PRACTICAL WIRELESS

APRIL 1973
20p

PW

TRICOLOUR Mood Lighting System

also

I.C. POWER AMPLIFIER
DARKROOM EXPOSURE METER

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PACKAGE PRICE R.S.C. STEREO PACKAGE OFFERS HIGH FIDELITY UNITS

FOR ILLUSTRATED UNITS
ONLY £39·59

Carr. £1·00
Or deposit £6·95 and 9 monthly payments £4·22 (Total £44·93).

Individual Rec. Retail Prices

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

SEND S.A.E. FOR FREE COLOUR BROCHURE

SAVE £31·60

PACKAGE PRICE **£99·95** Carr. £1·75
FOR ILLUSTRATED UNITS

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

Individual Rec. Retail Prices:

GOLDRING GL72 Transcription Turntable + P.U.	£31·89
GOLDRING G800 Magnetic Cartridge	£12·21
DE-LUXE PLINTH with Roll-over Cover	£10·50
Pair R.S.C. MONARCH LOUDSPEAKERS	£38·70
R.S.C. SUPER 30 Mk III AMPLIFIER	£38·75
TOTAL	£131·55

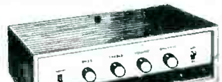
FANE 'MODE ONE' HIGH FIDELITY SPEAKER KIT

Incorporating a model 803 8" 13,000 Gauss Bass Speaker with ultra low resonance. P.V.C. surround cone. Printed circuit cross-over assembly with ferrite cored coils. Model 303 Pressure Tweeter, Acoustic damping material, Screws, Panels etc., and instructive diagrams. Frequency Response 25 Hz–2 KHz. Impedance 8–15 ohms. **£9·95** post free

Or Dep. £2·25 & 9 mthly pymnts. £1 (Tot. £11·25)

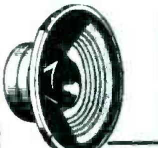
RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

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



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£11·50** Carr. 40p
Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £14·99 or dep. £2·20 and 9 monthly payments £1·70 (Total £17·50).

AUDIOTRINE HIGH FIDELITY SPEAKERS



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

Exceptional performance at low cost.

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

FANE 807T HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω. PLEASE STATE IMPEDANCE WHEN ORDERING **£3·85**
MODEL 803T 8" 15w. with parasitic Tweeter. Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8–15. **£4·95**

R.S.C. BATTERY/MAINS CONVERSION UNITS

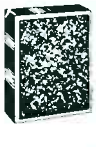
TYPE BM1. An all-dry battery eliminator. Size 5½ × 4½ × 2in. approx. Completely replaces batteries supplying 1·5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available.
COMPLETE KIT WITH DIAGRAM **£3·25** ASSEMBLED READY FOR USE **£3·75**

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.
DORCHESTER (Illustrated) Size 16 × 11 × 9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13 × 8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9·45** Carr. 40p.
MONARCH Size 19 × 10 × 9in. approx. Rating 10 watts. Inc. 13 × 8in. speaker with highly flexible P.V.C. cone surround, long throw voice coil and 10,000 line magnet. High flux pressure tweeter. Handsome design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output.
See 'package offers' for illustration. Carr. 50p **£19·35**

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

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



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

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 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

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 × 2¼ × 5½in. Attractive brushed silver finish facia plate 10½ × 3½in. and matching knobs.
Complete kit of parts with full wiring diagrams and instructions. **£7·75** Carr. 40p.
OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £10·95

NOW IN STOCK!
FANE 'CRESCENDO' SUPER EFFICIENT GROUP/DISCO LOUDSPEAKERS

Send S.A.E. for leaflet on this range of extraordinarily efficient units including the very latest BASS CRESCENDO '12' 100 Watts.
FULL DISCOUNT to Genuine Trade Customers. CARR. FREE.

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

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

MIDGET CLAMPED TYPE 2½ × 2½ × 2½in.

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

FULLY SHROUDED UPRIGHT MOUNTING

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

TOP SHROUDED DROP-THRO' TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·35
250-0-250v. 100mA, 6·3v. 3·5a.	£1·55
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a.	£1·60
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·65
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 130mA, 6·3v. 4a., c.t. 6·3v. 1a. Suitable for Mullard 510 Amplifier	£2·60
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·60

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

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

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

OUTPUT TRANSFORMERS

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

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. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET
Only high grade components by leading manufacturers

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

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

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

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

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

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

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

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

COMPLETE KIT **£23** Carr. 65p

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

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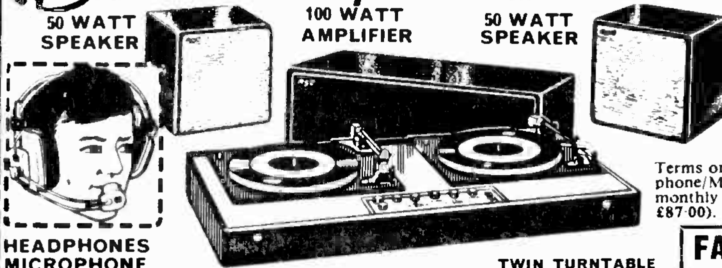
GROUP/DISCO UNITS



PACKAGE OFFER

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

(a)(b)(c)&(d) **£72·85** Carr. £1·25

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

TDI DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. see illus. on left

Carr. £1·25 **£67·10**

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

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

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

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

TYPE C412S 50 WATTS Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56 × 14 × 9in Terms: Dep. £4 and 9 monthly payments £3·37 (Total £34·33) Carr. 75p **£31**

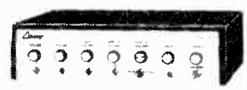
TYPE C4100 100 WATTS inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 56 × 16 × 10" Acoustically filled and pressurised. Terms: Dep. £11 and 12 mthly. pyts. £5·18 (Total £73.16). **£65** Carr. £1

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

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

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

LINEAR T40/60D 50W GROUP/DISCO AMPLIFIER



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

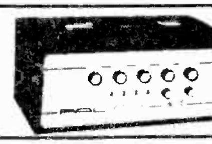
FRONT PANEL (Jack Inputs)
Gram, Gram, Microphone/Guitar P.U; plus monitoring socket.
CONTROLS Vol. (1) (2) (3) and (4). Bass, Treble, Master Vol., Monitor Selection Switch Gram (1) or (2), Mains Switch

£49·50 Carr. free
Or Deposit £7·50 and 9 monthly payments £5·37 (Total £55·83)

Simulated black rexine, plastic bonded metal case.

ALSO STOCKED LINEAR T80/100D £69·75

FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.



Solid state. 4 Separately controlled Inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3 to 30 ohms. Size 17" × 7" × 7¼". 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £7·25 & 9 monthly payments £3 55. Total £39·20. **£34·95** Carr. 75p.

RSC PHANTOM '50'

Combined 50w Amplifier and 12in. Loudspeaker. For Lead Guitar, mic., Gram, Radio, Tape (Not for use with Bass instruments). Inc. 3 inputs and 2 vol. controls plus Treble, Bass and Presence. Output Jack for additional 15 ohm Speaker. Attractively finished in black with silver-finished fascia and trimmings. Compact size. Fitted carrying handle. Terms: Deposit £8·95 and 9 monthly payments £6 (Total £62·95). Carr. £1·50 **ONLY £55·95**

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

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

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

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

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

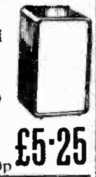
F.A.L. PHASE 50 MK.III AMPLIFIER £34·95
PR. FANE POP 25/2 25W L/SPEAKERS £13·50
£48·45
Terms: Deposit £6.50 and 9 monthly payments of £4.92 (Total £50.78)
PACKAGE PRICE **£45** carr. £1

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 £5·87 (Total £58.83)
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

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 £10·78 (Total £112·52)
PACKAGE PRICE **£99·95** carr. £2

HIGH QUALITY LOUDSPEAKER UNITS



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

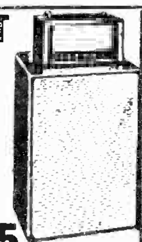
L12/20 12" 20-25 WATT 13,000 lines 15 ohms. Carr. 50p. **£11·95**

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

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

V.A.T!
PRICES QUOTED—INCREASE FROM APRIL 1st.

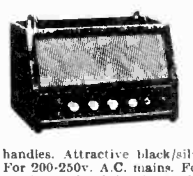
RSC BASS-REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit either horizontal or vertical mounting.
★ Two extra heavy duty 12in. 50w Loudspeakers.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls. Send S.A.E. for leaflet.

Credit Terms: Deposit £15 & 9 monthly payments of £6·25. (Total £71·25.) Carr. £2 **£65**

RSC GP30 HI-FI AMPLIFIER



For Guitar, Vocal or Instrumental Group

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

NOW FOUR NEW BRANCHES

NOTTINGHAM 19/19A MARKET STREET
SUNDERLAND 5 MARKET SQUARE
STOCKPORT 8 LITTLE UNDERBANK
COVENTRY 17 SHELTON SQUARE
NEW LARGER PREMISES AT HULL, DARLINGTON & NEWCASTLE See Addresses

HI-FI CENTRES LTD.

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AUDIO HOUSE, HENCONNER LANE, LEEDS, 13.
Tel: Pudsey (09735) 77631.
TERMS C.W.O. or C.O.D. No C.O.D. under £1. POSTAGE 25p EXTRA UNDER £2. 30p EXTRA OVER £2 OR AS QUOTED. TRADE SUPPLIED.
S.A.E. PLEASE WITH ENQUIRIES.
SUPPLIERS TO GOVT. DEPTS. H.M. FORCES. EDUCATION AUTHORITIES & HOSPITALS. Etc.
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Open all day Saturday

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NEWCASTLE UPON TYNE Tel. 47096 24 Newgate Shopping Centre (Closed Wed.). Tel. 21469
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SHEFFIELD 13 Exchange Street (Castle Market Blds.) (Closed Thurs.). Tel. 20716
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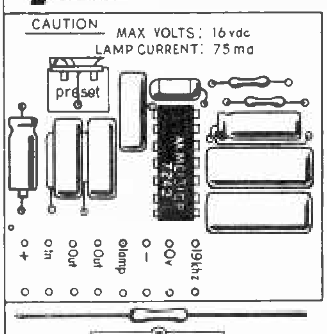
Tune into the world with this amazing world radio. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220–240 volt domestic mains supply. 14 Transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the **8 WAVEBANDS.** Complete with earphone for personal listening. Frequency ranges: **Long wave** 150–350Kcs. **Medium** 353–1605Kcs. **Marine** 1·6–4·5Mcs. **Short Wave** 12–24Mcs. **FM/VHF** 88–108Mcs. **Aircraft** 108–135 Mcs. **PUBLIC SERVICE BANDS** 135–174Mcs. Fully guaranteed.

N.B. The Ministry of Post & Telecommunications has pointed out that a licence (not generally available to the public) is required for reception of transmissions by Fire Brigade, Aircraft, Shipping, etc.

SONIC SOUND AUDIO LTD. (Dept. PW11), 372 EDGWARE ROAD, LONDON, W.2. Tel. 01-723 0094. Callers welcome Monday to Saturday 9 a.m.–6 p.m.

Stereo radio from your existing tuner.



A complete set of parts from Jermyn to build a stereo decoder module that will convert your existing mono tuner for stereo reception whilst maintaining a high standard of reproduction.

The distortion is very low (typically 0.3% at 560 mV RMS composite input signal) with 40dB channel separation.

The stereo switching is automatic and there is a light emitting diode which acts as a stereo beacon.

The kit requires no coil and there are no alignment problems.

Fitting. The module requires a 10-16 volt power supply which can normally be tapped off the existing tuner. The signal input is taken off before the de-emphasis circuit which in practice means disconnecting one, or at the most, two capacitors. Any radio engineer will be able to spot these capacitors, but if you're really stuck send the circuit with a SAE to us and one of our engineers will indicate the output point. (This is the full extent of our involvement, no hardware please).

Of course, if you have a modern mono tuner with a multiplex output our module simply plugs in.

The outputs go via a screened twin cable to the tuner inputs of your stereo amplifier.

And the cost? £4.90 for the Kit with 100% tested integrated circuit. Also available assembled and aligned, checked and ready for use at £6.90 (includes 12 month guarantee). Beat that!

To Jermyn Industries
74 Vestry Estate
Sevenoaks
Kent

Please rush me ☐ Kit(s), ☐ made up Stereo decoders.
I enclose cheque/postal order for £

Name
Address

Block Capitals Please

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There are 195 other good reasons for buying AMTRON electronic kits

Apart from the five items shown above, there are another 195 kits to choose from in the vast AMTRON range of electronic kits.

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Power supplies, preamplifiers, amplifiers, L.F.instruments, accessories for musical instruments, amateur and radio control transmitters and receivers, battery chargers, electronic car accessories, psychedelic lighting equipment, measuring instruments, tuners, receivers, I.C.digital equipment.

Only 1st class fully guaranteed components are used —solder is included with every kit.

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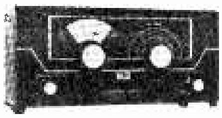
AMATEUR RADIO EQUIPMENT

CODAR

P.R.40

SOLID STATE
R.F. PRESELECTOR

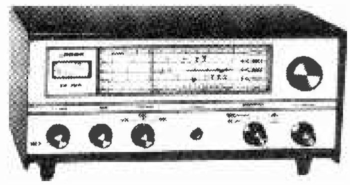
The PR40 R.F. Preselector is the solid state version of the world famous PR30 which it now supercedes.
It employs Silicon "N" Channel FET (Field Effect Transistor) front end, followed by silicon NPN Broad Band R.F. Amp., and will substantially improve receiver performance over the range 1·5 to 35 MHz, 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.

SEND FOR YOURS TODAY!

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.

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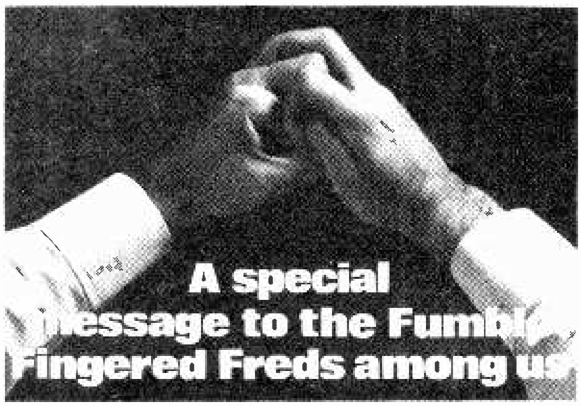

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Complete kit with full instruction data **£9·50**

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Kit includes only capacitors, semiconductors, switches, preset and loudspeaker. **£2·80 OR**
COMPLETE kit including above plus resistors, PC board and box **£4·40**

TRIFFID RADIO (P.E. Feb. 1973)
Kit of resistors, Capacitors, Transistors, Diodes, Potentiometer and I.C. **£4·95**

LIGHT DIMMER kit contains all parts including circuit and construction data. Fully suppressed, 480 Watts **£2·10**

DRILL SPEED CONTROLLER (E.E. Aug. 1972)
Complete kit (less MK box, plate and socket) **£1·05**
Complete kit including MK box, plate and socket **£2·20**

P.C. Boards not supplied, unless otherwise stated.
We are also able to supply other kits for articles published in *Practical Wireless* and other Electronic magazines. Send for details of other kits available. Please enclose a stamped addressed Envelope.

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Telephone 01 - 286 0011 MON.–FRI. 9.30–5.30 THURS. 9.30–6.30

www.americanradiohistory.com

ZN414 £1.25 POST FREE

The I.C. Radio in a TO18 can. Supplied complete with data sheet No. 10 which contains specification, circuit and details and prices of components such as ferrite rods, compression trimmers etc.

I.C. Sockets

Dual-in-line or Zig-Zag (Quil), 14 and 16 pin
Our Price 1p per pin

Slider Pots

Single	Dual	log
10K	10 + 10K	or
25K	25 + 25K	lin
50K	50 + 50K	
100K	100 + 100K	Knobs
30p	50p	10p

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AA119	9p	BA156	15p	BY176	£1·50
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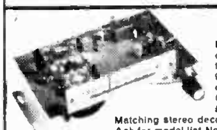
AA129	9p	OA47	10p	BY250	23p
BA102	25p	OA79	9p	IN4001	6p
BA115	17p	OA90	7p	IN4002	7p
BA130	10p	OA91	7p	IN4003	8p
BA145	20p	OA200	10p	IN4004	8p
BA148	20p	BY100	15p	IN4005	10p
BA154	13p	BY126	15p	IN4006	12p
BA155	14p	BY127	15p	IN4007	15p

BZY88 ZENER SERIES 10p each



FM TUNER chassis fully transistorised 9 volt operation. OUR PRICE £6·25
Matching stereo decoder £4·97
Ask for model list No. 11.

VDR's & Thermistors

A15B	75p	GL23	£1·00	VA1005	15p
CZ1	15p	R53	£1·32	VA1026	13p
CZ4	13p	R54	£1·46	VA1033	13p
CZ13A	13p			VA1040	10p
E298 ED/A258	10p			VA1053	10p
E298 ZZ/06	10p			VA1055S	10p
GL16	£1			VA1034	10p

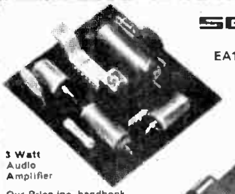
Resistors

½ watt 5% Carbon Film – low noise Hi-Stabs
All E24 values 1p each plus p. & p. 7p for up to 50 Resistors and a further 2p for each additional 50 Deduct 33⅓% for 100 of one type or 25% for mixed orders over £1 in value.

