo-yo, there will be a need for a high enough Vcc to accommodate this change in collector voltage. Thus far, we have been managing with 9-volt batteries, convenient, easily obtainable, a constructor's aid. Now we must face the need for adding several in series or building a power supply operated from the a.c. mains. We shall look at the latter in a moment. For now, remember that the Vcc is 20 volts and for an emitter current of 2mA in the Tr2 circuitry, and a voltage at the emitter of about half the supply, we get Re2=10/0·002=5,000 ohms.

Remembering that the base-emitter voltage will normally be 0·6V for the BC109, we say the base voltage will be 10·6V, and this is also the voltage at the Tr1 collector. We have already noted that for good stability it is desirable that the voltage drop across Rb is small. Under these proposed conditions, Tr1 would be operating with a collector to emitter voltage of a mere 600mV.

Now it is perfectly possible to use a transistor under these conditions, but the signal swing will be somewhat limited, so we look for an alternative way of doing things. One method is to split the feedback point, as in Fig. 63(b). Re1 is maintained at the same ohmic value, but the feedback is tapped off

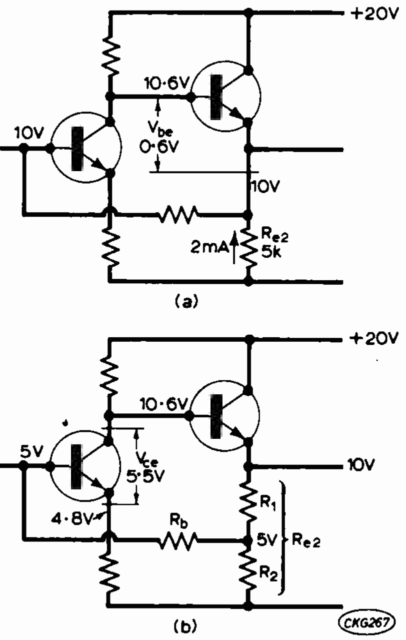

Fig. 63 (a): V.E. circuit redrawn. (b) tapping off of feedback point.

from the junction of the divided Re2, so that 5 volts is available at the base of Tr1 as bias. The voltages at Tr2 base and collector have not altered, so we have the condition now where Tr1 operates at a collector-to-emitter voltage of something like 5·5 volts.

Again allowing a 0·6 volts difference between base and emitter, we can now calculate Tr1 emitter resistor. The current flowing through Re1 can be large, using a small value of resistor, but this will not help us guard against noise. On the other hand, if we aim at a very low current, and hence a large resistor, our open-loop gain goes for a chop! Take an example: if the emitter current of the first transistor were to be 100 microamps, then Re1 would be 48kΩ and Rc1 would have to be something like 94kΩ. From our earlier formula, $G_o = \frac{R_c}{R_e} = \frac{94k\Omega}{48k\Omega}$, i.e., an open loop gain of something like two!

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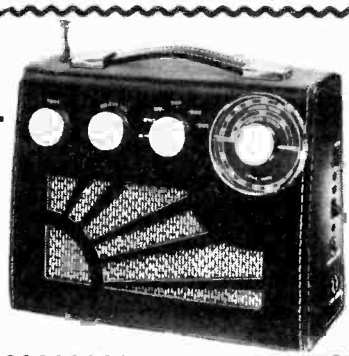

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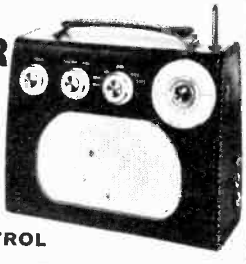

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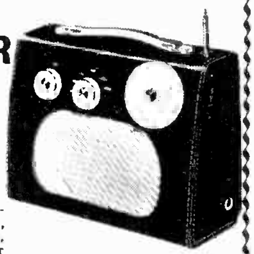

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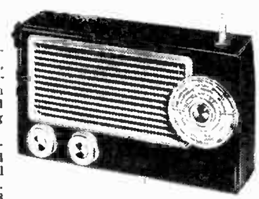

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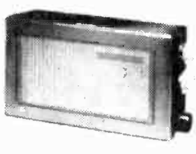

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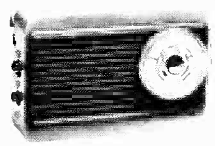

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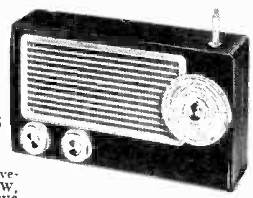

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We can, true, bypass the first emitter resistor with a whacking great capacitor, but let's not complicate matters at this stage. I hope the point is gradually being made that in this type of deceptively simple transistor circuit design one has to consider both a.c. and d.c. conditions; one can affect the other. What may be fine from the bias point of view may not be the best for signal conditions. We must press on . . .

In practice

The practical answer to the problem is to use the potential divider again, but this time as shown in Fig. 64. This circuit is more like the real thing, as our airy-fairy calculated values of components now give way to preferred values, such as 4·7kΩ for Re2.

Calculating the rest of the values requires recourse to the graphs for the particular transistor. If you have been following this series—and our mailbag shows, bless you, that quite a few have—you will be able to turn up the June issue and refer to Fig. 42, which was the h_{FE} against I_c curve for a BC109. We ignore the illustrative co-ordinates this time, and find that for an I_c of 2mA, the h_{FE} is 440, so our base current of Tr2 is $\frac{2\text{mA}}{440}$ or around 4·5 microamps.

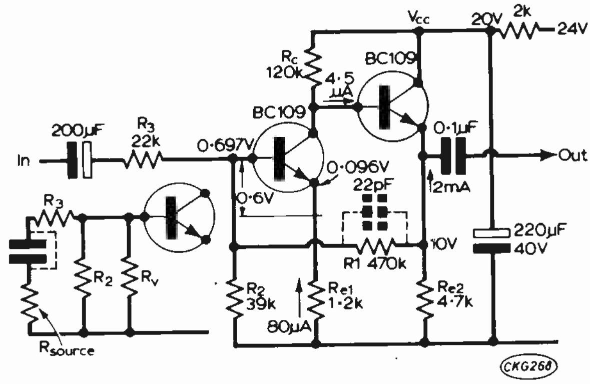


Fig. 64: Working circuit with component values.

As this current is flowing through the collector load of the first transistor, and is very small in comparison with the collector current of Tr1, we can safely disregard it in our next calculation. The emitter voltage of Tr2, we have said, is 10V, and the base will be 0·6V greater, so this 10·6 volts will be the collector voltage of Tr1. Therefore, the voltage across Rc1 will be the difference between the supply of 20 volts and this 10·6V, i.e., 9·4V.

From what we have already said about the choice between noise figures and signal swing at Tr1, we realise that there are limitations, upper and lower, for the emitter current, and for the balance between the feedback resistor and R2, now part of the bias circuit. Practically, our limits are from a minimum of 3 microamps and an upper of 200 microamps, which gives us R1+R2 of between 47kΩ and 3·4MΩ.

Plenty of choice? Maybe, but for a compromise value of emitter current that gives us preferred values of resistors and practical conditions, we have plumped for a figure of 80 microamps, as shown in Fig. 64. So R_c becomes $\frac{9 \cdot 4}{80 \times 10^{-6}}$ or approx. 120kΩ.

An open loop gain G_o of 100 is a healthy figure and as this is $\frac{R_c}{R_e}$ so R_e becomes $\frac{120\text{k}\Omega}{100}$ or 1·2kΩ.

If we again ignore the very small base current of the transistor, we can take it that the emitter current of Tr1 will be very near 80 microamps, and the voltage drop across Re1 will be 0·096V, which gives us a base voltage of nearly 0·7V. Referring again to the graph, we find for an Ic of 80 microamps we get an h_{FE} of around 280. So the base current will be $\frac{I_c 1}{h_{FE} 1} = \frac{80 \text{ microamps}}{280}$ or 0·2857 microamps.

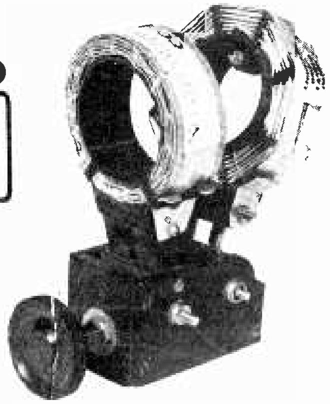
If the base current is to be provided by the potential divider R1 and R2, provided the current through these resistors is much greater than this, then Ib1 can be left out of subsequent calculations. But too *low* a combination of these resistors will affect the bias conditions of Tr2 (since we shall be shunting Re2 with the R1+R2 network). If we aim at a sum of the two at least 10 times that of Re2, we shall be safe. This summed resistance would be 47kΩ, and the current through them would be 200 microamps approximately—nearly a thousand times Ib1.

As to those limits: the minimum current we can allow through R1+R2 will be ten times Ib1, around 3 microamps, and the sum resistance would be 3·4MΩ. We have a very wide choice of values, but experience tells us that we cannot dip indiscriminately into the spares box.

TO BE CONTINUED

GOING BACK...

1970 60 50 40 30 20



COLIN RICHES
ARTHUR DOW

FIRST, we would like to apologise if anyone has written to us and not received a reply but from correspondence we are now receiving, it appears as though a few letters have gone astray. If, therefore, you have not heard from us and would like to repeat your letters, we will be pleased to reply as soon as possible.

We have received quite a large number of "points from the post" that we feel merit publishing almost as they have been written, so, without any more ado, let's begin . . .

R. L. Graper, 16 St. John's Avenue, Chelmsford, Essex tells us . . .

"In June 1922 I bought the first issue of Popular Wireless . . . No. 1, Vol. 1, and later, also the first issue of Television, No. 1, Vol. 1 in March 1928. I kept them and still have them (a little soiled) in the hope that they might later become valuable as "collectors items". As the address of Popular Wireless is the same as that of your present premises, I am wondering whether you took over the above journal.

There is much of interest in this first issue, and I quote you a few items as follows.

"Have you a wireless? First take out a licence. In a week or so this may be obtained direct from any post office. At present you must apply to the Secretary of the G.P.O. Cost of licence . . . 10/-.

Article. "Mr. Selfridge expresses his views. The business man and radio, by G. Selfridge."

I do not think the radiophone will ever supercede the telephone. Many wild predictions have been made on this point, and it has even been said that before long the man in the street will have his pocket transmitter with which to call up his friends or business colleagues. That prediction is very far fetched indeed. The pocket radiophone will never replace the telephone, because it will always be limited by the number of messages that can travel through the ether at the same time. At the moment, American amateurs are realising the bad effects of unlimited radio transmission . . . The ether is crammed with their messages, which consequently get so mixed up that it is impossible to hear a coherent sentence when listening in".