1 W	10% Carbon Composition	3p each
2 W	10% Carbon Composition	6p each
2½ W	5% Wire wound	9p each
5 W	Wire wound	9p each
10 W	Wire wound	10p each

plus p. & p. 7p for up to 25 resistors plus 1p for each additional 25.

SGS



EA1000

3 Watt Audio Amplifier
Our Price inc. handbook £2·49

10+ less 15%
25+ less 25%
100+ less 33⅓%

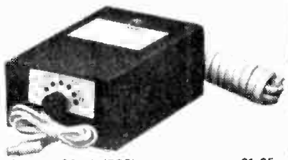
5 Watt Audio Amplifier
Our Price £3·99
Less quantity discount.

Potentiometers

5KΩ	50KΩ	500KΩ
10KΩ	100KΩ	1MΩ
25KΩ	250KΩ	2MΩ

log or lin less switch (& 1KΩ lin)	12p
log or lin with switch	24p
dual less switch	40p
dual with switch 10K, 100K & 1M log only	52p
10K log 10K antilog less switch	40p

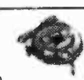
Eliminators



9 volt 20mA (PP3)	£1.25
6 volt 50mA	£1.50
9 volt 50mA	£1.50
6 6 volt, 50mA	£2.50
9 9 volt, 50mA	£2.50
7½ volt for cassette recorders	£2.00
6, 7½ or 9 volt	£3.00
3, 4½, 6, 7½, 9, 12 500mA (illus.)	£3.99
Car Battery Converter fully stabilised to provide 6, 7½ or 9 volts	£4.99

(p & p. 15p on all types)

Presets



Vertical or Horizontal
0·1 watt 5p 0·25 watt 7p

100	1KΩ	10KΩ	100KΩ	1MΩ
250	2·5KΩ	25KΩ	250KΩ	2·5MΩ
500	5KΩ	50KΩ	500KΩ	5MΩ

Capacitors

disc ceramic

·01μF	18v	5p
·022μF	18v	5p
·047μF	12v	5p

low voltage

0·1μF	30v	5p
0·22μF	6v	5p
0·47μF	3v	5p

ceramic plate

1000pf	10p
2200pf	10p

30V

4700pf	10p
10,000pf	10p

Ceramic – plate / **63V (C333)**

1·8pf	8·2pf	33pf	120pf
2·2pf	10pf	39pf	150pf
3·3pf	12pf	47pf	180pf
3·9pf	15pf	56pf	220pf
4·7pf	18pf	68pf	270pf
5·6pf	22pf	82pf	330pf
6·8pf	27pf	100pf	

all 5p. each

mylar film 100V

1000pf	2p	·01μF	3p	·068μF	4p
2000pf	2p	·02μF	3p	·1μF	4p
5000pf	2p	·04μF	3p	·2μF	5p
		·05μF	3p		

polystyrene 160V
10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68. **3p each**

metallised polyester 250V (C280)

·01μF	3p	·068μF	3½p	·47μF	8p
·015μF	3p	·1μF	4p	·68μF	11p
·022μF	3p	·15μF	4p	1μF	13p
·033μF	3p	·22μF	5p	1·5μF	20p
·047μF	3p	·33μF	6½p	2·2μF	24p

metallised polyester 400V (C281)

·01μF	4½p	·047μF	6p	·22μF	10p
·015μF	4½p	·068μF	6p	·33μF	14p
·022μF	4½p	·1μF	7p	·47μF	15p
·033μF	5½p	·15μF	8p		

silvered mica 1% (>50pf) 500V

2·2pf—820pf	7p	4·7nF—5600pf	19p
1nF—2·2nf	9p	6800pf—·01μF	29p
2·7nF—3·6nF	16p		

mixed dielectric 600V

·01μF	7p	·047μF	7p	·22μF	16p
·022μF	7p	·068μF	8p	·47μF	24p
·033μF	7p	·1μF	8p	1μF	33p

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ADDRESS TO: **Component Dept.**
56, Fortis Green Road, London N10 3HN
Telephone 01-883 3705

CHROMASONIC electronics

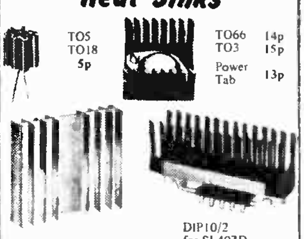
mixed dielectric 1000V

1000pf	6p	6800pf	9p	·1μF	12p
2200pf	6p	·01μF	9p	·22μF	22p
3300pf	6p	·022μF	9p	·47μF	30p
4700pf	6p	·047μF	12p		

Ceramic

12KV.d.c.		8KV.d.c.		HI-K 750V.	
10pf	9p	200pf	9p	1000pf	5p
15pf	9p	220pf	9p	1500pf	5p
22pf	9p	250pf	9p	2000pf	5p
68pf	9p	270pf	9p	3000pf	5p
82pf	9p	300pf	9p	5000pf	5p
100pf	9p	750V DISC		10,000pf	5p
120pf	9p	470pf	5p	feed-through	
140pf	9p	1000pf	5p		
150pf	9p	5000pf	5p		
180pf	9p	10,000pf	5p	1000pf	5p

Heat Sinks



TO5 TO18	5p
TO66	14p
TO3	15p
Power Tab	13p
10D	50p
DIP10/2 for SL403D	15p

Veroboard

	Copperclad 0.1"	Copperclad 0.15"	Plain 0.15"
2½" x 1"	6p	6p	–
2½" x 3¾"	20p	16p (9)	10p
2½" x 5"	24p	21p (7)	12p
3¾" x 3¾"	24p	21p (8)	–
3¾" x 5"	27p	27p (10)	17p
17" x 2½"	67p	50p	37p
17" x 3¾"	90p	70p	52p
17" x 5"	–	–	75p

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Pin Insertion Tool	47p
Terminal Pins	18p per pack of 36

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TRANSISTORS, I.C.'s, etc. (soon)
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Aluminium Boxes

Including baseplate and screws

No.	L. W. D.	Price	p. & p.
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12	3" x 2" x 1"	32p	9p
13	6" x 4" x 2"	50p	10p
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15	8" x 6" x 3"	75p	18p
16	10" x 7" x 3"	85p	20p

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AC107	25p	BC147	10p	BF196	15p	OC81	19p	2N1304	22p	2N5172	15p
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AC127	15p	BC149	10p	BF272	53p	OC170	23p	2N1893	30p	LO36TI	£1·50
AC128	15p	BC157	12p	BFY50	24p	OC171	30p	2N2926 all	10p	LO37TI	£1·50
AC176	15p	BC158	10p	BFY51	21p	ZTX107	15p	2N3053	23p	MC1303L	£1·75
AC187	25p	BC159	12p	BRY39	36p	ZTX108	12p	2N3054	50p	MC1330	80p
AC187K	25p	BC169	15p	BSX21	26p	ZTX109	15p	2N3055	49p	MC1350	75p
AC188	25p	BC268	15p	BSY95A	14p	ZTX300	12p	2N3702	12p	MC1351	£1·00
AC188K	25p	BD115	67p	BU105/02	£1.75	ZTX301	15p	2N3703	12p	MC1352	£1·00
ACY20	20p	BD131	70p	MJE340	67p	ZTX302	20p	2N3704	10p	MFC4000B	49p
AD140	40p	BD132	70p	MPF192	40p	ZTX303	20p	2N3705	10p	MFC4010A	55p
AD149	40p	BD131/2M.P	149p	MPF103	37p	ZTX304	25p	2N3706	10p	LM380	£1·45
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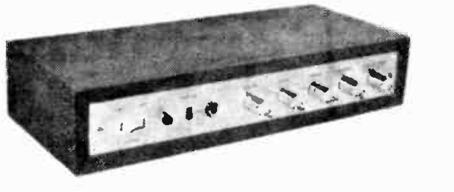
AF117	18p	BF181	30p	OC44	15p	ZTX504	50p	2N3819	35p	μA710	45p
AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3903	15p	μA723C	95p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3904	17p	μA741C	47p
BC108	10p	BF194	15p	OC72	17p	2N706	12p	2N3905	21p	μA748C	60p
BC109	10p	BF195	15p	OC76	15p	2N708	15p	2N3906	12p		

THE TEXAN



Complete Kit (inc. Teak Case) **£28.50** P&P 45p

20 Watts per channel integrated stereo amplifier developed by engineers of Texas Instruments Ltd. This designer approved kit has a state-of-the-art specification, including distortion of only 0.09% at 20 Watts into 8 ohms and a bandwidth of 5 – 35,000 at –3db. The semiconductor compliment of this superb kit includes no less than 6 integrated circuits, 10 Silicon transistors, 4 rectifiers and 2 zeners. Controls include bass; treble; volume; balance, on/off; 'on' indicator; headphone sockets; scratch filter; rumble filter, inputs for magnetic phono; tuner; aux or tape; tape head etc; input; selector, mono/stereo switch. The construction of this kit was featured in 'Practical Wireless' May - Aug. 1972.

Mullard & Siemens Electrolytics

CAP μF	4	6.3	10	16	25	40	63
1	—	—	—	—	—	—	6p
1·5	—	—	—	—	—	—	6p
2·2	—	—	—	—	—	—	6p
3·3	—	—	—	—	—	—	6p
4·7	—	—	—	—	—	—	6p
6·8	—	—	—	—	—	6p	6p
10	—	—	—	—	6p	—	6p
15	—	—	—	6p	—	6p	6p
22	—	—	6p	—	6p	—	6p
33	—	6p	—	6p	—	6p	—
47	6p	—	6p	—	6p	6p	6p
68	—	6p	—	6p	—	—	10p
100	6p	—	6p	—	6p	6p	12p
150	—	6p	—	6p	6p	10p	12p
220	6p	—	6p	6p	10p	12p	18p
330	6p	—	6p	10p	—	—	21p
470	—	6p	10p	—	12p	18p	40p
680	—	10p	—	12p	18p	21p	—
1000	10p	—	12p	18p	21p	40p	60p
1500	—	12p	18p	21p	—	—	—
2200	—	18p	21p	40p	45p	55p	93p
3300	—	21p	—	—	—	—	—
4700	21p	—	—	60p	75p	93p	—

CAP μF	16	25	40	64
500			33p	40p
1250			50p	—
1600			—	75p
2000	40p	50p	—	—
2500	—	—	75p	93p
3200	50p	—	—	—
4000		75p	93p	—
6400	75p	93p	—	—

Quantity Prices on application.

Hi-Volt Electrolytics

1, 2; 4; 8μF 450V	14p	32μF 450V	20p
16μF 450V	15p	50μF 350V	20p
8 8μF; 450 V.W	18p	32 32μF; 350 V.W	25p
8 16μF; 450 V.W	20p	32 32μF; 450 V.W	43p
16 16μF; 450 V.W	25p	50 50μF; 350 V.W	35p

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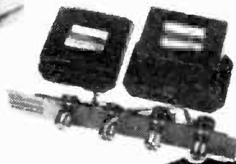
It's the RT-VC system that screws together to save you pounds! Unisound comprises two superb speakers and an amplifier/record deck plinth—all beautifully finished in simulated teak. The stereo amplifier (4 watts per channel into 8 ohms) is based on the famous Mullard Unilex system brought up-to-date by RTVC using intergrated circuits. Turntable is the proven Garrard 2025TC complete with stereo cartridge and tinted acrylic cover. Speakers are big EMI Twin-cone units all ready for mounting in their elegant cabinets, which simply need screwing and glueing together. Easy step-by-step instructions. **£26·12 complete plus £1·40 packing + £1·40 post.** Diamond Stylus £1·25 extra. Stereo headphones with adaptor £4 extra. Send for leaflet.

AN RTVC EXCLUSIVE DESIGN



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RTVC No price in

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

THE TOURIST PB CAR RADIO KIT
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ONLY FROM RTVC

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. It is permeability tuned and sturdily constructed. Output is a full 2·5 watts into an 8ohms speaker. But the Tourist PB will operate into any loudspeaker from 8 to 15 ohms.
Apart from the output stage, which is an intergrated 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 can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7" wide, 2" high and 4 1/16" deep.

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

PRICE ONLY £7·70 p. and p. 55p
Speaker with baffle and fixing strips £1·50. 25 p. & p., post free if bought with the kit. Send for leaflet.

RELIANT MkIV

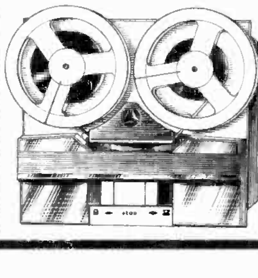
A GOOD QUALITY AMPLIFIER—12 Watts £10·50 (inc. VAT). 20 Watts £13·50 (inc. VAT)
*5 Electrically Mixed inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling INPUTS 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. Power output: 12/20 watts into 8 ohms. Size approx. 12½ x 6 x 3½ ins.

12W version **£10·50** plus 60p p & p
20W version **£13·50**

SOUND 50

50 WATT AMPLIFIER. Output Power: 45 watts R.M.S. (Sine Wave) Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs conrotlled by separate volume control. 2 inputs at 200mV into 470K. Size: 19¼ x 10¼ x 8ins. Amplifier £31·85 plus £1·50 p. and p.

£38·51 (inc. VAT)



PE TAPE LINK CONSTRUCTORS
Suitable 3 speed tape deck, less leads. Caters up to 7ins. spools. Unused but store soiled hence no warranty.
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* Denotes VAT has been absorbed in the price without increase on VISCOUNT audio systems.

crease* with VAT!

PRICES: SYSTEM 1

Viscount III R 101 amplifier	£24·20	+ £1 p & p
2 Duo Type II speakers	£15·40	+ £2·20 p & p
Garrard SP25 Mk.III with MAG. cartridge plinth & cover	£25·00	+ £1·75 p & p
total	£64·60	

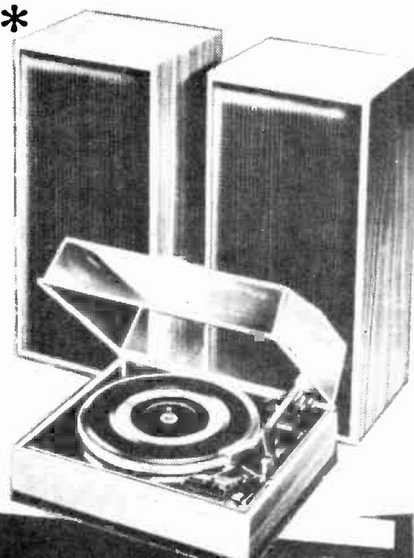
Available complete for only £52* + £3·50 p & p

PRICES: SYSTEM 2

Vicount R 101 amplifier	£24·20	+ £1 p & p
2 Duo Type III speakers	£35·20	+ £3·30 p & p
Garrard SP25 Mk. III with MAG. cartridge plinth & cover	£25·00	+ £1·75 p & p
total	£84·40	

Available complete for £69* + £4 p & p

VISCOUNT III AUDIO STILL ONLY £52* COMPLETE



14 + 14w. r.m.s. 40Hz to 40kHz ± 3dB. Total distortion at 10w. at 1kHz – 0·1%. This is real value for money! We have designed 2 systems and the heart of them both 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.

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

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

SPEAKERS: Duo Type II Size approx. 17in. × 10¾in. × 6¾in. Drive unit 13in. x 8in. with parasitic tweeter. Max. power 10 watts ohms. Simulated Teak cabinet. £15·40 a pair (inc. VAT), £3·30 p. and p. Duo Type III Size approx. 23½in. × 11½in. × 9½in. Drive unit 13½in. 8½in. with H.F. speaker. Max. power 20 watts ohms. Freq. range 20Hz to 20KHz. Teak veneer cabinet.
SPECIFICATION R101: 14 watts per channel into 3 to 4 ohms (suitable 3–15 ohms.) Total distortion @ 10W 1kHz @ 0·1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within idB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. Signal-to-noise ratio: (all controls at max.)—P.U.1. and radio — 65dB, P.U.2 — 58dB. Cross talk better than — 35dB on all inputs. Size approx. 13¾in. × 9in. × 3¾in. Send S.A.E. for fully illustrated brochure. 12 month's written guarantee.

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		6BE6	30	6J7M	45	7C6	75	14H7	50	42	50	DAF96	45	EC90	33	EL41	60	N108	£1·50	PL504	80	U404	60
		6BH6	75	6J7G	30	7H5	60	19AQ5	50	50B5	50	DCC90	£1·35	ECC81	35	EL42	65	OA2	38	PL508	90	U801	£1·18
1A7GT	45	6BJ6	50	6J7GT	45	7H7	50	20D1	50	50C5	50	DF33	55	ECC82	30	EL84	25	OC3	38	PL509	£1·10	UABC80	40
1CP31	£7·00	6BQ7A	45	6K6GT	60	7R7	75	20F2	70	50CD6G	£1·20	DF70	45	ECC83	30	EL95	35	OZ4	40	PL802	95	UAF42	55
1D5	50	6BR7	90	6K7M	35	7S7	£2·25	20L1	£1·10	50L6GT	55	DF91	30	ECC84	30	ELL80	£1·00	PC86	60	PX4	£2·50	UBC41	50
1H5	50	6BR8	70	6K7G	35	7Y4	65	20P1	£1·10	72	50	DF92	20	ECC85	40	EM80	45	PC88	60	PX25	£2·50	UBC81	40
1N5GT	55	6BS7	£1·30	6K7GT	35	9BW6	60	20P3	£1·20	78	45	DF96	45	ECC88	40	EM81	60	PC97	50	PY33	63	UBF80	40
1R5	40	6BW6	85	6K8M	60	10C2	63	25A6	35	80	55	DH3-91	£7·00	ECH21	63	EM84	35	PCC84	40	PY81	30	UBF89	35
1S4	30	6BW7	80	6K8G	40	10F1	75	25L6GT	50	85A2	50	DH77	35	ECH35	£1·00	EY51	40	PCC89	50	PY82	35	UCC84	43
1S5	30	6C4	33	6K8GT	50	10F3	90	25Y5	65	150B2	60	DK32	45	ECH42	75	EY86	40	PCC189	55	PY83	38	UCC85	40
1T4	30	6C5G	35	6K25	75	10F9	60	25Z4	30	150C4	60	DK91	40	ECH81	30	EZ35	40	PCF80	30	PY500	£1·00	UCF80	55
3A4	40	6C6	25	6L6G	50	10F18	50	25Z5GT	55	801	60	DK92	55	ECH83	45	EZ40	50	PCF82	35	PY800	40	UCH42	70
3Q4	50	6CD6G	£1·25	6L18	45	10LD11	65	25Z6	65	807	50	DK96	50	ECL80	45	EZ41	50	PCF84	60	PY801	50	UCH81	40
3Q5	50	6CH6	60	6Q7G	40	10P13	60	30C1	30	8131 SA	£3·75	DL66	£1·25	ECL82	35	EZ80	27	PCF86	60	R18	75	UCL82	35
3B4	35	6CW4	65	6Q7GT	43	11E3	£4·00	30C15	80	866A	75	DL92	35	ECL83	70	EZ81	29	PCF801	50	R19	50	UCL83	60
3V4	48	6D6	35	6SA7M	40	12AT6	30	30C17	90	954	60	DL93	40	ECL86	40	GY501	80	PCF802	50	S130	£1·75	UF41	60
5R4GY	75	6E5	£1·00	6SC7M	75	12AT7	35	30C18	80	1625	55	DL94	48	ECLL800		GZ30	40	PCF805	80	SP4	50	UF89	40
5U4G	85	6F1	70	6SG7M	40	12AU6	35	30F5	85	4022AR	£5·50	DL95	50		£1·65	GZ32	48	PCF806	70	SP41	£3·00	UL41	65
5V4G	45	6F5G	90	6SH7M	40	12AU7	30	30FL1	75	5763	70	DL96	45	EF9	75	GZ34	60	PCF808	85	SP61	75	UL84	40
5Y3GT	40	6F6G	35	6SJ7GT	30	12AX7	30	30FL12	£1·20	7193	30	DM70	45	EF37A	£1·20	HN309	£1·50	PCL82	35	STV280/80		UM80	30
5Z4G	40	6F8G	50	6SK7GT	40	12BA6	40	30FL14	85	7475	50	DY86	33	EF39	60	KT36	£1·00	PCL83	65		£10·00	UU9	50
6/30L2	80	6F11	40	6SL7GT	35	12BE6	40	30L15	85	A61	48	DY87	33	EF41	65	KT61	£1·25	PCL84	45	SU25	£1·00	UY21	50
6A7	75	6F13	45	6SN7GT	35	12C8GT	35	30L17	80	ATP4	45	E88CC	65	EF50	25	KT66	£2·05	PCL85	40	SU2150	75	UY41	48
6A8G	40	6F14	70	6SQ7GT	40	12E1	£3·00	30P4	£1·12	ATP5	60	EA50	20	EF54	£1·25	KT81	£1·75	PCL86	45	T41	£1·00	UY85	40
6AK5	35	6F23	85	6U4GT	65	12J5GT	30	30P12	80	ATP7	60	EABC80	35	EF80	25	KT81(7C5)		PD500	£1·30	TDD4	60		
6AM5	35	6F24	75	6U5G	£1·00	12J7GT	50	30P19	85	AU2	£4·00	EAF42	55	EF85	35		£1·13	PEN A4	£1·00	U10	75	VMP4G	85
		6F25	£1·00	6V6M	60	12K7GT	40	30PL1	75	AU5	75	EB91	20	EF86	30	KT88	£2·00	PEN B4	£1·00	U14	75	VP4B	£1·25
6AM6	33	6F28	65	6V6G	30	12K8GT	50	30PL13	93	AZ1	55	EBC33	50	EF89	28	KTW61	£1·75	PEN45	75	U19	£3·00	VR105/30	38
6AQ5	38	6F32	25	6V6GT	40	12Q7GT	40	30PL14	90	AZ31	55	EBC41	55	EF91	33	KTZ41	50	PEN46	40	U25	80	VR150/30	35
6AS7G	85	6G6	35	6X4	35	12SA7GT	50	35A5	75	CBL31	£1·00	EBC90	35	EF92	35	ML4	88	PL36	55	U26	80	VU111	75
6AT6	35	6H6	23	6X5G	40	12SG7	35	35L6	50	CCH35	75	EBF80	40	EF98	75	ML6	40	PL81	50	U78	35	VU120	£1·00
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6B4G	£1·00	6J5G	20	7B6	70	12SJ7	40	35Z3	70	CY30	63	EBF89	30	EF184	35	MU14	75	PL83	45	U251	80	W81M	68
6B8G	25	6J5GT	30	7B7	50	12SK7	50	35Z4GT	60	CY31	43	EBL1	£1·00	EL32	50	MX40	63	PL84	40	U301	63	Y63	£1·25
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				ACY20	20	BZY88	15	OA70	10	OC45	12
				ACY39	50	CRS1-40	47	OA71	10	OC57	60
1N914	07	2N2219	20	AD140	50	DD003	15	OA81	08	OC58	60
1S113	25	2N2369A	15	AD149	50	GET102	30	OA85	12	OC59	65
1S202	23	2N2444	£1·91	AD161	37	GET882	25	OA91	07	OC71	12
2G302	22	2N2646	45	AF115	25	GJ7M	37	OA211	30	OC72	20
2G371	22	2N2904	20	AF117	25	KS100A	20	OAZ201	50	OC81	20
2N404	20	2N2926	10	ASY26	25	MJE520	87	OAZ207	47	OC81D	20
2N697	15	2N3055	75	BC107	10	MJE2955		OAZ210	32	OC82	25
2N706	10	2N3702	10	BC108	10		£1·37	OAZ222	45	OC82D	20
2N1132	25	2N3819	35	BC109	10	MJE3055	87	OAZ224	45	OC84	25
2N1305	22			BC169C	15	NKT212	27	OAZ241	22	OC170	25
2N2147	75	AAZ12	30	BF898	28	NKT214	15	OAZ242	23	OC171	30
2N2160	60	AC126	20	BFY50	22	NKT223	33	OAZ246	23	OC200	40
2N2218	20	AC127	25	BFY51	20	NKT251	24	OC35	50	OCP71	97

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				7437	65	7480	80	74111	£1·45	74175	£1·35
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7400	20	7411	23	7440	20	7483	£1 00	74119	£1·90	74190	£1·95
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7403	20	7416	30	7450	20	7490	75	74123	£2·70	74193	£2 00
7404	20	7417	30	7451	20	7491AN	£1 00	74141	£1·00	74194	£2·50
7405	20	7420	20	7453	20	7492	75	74145	£1·50	74195	£1·85
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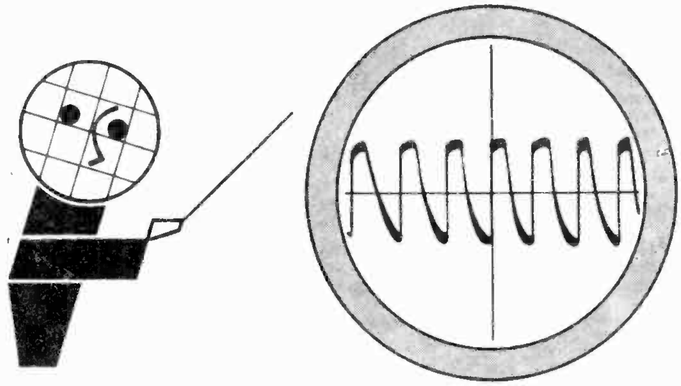

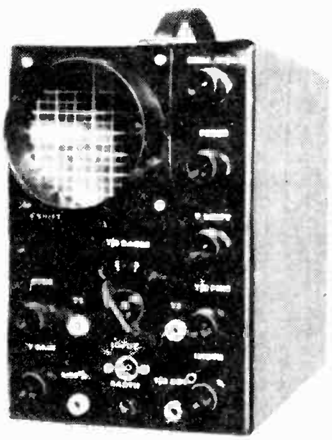

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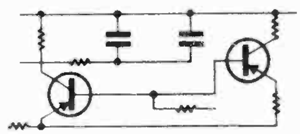

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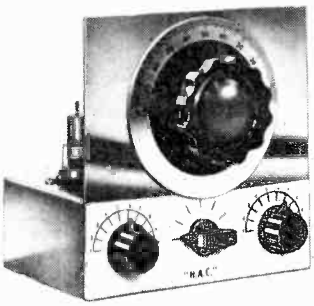

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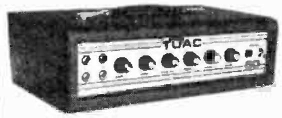

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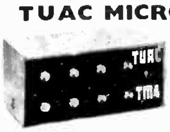

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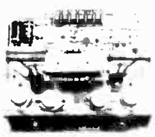

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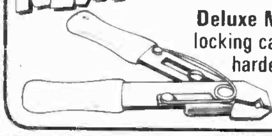

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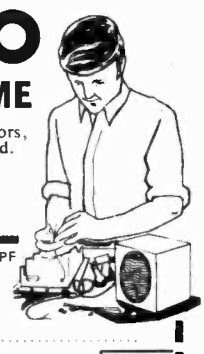

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AC107	0·20
AC113	0·20
AC115	0·23
AC117K	0·20
AC122	0·12
AC125	0·17
AC126	0·17
AC127	0·17
AC128	0·17
AC132	0·14
AC134	0·14
AC137	0·14
AC141	0·14
AC141K	0·17
AC142	0·14
AC142K	0·17
AC151	0·15
AC154	0·20
AC155	0·20
AC156	0·20
AC157	0·24
AC165	0·20
AC166	0·20
AC167	0·20
AC168	0·24
AC169	0·14
AC176	0·20
AC177	0·24
AC178	0·28
AC179	0·28
AC180	0·17
AC180K	0·20
AC181	0·17
AC181K	0·20
AC187	0·22
AC187K	0·20
AC188	0·22
AC188K	0·20
ACY17	0·25
ACY18	0·20
ACY19	0·20
ACY20	0·20
ACY21	0·20
ACY22	0·16
ACY27	0·18
ACY28	0·19
ACY29	0·35
ACY30	0·28
ACY31	0·28
ACY34	0·21
ACY35	0·21
ACY36	0·28
ACY40	0·17
ACY41	0·18
ACY44	0·35
AD130	0·38
AD140	0·48
AD142	0·48
AD143	0·38
AD149	0·50
AD161	0·33

AD162	0·33
AD161 & AD162 (MP)	0·55
ADT140	0·50
AF114	0·24
AF115	0·24
AF116	0·24
AF117	0·24
AF118	0·35
AF124	0·30
AF125	0·25
AF126	0·28
AF127	0·28
AF139	0·30
AF178	0·50
AF179	0·50
AF180	0·50
AF181	0·45
AF186	0·46
AF239	0·37
AL102	0·65
AL103	0·65
ASY26	0·25
ASY27	0·30
ASY28	0·25
ASY29	0·25
ASY50	0·25
ASY51	0·25
ASY52	0·25
ASY54	0·25
ASY55	0·25
ASY56	0·25
ASY57	0·25
ASY58	0·25
ASZ21	0·40
BC107	0·09
BC108	0·09
BC109	0·10
BC113	0·10
BC114	0·15
BC115	0·15
BC116	0·15
BC117	0·15
BC118	0·10
BC119	0·30
BC120	0·80
BC125	0·12
BC126	0·18
BC132	0·12
BC134	0·18
BC135	0·12
BC136	0·15
BC137	0·15
BC139	0·40
BC140	0·30
BC141	0·30
BC142	0·30
BC143	0·30
BC145	0·45
BC147	0·10

BC148	0·10
BC149	0·12
BC150	0·18
BC151	0·20
BC152	0·17
BC153	0·28
BC154	0·30
BC157	0·18
BC158	0·12
BC159	0·12
BC160	0·45
BC161	0·50
BC167	0·12
BC168	0·12
BC169	0·12
BC170	0·12
BC171	0·14
BC172	0·14
BC173	0·14
BC174	0·14
BC175	0·22
BC177	0·19
BC178	0·19
BC179	0·19
BC180	0·24
BC181	0·24
BC182	0·10
BC182L	0·10
BC183	0·10
BC183L	0·10
BC184	0·12
BC184L	0 12
BC186	0·28
BC187	0·28
BC207	0·11
BC208	0·11
BC209	0·12
BC212L	0·11
BC213L	0·11
BC214L	0·14
BC225	0·25
BC226	0·35
BCY30	0·24
BCY31	0·26
BCY32	0·30
BCY33	0·22
BCY34	0·25
BCY70	0·14
BCY71	0·18
BCY72	0·14
BCZ10	0·20
BCZ11	0·25
BCZ12	0·25
BD121	0·60
BD123	0·65
BD124	0·60
BD131	0·50
BD132	0·60
BD133	0·65
BD135	0·40
BD136	0·40

BD137	0·45
BD138	0·50
BD139	0·55
BD140	0·60
BD155	0·80
BD175	0·60
BD176	0·60
BD177	0·65
BD178	0·65
BD179	0·70
BD180	0·70
BD185	0·65
BD186	0·65
BD187	0·70
BD188	0·70
BD189	0·75
BD190	0·75
BD195	0·85
BD196	0·85
BD197	0·90
BD198	0·90
BD199	0·95
BD200	0·95
BD205	0·80
BD206	0·80
BD207	0·95
BD208	0·95
BDY20	1·00
BF115	0·24
BF117	0·45
BF118	0·70
BF119	0·70
BF121	0·45
BF123	0·50
BF125	0·45
BF127	0·50
BF152	0·55
BF153	0·45
BF154	0·45
BF155	0·70
BF156	0·48
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BF162	0·40
BF163	0·40
BF164	0·40
BF165	0·40
BF167	0·22
BF173	0·22
BF176	0·35
BF177	0·35
BF178	0·30
BF179	0·30
BF180	0·30
BF181	0·30
BF182	0·40
BF183	0·40
BF184	0·25
BF185	0·30

BF188	0·40
BF194	0·12
BF195	0·12
BF196	0·14
BF197	0·14
BF200	0·45
BF222	0·95
BF257	0·45
BF258	0·60
BF259	0·85
BF262	0·55
BF263	0·55
BF270	0·35
BF271	0·30
BF272	0·80
BF273	0·35
BF274	0·35
BFW10	0·60
BFX29	0·27
BFX84	0·22
BFX85	0·30
BFX86	0·22
BFX87	0·24
BFX88	0·22
BFY50	0·20
BFY51	0·20
BFY52	0·20
BFY53	0·17
BPX25	0·85
BSX19	0·15
BSX20	0·15
BSY25	0·15
BSY26	0·15
BSY27	0·15
BSY28	0·15
BSY29	0·15
BSY38	0·18
BSY39	0·18
BSY40	0·28
BSY41	0·28
BSY95	0·12
BSY95A	0·12
Bu105	2·00
C111E	0·50
C400	0·30
C407	0·25
C424	0·20
C425	0·50
C426	0·35
C428	0·20
C441	0·30
C442	0·30
C444	0·35
C450	0·22
MAT100	0·19
MAT101	0·20
MAT120	0·19
MAT121	0·20
MPF102	0·42
MPF104	0·37
MPF105	0·37

OC19	0·35
OC20	0·63
OC22	0·38
OC23	0·42
OC24	0·56
OC25	0·38
OC26	0·25
OC28	0·50
OC29	0·50
OC35	0·42
OC36	0·50
OC41	0·20
OC42	0·24
OC44	0·15
OC45	0·12
OC70	0·10
OC71	0·10
OC72	0·14
OC74	0·14
OC75	0·15
OC76	0·15
OC77	0·25
OC81	0·15
OC81D	0·15
OC82	0·15
OC82D	0·15
OC83	0·20
OC84	0·20
OC139	0·20
OC140	0·20
OC169	0·25
OC170	0·25
OC171	0·25
OC200	0·25
OC201	0·28
OC202	0·28
OC203	0·25
OC204	0·25
OC205	0·35
OC309	0·40
P346A	0·20
P397	0·42
OCP71	0·43
ORP12	0·43
ORP60	0·40
ORP61	0·40
ST140	0·12
ST141	0·17
TI843	0·80
UT46	0·27
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2G302	0·19
2G303	0·19
2G304	0·24
2G306	0·40
2G308	0·35
2G309	0·35
2G339	0·20
2G339A	0·16
2G344	0·18
2G345	0·16

2G371	0·16
2G371B	0·12
2G373	0·17
2G374	0·17
2G377	0·30
2G378	0·16
2G381	0·16
2G382	0·16
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2N930	0·21
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2N1893	0·37
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2N2714	0·21
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2N2905A	0·21
2N2906	0·15
2N2906A	0·18
2N2907	0·20
2N2907A	0·22
2N2923	0·14
2N2924	0·14
2N2925	0·14
2N2926 (G)	0·12
2N2926 (Y)	0·11
2N2926 (O)	0·10
2N2926 (R)	0·10
2N2926 (B)	0·10
2N3010	0·70
2N3011	0·14
2N3053	0·17