Short NEWS FLASH . . . Mr. Marconi's voyage . . . Mr. Marconi proposes to carry out experiments on the Atlantic with direction finders on the Short-wave, and the Long-wave transmission. Besides his other experiments, Mr. Marconi will carry out tests for the Meteorological Office. The "Electra", Mr. Marconi's steam yacht of 700 tons, is the finest equipped floating wireless laboratory in the world."

Interesting prices . . . Instrument wires. Aerial Wire 7/23, which was of course seven strands of 23 swg. copper wire. Price: 6/6 per 100 feet. Double silk covered wire 12 swg: 4/- per lb, Single valve Detector panel: 32/-, single valve h.f. panel: 35/-. These two panels together gave, it was claimed by the advertiser, a complete two valve receiving set. This was capable of receiving all music, speech etc. from *all* British stations.

In my copy of Television No. 1, March 1928, there are many interesting items, such as the early experiments by Baird, with a short paragraph giving details of his first demonstration before the Royal Institution.

There are pages of advertisements for (guess what) Radio sets and parts for the radio constructor. As no Television receiver is shown or advertised, I presume this came a few months later. The first experimental transmissions on the 30 line system could be received on home made apparatus, and there are articles (most detailed) on Disc Receivers, Light sensitive cells, a cartoon drawn specially by Heath Robinson, and several articles on the future miracles of this new science . . . which indeed have in some cases become fact today.

In this year there were quite a number of Valve Portables, then priced in the £30 region, but one would rather call them "transportables" I think.

Vintage Equipment

Mr. G. H. Wallace was recently presented with a pair of old headphones and he would like to know what impedance they are and what vintage they are likely to be.

continued on page 641

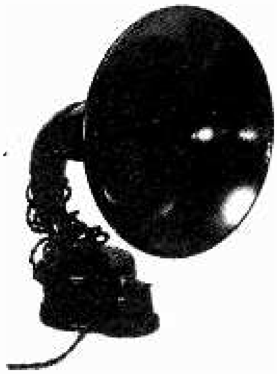
GOING BACK —*continued from page 638*

They are about $2^1{}_8$in. diameter and constructed from aluminium. We have persuaded the great "PAX" of "Practically Wireless" fame to switch off his vintage Hawaiian 78's for a moment and do a sketch to show how Mr. Wallace's headphones look.

If you have any information on these, please send it to Mr. Wallace at 3 Woodside Avenue, Kilmarnock, Ayrshire, Scotland.

Miss C. Crabb writing from Bournemouth, Hampshire, tells us that she recently unearthed the receiver and speaker shown in the photographs.

The receiver was licensed under the Marconi patent and has reactance tuning. The grid bias battery is fitted inside the cabinet.



Miss C. Crabb's horn loudspeaker

Miss Crabb asks if this equipment is of any value as a curio or as a collectors' item.

In answer, we can only stress once more that equipment of this vintage (and indeed any equipment pre-1930) is certainly worth hanging on to. Collectors would put a value on it and even the person wanting such an item as just a "curio to put on the shelving in the lounge" would possibly be prepared to offer a reasonable sum.

The receiver

If any other readers have any information on this receiver and would care to write to us, we will be pleased to pass on the information to Miss Crabb.

Vintage Record Bazaar

We would like to thank readers who have written in letting us know of their old gramophone records and equipment. We hope to run an article in a future issue on early gramophones, and will find the information you have provided will help us greatly in our project.

Readers may also be interested to know that the 5th annual Vintage Record Bazaar will be held on Saturday, Oct. 14th, at St. Silas Hall, 74 Penton Street, Islington, London, N.1.

The first two of these record sales, five years ago were held in conjunction with vintage car rallies, there being 15 record stalls.

This year, there will be 50 stalls with over 30,000 vintage records on sale. Vintage post cards will also be in evidence if you are interested in collecting them. In addition, there is a strong possibility that there will be some vintage radio equipment there!

The Bazaar is open from 10 a.m. to 5 p.m. and admission is 25p.

If anyone would like any further information on the Vintage Record Bazaar, phone John Carter (Shurlock Row) 539, or if you are phoning from London, 0735-81-539.

ELECTRONOTES—*continued from page 625*

the physical properties of the medium at various depths.

These points are important since the acoustic signal pulsed out by the transmitter in an "active" system could be diffracted in a curved path and thus there would be certain completely blind areas.

The thermal profile of the water at various depths can be quite a complex thing. This profile will alter daily being dependant upon the day to day variation of the solar activity of the sun. Again, winds and rain cause a mixing action which is yet another variable.

We have barely scratched the surface of this fascinating subject. However, it appears that we have a long time to wait before some boffin comes up with a useful sonar device for the accurate location of the soap in murky bath water. Or does some reader just happen to have a practical circuit handy?

I.C. Stabilised Power Supplies—*continued from page 625*

NOTES

Although component layout is unimportant two details *must* be observed. The voltage across C1 must be less than 36V before the i.c. is inserted into the circuit. If the voltage across C1 exceeds 36V this voltage can be reduced by altering the tapping of the transformer. Secondly it should be noted that the output power transistor will, under current limiting conditions, have to dissipate about 40W. An adequate heat sink for this component must be provided, the chassis of the supply being used for this purpose. The transistor is however electrically isolated from the chassis by using a greased mica washer and bushes. Although no other difficulties should arise it is recommended that the semiconductors, and especially the i.c. should be guaranteed to be to the full specification. Providing all these precautions are taken the supply should prove to be completely reliable. ■

★ components list

R1 2kΩ ½W 5% R2 560Ω ½W 5%
R3 0·5Ω 3W wirewound R4 1·5kΩ ½W 5%
VR1 10kΩ skeleton preset potentiometer
C1, C2 2500μF 40VW minimum. C3 0·01μF

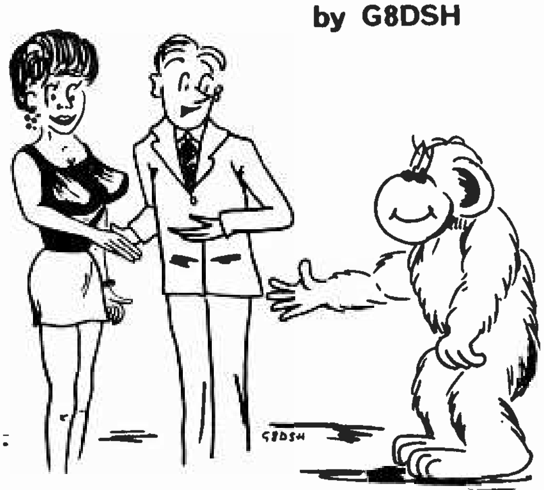
Tr1 2N3055 Tr2 2N3704 Tr3 2N3704
D1–4 3A silicon rectifiers or bridge
D5 BZY88C9V1 (9·1V 400mW)
D6 BZY88C6V2 (6·2V 400mW)
IC1 μA741C T1 230V/24V 1·5–2A

Red and black insulated terminals. Neon lamp and holder 230V. Fuses 2·5A and 1A with holders. Meter 50VDC. Mains input plug and socket. On-off switch. Case and chassis. Veroboard 4½ x 4in.

The components list above applies only to the variable voltage supply. The veroboard used in the prototype has pins fitted which plug into a chassis mounted socket.

MAXWELL

by G8DSH



" I should like to introduce you to the wife of our Stereo expert! "

CQ! CQ! CQ! CQ! CQ!

BOOKS WANTED

..buy or borrow any books on crystal radios, and extremely simple transistor amplifiers or radios; also any useful circuits.—B. Ewing, 25 Water Lane, Seven Kings, Ilford, Essex.

ISSUES FOR DISPOSAL

..most copies of P.W. 1960-1970 inclusive for sale.—E. Dale, 2 Fordham Square, Sunderland SR4-OBB.

..The following volumes of P.W. Vol 42 (May 1966—April 1967), vol 43 (May 1967—April 1968), Vol 44 (April 1968—May 1969), Vol 45 (May 1969—April 1970) at 75p per vol postage included.—C. Butler,81 Rutland Avenue, Southend-on-Sea, Essex.

..Practical Wireless 1948-1965 and Practical Television 1950-1964. Offers to J Skelly, 8 Sylvia Avenue, Hutton, Brentwood, Essex.

..full issues for 1967—1968—1969—1970 and 1971 in mint condition, for which I will accept the best offers, plus postage.—L. J. Bellingham, Woodside, Red Lane, Limpfield, Surrey.

..P.W. 1962-1964 (inc) Feb 1962, May 1963, Sept. 1964 missing. P.E. Nov 1964-Apr. 1966 with Vol. 1 binder. Offers to C.J. Barrett, 13B Millers Road, Brighton, BN1 5NP.

..issues of P. W. June 1969—March 1972 all in good condition. Offers please to.—M. Wolock, October Cottage, Station Road, Eynsford, Kent.

..P.E. from Oct 1969—Dec. 1971, sell at cover price & P & P, any reasonable offers accepted.—S. Smith, Ardvaros, Main Street, Polmont, Falkirk.

..many P.W. and P.E. from 1964 on.—A.G. Hodgett, 3 Ely Way, Fellgate, Co Durham.

..approx 85 P.W. 1962—1969 also most blueprints. Few P.W., 1949—1950, 1958, 1960, 1961. 17 in all. approx 100 PT 1952—1963. Most Short Wave Mag', 1963—1967 Offers.—M. Blackburn. 107 St. Paul's Road, Jarrow, Co. Durham.

..P.W. Feb. 1970—May 1972, also Jul. 1969—Jan. 1970.—P. Dunn, 3 Tassie Place, East Kilbride, G74 3EB.

..various dates: P.Ts. 1959—1965, P.Ws. 1968—1971 P.Es 1965—1968. P.W. 21st ANN; Oct. 1953, (1) "Wireless Constructor" 1931.—S.W. Owen Bryngwynedd, Rhiw, Blaenau, Ffestiniog, Merionethshire.

..complete Vol. P.W.—1969 1970 & 1971 complete Vol. R. Communication 1969 & 1970. Also P.W. April—Dec. 1968.—V. Simpson, 107 Derryhale Road, Portadown, Co. Armagh, NI.