2N3054	0·46
2N3055	0·50
2N3391	0·14
2N3391A	0·16
2N3392	0·14
2N3393	0·14
2N3394	0·14
2N3395	0·17
2N3402	0·21
2N3403	0·21
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2N3405	0·42
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2N3415	0·15
2N3416	0·28
2N3417	0·28
2N3525	0·75
2N3646	0·09
2N3702	0·10
2N3703	0·10
2N3704	0·11
2N3705	0·10
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2N3707	0·11
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2N3821	0·35
2N3823	0·28
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2N4062	0·12
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2N4285	0·17
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2N4292	0·17
2N4293	0·17
2N5172	0·12
2N5457	0·32
2N5458	0·32
2N5459	0·40
2S301	0·50
2S302A	0·42
2S302	0·42
2S303	0·55
2S304	0·70
2S305	0·84
2S306	0·84
2S307	0·84
2S321	0·56
2S322	0·42
2S322A	0·42
2S323	0·56
2S324	0·70
2S325	0·70
2S326	0·70
2S327	0·70
2S701	0·42
40361	0·40
40362	0·45

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AAY30	0·09			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 (Eg) OA91	0·05	SD19	0·05
BY101	0·12			1N34	0·07
BY105	0·17			1N34A	0·07
BY114	0·12	CG651		1N914	0·06
BY126	0·14	(Eq) OA70-		1N916	0·06
BY127	0·15	OA79	0·06	1N4148	0·06
BY128	0·15	OA5	0·35	1S021	0·10
BY130	0·16	OA5SL	0·21	1S951	0·06

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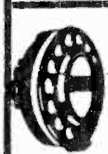

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PIV	1A	3A	5A	5A	7A	10A	16A	30A
	TO5	TO66	TO66	TO64	TO48	TO48	TO48	TO48
50	0·23	0·25	0·35	0·35	0·47	0·50	0·53	1·15
100	0·25	0·33	0·47	0·47	0·50	0·58	0·63	1·40
200	0·35	0·37	0·49	0·49	0·57	0·61	0·75	1·60
400	0·43	0·47	0·56	0·56	0·67	0·75	0·93	1·75
600	0·53	0·57	0·68	0·68	0·77	0·97	1·25	—
800	0·63	0·70	0·80	0·80	0·90	1·20	1·50	4·00

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·05	0·05	0·07	0·14	0·21	0·60
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·25	0·34	0·45	1·86
800	0·10	0·17	0·11	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·14	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·38	0·57	0·75	—

TRIACS

VBOM	2A	6A	10A
	TO-1	TO-66	TO-88
	£p	£p	£p
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200	50	60	90
400	70	75	1·10

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FULL RANGE OF ZENER DIODES VOLTAGE RANGE

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10 amp POTTED BRIDGE RECTIFIER

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2 Amp. BRIDGE RECTS.

50 v RMS	32p each	
100 v RMS	37p	,,
400 v RMS	46p	,,

Size 15 mm × 6 mm.

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Coded and Guaranteed

Pak No.			EQVT
T1	8	2G3713	OC71
T2	8	D1374	OC75
T3	8	D1216	OC81D
T4	8	2G381T	OC81
T5	8	2G382T	OC82
T6	8	2G344B	OC44
T7	8	2G345B	OC45
T8	8	2G378	OC78
T9	8	2G399A	2N1302
T10	8	2G417	AF117

All 50p each pak

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UT46. Eqvt. 2N2646, Eqvt. TIS43. BEN3000 27p each, 25-99 25p 100 UP 20p.

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ORP12 43p
ORP60, ORP61 40p each

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U37	30 Silicon Alloy Transistors SO-2 PNP OC200, 2S322	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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UIC13	= 8 × 7413	0·50	UIC72	= 8 × 7472	0·50	UIC121	= 5 × 74121	0·50
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UIC30	= 12 × 7430	0·50	UIC74	= 8 × 7474	0·50	UIC151	= 5 × 74151	0·50
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Type No.	Price 1–24	25–99	100 up
BP 201C—SL201C	63p	58p	45p
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BP 702C—SL702C	68p	50p	45p
BP 702—72702	53p	45p	40p
BP709—72709	36p	34p	30p
BP 709P—μA709C	36p	34p	30p
BP 710—72710	44p	42p	40p
BP 711—μA711	45p	43p	40p
BP 741—72741	75p	60p	50p
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TAA 350	170p	158p	150p

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Type No.	Price 1–24	25–99	100 up
BP930	12p	11p	10p
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BP945	25p	24p	22p
BP946	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.

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Epoxy TO-5 case	Price each 1–24	25–99	100 up
uL900 Buffer	35p	33p	27p
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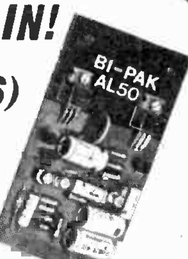

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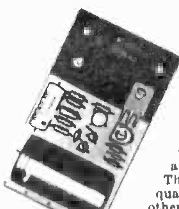

STABILISED POWER MODULE SPM80

AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
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TRANSFORMER BMT80 £1·95 p. & p. 25p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit tecnniques. 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

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CONTROL UNIT CAMERA. Contains meter 2¼" dia FSD I Ma special scale markings, 3 × toggle swts, 2 × Ind lamps, push swt etc. supplied in fitted wooden transit case. New condition. **£1·85.**

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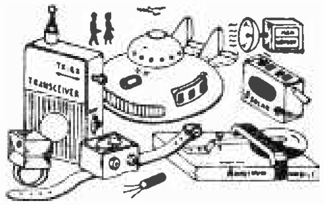

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1S4	.22	6C9	.73	6SK7GT	.23	20P1	.50	AC/PEN	.98	EBF89	.26
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3S4	.23	6DT6A	.50	7H7	.28	25Z6G	.43	AZ31	.46	ECC82	.19
4CB6	.50	6EW6	.55	7R7	.65	30A5	.44	AZ41	.53	ECC83	.21
5CG8	.50	6E5	.55	7Y4	.60	30C15	.55	CL33	.90	ECC84	.28
5T4	.30	6F1	.59	7Z4	.50	30C17	.74	CV63	.53	ECC85	.32
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6/30L2	.53	6F24	.68	10F9	.45	30FL13	.47	DF91	.14	ECF86	.64
6A8G	.33	6F25	51	10F18	.35	30FL14	.66	DF96	.34	ECF804	
6AC7	.15	6F28	.60	10LD11	.53	30L15	.55	DH76	.28		2.10
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6AH6	.50	6GH8A	.50	10P14	1.08	30P4MR	.95	DK92	.35	ECH35	.50
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EL41	.53	PC97	.36	PY82	.23	U251	.62	ACY19	.19	BF180	.30	OC24	.38
EL81	.50	PC900	.29	PY83	.26	U301	.40	ACY20	.18	BF181	.40	OC25	.38
EL83	.38	PCC84	.27	PY88	.31	U403	.33	ACY21	.19	BF185	.40	OC28	.60
EL84	.21	PCC85	.24	PY500	.95	U404	.38	ACY22	.15	BF194	.15	OC29	.63
EL85	.40	PCC88	.39	PY800	.31	U801	.76	ACY28	.18	BFY50	.23	OC35	.32
EL86	.38	PCC89	.42	PY801	.31	U4020	.38	AD140	.36	BFY51	.19	OC36	.43
EL91	.23	PCC189	.46	PZ30	.48	VP23	.40	AD149	.50	BFY52	.20	OC44	.10
EL95	.32	PCF80	.26	QQV03/10		VP41	.38	AD161	.45	BY100	.18	OC45	.11
ELL80	.75	PCF82	.30		1.20	VT61A	.35	AD162	.45	BY105	.18	OC46	.15
EM80	.37	PCF84	.40	Q875/20	.63	VU111	.44	ADT140	.63	BY114	.18	OC70	.13
EM81	.37	PCF86	.44	Q895/10	.49	VU120	.60	AF106	.50	BY126	.15	OC71	.11
EM83	.75	PCF200	.67	QV04/7	.63	VU120A	.60	AF114	.25	BY127	.18	OC72	.11
EM84	.31	PCF801	.28	R19	.28	VU133	.35	AF115	.15	BYZ10	.25	OC74	.23
EM85	1.00	PCF802	.37	SP41	.75	W107	.50	AF117	.19	BYZ11	.25	OC75	.11
EM87	.34	PCF806	.55	SP61	.75	W729	.60	AF121	.30	BYZ12	.25	OC76	.15
EY51	.29	PCH200	.62	TH233	.98	X66	.50	AF124	.25	BYZ13	.25	OC77	.27
EY81	.35	PCL82	.29	TP2620	.98	**Transistors**		AF125	.17	CG12E	.20	OC78	.15
EY83	.54	PCL83	.54	UABC80	.30	**& Diodes**		AF126	.18	FSY11A	.23	OC78D	.15
EY84	.50	PCL84	.32	UAF42	.49	2N404	.18	AF139	.65	FSY41A	.23	OC81	.11
EY87/6	.27	PCL805/85		UBC41	.45	2N966	.53	AF178	.68	GD9	.20	OC81D	.11
EY88	.40		.37	UBC81	.40	2N1756	.50	AF180	.48	GET113	.20	OC82	.11
EZ40	.40	PCL86	.36	UBF80	.28	2N2147	.85	AF186	.55	GET118	.20	OC82D	.11
EZ41	.42	PD500	1.44	UBF89	.28	2N2297	.23	AF239	.38	GET119	.20	OC83	.20
EZ80	.19	PEN4DD		UBL21	.55	2N2369	.22	BA102	.45	GET573	.38	OC84	.24
EZ81	.20		1.38	UC92	.35	2N2613	.39	BA115	.14	GET587	.43	OC123	.23
GY501	.75	PEN45	.40	UCC84	.33	2N3053	.33	BA116	.25	GET873	.15	OC139	.23
GZ32	.39	PEN45DD		UCC85	.38	2N3121	2.50	BA129	.13	GET887	.23	OC169	.23
GZ33	.70		.75	UCF80	.31	2N3703	.19	BA130	.10	GET897	.23	OC172	.35
GZ34	.47	PEN46	.20	UCH21	.60	2N3709	.20	BA153	.15	GET898	.23	OC200	.22
GZ37	.67	PEN453DD		UCH42	.57	2N3988	.50	BC107	.13	M1	.15	OC201	.38
HABC80	.44		.98	UCH81	.29	2S323	.50	BC108	.13	OA5	.28	OC203	.30
HL23DD	.40	PENDD-		UCL82	.30	AA119	.15	BC113	.25	OA9	.13	OC204	.30
HL41DD	.98	4020	.88	UCL83	.48	AA120	.15	BC115	.15	OA10	.43	OC205	.43
HL42DD	.50	PFL200	.50	UF41	.50	AA129	.15	BC116	.25	OA47	.10	ORP12	.53
HN309	1.40	PL33	.38	UF42	.60	AAZ13	.18						
HVR2	.53	PL36	.46	UF80	.35	AC107	.15						
HVR2A	.53	PL81	.42	UF85	.34	AC113	.25						
KT2	.25	PL81A	.48	UF86	.63	AC126	.13						
KT41	.98	PL82	.28	UF89	.27	AC127	.17						

MATCHED TRANSISTOR SETS:— LP15 (AC113, AC154, AC157, AA120) **53p** per pack. 1—OC81D & 2—OC81, **43p.** 1—OC44 & 2—OC45, **43p.** 1—OC82D. & 2—OC82 **48p.** Set of 3—OC83 **65p.**

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We do not handle seconds nor rejects, which are often described as "New and Tested" but have a limited and unreliable life. No enquiries answered unless S.A.E. is enclosed for reply.

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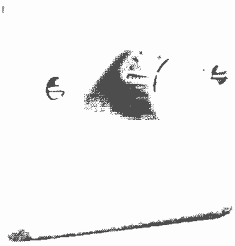

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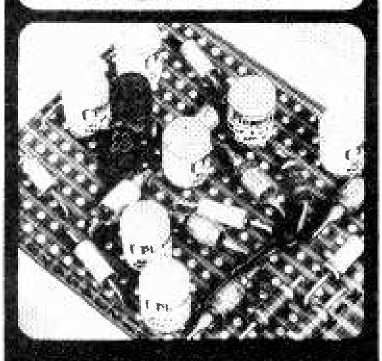

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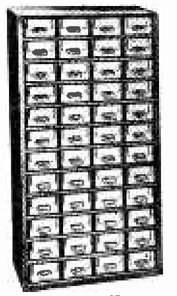

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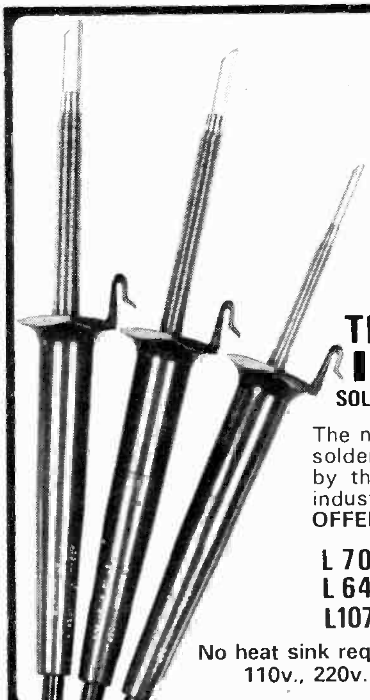
686 SOLDERING STAND
646 INVADER SOLDERING TOOL



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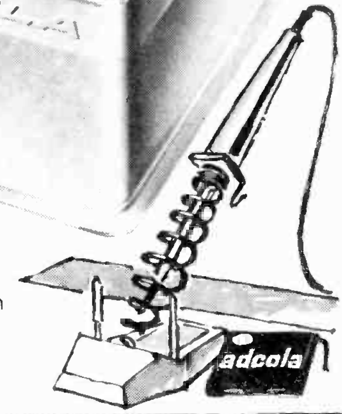

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AMSTRAD Integra 4000	35 50	21·50
ARMSTRONG 521	59·00	43·75
FERROGRAPH F307 Mk. II (cased)	68 00	45·50
GOODWIN RH 25 25	59 95	47 95
GLIXOR MW3000, 15 watts RMS per channel	49·50	23 95
JVC NIVICO VN 300	58 00	48·95
MCA 104Z	85 00	70·95
MCA 105E	130·50	109·95
MCA V5E VN550 Quadraphonic	89 00	74·95
MCA V9E VN880 Quadraphonic	148·00	124 95
KELETRON KSA 700	29·00	17·95
KELETRON KSA 1500	39·00	23 95
LEAK Delta 30 (cased)	69·90	46·95
LEAK Delta 70 (cased)	85·90	57·95
METROSOUND ST20E	39·50	24·20
METROSOUND ST60	70·00	45·45
PHILIPS RH521	109·00	89·95
PIONEER SA500A	47·10	32·95
SA600	95·48	57·95
SA800	126·55	75·95
SA1000	155·82	94·95
QL600A Quadraphonic Convertor	118·95	78·95
QD 210 Quadraphonic decoder	42·85	29·95
QA 800 Quadraphonic	188·60	122·95
Reverberation 202w	54·95	35·95
RANK ROTEL 210	34·90	22·95
RANK ROTEL 310	52·00	34·95
RANK ROTEL 610	78·50	51·95
RANK ROTEL RA 810	105·50	72·95
RANK ROTEL RA 1210	129·00	89·95
ROGERS Ravensbourne	70·00	53 95
Ravensbourne (cased)	75·00	58·95
Ravensbrook Mk. II	52·50	40·95
Ravensbrook (cased) Mk. II	57 50	43·95
SINCLAIR 2000	35 00	22·95
3000	45·00	28·95
PROJECT 605	29 95	18 90
SOLARVOX 20. 10 watts RMS per channel	39 95	24 95
SOLARVOX 30. 15 watts RMS per channel	46 95	32 95
SOLARVOX MA801 2 x 8 watts. RMS plus MATRIX 4 channel	38 45	26 95
SOLARVOX MA813 2 x 18 watts. plus MATRIX 4 channel	51 38	38·95
TANDBERG TA300	69·90	54·95
TANDBERG TA300M	79·50	65 95
WHARFEDALE Linton amplifier	65·00	42·95

All take both ceramic and magnetic cartridges.