..I have the following issues for disposal Feb, Apr—Jun, Aug, Oct, Nov. 1967, Mar—Jun, Aug, Sep, Nov, Dec. 1968, Jan., Feb., May 1969, Feb.—May, Oct. 1970 Aug. 1971 and 2 each Jul. 1967, 1968 of P.W. Jun. 1966, Jun. 1967, Dec., 1967, Jan., Apr.—Aug., Nov., Dec. 1968, Mar. 1969, Feb., Mar., Nov. 1970, Feb. Mar., Aug. 1971 2 each Jul., Aug. 1967 and Mar. 1968 of P.E. 1 issue of Television Aug. 1971, Jul., Sep. 1970, Mar.—Nov. 1971 of Radio Constructor.—R. H. K. Grayson, 34 Victoria Road, Haywards Heath, Sussex, RH16 3LY.

..Most of P.W. from 1960. Radio Communication from 1968. Wireless World—1959/1960/1961. S.A.E. list.—R. Forsberg, 123 Harestone Hill, Caterham, Surrey, CR3 6DL.

..P.W. 1958 onwards. Rc 1951—1957 Bound, also RC 1958—Sept. 1965, and Dec 1968 Aug. 1970.—G. F. Allan, 21 Borrowdale Close, Redbridge, Ilford.

..the following issues of the Practical Wireless. Volume 43. Dec. 1967 missing. Volume 44 complete. Volume 45 April 1970 missing. and October 1970 to March 1971 inclusive. All for disposal.—R. Grant, 27 Campbell Crescent, Laurieston, Falkirk, Stirlingshire.

..most issues of P.W., P.T., P.E., and short wave mags available at cover price, please include S.A.E. also PCB's (miniature) 10p and most radio/TV spares. S.A.E. for list.—J. K. Nicholson, 38 Graham Road, Bicester, Oxon.

..I have for disposal many issues of P.W. and short Wave Mag. from 1966 to 1970 all in as new condition. S.A.E. for details. —G. W. Norris, 69 Hillside, Stowmarket. Suffolk..

..I have for disposal the following issues of PW. Mar. Aug. 1967, Apr., Jul., Aug., Oct., Dec., 1968 Jan., Feb., Apr., May, 1969, Oct., Dec. 1970.—H. Ferns, 11 King Street, Coatbridge, Lanarkshire, Scotland.

CORRESPONDENTS WANTED

..wanted to correspond; Someone of my own age (17). Interested in Electronics and Modern Music.—P. Richards, 7 Holwood Drive, Whalley Range, Manchester M16 8WS.

..girl or boy of my own age (14) to correspond or tapespond with. I have a Prinzsound TR-5 1 7/8 cassette recorder and a Ferguson 3¾ and 1⅞ spool recorder with 4 tracks. I am interested in electronics and SWLing.—K. Goldsworthy, 165 Ellerdine Road, Hounslow, TN3 2PV.

..boy or girl of my own age (16). Anyone who is interested in TX circuits and short wave listening.—P. Jenkins, 30 Gainsborough Road, North Finchley, London, N.12 8AG.

..anyone who is interested in offshore radio and radio equipment to correspond. Aged 18-24.—P. Leach, The Post Office, Snodland, Kent.

..Either sex of my own age (24). I have a four track Izlow AKAL stereo tape recorder and interested in modern music, radio electronic, and pen friendship.—M. Ekramul Haque, BBC eastern relay station, BFPO 65, Via London.

..boy or girl of my own age (13) interested in Radio and Electronics.—D. Thorpe, 161 Tomswood Hill, Hainault, Ilford, Essex.

..girl or boy (16-19) living abroad; to write or tapespond (Philips Cassette). I am a boy (18) with Interests; short-wave listening, cars, all music. I am studying electrical engineering. Speaks English, also French and German (badly!).—J. V. Moss, 4 Gilbert Close, Rayleigh, Essex, England.

..anyone of about my age, 17, interested in amateur radio and S.W.L.,—P. Jenkins, 30 Gainsborough Road, North Finchley, London, N.12 8AG.

..I would be delighted to correspond with any radio constructor from England, of my own age (25).—K. H. E. Perera, 352 Kerawalapitiya, Hendala, Wattala, Ceylon,

..girl of my own age (almost 13) interested in Electronics and pop music.—L. Cox, Ford Bank Cottage, Victoria Avenue, Didsbury, M20 8RA.

..I would like to correspond with radio constructors from England, of my own age (18) S.A.M.P. Ratnayaka, no 330 Rajamaha Vihara Road, Mirihana, Pita-Kotte, Ceylon.

..anyone in Australia preferably in the Electronic trade. With a view to settling in Australia. Age 24.—M. Yambo, 13 Chamberlain Gardens, Arborfield, Reading, Berks.

..Anyone interested in sending me Radio parts against anything of equal value from India.—S. Khaitan, 25/1 Rowland Road, Calcutta 20, W. Bengal, India.

TAPESPONDENTS WANTED

..boy aged 20 request for pals of both sexes. Interest: Electronics, Music.—D. Peters. Liverpool Street, P.O. Box 6, Eket, S. East State of Nigeria.

..boy or girl 15-18. Cassette or open reel catered for. My interests include music, tape recording (!) and electronics. Please write stating interests, recording equipment etc.—M. Tillman, 86 Chestnut Drive, Pinner, Middlesex. HA5 ILZ.

EQUIPMENT FOR DISPOSAL

..a lot of miscellaneous components for sale; valves, resistors, capacitors, pots. etc. Any offers? Please enquire!—J. P. Fletcher, Rendcomb College, Cirencester, Glos, GL7 7E2.

..Magnavox 363 tape deck + plinth with record and erase heads. Unused £15.—P. Dunn, 3 Tassie Place, East Kilbride, HTL 3EB.

..Ferrograph/3CFN/X tape recorder for sale, good running order. Any offers.—S. G. Parsons, 7 Randolph Terrace, Stirling, FK7 7AB.

..FOR SALE; Five old valves (from Portadyne 230 radiogram) all in good condition, probably working. All marked very clearly. 5, 6, 7, & 8 pin bases. Any offers.—M. Baldwin, 8 Oakcroft Road, London, SE13 7ED.

..Offers asked for pair air, sea rescue sets & circuits, still in tack.—C. G. Farrimond, 65 Broomfield Avenue, Hasland, Chesterfield, S41 OLY.

APPARATUS REQUIRED

..Baird 620/640 D complete or time base panel, any condition.—W. Woodham, 13 Wallasey Crescent, Ickenham, Uxbridge, Middlesex.

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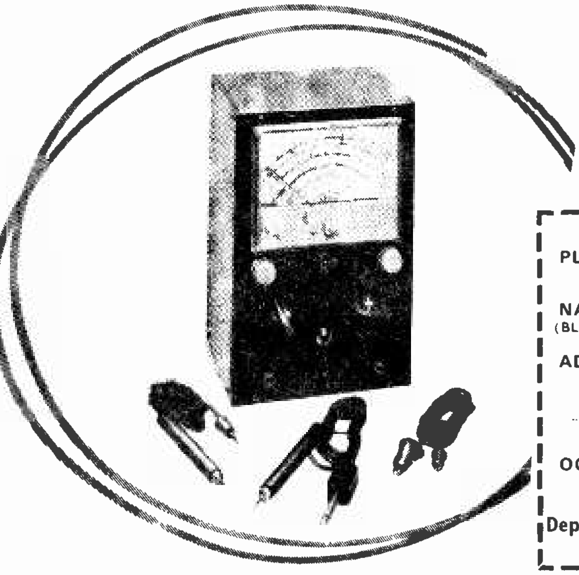

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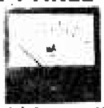
100 x 80 mm.

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

BAKELITE PANEL METERS

TYPE S-80
80 mm.
square fronts



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

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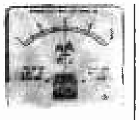


		50mA	£3·10
		100mA	£3·10
		500mA	£3·10
		1 amp.	£3·10
		5 amp.	£3·10
		15 amp.	£3·10
		30 amp.	£3·20
		20V. D.C.	£3·10
		50V. D.C.	£3·10
50μA	£3·95	150V. D.C.	£3·10
50-0-50μA	£3·40	300V. D.C.	£3·10
100μA	£3·40	15V. A.C.	£3·10
100-0-100μA	£3·30	300V. A.C.	£3·10
200μA	£3·30	8 Meter 1mA	£3·15
500μA	£3·20	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

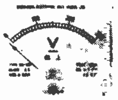
Type MR.52P. 2½in. square fronts.

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	8 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. 3½in. × 3¼in. 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	8 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

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



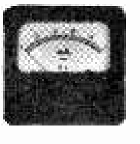
		200mA	£1·75
		300mA	£1·75
		500mA	£1·75
		750mA	£1·75
		1 amp.	£1·75
		2 amp.	£1·75
		5 amp.	£1·75
		10 amp.	£1·75
		3V. D.C.	£1·75
50μA	£2·30	10V. D.C.	£1·75
50-0-50μA	£2·10	15V. D.C.	£1·75
100μA	£2·10	20V. D.C.	£1·75
100-0-100μA	£1·95	50V. D.C.	£1·75
200μA	£1·95	100V. D.C.	£1·75
500μA	£1·80	150V. D.C.	£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	8 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	8 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

"SEW" BAKELITE PANEL METER

Type MR.65. 3½in. square fronts.



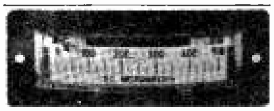
		1 amp.	£2·15
		5 amp.	£2·15
		15 amp.	£2·15
		30 amp.	£2·15
		50 amp.	£2·15
		5V. D.C.	£2·15
		10V. D.C.	£2·15
		20V. D.C.	£2·15
		50V. D.C.	£2·15
		150V. D.C.	£2·15
		300V. D.C.	£2·15
25μA	£3·85	30V. A.C.*	£2·20
50μA	£3·00	50V. A.C.*	£2·20
50-0-50μA	£2·60	150V. A.C.*	£2·20
100μA	£2·60	300V. A.C.*	£2·20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

*MOVING—IRON
ALL OTHERS MOVING COIL
Please add postage

SEW EDUCATIONAL METERS

Type ED.107. Size overall 100mm × 90mm × 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50μA	£5·50	20V d.c.	£4·85
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
5A d.c.	£4 85	5V/50V d.c.	£5·10
10V. d.c.	£4·85		



EDGWISE METERS

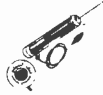
Type PE.70. 3 17/32in. × 1 15/32in. × 2¾in. deep

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		

Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

MULTIMETERS for EVERY purpose!