	Rec. Retail Price	Comet Price
TUNERS		
AMSTRAD Multiplex 3000 FM	39·95	28·95
*ARMSTRONG 523 AM/FM	52·68	40·95
*ARMSTRONG 524 FM	40·97	31·95
ARMSTRONG M8 Decoder	9·50	6·95
*DULCI FMT 7 FM	24·43	14·95
GOODMANS Stereomax	75·74	35·95
JVC Nivico MCT V5E/VT500 AM/FM	86·00	69·95
MCT V7E AM/FM	122·42	99·95
LEAK Delta FM	79·50	57·95
LEAK Delta AM/FM	89·50	69·95
METROSOUND FMS 20	54·92	38·75
PHILIPS RH 690	48·50	31·95
PHILIPS RH 621	109·00	89·95
PIONEER TX500A AM/FM	75·52	50 95
PIONEER TX600 AM/FM	104·57	73 95
RANK ROTEL 320	59·50	42·95
RANK ROTEL 620	93·50	67·95
ROGERS Ravensbourne Chassis	60·29	45·95
Ravensbourne in Teak Case	64 97	49·95
Ravensbrook Chassis	43·90	33·50
Ravensbrook (cased)	49·75	38·50
SINCLAIR 2000	45·00	29·95
3000	45·00	29·95
Project 60 Tuner (stereo)	25·00	17·50

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

	Rec. Retail Price	Comet Price
TUNER/AMPLIFIERS		
AKAI CR80T AM/FM Tuner Amplifier with built in Eight Track Tape Recorder	149 84	89·95
AKAI AA8030	139·50	106·95
AKAI AA8080	189·50	145·95
AKAI AA8500	249·00	179·85
AKAI 6300	137·50	79·95
ARENA 2600	111·30	59·95
ARMSTRONG M8 Decoder	9·50	6·95
ARMSTRONG 525	90·14	69·95
ARMSTRONG 526	102·72	77·95
GOODMANS Module 80, 35w. RMS	93·00	69·95
Module 80 Compact	168·00	127·95
Module 90	119·00	91·95
Module 110 FM/MW/LW/SW/ 100w. RMS	139·00	105·95
GOODMANS Module 110, Compact	245·00	187·50
JVC Nivico 4MM 1000 Quadraphonic	159·50	134·95
JVC Nivico VR 5500/5501 AM/FM	96·96	81·95
VR 5521L AM/FM and SEA	175·00	146·95
4VR 5414 Quadraphonic	212·00	179·95
KYOTO 1000 AM/FM Tuner/Amplifier with built in Stereo Cassette Recorder. Complete with two speakers and two microphones	85·00	61·95

	Rec. Retail Price	Comet Price
TUNER/AMPLIFIERS—*continued*		
LEAK Delta 75	175·00	129·95
PHILIPS RH 720	215·00	179·95
PIONEER SX525	140·53	98·95
SX626	192·49	134·35
SX727	231·74	162·95
SX828	297·20	208·95
QX 4000 Quadraphonic	225·93	164·95
QX 8000 Quadraphonic	286·24	199·95
ROGERS Ravensbrook Chassis	96·57	73·95
ROGERS Ravensbrook (cased)	105·35	78·45
ROTEL RX 150A	69·90	50·95
ROTEL RX200A	89·50	65·95
ROTEL RX 400A	107·50	78·95
ROTEL RX 600A	149·00	109·95
ROTEL RX 800A	189·50	139·95
ROTEL RX 154A Quadraphonic	129·50	94 95
SOLARVOX TAM 1105 2 x 5 watts RMS AM/FM Multiplex comp. with 2 speakers and featuring Matrix 4 channel	38·50	29·95
TANDBERG TR200 MPX	106·00	85·95
TANDBERG TR1000 FM MPX (teak)	156·00	129·80
TANDBERG TR 1010 AM/FM MPX	169·00	139·95
TELETON CR55	125·26	68·50
TELETON R8000 AM/FM	42·16	21·95
WHARFEDALE LINTON WE40	115·00	95·95

All the above take magnetic cartridges except Teleton R8000 and Kyoto 1000 which take ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where M8 decoder is extra

	Rec. Retail Price	Comet Price
TURNTABLES		
CONNOISSEUR BD1 kit	13·34	10·95
CONNOISSEUR BD2 Chassis	32·71	25·95
CONNOISSEUR BD2 P/C/SAU2	41·29	33·95
GARRARD SP25 Mk. III	16·17	10·50
GARRARD 40B	13·63	10·95
GARRARD SL65B	20·93	13·75
GARRARD SL95B	49·21	32·25
GARRARD 401	42·88	29·50
GARRARD SL72B	32·60	21·95
GARRARD AP76	28·44	17·25
GARRARD Zero 100A	57·42	38·95
GARRARD Zero 100S	52·83	36·95

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McDONALD MP60 with Goldring G800	**Special Price £17·50**
McDONALD MP60 with SHURE M 44/7	**Special Price £18·95**
McDONALD MP60 with SHURE M 44/E	**Special Price £19·95**
McDONALD HT70 with Goldring G800	**Special Price £25·50**
GARRARD AP76 with Goldring G800	**Special Price £26·50**
GARRARD AP76 with Shure M55E	**Special Price £30·50**
GARRARD AP76 with Shure M75EJ	**Special Price £32·50**
GARRARD 2025 with Sonotone 9TAHC	**Special Price £12·75**
GOLDRING GL75 with G800	**Special Price £39·50**
GOODMANS TD100 with G800E	**75·00 51·95**

	Rec. Retail Price	Comet Price
Base and cover to fit GARRARD SP25, SL55, SL65B	Sp. Price	3·60
GOLDRING G101P/C	29·64	20·50
GOLDRING GL72 Chassis	31·39	20·95
GOLDRING GL72P	40·81	27·50
GOLDRING GL75	41·86	26·95
GOLDRING GL75P	51·62	35·25
GOLDRING GL85P/Cover	87·19	56·95
Cover for 72P	4·71	3·25
Cover for 75P (de Luxe)	5·23	3·50
Cover for 85P	6·98	4·95
C99-plinth and cover for G99	15·35	11·95
GOLDRING G99	29·64	19·25
LEAK Delta	69·50	52·50
JVC Nivico SRP 473 Quadraphonic, including plinth and cover	69·50	58·95
McDONALD MP60	14·78	9·50
McDONALD 610	18·75	12·95
McDONALD HT70	20·63	14·50
Base and cover for MP60 and 610	Sp. Price	3·95
PHILIPS GA212 Electronic	69·00	57·50
PIONEER PL12D with base and cover	49·18	34·50
PIONEER PL61 with base and cover	176·83	119·95
THORENS TX25 cover	8·85	6·50
THORENS TD125 Mk. II	82·63	66·50
THORENS TD125AB	115·69	79·95
THORENS TD125AB Mk. II with TP 16 arm	124·54	99·95
THORENS TD160/c including base and cover	69·80	56·95
THORENS TX11 cover	4·49	3·60
WHARFEDALE Linton	37·50	26·95

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*AKAI SW 155	64·50	44·95
*B and W Model 70	159 50	109·95
B and W DM2	69·99	47·50
B and W DM4	49·66	37·95
B and W DM5 (pair)	59·48	43·95
CELESTION COUNTY (pair)	47·94	35·95
Ditton 120 (pair)	56·40	38·50
Ditton 15	37·40	26·00
*Ditton 25	65·00	42·50
*Ditton 44	54·00	35·00
*Ditton 66	99·00	70·95
*FERROGRAPH S1 inc. stand	95·00	67·95
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*Magister	65·63	42·50
Double Maxim (pair)	67·40	47·95
*Mezzo 3	35 70	23·45
*Magnum K2	46·20	29·50
*Goodwood	55·00	36·95
*Dimension 8	72 44	44·95
DIN 20 NT Kit	12 19	8·50
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*KN800 3-speaker system (pair)	31·80	18·95
*KN1100 4-speaker system (pair)	40·80	23·95
*KN1600 3-speaker system	25·20	14·95
*KN2100 3-speaker system	30·60	18·95
LEAK 150 (pair)	50·00	37·50
LEAK 250 (pair)	63·00	47·95
*LEAK 600	49·50	34·50
*LINEAR 10 watt Teak (Pair)	Sp. Price	12·95
METROSOUND HFS 103 (pair)	29·21	20·95
*202	21·50	14·75
*Duplex 15	32·00	23·95
*Duplex 25	56·00	37·50
*PIONEER CS53	46·72	29·95
SINCLAIR Q16	8·98	6·50
TANDBERG Tan 7	29 50	23·60
Tan 11 (pair)	40 00	31·95
TL 12 Teak (pair)	55·50	44·50
TL 25 Teak (pair)	71·50	56·95
*TL 50 Teak	68·00	50·95
TELETON 8000 (pair)	21·08	11·95
*THORPE GRENVILLE TG100 (pair)	28 95	16·95
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*TG300 (pair)	55·95	29·95
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	Rec. Retail Price	Comet Price
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***Items are tax free—buy now before V.A.T.**		
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Twin Axiom 10	10·06	7·50
*Axiom 401	17·68	11·95
Audiom 8P	5·49	4·15
Audiom 10P	5·97	4·50
*Audiom 12P	13·00	9·15
*Audiom 15P	21·00	14·60
*Audiom 18P	35·70	24·45
*Audiom 100 40 watts din.	12·00	8·35
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*Axent 100	6·90	4·80
*Midax 650	13·39	9·50
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WHARFEDALE 8 in. Bronze/RS/DD	4·75	3·30
Super 8/RS/DD	8·50	6·25
Super 10/RS/DD	14·00	9·95

	Rec. Retail Price	Comet Price
CARTRIDGES		
AMSTRAD 900C	5·32	3·40
AMSTRAD 900D	8·10	5·40
AMSTRAD 900 EX	11·90	8·50
AUDIO TECHNICA AT 66	6·47	3·45
*CONNOISSEUR Ceramic SCU1	6·09	4·95
GOLDRING G850	6·10	3·10
GOLDRING G800	12·21	4·50
GOLDRING G800E	17·67	7·00
GOLDRING G820	11·62	8·25
GOLDRING G820E	17·44	12·25
GOLDRING G820 Super E	23·25	16·25
GOLDRING G800 Super E	24·41	15·25
EMPIRE 1000ZE/X	62·22	39·95
EMPIRE 999VE/X	44·44	28·95
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	Rec. Retail Price	Comet Price
CARTRIDGES—*continued*		
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EMPIRE 90EE/X	9·94	6·95
SHURE M3DM	6·10	3·75
SHURE M31E	11·63	6·95
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SHURE M44-G	8·30	4·95
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SHURE M-44C	7·90	4·90
SHURE M44E	8·60	4·75
SHURE M55E	9·70	5·45
SHURE M75G	14·70	8·35
SHURE M75-6 (S)	8·36	5·45
SHURE M75-6	13·60	7·60
SHURE M75EJ	15·40	8·75
SHURE M75ED	19·00	10·15
SHURE M75E/95G	20·80	12·95
SHURE M91ED	18·45	9·95
SHURE V15-11	39·40	24·95
*SONOTONE 9TAHC Diam/Saph	3·75	1·45

Starred cartridges above are ceramic. All others are magnetic.

	Rec. Retail Price	Comet Price
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CONNOISSEUR Plinth BD1	5·57	4·50
CONNOISSEUR Cover	4·17	3·40
CONNOISSEUR P.U. Mount Board	0·95	0·75
GARRARD WB1 Base	3·78	2·95
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GOLDRING Plinth 72	9·42	6·50
GOLDRING Covers for 72P	4·71	3·25
Cover for 75P De Luxe	5·23	3·60
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MOTORBOARDS only	5·85	4·45
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C90	1·45	0·85
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KOSS PRO 5 L/C	30·00	23·95
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	Rec. Retail Price	Comet Price
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KOSS 747	20·00	14·95
KOSS K-711	10·00	7·75
KOSS K6	12·50	9·50
KOSS K6/LC (with volume control)	14·00	10·50
KOSS K6/LCQ Quadrafone	20·00	16·95
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PIONEER SE 30A	12·60	8·25
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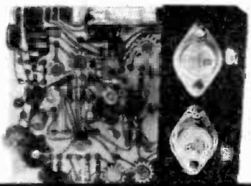

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35 WATTS RMS. 7 transistors 7 diodes

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

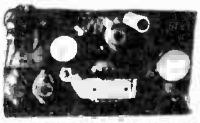
PU45	Unstabilized supply for 2 SA25/35	£4·90
PU70	Unstabilized supply for one or two SA100	£7·75 carr. 40p
MT45	Transformer for above, heavy duty	£2·85 carr. 20p
Stab PS45	Stabilized module for 2 SA25's or two SA35's	£3·50 carr. free
MT30	Transformer for unstabilized supply complete with rectifier diodes mounted	£3·50 carr. 20p
MT70	Transformer for PS70	£4·90 carr. 40p
PS70	Stabilized supply module for one or two SA100's	£4·90 carr. free

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

OTHER SAXON PRODUCTS . . .

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

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



SPECIFICATION

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

Low distortion parallel push-pull output stage.

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

SINGLE CHANNEL SOUND/LIGHT CONVERTER

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

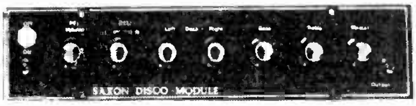
Operation is simplicity itself and the unit is fully fused. The unit is supplied to function from bass notes but may easily be converted to respond only to treble or mid-range notes by the addition of components costing less than 5p.

£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 leads etc. Supplied in tough white steel case with a blue hooded cover. Fully guaranteed. **£19·75** carr. 30p

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



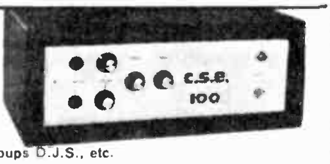
£15·80 carr. 30p

SAXON STEREO CONTROL UNIT

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½" x 3" x 4" deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass, treble, mains on/off.
THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCOTHEQUE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE. (N.B.—Stereo only has mic input.)

COMPLETE AMPLIFIERS

The CSE 100. £34·90 carr. free



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

The SAXON 100 £48·50 carr. free

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

LOUDSPEAKERS British made bargains!!
12" 25 watt 8/15 ohms £5·95 carr. 30p. 15" 50W.8/15 ohm £14·50 carr. 50p.
12" 40 watt 15,000 gauss magnet system 8/15 ohm £11·50 carr. 40p.

A.K.G. MICROPHONES suitable for disco, group or general P.A. use.
O11DHL rrp £11·00 our price £9·45 post free
D190C High Z rrp £21·50 our price £17·45 post free
D1000C 24 ct gold plate rrp £37·00 our price £32·00 post free

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All cash in regd. envelopes please!
Telephone orders to our CROYDON BRANCH.
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PRACTICAL WIRELESS

VOL 48 NO 12
Issue 794

APRIL 1973

The Buyer and VAT

During these last few weeks before Value Added Tax takes effect, readers will be contemplating whether to buy now or wait until after April 1st. It will undoubtedly pay to wait on such items as domestic receivers, some Hi-Fi equipment and electrical goods, but component suppliers are being hard pressed to meet demand before the infliction of VAT.

One way of circumventing purchase tax has been to supply equipment in kit form, but these items in any form will be liable for VAT at one common percentage rate, since VAT is a tax on the basic purchase price or charge for service.

We would expect that all suppliers will make it quite clear to all customers, at the trading premises and through advertisements, whether quoted prices include VAT. The basic retail price should remain the same as now. Whatever you pay for goods or services from April 1st, you should not be paying any purchase tax or selective employment tax levies; you should be paying VAT on top of the normal retail price, based on the Chancellor's Budget announcement on March 6th.

Kit and component prices should not be raised before April 1st and manufactured goods subject to purchase tax of more than 15% should be noticeably reduced after April 1st.

Shopkeepers and other traders are not legally bound to show the amount of VAT in cash transactions; neither will they necessarily show special "tax invoices" for retail sales, but it is worth remembering that if you purchase at a cut price rate, the VAT charged will be correspondingly lower. Goods obtained by hire purchase or credit agreements will be subject to tax at the current rate at the time when transaction documents are signed. Interest rates on these terms are not taxable. Private sales between individuals do not attract VAT because neither party is defined as a "taxable person", unless the seller is a trader required to register with H.M. Customs and Excise.

Our advice to readers who are thinking of buying goods by mail order during March is to determine first whether purchase tax is chargeable; if it is then wait until April. Items not subject to purchase tax (such as components and secondhand or used goods) should be ordered early. If of substantial value, send your order by P.O. "Recorded Delivery" and keep the counterfoil of your Postal Order, Money Order, or cheque.

You should be prepared for a VAT levy on charges for packing service but not for postage.

continued on next page

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

THE MAY ISSUE WILL BE PUBLISHED ON APRIL 6th

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

by Colin Riches

VAT

To the best of our knowledge, the prices quoted in this issue were correct at the time of going to press.

From April 1st 1973, there will be no purchase tax but a large number of goods will carry Value Added Tax. For further details, see our Leader article.

Tulip Time Rally

The 1973 "Tulip-Time" mobile rally will be held on Sunday May 6th at Surfleet, 4 miles north of Spalding on the A16.

The Spalding and District Amateur Radio Society will also be operating a Special Activity station, GB3STF on 12th-13th May from The Grammar School, Priory Road, Spalding, in connection with the 1973 Tulip Festival. Operation will be on s.s.b./c.w. on all bands 160-10m. with a.m. on 2m. All contacts will be confirmed by special QSL cards.

Of interest to "Going Back" fans—the Wireless Preservation Society will have an exhibition of vintage radio on show to the public. I hope to be able to publish further details later.

RSGB "Jubilee Year" President

Photograph by P. M. Fletcher.

This picture shows Dr. J. A. Saxton, D.Sc., PhD, CEng, FIEE, FInstP, the new President of the RSGB. On the left of the picture is Swedish Amateur Lt. Col. Per Anders Kinman, SM5ZD, who received the Calcutta Silver Key award. Sir John Eden, the P.M.G. is on the right.

In his address, Dr. Saxton said he felt very proud that he had been chosen as President of the RSGB for its Diamond Jubilee Year. He also said that he was extremely delighted that Sir John had been able to attend and that all there were greatly honoured by his presence.

Dr. Saxton went on to say that the Society would continue to do all in its power to continue to deserve the Ministry's support.

Per Anders Kinman has been made an Honoury Vice President of the RSGB in recognition of his outstanding service with the IARU Region 1 in which he has served for many years.