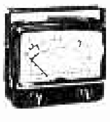
ROUND SCALE TYPE PENCIL TESTER MODEL TS.68



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

SKYWOOD SW-500

50K Ω/Volt. Mirror scale DC Volts 0·6/3/12/30/300/600. DC current 20uA/6/600mA Resistance 10K/100K/1 Meg/10 Meg. Decibels −20 to +57 db. £7·50. P. & P. 15p.



TMK LAB TESTER. 100,000 O.P.V. 6½in-Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: ·5. 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size: 7½in. × 6¾in. × 3¼in. £18·90. P. & P. 25p

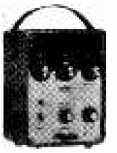
TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. £17·50. Carr. 37½p.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V A.C. Brand new with instruction. £15 P. & P. 37½p.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



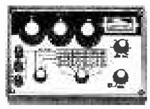
New high quality portable instrument. Sine 1 Hz to 100 kHz. Square 20 Hz to 20 kHz. Output max +10 dB (10 K ohms). Operation 220/240v. A.C. Size 215mm × 150mm × 120mm.
Price £27·50. Carr. 25p

240° Wide Angle 1mA Meters

MW1-6 60mm square	£3·97½
MW1-8 80mm square	£4·97½

P. & P. extra

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



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω–11·1 meg Ω 6 Ranges ±1% L.1 μ H · 111 HENRYS 6 Ranges 2=%C.10pF ±1110mFd 6 Ranges ± 2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. £20. P. & P. 25p

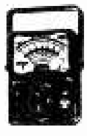
230V/240V SMITHS SYNCHRONOUS GEARED MOTORS

Built in gearbox. All brand new and boxed. 60 RPM CW; 30 RPH CW; 2R/HR ACW; 2R/HR CW; 8R/DAY CW; 10 RPM CW; 20R/HR ACW.
50p each Post 12p.

HIOKI MODEL 720X

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

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



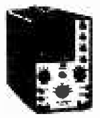
MODEL 500 30,000 O.P.V with overload protection mirror scale 0/·5/2·5/10/25 100/250/500/1,000v. D.C 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω. £8·87½. Post paid.

MODEL 5025 57 Ranges, Giant 5½in. Meter, Polarity Reverse Switch.
Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50IA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. £12·50. P. & P. 17½p.

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 100 wA/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.

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 1.5 cps –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 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £40·00. Carr. 50p

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: 5¾in. × 2 13/16in. × 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. £35·50. Carr. 50p.

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2G308	30p
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2G371	15p
2G374	20p
2G381	22p
2N388A	49p
2N404	20p
2N696	15p
2N697	15p
2N698	25p
2N699	30p
2N706	10p
2N706A	12p
2N708	15p
2N709	62p
2N718	25p
2N718A	30p
2N726	30p
2N727	30p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	20p
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2N1638	27p
2N1639	27p
2N1701	162p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
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2N2194A	30p
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GET118	20p
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GET880	30p
GET887	20p
GET889	22p
GET890	22p
GET896	22p
GET897	22p
GET898	22p
MAT100	25p
MAT101	25p
MAT120	25p
MAT121	25p
MJ400	107p
MJ420	80p
MJ421	80p
MJ430	102p
MJ440	95p
MJ480	97p
MJ481	125p
MJ490	100p
MJ491	137p
MJE340	50p
MJE370	80p
MJE371	80p
MJE520	60p
MJE521	70p
MPF102	42p
MPF103	35p
MPF104	37p
MPF105	37p
MPS3638	32p
NKT124	42p
NKT125	27p
NKT126	27p
NKT128	27p
NKT135	27p
NKT137	32p
NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
NKT214	20p
NKT215	22p
NKT216	35p
NKT217	40p

NKT219	30p
NKT223	27p
NKT224	22p
NKT225	22p
NKT229	30p
NKT237	35p
NKT238	25p
NKT240	27p
NKT241	27p
NKT242	20p
NKT243	62p
NKT244	17p
NKT245	20p
NKT261	20p
NKT262	30p
NKT264	20p
NKT271	20p
NKT262	20p
NKT274	20p
NKT275	20p
NKT278	25p
NKT281	27p
NKT401	87p
NKT402	90p
MKT403	75p
NKT404	55p
NKT405	75p
NKT406	62p
NKT451	62p
NKT452	62p
NKT453	47p
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NKT734	27p
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OC19	37p
OC20	75p
OC22	50p
OC23	60p
OC24	60p
OC25	40p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC41	22p
OC42	25p
OC44	15p
OC45	12p
OC46	15p
OC70	15p
OC71	12p
OC72	12p
OC73	30p
OC74	30p
OC75	22p
OC76	22p
OC77	30p
OC78	20p
OC81	20p
OC81D	20p
OC82	25p
OC82D	15p
OC83	25p
OC84	25p
OC139	25p
OC140	32p
OC170	25p
OC171	30p
OC200	40p
OC201	60p
OC202	75p
OC203	40p
OC204	40p
OC205	75p
OC206	95p
OC207	75p
OCP71	42p
ORP12	50p
ORP60	40p
ORP61	42p
P346A	22p
ST140	15p
ST141	20p
TI834	62p
TI843	40p
TI844	10p
TI845	27p
TI846	11p
TI847	11p
TI848	12p
TI849	12p
TI850	12p
TI851	10p
TI852	11p
TI853	22p
XB112	12p
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CA3043	137p
CA3044	120p
CA3045	122p
CA3046	81p
CA3047	137p
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CA3049	160p
CA3050	185p
CA3051	134p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
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FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH171	105p
FCH181	105p
FCH191	105p
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FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
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FJJ121	60p
FJJ131	60p
FJJ141	125p
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SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
SN7493	87p
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SN74107	52p
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SN74164	220p
SN74165	225p
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50 + less 15% 100 + less 20%

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6BZ6	40p	DL94	48p	PCL84	45p
6C4	33p	DL96	45p	PCL85	40p
6CD6	125p	DM70	40p	PCL86	45p
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6F1	62p	E88CC	100p	PL81	50p
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6F14	70p	EAF42	35p	PL84	40p
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6F18	50p	EBC41	55p	PL504	80p
6F23	85p	EBC81	30p	PY32	55p
6H6	17p	EBF80	40p	PY33	63p
6J4	50p	EBF83	40p	PY80	40p
6J5	25p	EBF89	32p	PY81	30p
6J5GT	30p	EBL21	60p	PY82	35p
6J6	20p	EC86	60p	PY83	38p
6J7	45p	EC88	60p	PY88	40p
6K8G	40p	ECC40	65p	PY800	40p
6L6GT	45p	ECC84	30p	PY801	50p
6LD20	50p	ECC85	40p	U25	80p
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6SA7	40p	ECF80	35p	U50	40p
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12AV6	40p	EF91	30p	UF41	60p
12BA6	40p	EF92	35p	UF80	35p
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12BH7	45p	EF184	35p	UF89	40p
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20F2	65p	EL41	60p	UY41	48p
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AA119	7p	BAY31	7p	OA10	22p
AA129	10p	BAY38	15p	OA9	10p
AAZ13	10p	BY100	15p	OA47	8p
AAZ15	10p	BY103	22p	OA70	7p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	7p
BA110	25p	BY126	12p	OA81	8p
BA111	27p	BY127	15p	OA85	7p
BA112	70p	BY164	52p	OA90	7p
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Carriage 50p extra any model.

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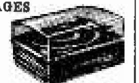

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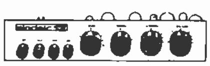

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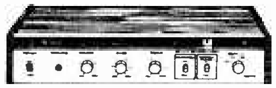

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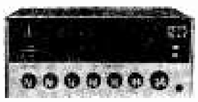

Solid state. Coverage on 5 bands 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning. BFO, AVC, ANL, 'S' meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 x 266 x 150 mm. Complete with instructions and circuit. £28·50. Carr.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

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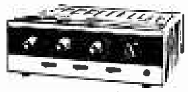

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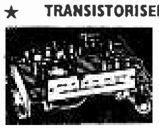

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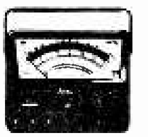
Stereo multiplex adaptors £4·97½.

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



Battery operated, 11 meg input, 26 ranges. Large 4½" mirror scale. Size 5¼" × 4¾" × 2¼". DC VOLTS 0.3–1200V. AC VOLTS 3–300V RMS. 8·0–800V P-P. DC CURRENT ·12–12MA. Resistance up to 2000M ohm. Decibels – 20 to + 51 db. Complete with leads/instructions. £17·50, P. & P. 20p.

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.

SINCLAIR IC-12

List Price £2·98

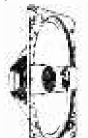
OUR PRICE £1·80

P. & P. 10p

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.

EMI LOUDSPEAKERS

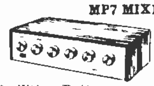


Model 350. 13" x 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. £7·50 each P. & P. 37p.
Model 450. 13" x 8" with twin tweeter/crossover. 55-13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. £3·50 each. P. & P. 25 p.

TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

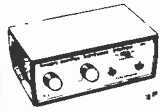
Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms.
£1·97, P. & P. 15p.

MP7 MIXER PREAMPLIFIER



5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½" × 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.

1021 STEREO LISTENING STATION

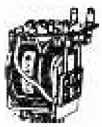


For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6" × 4" × 2¼". £2·[illegible] P. & P. 15p.

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.

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.

SPECIAL OFFER! SINCLAIR PROJECT 60 STEREO FM TUNER

The first tuner in the world to use the phase lock loop principle—as used for receiving signals from space craft because of its vastly improved signal to noise ratio. Provides fantastic results even in difficult areas. Tuning range 87·5 to 108MHz. Automatic stereo indicator. Sensitivity: 2μV. AFC range ± 200KHz. Signal to noise ratio: 65dB. Output voltage 2 × 150mV. Operating voltage 25–30V DC. Size 93 × 40 × 207 mm. REC. LIST PRICE £25.
OUR PRICE ONLY £15·75 P. & P. 25p
Unrepeatable offer—buy now and save over £9.

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.

PRS-2 PHOTO ELECTRIC RELAY SYSTEM

Inexpensive warning or counting system consisting of an enciter and relay unit. Relay unit has variable sensitivity control and switch for intermittent alarm operation. Enciter unit [illegible] infra red filter and [illegible] to operate bells, [illegible] Complete with [illegible] and instructions. [illegible] P. & P. 25p.

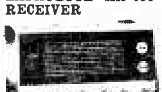
WHARFEDALE MID-RANGE HI-FI UNITS

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.

[illegible] 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.

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" × 9½ × 8¼". 18 lbs. 220/240v. A.C. or 12v. D.C. Brand new with instructions. £50. Carr. 50p.

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock. Single hole fixing, ⅜in. dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, 90p, P. & P. 7½p.
50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, £1·15 P. & P. 7½p.
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Excellent quality . Low price . Immediate delivery

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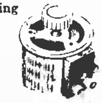
2·5 Amp	£8·05
5 Amp	£11·75
8 Amp	£15·30
10 Amp	£22·50
12 Amp	£23·80
20 Amp	£49·00



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Large Transistor Panels.

Plug in frame unit with printed circ cards, these contain a number of 2N560 transistors, these are a Silicon N.P.N. type Vc 60v Ic 100 Ma Col Disp 500 Mill/W cut off freq 50 Mc/s, also close tol resistors metal fittings etc. In new cond ex USAF surplus, we supply two panel with not less than 40 2N560s. Price £1 plus 37p post for two.

Cathode Ray Tubes

Type 7BP7A 7" flat face, 7Kv E.H.T. 6·3v heater, Emag focus & Deflection, are long persistance Blue short with Yell afterglow. Okay for flying spot scanners, T.V. to scope conversions etc. Supplied new boxed with connections.

Price **£1·25** plus 30p post.

Low Voltage Trans.

These are a small potted trans Pria 115v 50c/s Secs 6v at 1 amp twice and 260v ct at 9 Ma, used in pairs these will supply from 230v mains 6, 12, 18 or 24v at 1 amp or 12v D.C. 2 amps using byphase rect also 260v ct at 18 Ma, okay for BC221 P.U.

24V 1A = £1.25 Price £1 plus 25p post per pair.

H.F. Radio Sub Units.

Parts of R4187 Rx, Amp 4207 R.F. & I.F. section tunes 2·8 to 18 Mc/s in 3 bands, remote tuned by small 24v motor as 2 RF, 1st Mix, 1st IF 2·15 Mc/s, 2nd Mix, 100Kc O/P 5 miniature valves, req ext L.O. good cond Price **£1·75** plus 35p post. Amp 4208 I.F. & A.F. section as 2nd L.O. 100Kc filters, 2 100Kc I.F. stages, Det, M.L. B.F.O. A.F. amp & O/P. uses 9 valves, supplied in good cond Price **£3·50** plus 35p post. Both units supplied with coax conn, circuits etc, used together form good basis for Rx, req ext L.O. for 1st Mix

MISC ITEMS.

VALVES. 6X4, ECC83, 6AK6, 85A2, OB2, CV2179 (Similar to N78), 6AK5, EL85, 6BH6 all 3 for **50p.** 6SN7, 6H6, 6SK7M all 5 for **50p**, TRIMMER conds 20pf air spaced ceramic base new 10 for **50p** or **£4** per 100, BC221 Freq meters with int mains P.U. tested **£21**. PUSH SWITCHES with neon Ind have one N.O. contact single hole fixing 2 for **35p**, CONDS L.V. type 2500uf 50v Wk with clips for **60p**. SIGNAL UNIT contains 3 mercury wetted relays 4 small ... 2 toroids, misc transis, conds, pots etc. nice unit **£1·30**, INDICATORS type DM160 miniature type tuning Ind with gen and panel fixing 4 for **50p**, SELECTOR UNIT contains small 24v DC motor with worm drive yax swts etc. **£1·55.** METERS R.F. type 4 amps FSD new cond **90p**. U.H.F. Rx sub unit with 10 valves, 15q8 Mc/s xtal, I.F. trans, trimmers, coax plugs & sks etc. **£1·60.** PHOTO FLASH conds 40uf 2·5Kv size 6 x 3½" **£1q70**, CONTAMINATION METERS range 1 to 10 Mill/Rongt per Hr with probe in haversack tested, req 2 x 150x batts **£3·50**. SCOPES American service type USM-24C 115v 50c/s a single-beam bandwidth constant 5 c/s to 8 Mc/s, top quality unit **£33·50.** TRANSISTORS type OC42 with long leads on boards with parts 12 for **50p** also with DAT. 1 type similar to OC71, 10 boards approx 40 transis etc. for **65p.** DIODES ZR22 200 P.I.V. at 8 amps 4 for **60p.** TRANSISTORS Texas type 25012a Silicon H.F./power type N.P.N. Vc 70v Ic 2 amps Col Disp 40w, cut off 5 Mc/s 2 for **60p.** DIODE PANELS contains 18 ZR12 diodes 200 P.I.V. at 1·5 amp plus misc parts **85p.** METER 270 Deg FSD 1 Ma size 2" OSD 3½" long scale marked 0, 2, 4, 8 x 100 Deg Cent new **£1·40.**

CIRCUIT DIAGRAMS

R1155, B.F.L.N with values **50p.** R1392, R1475 (88) **30p**, B40 **50p**, CT38 **50p**, Scopes CD518 (CT316), 13A, 1035 Mks 1, 2 & 3, 1049 Mk3a all **50p** ea, Sge Gens TF144G **50p**, TF801a **75p**, Rx STC R4187 set of circs parts list and block diagram **£1**. Send SAE for list of other circs.

Above prices include post or carriage. All above goods ex equipment unless otherwise stated. Carr charges apply to U.K. mainland only. SAE with enquiries.

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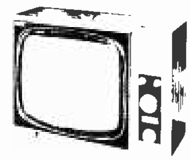

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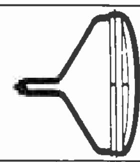

17" and 19" **£5·95**; 21" and 23" **£6·45**
Exchange Bowls carr. 55p

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Pots.: 25p each. Post 5p. D/SW 500/500 KΩ. D SW 500/100 KΩ. D/SW 1 meg./100. KΩ. S/SW 500,500 KΩ. S/SW 500/1 meg.

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P. E. 'GEMINI' STEREO AMPLIFIER

30 Watts (R.M.S.) per Channel into 8 Ohms ! !
Total Harmonic Distortion 0·02% ! !
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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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2N174	1·40
2N176	0·75
2N274	0·75
2N335	0·75
2N551	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	0·18
2N2219	0·20
2N2219A	0·20
2N2220	0·20
2N2221	0·20
2N2221A	0·22
2N2222	0·20
2N2222A	0·25
2N2368	0·11
2N2369	0·12
2N2369A	0·15
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	0·15
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
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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	3·37
2N3789	1·76
2N3790	1·90
2N3791	2·06
2N3792	2·20
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2N3854	0·16
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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
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2N4036	0·40
2N4037	0·35
2N4058	0·12
2N3059	0·90
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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	0·33
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	0·50
40251	0·58
40309	0·26
40310	0·37
40313	1·05
40316	0·44
40318	0·97
40322	1·00
40360	0·35
40361	0·37
40362	0·40
43063	0·61
40389	0·37
40394	0·58
40395	0·50
40406	0·40
40407	0·31
40408	0·41
40409	0·49
40410	0·53
40411	1·40
40414	2·42
40438	1·44
40467A	0·57
40468A	0·35
40600	0·57
40601	0·55
40602	0·40
40603	0·49
40604	0·45
40636	0·33
40673	0·60
AC107	0·30
AC113	0·16
AC115	0·16
AC117	0·20
AC121	0·11
AC126	0·20
AC127	0·20
AC128	0·20
AC141K	0·30
AC142K	0·25
AC151V	0·12
AC152V	0·15
AC153	0·19
AC153K	0·22
AC154	0·20
AC176	0·16
AC176K	0·17
AC187K	0·17
AC188K	0·23
ACY17	0·25
ACY18	0·15
ACY19	0·20
ACY20	0·20
ACY21	0·18
ACY22	0·10
ACY28	0·17
ACY30	0·42
ACY39	0·47
ACY40	0·17
ACY41	0·15
ACY44	0·25
AD136V	0·84
AD140	0·49
AD140	0·55
AD142	0·50
AD143	0·45
AD149V	0·50
AD149V	1·23
AD150	0·55
AD161	0·33
AD162	0·35
AD161 }	PR
AD162 }	0·60
ADZ11	1·50
ADZ12	1·75
AF106	0·24
AF109R	0·35
AF114	0·25
AF115	0·24