The Calcutta Key he received was first presented 20 years ago and it has been awarded annually by the RSGB to the person they feel has made, in any one year, the most significant contribution to international friendship and goodwill through the medium of Amateur radio.

The Buyer and VAT

continued from previous page

If you order from a current catalogue or advertisement after April 1st, you should add the VAT percentage rate to the basic retail price shown. Then add the estimated or stated charge for postage and packing. If a service is chargeable, such as equipment repair or consultation, VAT will be levied at the standard rate. Trading in second-hand and used goods will also be taxable under VAT.

Finally, good news for P.W. readers: newspapers and magazines will be "zero-rated", which means that no VAT is chargeable on these. Transactions of any kind in the U.K. for the direct exportation of goods and services are exempt from VAT.

M. A. COLWELL—Editor.

Feb P.W. Cover

Many enquiries have been received for information on the book and log book shown on the front cover of the February issue of *PW*. Both can be obtained from the Radio Society of Great Britain, 35 Doughty Street, London, W.C.1. "How to Listen to the World" costs £2 post paid. The log book shown is intended for transmitting Amateurs and costs 60p post paid but another one, intended for listeners, is available at 45p post paid.

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

Cordless Iron

This cordless soldering iron comes from the U.S.A. It is completely portable needing no mains power for operation. It has its own power supply which is automatically charged from the stand which itself is connected to the mains. There is a small light near the tip which is very useful for seeing exactly where you are applying heat.

The iron heats up in under 5 seconds and has an "indestructible" iron-plated bit. It costs £9·25 complete with charging stand and fine bit. A heavy-duty bit is also available.

The exclusive distributors in Great Britain are *Pact International Electronics Ltd., P.O. Box 19, Royston, Herts, SG8 5HH.*

Sonex 1973

The technical author and writer Donald Aldous will be heading a small team to organise the Special Features at "Sonex '73".

Two recital/lecture sessions will be presented each day at the Exhibition's new venue the *Excelsior Hotel, London Airport, Heathrow.*

Speakers will include Bert Webb, who will lecture on pick-ups, arms and turntables and Kenneth Shearer, speaking on listening room acoustics.

There will also be a lecture on tape cassettes and an examination of current loudspeakers and trends.

Sonex '73 will run from Friday, March 30th to Sunday, April 1st, inclusive.

Sound '73

"Sound '73" is the exhibition run by the Association of Public Address Engineers. New P.A. equipment and new techniques in the public address and allied fields will be on show.

As in past years, there will be a lecture programme held in the hotel's "City Room". John Maunder from Shure Electronics will give a lecture and demonstration on microphones on Tuesday, 13th March at 14.30hrs.

Mike Beville from Audio and Design Recordings Ltd. will lecture on Components and Limiters (Wednesday at 14.30hrs.)

On Thursday March 15th at 10.30hrs, a member of the Hornsey College of Art will talk on Industrial design of Public Address Equipment.

Venue will be the Bloomsbury Centre Hotel, March 13-15, from 10.00-18.00hrs.

I.E.E. Conferences

The following new conferences to be held in 1973 and 1974 are being organised by the Institution of Electrical Engineers.

"Electrical Signals from the Brain" 27-30 August 1973—in Oxford.

"Symposium on Electromagnetic Wave Theory" 8-12 July 1974—in London.

Further details of the conferences mentioned above are available from the *Conference Department, IEE, Savoy Place, London WC2R 0BL.*

De-soldering Unit

In the February issue we mentioned the Litesold De-Soldering Unit and a misprint stated the price at £·75. This should have read £2·75. Apologies to Light Soldering Developments and any readers that may have been inconvenienced.

Jermyn Inverters

Jermyn Distribution market two inverters, both giving an output of 250V. Input for the 150W version is 12V and for the 300W type, 24V.

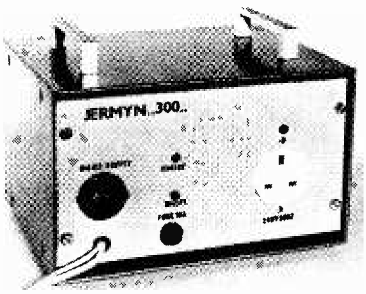
A feature of the design enables these inverters to charge the 12/24V batteries up to 10A when plugged into a power socket.

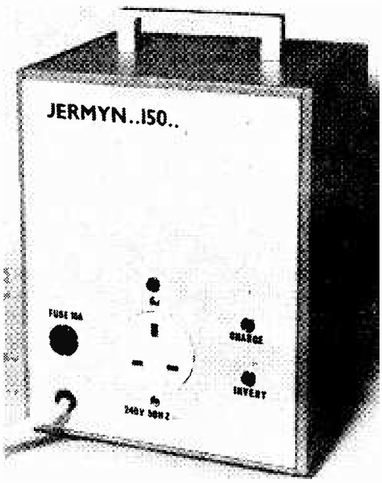
If the mains supply fails, the inverter automatically switches to its "invert mode" providing 240V emergency power immediately.

Should the unit be accidentally overloaded its drive is so adjusted, that the output voltage falls completely, switching the unit off, eliminating any problems.

An internal 15A fuse blows should the battery leads be connected wrongly. Indicator lights illuminate to show whether the unit is charging a battery or providing a 250V 50Hz output.

Both types of inverter can be obtained in kit form or already built. The kit for 150W costs £25 (£29 built) and 300W £34 (£39 built). *Jermyn Distribution, Vestry Estate, Sevenoaks, Kent.*





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improving VHF radio

A.N.AINSLIE

VHF radio provides a most useful signal source for any hi-fi enthusiast and, despite the 15 kHz frequency limits, the live BBC broadcasts are certainly up to the standards of the finest records.

The advantages are numerous—being a non-mechanical system the distortion is very low and the self-generated noise is also very low, the result being a large dynamic range and the possibility of encoding two channels on a single signal. This, plus the excellent BBC technique, makes f.m. radio an invaluable source of material. Unfortunately there are several difficulties in securing top quality f.m., regardless of the equipment used.

SIGNAL-TO-NOISE

Referring to Fig. 1, it can be seen that the performance of a receiver depends on the strength of the signal applied to the aerial socket of the receiver. The mono signal-to-noise ratio assumes an optimum value (usually 50 or 60 dB) with only a few μV input—even on cheap tuners. The signal-to-noise performance does not improve so rapidly on stereo, however, and in many cases could be improved on even with inputs in the region of a few hundred μV—hence the increase in noise on stereo in most situations. A person who gets no increase in noise is indeed most fortunate and need read no further!

As regards crosstalk and distortion, these parameters usually reach optimum values with fairly small inputs and usually there is not much improvement to be had by an increase in the signal.

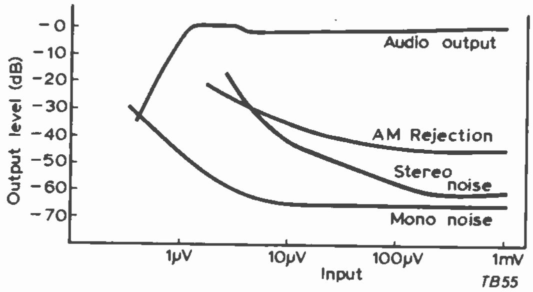
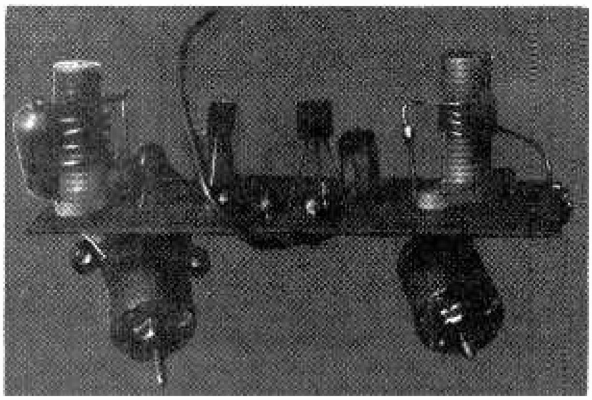


Fig. 1: Graphs comparing receiver performance with the input signal level.

Very few people are fortunate enough to be able to receive "near perfect" stereo without a large aerial, loft or roof mounted. A large aerial, besides having the necessary gain usually has the advantage that it is highly directional and eliminates multi-path distortion from reflected signals. In many situations, a reasonably large aerial, three or more elements, carefully sited, and with a low loss feeder gives good stereo but perhaps not of the very highest quality.

The major downfall in domestic stereo reception is that of "stereo" noise—perhaps not excessive but sufficient to mar an otherwise excellent signal. The obvious way to reduce this noise is to increase the signal feeding the tuner by an "aerial amplifier". At present in this discussion we must assume that the amplifier be perfect, having gain but generating no noise itself.



First of the two VHF amplifiers described in the article. This one uses field-effect transistors.

OTHER NOISE

At this point many readers may well be wondering about the other forms of noise, thermostats, car ignition and other spurious signals. These signals

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are picked up by the aerial and sometimes, even, by the feeder, and consequently will be amplified, together with the f.m. signal, by our "ideal" amplifier, which we are using to combat stereo noise. This brings us to the last important parameter of f.m. receivers, amplitude modulation limiting.

The "ideal" f.m. tuner is designed to respond to f.m. only and a.m. signals are rejected to an infinite degree. Unfortunately, no receiver is perfect and some degree of sensitivity to a.m. is unavoidable.

The a.m. limiting of the receiver improves with increasing signal input, as seen from Fig. 1, so that increasing the signal and spurious a.m. together actually reduces the level of audible interference. Unfortunately, when the receiver is switched to receive a stereo transmission, the stereo decoder in the receiver is actually only sensitive to amplitude modulation of the stereo subcarrier. In the decoder some measure of a.g.c. is applied to the subcarrier amplifier and this maintains a constant level of stereo interference from an a.m. signal regardless of the actual input voltage to the tuner.

It can therefore be seen that whilst increasing the tuner input with an "ideal" amplifier, the "stereo" interference level remains substantially constant whilst the "mono" component of the audible interference has been reduced by virtue of the amplitude limiting of the f.m. discriminator.

AERIALS

Earlier in this discussion, we talked of elaborate and efficient aerial systems but the previous discussion on aerial signal amplification implies that, with a good amplifier, an aerial providing only a minimal "clean" signal can be used to run an f.m. tuner with a high degree of success.

Unfortunately, some tuners are not so sensitive as others and sometimes require millivolts to function at their best. This means considerable amplification of the few tens of microvolts coming from a rather poor aerial!

The better tuners nowadays use f.e.t.'s in the input circuits to keep noise to a minimum and to keep cross modulation low; so any proposed amplifier should have at least as good a performance as the front end of the tuner.

This is very demanding when tuners such as Sony, Radford and Fisher are considered, but it is possible to improve these tuners on a very poor signal by a remarkable degree.

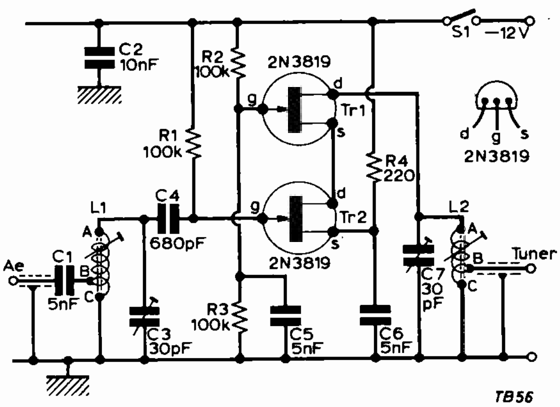

Fig. 2: Circuit of the amplifier using two f.e.t.'s.

To design an amplifier with a front-end comparable to the best tuners use has to made of f.e.t. devices which possess the best noise properties of all the common solid state devices presently available and are responsible for the excellent performance of the best tuners.

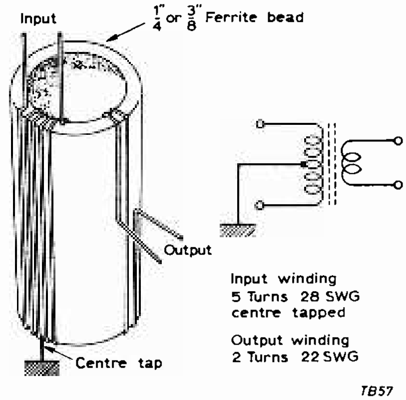

Fig. 3: Details of simple transformer to match balanced 400Ω feeder to 75Ω coaxial feeder.

The design chosen for the amplifiers in this article is not often used with solid state devices but was once very common with valve Band III television tuners. The amplifier is a cascode configuration giving reasonable gain with very low noise and good cross modulation.

The input to the amplifier, Fig. 2, is 75Ω co-axial feeder so Fig. 3 shows a transformer that can be constructed from a small ferrite bead for 400Ω balanced feeder.

THE PCB

The amplifier can be very easily built on a single piece of printed circuit 4"×2" and it is recommended that fibreglass board be used.

To etch the required print design as shown in Fig. 4 (full size), the diagram is traced on to the copper side of the print with carbon paper and the marked areas painted in with high quality enamel. When the paint is dry, the print is immersed in the etching solution and agitated until completely etched (only paint and base material can be seen). The etching solution can be ferric chloride solution but a useful alternative is "Liquor-Ferri Perchloridi Fort" which is obtainable from chemists and should be used undiluted. Rub the copper surface of the board with "Ajax" or similar scourer before painting, to ensure a clean surface.

The enamel paint can be removed with paint stripper once the etching is complete and the board washed and cleaned with wire-wool. The holes for the components should be drilled with a $\frac{1}{32}$" drill, preferably in a wheel brace.

Construction is straightforward except that the f.e.t.'s should be left until last and soldered in with the iron disconnected from the mains—surprisingly little voltage will break down the gate junction.

The coils, Fig. 5, are wound on the formers which are located on the board and stuck with Araldite. The 30pF variable capacitors must be connected so that the rotor is connected to the earth line. The author used 30pF Philips beehive trimmers mounted

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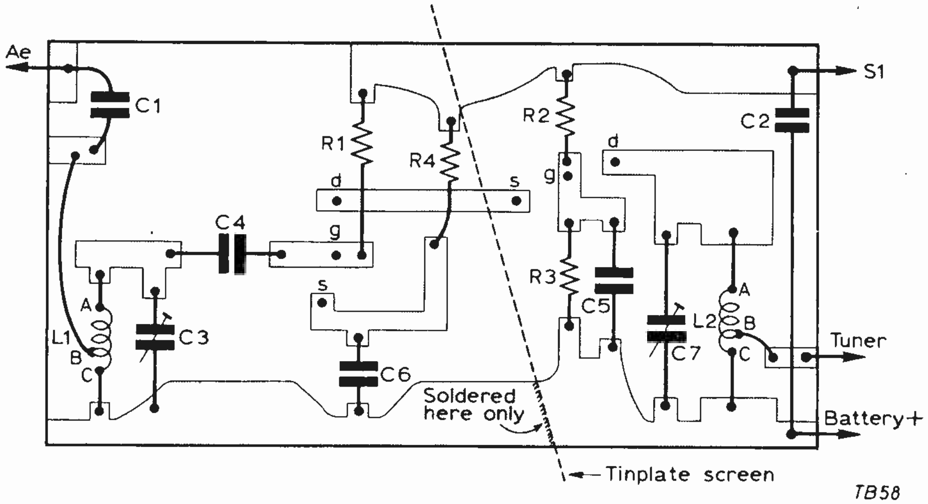

Fig. 4: Printed circuit board, for the circuit of Fig. 2, shown actual size.

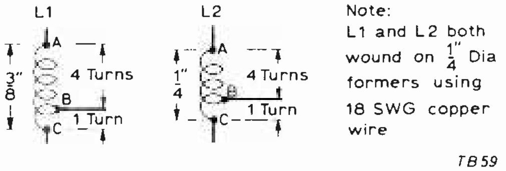

Fig. 5: Winding information for L1 and L2.

★ components list

FET AMPLIFIER
Resistors
R1 100kΩ R2 100kΩ R3 100kΩ R4 220Ω
All ¼W 5%

Capacitors

C1 5nF 400V	C5 5nF 12V
C2 10nF 12V	C6 5nF 12V
C3 30pF Trimmer	C7 30pF Trimmer
C4 680pF 12V	

Miscellaneous
Tr1-Tr2, 2N3819. On-off switch. 12V battery. Co-axial sockets (2). PCB, see text. Coil formers.

BF200 AMPLIFIER
Resistors

R1 1·5kΩ	R3 6·8kΩ	R5 10kΩ
R2 10kΩ	R4 1·5kΩ	R6 6·8kΩ

All ¼W 5%

Capacitors

C1 1nF 400V	C6 30pF Trimmer
C2 30pF Trimmer	C7 10nF 12V
C3 10nF 12V	C8 680pF 12V
C4 680pF 12V	C9 1nF Feed-through
C5 1nF Feed-through	C10 30pF Trimmer

Miscellaneous
Tr1-Tr2, BF200. On-off switch. 12V battery. Co-axial sockets (2). PCB, see text. Coil formers.

POWER SUPPLY
Capacitors

C1 100nF 1kV	C3 2000µF 10V	C5 100nF 12V
C2 2000µF 10V	C4 1000µF 15V	

Miscellaneous
R1, 10Ω ¼W 5%. D1-D2, 1N4002. D3, 12V zener 2W, mounted on aluminium 2" × 1" minimum. T1, 8V bell transformer. Fuse, 1A. On-off DP mains switch. LP1, 3·5V 20mA for FET amp + 2 stages or 3·5V 40mA for FET amp + 4 stages.

on the copper side of the board. The resistors should be small low noise types and the capacitors need only be low working voltage.