AF116	0·23	BC307	0·09	BF271	0·21
AF117	0·20	BC307A	0·09	BF272	0·53
AF118	0·50	BC307VI	0·09	BF273	0·25
AF121	0·22	BC308	0·08	BF274	0·28
AF124	0·22	BC308A	0·08	BF457	0·46
AF125	0·20	BC308B	0·08	BF458	0·57
AF126	0·19	BC309	0·09	BF459	0·57
AF127	0·20	BC309A	0·09	BF821	2·10
AF139	0·30	BC309B	0·09	BF821A	2·30
AF170	0·25	BC313	0·30	BF828	0·92
AF172	0·25	BC327	0·21	BF861	0·27
AF178	0·42	BC328	0·19	BF898	0·28
AF179	0·45	BC337	0·17	BFW10	0·61
AF180	0·50	BC338	0·17	BFW11	0·61
AF186	0·40	BCY30	0·27	BFW15	0·35
AF200	0·35	BCY31	0·30	BFX13	0·23
AF239	0·36	BCY32	0·50	BFX29	0·25
AF240	0·63	BCY32	0·50	BFX30	0·25
AF279	0·47	BCY33	0·25	BFX37	0·30
AF280	0·47	BCY34	0·30	BFX44	0·33
AFY42	0·65	BCY38	0·40	BFX63	2·48
AF211	0·55	BCY39	0·60	BFX68	0·30
AL102	0·75	BCY40	0·50	BFX84	0·24
AL103	0·70	BCY42	0·15	BFX85	0·29
ASY26	0·25	BCY43	0·15	BFX86	0·24
ASY27	0·30	BCY58	0·18	BFX87	0·25
ASY28	0·25	BCY59	0·19	BFX88	0·20
ASY29	0·27	BCY66	0·58	BFX89	0·45
ASY50	0·20	BCY67	0·82	BFY10	0·35
ASY55	0·35	BCY70	0·15	BFY11	0·45
ASZ21	0·51	BCY71	0·20	BFY17	0·90
AU103	1·25	BCY72	0·13	BFY18	0·25
BC107	0·10	BCY87	3·47	BFY19	0·25
BC108	0·10	BCY88	2·40	BFY20	0·50
BC109	0·12	BCY89	0·80	BFY29	0·40
BC113	0·10	BCZ10	0·27	BFY37	0·20
BC114	0·12	BCZ11	0·40	BFY41	0·43
BC115	0·15	BD115	0·75	BFY43	0·62
BC116	0·15	BD116	0·75	BFY50	0·16
BC116A	0·18	BD121	0·65	BFY51	0·16
BC117	0·20	BD123	0·80	VFY52	0·16
BC118	0·11	BD124	0·60	BFY53	0·15
BC119	0·27	BD130	0·50	BFY56	0·34
BC121	0·20	BD131	0·75	BFY64	0·41
BC123	0·25	BD132	0·75	BFY75	0·40
BC125	0·15	BD135	0·38	BFY76	0·22
BC126	0·20	BD136	0·44	BFY77	0·24
BC132	0·30	BD137	0·47	BFY78	0·36
BC134	0·11	BD138	0·55	BFY90	0·55
BC135	0·11	BD139	0·62	BRY39	0·30
BC136	0·15	BD140	0·73	BSX19	0·13
BC137	0·15	BDY10	1·25	BSX20	0·14
BC138	0·20	BDY11	1·50	BSX21	0·20
BC140	0·30	BDY17	1·50	BSX26	0·34
BC141	0·34	BDY18	1·75	BSX27	0·34
BC142	0·18	BDY19	1·97	BSX28	0·25
BC143	0·21	BDY20	0·92	BSX29	0·47
BC144	0·24	BDY38	0·65	BSX30	0·68
BC145	0·21	BDY60	0·90	BSX59	0·78
BC147	0·10	BDY61	0·85	BSX60	0·54
BC148	0·09	BDY62	0·75	BSX61	0·42
BC149	0·10	BF115	0·23	BSX76	0·15
BC153	0·10	BF117	0·43	BSX77	0·20
BC154	0·11	BF119	0·58	ASX78	0·25
BC157	0·09	BF121	0·25	BSW70	0·28
BC158	0·10	BF123	0·27	BSY24	0·20
BC159	0·10	BF125	0·25	BSY25	0·15
BC160	0·11	BF127	0·27	BSY26	0·20
BC167B	0·11	BF152	0·20	BSY27	0·15
BC168B	0·10	BF153	0·29	BSY28	0·15
BC168C	0·10	BF154	0·16	BSY38	0·15
BC169B	0·11	BF158	0·15	BSY39	0·15
BC169C	0·11	BF159	0·27	BSY51	0·25
BC170	0·11	BF160	0·23	BSY52	0·25
BC171	0·13	BF161	0·35	BSY53	0·25
BC172	0·11	BF163	0·20	BSY54	0·30
BC182	0·10	BF166	0·35	BSY56	0·79
BC182L	0·10	BF167	0·18	BSY65	0·15
BC183	0·09	BF173	0·19	BSY78	0·40
BC183L	0·09	BF177	0·25	BSY79	0·40
BC184	0·11	BF178	0·25	BSY790	0·45
BC184L	0·11	BF179	0·30	BSY95A	0·09
BC186	0·25	BF180	0·35	BU104	1·42
BC187	0·25	BF181	0·32	BU105	2·25
BC204	0·11	BF182	0·30	C111	0·53
BC205	0·10	BF183	0·40	C407	0·18
BC206	0·11	BF184	0·17	C424	0·15
BC207	0·10	BF185	0·17	C425	0·36
BC268	0·09	BF194	0·14	C426	0·25
BC209	0·10	BF195	0·15	C428	0·25
BC211	0·30	BF196	0·15	C444	0·26
BC212K	0·10	BF197	0·15	D40N3	0·62
BC212L	0·12	BF198	0·15	GET111	0·45
BC214L	0·14	BF199	0·18	GET113	0·20
BC236	0·16	BF200	0·35	GET114	0·20
BC237	0·08	BF224J	0·14	GET115	0·50
BC238	0·08	BF225J	0·19	GET119	0·35
BC239	0·08	BF257	0·22	GET120	0·25
BC251	0·20	BF238	0·22	GET535	0·20
BC252	0·18	BF244	0·16	GET536	0·20
BC253	0·23	BF245	0·33	GET538	0·20
BC257	0·08	BF246	0·43	GET873	0·12
BC258	0·08	BF247	0·49	GET880	0·30
BC259	0·11	BF254	0·14	GET883	0·20
BC261	0·20	BF255	0·15	GET887	0·20
BC262	0·18	BF257	0·41	GET890	0·22
BC263	0·23	BF258	0·46	GET895	0·25
BC300	0·42	BF259	0·48	MA8001	0·16
BC301	0·34	BF261	0·23	MA8002	0·47
BC302	0·27	BF264	1·45	MA8003	0·47
BC303	0·50	BF270	0·25		
BC304	0·43				

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 £p	25+ £p		1-24 £p	25+ £p		1-24 £p	25+ £p
SN7400	0·20	0·18	SN7428	0·50	0·41	SN7460	0·20	0·18
SN7401	0·20	0·18	SN7430	0·14	0·12	SN7470	0·30	0·26
SN7402	0·20	0·18	SN7432	0·42	0·36	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	0·46	0·35
SN7406	0·30	0·24	SN7439	0·52	0·45	SN7476	0·44	0·39
SN7407	0·30	0·24	SN7440	0·20	0·18	SN7480	0·70	0·65
SN7408	0·20	0·18	SN7441AN	0·75	0·72	SN7481	1·25	1·07
SN7409	0·20	0·18	SN7442	0·79	0·68	SN7482	0·87	0·61
SN7410	0·20	0·18	SN7443	1·04	0·88	SN7483	0·96	0·71
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	1·00	0·90	SN7486	0·33	0·28
SN7416	0·30	0·25	SN7447	1·30	1·20	SN7488	12·40	11·80
SN7417	0·30	0·25	SN7448	1·04	0·92	SN7489	4·97	4·40
SN7420	0·20	0·18	SN7449	Price to be		SN7490	0·75	0·70
SN7421	0·22	0·20		announced shortly		SN7491	1·00	0·80
SN7422	0·48	0·42	SN7450	0·20	0·18	SN7492	0·75	0·70
SN7423	0·48	0·41	SN7451	0·20	0·18	SN7493	0·75	0·70
SN7425	0·48	0·42	SN7452	0·20	0·18	SN7494	0·80	0·74
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	0·87	0·77

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

OPTOELECTRONICS

MINITRON 3015F 7-SEGMENT INDICATOR (16 PIN DIL) £2·00
May be driven by SN7447

TIL 209 LIGHT EMITTING DIODE. Made by TEXAS INST. (Red). 35p

B9900 PHOTORESISTOR 38p

VEROBOARD

	0.15 Matrix	0.1 Matrix
2½ × 3¾in	17p	23p
2½ × 5in	25p	25p
3¾ × 3¾in	25p	25p
3¾ × 5in	30p	29p
5 × 17in (Plain)	82p	—

Vero Pins (Bag of 36) 20p
Vero Cutter 45p
Pin insertion Tools (·1 and ·15 matrix) at 55p.

"SCORPIO" CAP DISCHARGE IGNITION SYSTEM
(As published in P.E. November 1971)
Complete kit £10·00
P. & P. 50p.

RESISTORS

Carbon Film

¼ watt 5%, 1p, ⅛W, 1W & 2W
⅜ watt 5%, 1p E12 Series
½ watt 5%, 1½p
½ watt 2%, M/O 4p
1 watt 10%, 2½p ⅛W & ¼W
2 watt 10%, 6p E24 Series.

SLIDE POTENTIOMETERS

58 mm, TRACK
SINGLE GANGED. LOG or LIN 1k to 1M. 40p each.
TWIN GANGED. LOG or LIN 1k to 500k 60p each

MULLARD C280 M/FOIL CAPACITORS

0·01, 0·022, 0·033, 0·047	3p each
0·068, 0·10	4p each
0·15, 0·22, 0·33	5p each
0·47	9p
0·68	11p
1μF	14p
1·5μF	21p
2.2μF	25p

WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only). 7p
5 watt 5% (up to 8·2k Ω only), 9p
10 watt 5% (up to 26k Ω only), 10p

POTENTIOMETERS

Carbon:
Log. or Lin., less switch, 16p
Log. or Lin., with switch, 25p
Wire-wound Pots (3W), 38p
Twin Ganged Stereo Pots, Log. or Lin. 40p.

PRESETS (CARBON)

0·1 Watt	6p	VERTICAL
0·2 Watt	6p	OR
0·3 Watt	7½p	HORIZONTAL

SPECIAL OFFER

TOSHIBA TH9013P 20 WATT AMP £3·50
TH9014P PRE-AMP £1·25

Tel. 01-452 0161/2/3
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A. MARSHALL & SON
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CALLERS WELCOME
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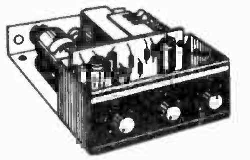
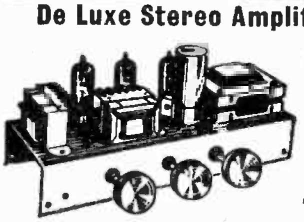
9–5.0 SAT.

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 300mV 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 x 4"d. Overall height including valves 5". Ready built & tested to a high standard. PRICE £8·92 P.&P. 45p.

NEW! POWER SUPPLY UNIT

200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp continuous (1½amp intermittent).
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3½" × 2½".
Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested.

PRICE £4·50 P & P 35p.

BLACK ANODISED, 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2½" × 3" approx. 25p pair. P. & P. 5p.

HIGH GRADE COPPER LAMINATE BOARDS. 8 × 6 × $\frac{1}{16}$in. FIVE for 50p. P. & P. 13p.

COILED SPRING BACK TELEPHONE CABLE. Closed approx. 10" extends to 36". 4 core or 6 core. 25p each P. & P. 5p. 5 or more post free. LIMITED NUMBER!

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0–210–240v. Secondary combinations 0–5–10–15–20–25–30–35–40–60v. half wave at 1 amp. or 10–0–10, 20–0–20, 30–0–30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £1·75 P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240v. Sec. 9–0–9 at 500mA. 70p. P. & P. 13p. Pri. 200/240v. Sec. 12–0–12 at 1 amp. 88p. P. & P. 13p. Pri. 200/240v. Sec. 10–0–10 at 2 amp. £1·38. P. & P. 30p.

SPECIAL OFFER MAINS TRANSFORMER 200/240v. A.C. Input 35v at 1½ amp A.C. output overall size 2½" × 2½" × 3" approx. Suitable drop through or vertical mounting 75p. P. & P. 30p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1½" x 1½" x ½". Brand new complete with instructions. Price 88p. P. & P. 13p.

x2

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY 40p. Post 5p.

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER. With latest mono compatible cartridge £6·97 Carr. 50p. With stereo cartridge £7·97 Carr. 50p.
LATEST GARRARD MODELS. S.A.E. for latest Prices!

PRECISION ENGINEERED PLINTHS
Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60 etc. or B.S.R. C109, C129, A21 etc. Choice of Black leatherette or Teak grain finish. Size 12¼" x 14¼" x 3¼" high (approx. 7¼" high, including rigid smoked acrylic cover).
PRICE £5·50. P. & P. 60p.

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1·50 P. & P. 8p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78.
ONLY £2·50 P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3. P. & P. 10p.
LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. £1·63 P. & P. 10p.
LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £1·50 P. & P. 10p.

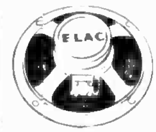
QUALITY RECORD PLAYER AMPLIFIER MK II
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE £3·75 P. & P. 40p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE £4·88 P. & P. 50p.
DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE £4·75, P. & P. 50p.

SPECIAL OFFER !
HI-FI LOUDSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½" high x 10½" wide x 5½" deep. Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 8 or 15 ohms impedance.

OUR PRICE £8.40 Carr. 65p
Cabinet Available Separately £4·50 Carr 60p
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter £6·50 Carr. 65p

LOUDSPEAKER BARGAINS
5in. 3 ohm £1·05, P. & P. 15p. 7 x 4in. 3 ohm £1·15, P. & P. 20p, 10 × 6in. 3 or 15 ohm £1·90, P & P. 30p, E.M.I. 8 × 5in. 3 ohm with high flux magnet £1·62, P. & P. 20p E.M.I. 13½ × 8in. with high flux ceramic magnet 3, 8 or 15 ohm £3·20. P. & P. 30p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network £4·20, P. & P. 30p. E.M.I. 13 × 8in. twin cone (parasitic tweeter) 8 ohm £2·25, P. & P. 30p.
BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly £6·75. Guitar models: 25w. £6·75, 35w. £8·50. P. & P. 38p



SPECIAL OFFER!
LIMITED NUMBER OF BRAND NEW ELAC 10" TWIN CONE LOUDSPEAKERS
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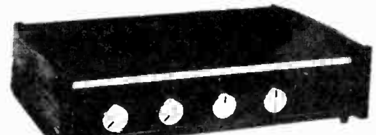

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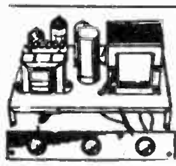

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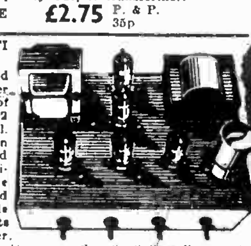

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5Z4G	.33	6F25	.51	10F18	.35	30L15	.55	DF96	.34		2.10
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EY87/6	.27	PCL84	.32	UAF42	.49	2N966	.53	AF178	.68	GD9	.20	OC81	.11
EY88	.40	PCL805/85		UBC41	.45	2N1756	.50	AF180	.48	GET113	.20	OC81D	.11
EZ40	.40		.37	UBC81	.40	2N2147	.85	AF186	.55	GET118	.20	OC82	.11
EZ41	.42	PCL86	.36	UBF80	.28	2N2297	.23	AF239	.38	GET119	.20	OC82D	.11
EZ80	.19	PD500	1.44	UBF89	.28	2N2369	.22	BA102	.45	GET573	.38	OC83	.20
EZ81	.20	PEN4DD		UBL21	.55	2N2613	.39	BA115	.14	GET587	.43	OC84	.24
GY501	.75		1.38	UC92	.35	2N3053	.33	BA116	.25	GET873	.15	OC123	.23
GZ30	.33	PEN45DD		UCC84	.33	2N3121	2.50	BA129	.13	GET887	.23	OC139	.23
GZ32	.39		.75	UCC85	.33	2N3703	.19	BA130	.10	GET897	.23	OC140	.95
GZ33	.70	PEN453DD		UCF80	.31	2N3709	.20	BA153	.15	GET898	.23	OC169	.23
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HN309	1.40	PL33	.38	UF42	.60	AC107	.15	BCY10	.45	OA73	.15	OC205	.43
HVR2	.58	PL36	.46	UF80	.35	AC113	.25	BCY12	.50	OA79	.09	ORP12	.53
HVR2A	.58	PL81	.42	UF85	.34	AC126	.13						
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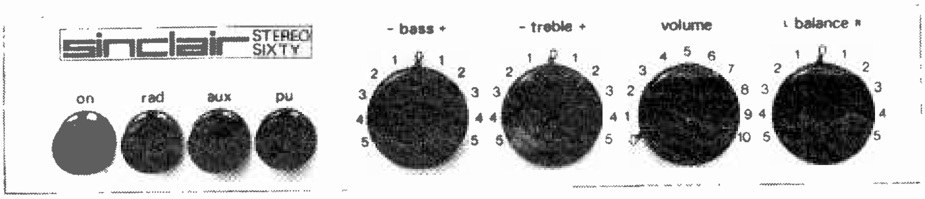

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SPECIFICATIONS

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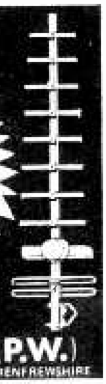

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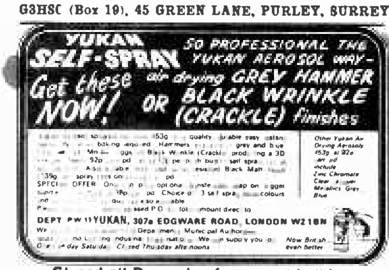

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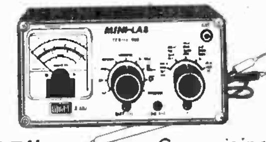

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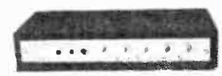

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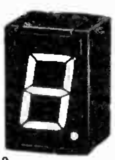

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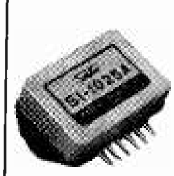

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5V4G	0.50	6CB6	0.40	6N7GT	0.55	12BA6	0.45
5Y3GT	0.45	6CD6GA		6P28	0.65	12BA7	0.50
5Z3	0.75		1.30	6Q7	0.50	12BE6	0.50
5Z4G	0.45	6CG7	0.60	6SA7	0.45	12BH7	0.50
6/30L2	0.90	6CH6	0.60	6SG7	0.45	12BY7	0.65
6AB4	0.45	6CL6	0.60	6SK7	0.50	12K5	1·00
6AF4A	0.60	6CU6	0·80	6SL7GT	0.45	12K7GT	0.50
6AG5	0.25	6CW4	0.70	6SN7GT	0.45	12Q7GT	0.45
6AG7	0.45	6CY5	0.50	6SQ7	0.50	12SR7	0.50
6AH6	0.60	6CY7	0.75	6SR7	0.50	20D1	0.60
6AJ8	0.30	6D3	0.55	6T8	0.38	20L1	1.10
6AK5	0.40	6DC6	0.80	6U4GT	0.70	20P1	0.50
6AK6	0.60	6DK6	0.60	6U5G	0·75	20P4	1.10
6AL3	0.43	6DQ6B	0.75	6U8A	0.48	20P5	1.20
6AL5	0.22	6DS4	1.25	6V6GT	0.45	25C5	0.60
6AM5	0.40	6EA8	0.65	6X4	0.40	25L6GT	0.50
6AM6	0.37	6EH7	0.30	6X5GT	0.45	25Z4G	0.35
6AQ5	0.42	6EJ7	0.35	6X8	0.65	25Z6GT	0.75
6AQ6	0.70	6EW6	0.70	6Y6G	0.80	30A5	0.60

30AE3	0.40	50EH5	0.65	DK96	0.60	ECC84	0.30
30C1	0.80	50L6GT	0.60	DL96	0.55	ECC85	0.40
30C15	1.00	85A2	0.55	DM70	0.60	ECC88	0.40
30C17	1.10	90AG	2.40	DM160	0.68	ECC89	0.50
30C18	0.90	90AV	2.50	DY51	0.55	ECC91	0.30
30F5	1.00	90C1	0.75	DY86	0.35	ECC189	0.65
30FL1	0.80	90CV	2.40	DY87	0.36	ECC807	1.00
30FL12	1.10	807	0.50	DY802	0.37	ECF80	0.35
30FL14	0.90	813	4.00	E88CC	0.70	ECF82	0.35
30L1	0.40	866A	0.85	E180F	1.00	ECF804	1.65
30L15	0.95	5642	0.70	E810F	2·90	ECH81	0.30
30L17	0.95	5670	0.60	EABC80	0.38	ECH83	0.45
30P12	1.00	6080	1.75	EAF42	0.60	ECH84	0.45
30P19	0.95	6146	1.60	EBC33	0.60	ECL80	0.50
30PL1	0.95	6146B	2.50	EBC41	0.65	ECL81	0.50
30PL13	1.10	6360	1.25	EBC81	0.33	ECL82	0.35
30PL14	1.25	6939	2.25	EBF80	0.40	ECL83	0.70
35A3	0.60	7199	0.65	EBF83	0.40	ECL84	0.55
35A5	0.75	7360	2.20	EBF89	0.32	ECL85	0.55
35B5	0.65	7586	1.50	EBL31	1·50	ECL86	0.40
35C5	0.60	7895	1.50	EC53	0.50	ECLL800	2·20
35D5	0.75	9002	0.45	EC86	0.60	EF40	0.50
35L6GT	0.75	A2293	2·20	EC88	0.60	EF41	0.65
35W4	0.40	AZ1	0.60	EC90	0.35	EF42	0.70
35Z3	0.75	AZ31	0.55	EC92	0.45	EF80	0.30
35Z4G	0.40	CBL1	0.99	EC93	0.60	EF85	0.35
35Z5GT	0.70	CBL31	1.00	ECC35	1.00	EF86	0.30
50A5	0.80	CY31	0.50	ECC40	0.70	EF89	0.28
50B5	0.70	DAF96	0.50	ECC81	0.40	EF91	0.37
50C5	0.60	DF96	0.50	ECC82	0.33	EF92	0.35
50CD6G	1.20	DK92	0.70	ECC83	0.33		