The completed amplifier should be screened by placing tin plate at the position indicated and soldered to the positive line as support.

The amplifier is mounted in a small wooden box, measuring approx. 4" cube internally, covered inside with tin foil, which is connected to the positive supply line. A front panel can be made from a piece of double-sided copper board with the input and output sockets and the on/off switch. The printed board is soldered to the front panel by the positive line, so earthing the front panel.

With a 12V battery connected, the output is fed to the tuner and the input is fed by an "inefficient" aerial, in most cases a short piece of wire.

With the amplifier on, the tuner is switched to the local stereo station and the tuning capacitors C3 and C7 set midway. The cores in the coils (L1 and L2) are then adjusted to give the strongest signal, best observed on a tuning meter or audibly by judging least noise.

The amplifier is then assembled in the case and the capacitors C3 and C7 tuned to give the best signal. The tuning will be sharp and critical, so care should be taken when adjusting.

The amplifier, when connected between the proper aerial and tuner, should have sufficient gain to overcome most of the tuner noise, without introducing significant noise itself. When used on weak local radio stations, the improvement will be very marked, especially in mono. Unfortunately, this usually requires the amplifier to be re-tuned to the local channels. However, connecting 27Ω resistors across L1 and L2 will broaden the bandwidth considerably, enabling the amplifier to be used over a number of channels.

BF200 AMPLIFIER

However, for many of the "poorer" tuners, this amplifier will still not be good enough to fully drive the tuner on a moderate signal. For optimum stereo in such cases two of the amplifiers could be

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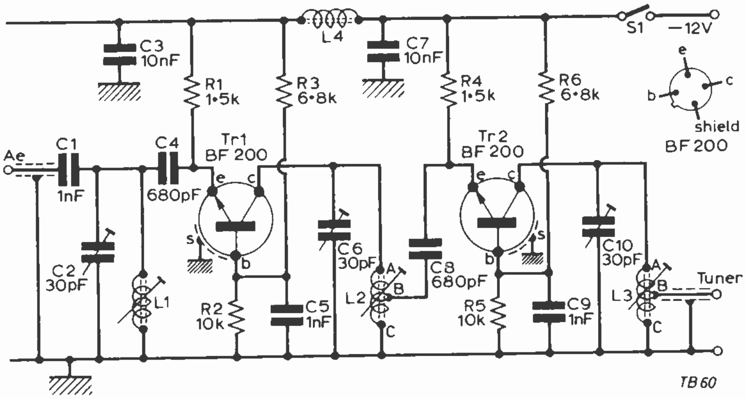


Fig. 6: Circuit of the second amplifier, using BF200 transistors.

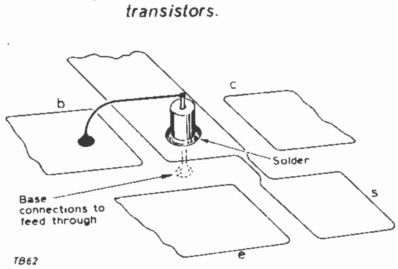


Fig. 8. Method of mounting feed-through capacitors.

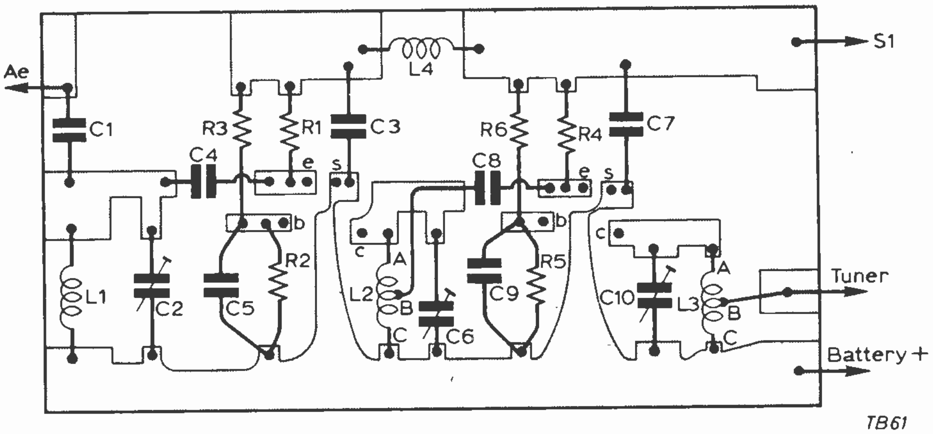


Fig. 7: Illustration, actual size, of the printed circuit board for the BF200 amplifier.

connected in series. The price of f.e.t.'s, however, makes this uneconomical and ordinary low-noise silicon transistors used after the f.e.t.'s work very well. The proposed amplifier, Fig. 6, is two stages of a conventional r.f. amplifier design. Fig. 7 shows a full size print layout for two stages, although for additional gain or bandwidth more stages can be used, although greater than five would be difficult to keep stable.

The board is etched in the same manner as before and a similar front panel and box are prepared. Alignment is the same, tuning the coils and finishing with the capacitors.

The transistors specified are BF200 and these should be used for at least the first two stages to keep the noise level down; after this such transistors as 2N706 work very well. An alternative for the BF200 is BF180 or BF181.

Fig. 8 shows how C5 and C9 are constructed with 1000pF feed-through capacitors. L4 is made by wrapping a few turns of 36s.w.g. d.c.c. copper wire round a ferrite bead. Fig. 9 gives the winding information for L1, L2 and L3.

The two amplifiers just described will enable good stereo to be obtained from a mediocre signal without the need for a "fancy" tuner. The improvement that can be expected depends greatly on the individual circumstances. The author has used the amplifiers with a Sony ST5100 tuner and a poor aerial and found the results almost as good as when a proper aerial was correctly installed on the roof. The cost of a pair of amplifiers is comparable to a decent

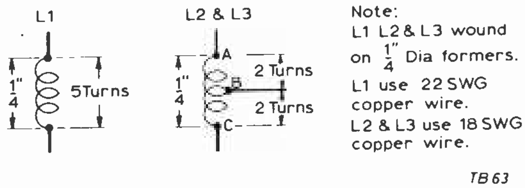
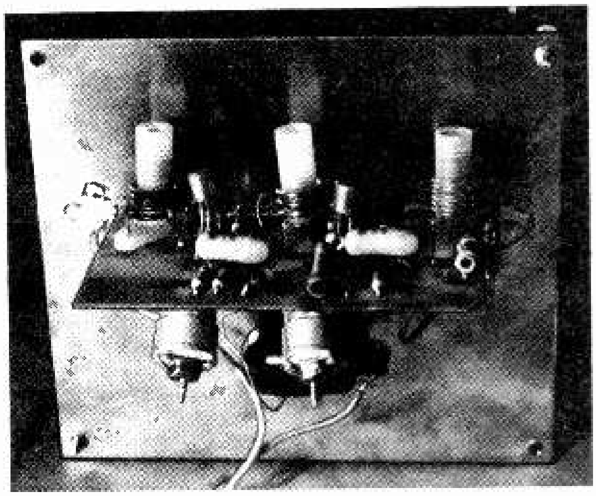


Fig. 9: (above) Details of the three coils shown in Fig. 6. In the photograph (below) the second amplifier board is shown soldered to the front panel consisting of double-sided p.c.b.



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aerial less downlead and fitting, so financially it is a viable proposition, although not a substitute for a first class aerial.

In order to split one signal to run several outlets and obtain maximum signal at each of the outlets, a star-splitter is used. This arrangement provides correct impedance matching throughout the system.

Figure 10 shows the circuit of a star-splitter. The value of the resistors R depends upon the impedance of the feeders (Z) usually 75Ω, and on the number of outlets (n) which can be as many as required.

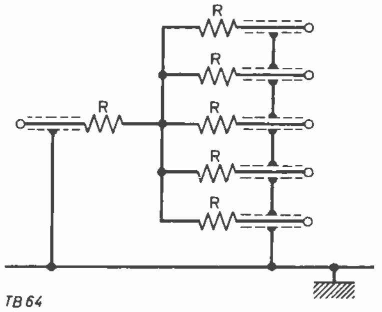

Fig. 10: Circuit of star-splitter enabling several outputs to be obtained from a single input.

The relationship is:— $R=Z(n-1)/n+1$. For example, for a splitter for a 75Ω system with two outputs the resistors to the nearest preferred value are 27Ω. Small ¼W resistors are suitable and indeed preferable to physically larger types.

All of these systems involve a loss of signal and this must be made up by amplification before the splitting. For a distribution system, splitting six or

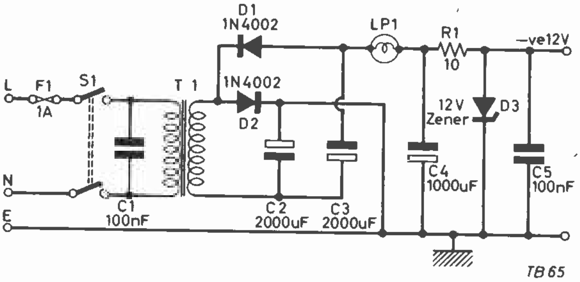

Fig. 11: Suggested power supply for the v.h.f. amplifiers.

eight ways, two f.e.t.'s followed by three transistors should be adequate. One important point to note is that the outputs of the splitter must all be loaded by a 75Ω resistor when not in use, otherwise a loss of signal results and the splitter may form the node of standing waves in the feeder.

If either of the amplifiers is built as a distribution system, it is perhaps a good idea to build a small mains unit to power the whole system. It is desirable that this supply be stabilised to guard against changes in the tuning of the f.e.t.'s if the supply voltage changes.

Fig. 11 gives a circuit of a simple power supply based on an 8V bell transformer with voltage doubling and zener stabilisation. The lamp, LP1, can be used to give on/off indication.

It is hoped that this article has given sufficient information for the home constructor to build an amplifier system to improve the performance of a tuner to reach the very high standards of the B.B.C. stereo transmisions. ■

EXPERIMENTERS CORNER

NOVEL TONE GENERATOR

N. NAUGHTON

WHENEVER home constructors and experimenters need to build a source of audio frequency, the choice nowadays is usually a transistor multivibrator. The reasons for this selection are easily understood. It requires few components, avoids the need for a transformer and gives a strong output signal. These virtues outweigh the fact that the square-wave output does not make for a particularly pleasing sound when amplified and fed to a loudspeaker.

In designing the a.f. tone generator to be described, the author set out to devise a circuit which would possess all the aforementioned merits of the multivibrator and at the same time give a better audio tone. In the circuit shown in Fig. 1—which, as a transistor circuit, is thought to be original—the writer believes these objectives have been largely achieved.

It will be noticed that the circuit is actually simpler than a multivibrator and basically it is a sawtooth generator. Like all sawtooth generators it depends upon the charge and discharge times of a

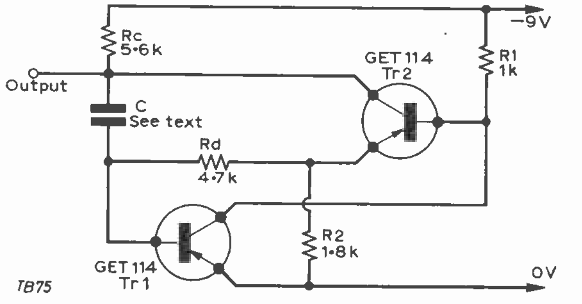

Fig. 1; Circuit of tone generator.

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capacitor for its action. But as linearity of the sawtooth ramp is not important for the required purpose, the provision of constant current is omitted in the circuit shown.

In Fig. 1 the two transistors perform the function of switches and the circuit operates as follows:—capacitor C charges via the charging resistor Rc and the base-emitter junction of Tr1. The charging current flowing through the B-E junction turns on Tr1 and the flow of collector current causes a voltage drop across R1 which results in the potential on the base of Tr2 dropping to a level low enough to turn off Tr2. As the charge on C rises the charging current diminishes so that the potential on the base of Tr1 decreases to a point where Tr1 turns off. The base of Tr2 now goes strongly negative causing Tr2 to turn on and C now discharges via Tr2 into the discharge resistor Rd. While discharge current is flowing in Rd it maintains a positive potential on the base of Tr1 thus preventing further switching action during the period of discharge. When C has discharged, it again draws current through Tr1 once again turning off Tr2. The cycle then repeats.

The foregoing is a simplified description of the operation but many will find it interesting to measure the balance of currents and potentials which exist in the circuit under static conditions when C is removed.

The frequency of oscillation is not readily calculated since it is influenced by several factors one of which will be determined by the type of coupling employed to connect the output. However, for practical purposes values of C ranging between 2μF and 5000pF will cover the audio spectrum.

APPLICATIONS

A useful feature of the circuit is that it uses only one capacitor. With the values given, the generator should oscillate at any point within the a.f. range the actual point being determined by the value of C selected. Thus it becomes a simple matter to construct a signal generator giving a number of spot frequencies as desired; the only extra components needed being a multi-pole switch and a few capacitors. Many other audio applications will doubtless occur to readers.

For those interested, an interesting feature of the circuit is that because the charge and discharge paths of C are independent, the circuit can readily be made to produce right-handed or left-handed sawtooth waveforms. Moreover, by choice of p.n.p. or n.p.n. transistors, the polarity of either slope can be created as desired at source, thereby eliminating inverting stages. Although some value of Rd is essential for circuit function, in practice this can be less than 100Ω thus allowing fast flyback times. There is no reason why C can not be a very large value electrolytic so that the circuit can easily be adapted for timing application.

GENERAL

No constructional details are given since the generator will mostly be incorporated in some larger project. Experimenters can assemble the components on a length of Veroboard or tagboard.

As stated at the outset, the circuit is primarily intended as an a.f. generator and the values given have been chosen to give a roughly pyramid waveform at the collector of Tr2. A strong output signal is also available at the collector of Tr1 but this is a steep sided pulse and the "softer" toned signal at the Tr2 output can be readily appreciated. Coupling of the output is perhaps best determined to suit the individual case but too tight a coupling to the Tr2 output is best avoided. This is less important if the Tr1 output is used.

With the component values given, the circuit places no critical demands on the transistors' characteristics. Seven widely differing types, in various combinations, have been tried with success. However, experimenters using low values of Rd—especially with a high value of C—should note that Tr2 must then be a device capable of handling the heavier discharge current. Tr1 and Tr2 must both be either p.n.p.'s or n.p.n.'s, the −9V becoming +9V if n.p.n.'s are used. ■

TELEVISION

APRIL ISSUE

TOUCH TUNING

The latest development in television receiver design is touch-sensitive tuning, using touch-button units which provide a completely non-mechanical means of channel changing. A very high-impedance electronic switching circuit selects the required channel when a finger is placed across a pair of contacts to complete the appropriate circuit. Several models featuring touch tuning are now on the market and this month we are investigating the technique and the circuitry involved. The change from mechanical to all-electronic channel selection should improve the stability and reliability of TV tuning.

BAND III PREAMPLIFIER

Another Bunney wideband aerial amplifier intended for DX work. The two-transistor (BF272) design on test lifted a weak signal from mere traces of line sync pulses to a solidly locked noisy image. Part of Roger's present programme of improving his DX receiving equipment.

SERVICING

Plenty on the servicing front this month. John Law in his new fault-finding series investigates the line timebase used in most KB-STC models. Vivian Capel completes his guide to power supply circuit servicing. Les Lawry-Johns starts on the single-standard **Bush-Murphy TV181S/V2016** series. And Caleb Bradley takes us further with the BRC 2000 colour chassis.

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IC POWER AMPLIFIER

D. SILVESTER

THE audio amplifier to be described was designed to deliver in excess of 10W r.m.s. into an 8Ω load, whilst being constructed in a $4\frac{1}{2}$in. x $3\frac{1}{2}$in. x 2in. diecast aluminium box. The size of the box is, in fact, limited not by the size of the i.c. but by the passive components, especially the output capacitor which must be included in the circuit. The use of the i.c. has added one inestimable advantage in that the current through (and the power dissipated by) the output stage under overload conditions can be limited. It is thus possible for the output to be short circuited without disastrous results.

The i.c., although capable of giving a 1 watt output without any other transistors, has been primarily designed for use as the driver stage of an amplifier capable of delivering up to 35 watts into an 8Ω load.

A description of the working of the i.c. has not been included as it is not necessary for the constructor to completely understand the operation of the device for it to be used successfully.

Two transistors in the i.c. are responsible for the current and power limiting facility. It was calculated that under maximum current limiting and with the normal current gain of a power transistor, the output stage of the i.c. would be overloaded. One way of curing this fault is to use a Darlington transistor. This in fact was done, the Darlington pair being contained in the TO3 metal case of the power transistor. The current gain of the complementary Darlington pairs is in excess of 1000.

CALCULATIONS

The final circuit used for the prototype amplifier is shown in Fig. 1 but since other constructors may wish to use different power supply voltages and load impedances from those used by the author, the method of calculation of the current and power limiting components is given. The basic circuit should be adhered to as it is only the values of R6, R8, R9 and R11 which need to be changed.

The following section shows the worked equations used to give the value of the components in Fig. 1.