EF95	0.40	GZ32	0.50	PL33	0.40	U403	0.70
EF97	0.65	GZ33	0.75	PL36	0.55	U404	0.70
EF98	0.75	GZ34	0.60	PL81	0.50	U801	0.80
EF183	0.30	HABC80	0.55	PL82	0.45	UABC80	0.40
EF184	0.35	HK90	0.50	PL83	0.45	UAF41	0.70
EF804	1.25	KT66	2.35	PL84	0.40	UAF42	0.60
EK90	0.32	KT88	2·25	PL302	0.95	UB41	0·65
EL34	0.50	N78	1·60	PL504	0.75	UBC41	0.55
EL36	0.50	PABC80	0.40	PL508	0.90	UBC81	0.45
EL37	1.70	PC86	0.60	PL509	1.10	UBF80	0.40
EL41	0.75	PC88	0.60	PL801	1.00	UBF89	0.40
EL81	0.55	PC92	0.05	PL802	0·95	UBL1	0.70
EL83	0.50	PC97	0.50	PM84	0.60	UBL21	0.70
EL84	0.25	PC900	0.48	PY31	0.35	UC92	0.45
EL85	0.43	PCC84	0.40	PY33	0.63	UCC85	0.45
EL86	0.40	PCC85	0.40	PY80	0.40	UCF80	0.70
EL90	0.42	PCC88	0.55	PY81	0.30	UCH21	[illegible]
EL95	0.35	PCC89	0.55	PY82	0.35	UC[illegible]	[illegible]
EL821	0.60	PCC189	0.60	PY83	0.38	UCH[illegible]	[illegible]
EL822	1.40	PCC805	0.95	PY88	0.40	UCL[illegible]	0.60
ELL80	0.75	PCC806	0.95	PY500	1.00	UCL[illegible]	0.35
EM34	1.00	PCF80	0.30	PY800	0.47	UCL[illegible]	0.65
EM71	0.80	PCF82	0.35	PY801	0.50	UF9	0.65
EM80	0.45	PCF84	0.60	PZ30	0.33	UF11	[illegible]
EM81	0.60	PCF86	0.60	QQVO2-6	2.25	UF41	0.65
EM83	0.50	PCF87	1·10	QQVO3-10	1.25	UF42	0.65
EM84	0.35	PCF801	0.50	QQV03-20A	5.25	UF43	0.65
EM85	1.00	PCF802	0.50	TT21	3.40	UF80	0.35
EM87	0.70	PCF805	0.90	TT22	3.50	UF85	0.40
EN91	0.40	PCF806	0.75	U18/20	0.75	UF89	0.40
EY51	0.40	PCF808	0.90	U25	0.85	UL4[illegible]	0·65
EY80	0.75	PCH200	0.70	U26	0.85	UL84	0.43
EY81	0.40	PCL81	0.50	U31	0.70	UM84	0.30
EY83	0.55	PCL82	0.35	U37	6.50	UY1N	0.50
EY86	0.40	PCL83	0.65	U52	0.40	UY11	1.00
EY87	0.43	PCL84	0.45	U76	0.40	UY41	0.43
EY88	0.43	PCL85	0.50	U78	0.40	UY82	0.50
EZ40	0.50	PCL86	0.45	U191	0.75	UY85	0.40
EZ41	0.75	PCL88	1.25	U201	0.50	W729	0.75
EZ80	0.28	PCL800	1.10	U281	0.55	Y63	0·75
EZ81	0.29	PCL801	0.95	U282	0.55	Z759	3·00
GT1C	3.00	PD500	1.30	U301	0.55	Z803U	1.35
GY501	0.70	PF86	0.70				
GZ30	0.45	PF818	1.00				
GZ31	0.40	PFL200	0.65				

TRANSISTORS

2N696	0.15	AC128	0.15	BD123	0.80
2N697	0.15	AC132	0.35	BD124	0.60
2N698	0.30	AC153	0.20	BD131	0.75
2N705	0.70	AC154	0.15	BD132	0.80
2N706	0.10	AC157	0.17	BF115	0.20
2N708	0.15	AC169	0.10	BF167	0.18
2N753	0.25	AC176	0.17	BF173	0.20
2N929	0.20	AC187	0.25	BF179	0.30
2N930	0.20	AC188	0.25	BF180	0.30
2N987	0.30	ACY17	0.25	BF181	0.30
2N1131	0.25	ACY18	0.20	BF184	0.20
2N1132	0.25	ACY19	0.25	BF185	0.20
2N1184	1.25	ACY20	0.20	BF194	0.14
2N1302	0.17	ACY21	0.20	BF195	0.14
2N1303	0.17	ACY22	0.10	BF196	0.12
2N1304	0.20	AD140	0.50	BF197	0.12
2N1305	0.20	AD149	0.45	BF200	0.35
2N1306	0.25	AD161	0.35	BFW87	0.25
2N1307	0.25	AD162	0.35	BFW88	0.20
2N1308	0.25	ADZ11	1.25	BFW89	0.20
2N1309	0.25	ADZ12	1.25	BFW91	0.20
2N1613	0.17	AF114	0.17	BFX88	0.20
2N1711	0.20	AF115	0.17	BFY17	0.40
2N1756	0.75	AF116	0.17	BFY19	0.25
2N2147	0.75	AF117	0.17	BFY50	0.20
2N2160	0.60	AF118	0.30	BFY51	0.20
2N2217	0.25	AF125	0.20	BFY52	0.20
2N2218	0.20	AF127	0.20	BSY26	0.17
2N2219	0.20	AF180	0.35	BSY27	0.15
2N2369A	0.15	AF181	0.35	BSY28	0.17
2N2477	0.65	AF186	0.40	BSY65	0.20
2N2646	0.40	AF239	0.36	BSY95A	0.12
2N2905	0.25	AFZ11	0.45	OC16	0.50
2N2923	0.12	AFZ12	1.00	OC22	0.50
2N2924	0.13	ASY26	0.25	OC23	0.60
2N2926	0.10	ASY27	0.30	OC24	0.60
2N3053	0.20	ASY28	0.25	OC25	0.35
2N3054	0.50	ASY29	0.30	OC26	0.25
2N3055	0.60	ASY54	0.25	OC28	0.50
2N3133	0.25	ASZ15	0.70	OC29	0.60
2N3134	0.25	ASZ16	0.70	OC35	0.50
2N3391	0.17	ASZ17	0.75	OC36	0.45
2N3392	0.17	ASZ18	0.75	OC42	0.20
2N3393	0.15	ASZ20	0.25	OC44	0.15
2N3394	0.15	ASZ21	0.40	OC45	0.12
2N3395	0.20	BC107	0.10	OC70	0.10
2N3402	0.15	BC108	0.10	OC71	0.12
2N3403	0.15	BC109	0.10	OC72	0.12
2N3404	0.32	BC113	0.10	OC73	0.30
2N3414	0.20	BC118	0.20	OC75	0.15
2N3415	0.15	BC134	0.20	OC76	0.15
2N3417	0.25	BC147	0.10	OC78	0.25
2N3702	0.10	BC148	0.10	OC78D	0.20
2N3703	0.10	BC149	0.12	OC81	0.20
2N3704	0.12	BC152	0.15	OC81D	0.20
2N3707	0.12	BC158	0.15	OC83	0.20
2N3709	0.10	BC175	0.20	OC139	0.30
2N3710	0.10	BC186	0.25	OC140	0.35
2N3819	0.35	BCY30	0.25	OC141	0.60
2N3906	0.25	BCY31	0.30	OC170	0.25
2S702	0.50	BCY33	0.25	OC171	0.25
2S746	0.25	BCY34	0.30	OC200	0.30
AC113	0.15	BCY72	0.15	OC201	0.60
AC125	0.30	BCZ10	0.30	OC202	0.65
AC126	0.20	BCZ11	0.40	OC203	0.40
AC127	0.17	BD121	0.65	OC204	0.40

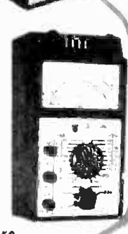
MULTIMETERS

U4312 667 Ω/V
AC: [illegible]·50mA–6A in 8 ranges.
DC: 300µA–6A in 9 ranges.
AC/DC: 0·3–900V in 9 ranges.
Resistance 0·2–5–50k Ω
£9·75

U4313
20,000 Ω/v DC: 2000 Ω/vAC.
AC: 0·6mA–1·5A in 6 ranges.
DC: 60µA–1·5A in 8 ranges.
AC/DC: 15–600V in 9 ranges.
Resistance 1–10–100–1000k Ω
£10·50

U435
20,000 Ω/v DC: 2000 Ω/v AC.
AC: 5mA–2·5A in 5 ranges.
DC: 50µA–2·5A in 7 ranges.
AC/DC: 2·5–1000V in 6 ranges.
Resistance 3–30–300k Ω
£8·75

U4324
20,000 Ω/V DC: 4000 Ω/V AC.
AC: 0·3–3A in 5 ranges.
DC: 60µA–3A in 6 ranges.
AC: 3–900V in 8 ranges.
DC: 0·6–1200Y in 9 ranges.
Resistance 500–20–200k Ω–2M Ω.
£8·00



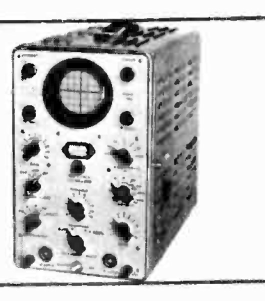
U4341 MULTIMETER
with transistor tester.
16700 Ω/v DC. 3300 Ω/v AC.
AC: 0·3–300mA in 4 ranges.
1·5–750V in 6 ranges
DC: 60µA–600mA in 5 ranges.
0·3–900V in 8 ranges.
Resistance 2–2M Ω in 4 ranges.
Transistor gain 10–350.
£10·50

11·5 AMPS THYRISTORS

Stud mounted 1200 P.I.V.; Continuous reverse voltage 800V. Minimum trigger voltage 3·5V; Holding current 10mA. Max. forward RMS current 25A
£1·85

MINIATURE SILICON HALF-WAVE MAINS RECTIFIERS

IN4002	100 p.i.v. 1A	0·07
IN4004	400 p.i.v. 1A	[illegible]
IN4006	800 p.i.v. 1A	0·12
BY127	600 p.i.v. 1A	0·12



SYNCHROSCOPE TYPE C1-5

3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2·5-10-30-100-300-1000-3000 µsec per stroke. Free-running time base 20 c/s to 200 kc/s with built-in crystal calibrator providing timing marks at ·05-·2-1-5-20-100 µsec.
Amplitude calibrator directly calibrated in volts.
Input attenuator 1-10-100.
Power supplies 127/230v AC.

PRICE £39.00. Packing and carriage 1.50

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