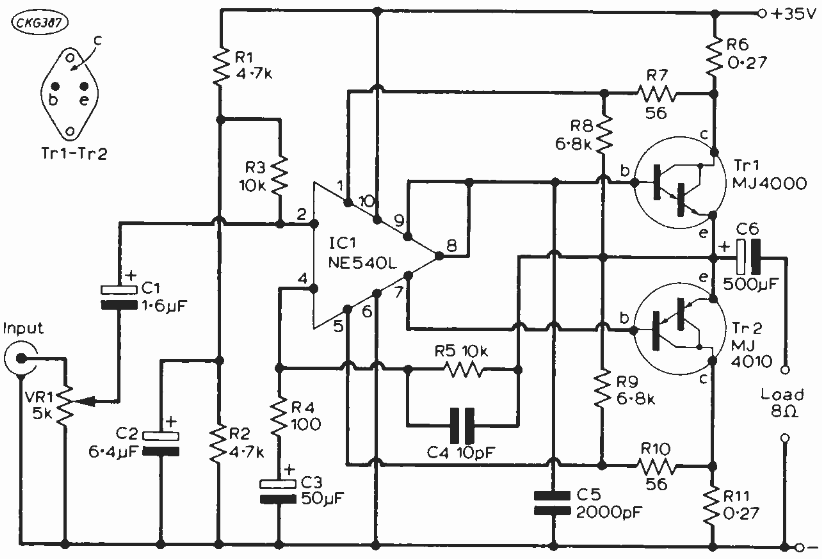

Fig. 1: Circuit diagram of the amplifier and pin connections for the output transistors.

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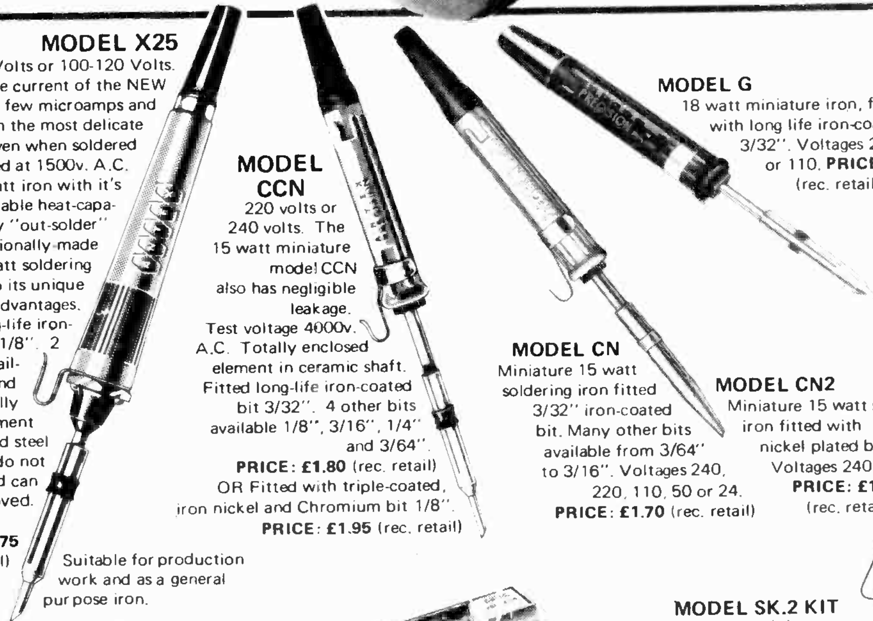

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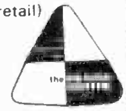

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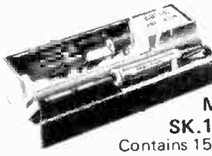

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2N711	~~0·30~~	2N3711	0·90
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2N919	0·20	2N3775	4·19
2N929	0·14	2N3776	5·95
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2N2222	0·31	2N3059	0·90
2N2222A	0·41	2N4060	0·11
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2N2369	0·39	2N4062	0·11
2N2369A	0·17	2N4302	0·25
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2N2711	0·12	2N4914	0·87
2N2712	0·12	2N4915	0·95
2N2713	0·17	2N4916	0·11
2N2714	0·17	2N4917	0·17
2N2904	0·18	2N4918	0·50
2N2904A	0·25	2N4919	0·53
2N2905	0·28	2N4920	0·60
2N2905A	~~0·23~~	2N4921	0·50
2N2906	0·18	2N4922	0·55
2N2906A	~~0·22~~	2N4923	0·65
2N2907	0·18	2N4926	0·90
2N2907A	0·25	2N4927	1·00
2N2913	0·75	2N4928	1·80
2N2923	0·12	2N4929	2·23
		2N4930	2·25

2N4931	2·70	AF116	0·25	BC307	0·10	BF271	0·21
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2N5174	0·22	AF118	0·50	BC307VI	0·10	BF273	~~0·25~~
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2N5176	0·32	AF124	0·24	BC308A	0·09	BF457	0·46
2N5245	0·43	AF125	0·20	BC308B	0·09	BF458	0·57
2N5190	0·92	AF126	0·19	BC309	0·10	BF459	0·57
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2N5193	1·01	AF170	0·25	BC313	0·30	BF828	0·92
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2N5245	0·43	AF179	0·65	BC337	0·19	BFW10	0·61
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2N5459	0·33	AF200	0·35	BCY31	0·40	BFX13	0·23
3N128	0·63	AF239	0·41	BCY32	0·60	BFX29	0·23
3N138	1·37	AF240	0·72	BCY33	0·75	BFX30	0·25
3N199	1·36	AF279	0·54	BCY33	0·34	BFX37	0·30
3N140	0·76	AF280	0·54	BCY34	0·35	BFX44	0·33
3N141	0·69	AFY42	0·74	BCY38	0·40	BFX63	2·48
3N142	0·54	AF211	0·55	BCY39	1·05	BFX68	0·30
3N143	0·64	AL102	0·75	BCY40	0·50	BFX84	0·24
3N152	0·79	AL103	0·70	BCY42	0·15	BFX85	0·29
3N153	0·74	ASY26	0·30	BCY43	0·15	BFX86	0·24
3N154	0·74	ASY27	0·36	BCY58	0·21	BFX87	0·25
3N159	1·00	ASY28	0·28	BCY59	0·22	BFX88	0·20
3N187	1·30	ASY29	0·30	BCY66	0·66	BFX89	0·45
3N200	2·07	ASY50	0·20	BCY67	0·94	BFY10	0·35
3N201	1·05	ASY55	0·35	BCY70	0·17	BFY11	0·45
		ASZ21	0·55	BCY71	0·22	BFY17	0·30
		AU103	1·25	BCY72	0·13	BFY18	0·25
40050	0·78	BC107	0·14	BCY87	3·47	BFY19	0·25
40251	0·81	BC108	0·13	BCY88	2·40	BFY20	0·50
40309	0·33	BC109	0·14	BCY89	0·80	BFY29	0·40
40310	0·50	BC113	0·13	BCZ10	0·35	BFY37	0·20
40313	0·92	BC114	0·12	BCZ11	0·50	BFY41	0·43
40316	0·50	BC115	0·15	BD115	0·75	BFY43	0·62
40318	0·92	BC116	0·15	BD116	0·75	BFY50	0·15
40322	0·92	BC116A	0·18	BD121	0·75	BFY51	0·16
40360	0·46	BC117	0·21	BD123	0·82	VFY52	0·16
40361	0·48	BC118	0·11	BD124	0·67	BFY53	0·15
40362	0·44	BC119	0·27	BD130	0·57	BFY56	0·34
43063	0·88	BC121	0·23	BD131	0·40	BFY64	0·41
40389	0·46	BC123	0·29	BD132	0·50	BFY75	0·40
40394	0·56	BC125	0·15	BD135	0·43	BFY76	0·22
40395	0·50	BC126	0·20	BD136	0·49	BFY77	0·24
40406	0·44	BC132	0·30	BD137	0·55	BFY78	0·36
40407	0·33	BC134	0·11	BD138	0·63	BFY90	0·60
40408	0·50	BC135	0·11	BD139	0·71	BRY39	0·30
40409	0·52	BC136	0·15	BD140	0·83	BSX19	0·13
40410	0·53	BC137	0·15	BDY10	1·25	BSX20	0·14
40411	2·00	BC138	0·20	BDY11	1·50	BSX21	0·30
40414	3·55	BC140	0·34	BDY17	1·50	BSX26	0·34
40436	1·44	BC141	0·39	BDY18	1·75	BSX27	0·34
40467A	0·69	BC142	0·24	BDY19	1·97	BSX28	0·35
40468A	0·44	BC143	0·21	BDY20	0·92	BSX29	0·47
40600	~~0·69~~	BC144	0·24	BDY38	0·65	BSX30	0·68
40601	0·67	BC145	0·21	BDY60	0·90	BSX59	0·78
40602	0·46	BC147	0·11	BDY61	0·85	BSX60	0·54
40603	0·58	BC148	0·10	BDY62	0·75	BSX61	0·42
40604	0·56	BC149	0·13	BF115	0·23	BSX76	0·16
40636	1·10	BC153	0·18	BF117	~~0·43~~	BSX77	0·15
40673	0·56	BC154	0·18	BF119	0·58	ASX78	0·25
AC107	0·35	BC157	0·14	BF121	0·25	BSW70	0·28
AC113	0·16	BC158	0·13	BF123	0·27	BSY24	0·20
AC115	0·16	BC159	0·14	BF125	0·25	BSY25	0·15
AC117	0·20	BC160	0·37	BF127	0·27	BSY26	0·20
AC121	0·13	BC167B	0·11	BF152	0·20	BSY27	0·15
AC126	0·20	BC168B	0·11	BF153	0·29	BSY28	0·15
AC127	0·20	BC168C	0·11	BF154	0·16	BS138	0·15
AC128	0·20	BC169B	0·13	BF158	0·15	BSY39	0·15
AC141K	0·30	BC169C	0·13	BF159	0·27	BSY51	0·25
AC142K	0·25	BC170	0·11	BF160	0·23	BSY52	0·25
AC151V	0·14	BC171	0·13	BF161	0·35	BSY53	0·25
AC152V	0·17	BC172	0·11	BF163	0·20	BSY54	0·30
AC153	0·22	BC182	0·10	BF166	0·35	BSY56	0·79
AC153K	0·25	BC182L	0·10	BF167	0·18	BSY65	0·15
AC154	0·20	BC183	0·09	BF173	0·19	BSY78	0·40
AC176	0·18	BC183L	0·09	BF177	0·25	BSY79	0·40
AC176K	0·20	BC184	0·11	BF178	0·25	BSY790	0·45
AC187K	0·20	BC184L	0·11	BF179	0·30	BSY95A	0·09
AC188K	0·26	BC186	0·25	BF180	0·35	BU104	1·42
ACY17	0·25	BC187	0·25	BF181	0·32	BU105	2·25
ACY18	0·15	BC204	0·11	BF182	0·30	C111	0·53
ACY19	0·20	BC205	0·20	BF183	0·40	D40N3	0·62
ACY20	0·20	BC206	0·11	BF184	0·17	GET111	0·45
ACY21	0·18	BC207	0·10	BF185	0·17	GET113	0·20
ACY22	0·13	BC208	0·09	BF194	0·14	GET114	0·20
ACY28	0·18	BC209	0·10	BF195	0·15	GET115	0·50
ACY30	0·42	BC211	0·30	BF196	0·15	GET119	0·35
ACY39	0·55	BC212K	0·10	BF197	0·15	GET120	0·25
ACY40	0·17	BC212L	0·12	BF198	0·15	GET535	0·20
ACY41	0·17	BC214L	0·14	BF199	0·19	GET536	0·20
ACY44	0·31	BC236	0·16	BF200	0·35	GET538	0·20
AD136V	0·96	BC237	0·09	BF224J	0·14	GET873	0·12
AD140	0·50	BC238	0·09	BF225J	0·19	GET880	0·30
AD140	0·55	BC239	0·09	BF237	0·22	GET883	0·20
AD142	0·50	BC251	0·20	BF238	0·22	GET887	0·20
AD143	0·45	BC252	0·18	BF244	0·16	GET890	0·22
AD149V	0·66	BC253	0·23	BF245	0·33	GET895	0·25
AD149V	1·26	BC257	0·09	BF246	0·43		
AD150	0·63	BC258	0·09	BF247	0·49		
AD161	0·37	BC259	0·13	BF254	0·14		
AD162	0·37	BC261	0·20	BF255	0·15		
AD161	PR	BC262	0·18	BF257	0·41		
AD162	0·69	BC263	0·23	BF258	0·46		
ADZ11	1·50	BC300	0·42	BF259	0·48		
ADZ12	1·75	BC301	0·34	BF261	0·23		
AF106	0·27	BC302	0·27	BF264	1·45		
AF109R	0·40	BC303	0·54	BF270	0·25		
AF114	0·25	BC304	0·43				
AF115	0·24						

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SN7403	0·20	0·18	SN7433	0·71	0·62	SN7473	0·40	0·34
SN7404	0·20	0·18	SN7437	0·52	0·45	SN7474	0·40	0·34
SN7405	0·20	0·18	SN7438	0·52	0·45	SN7475	0·45	0·35
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SN7410	0·20	0·18	SN7443	1·04	0·88	SN7483	1·00	0·82
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6A	—	—	25p	30p	32½p	35p	—	—
10A	30p	35p	40p	47p	56p	66p	75p	—
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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
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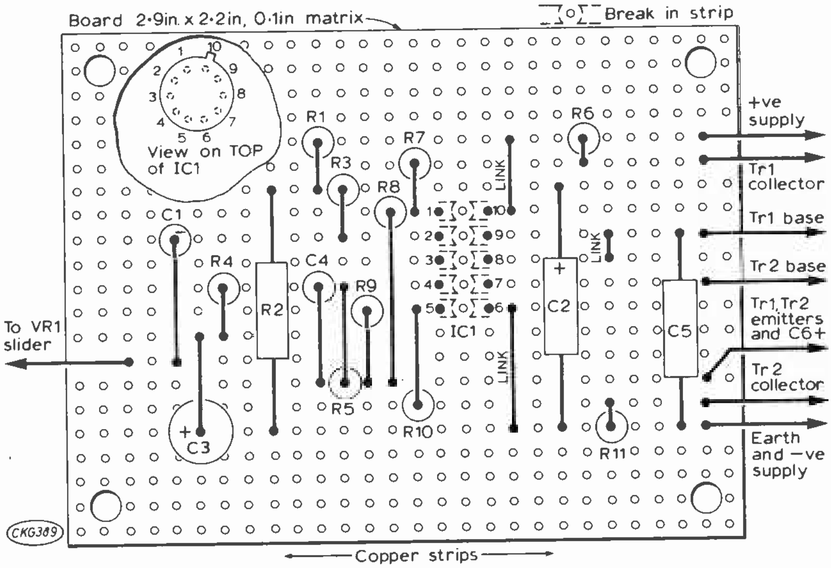


Fig. 3: Component layout on top of veroboard, the copper strips running horizontally underneath.

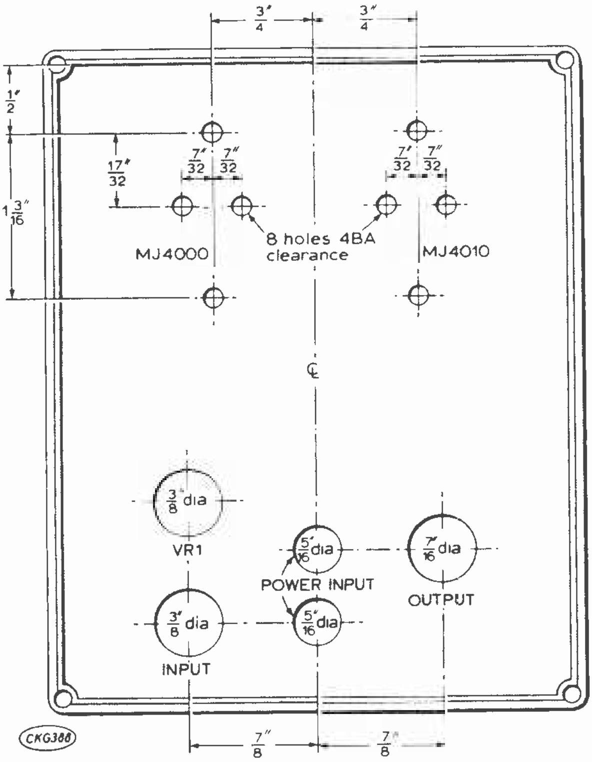
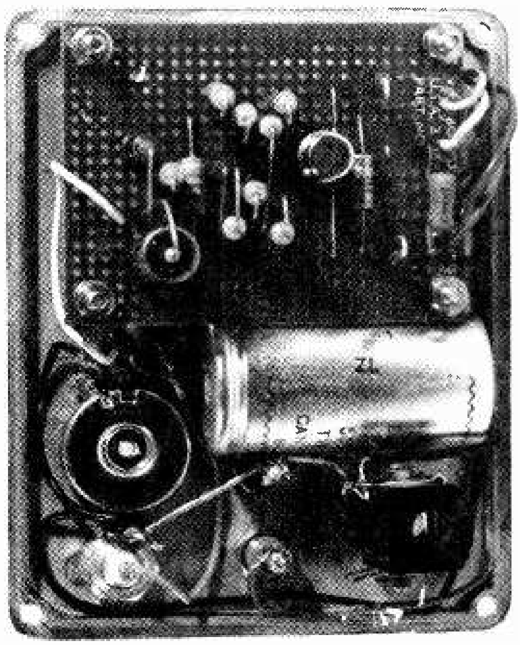


Fig. 2: Drilling details for the box lid on which components are mounted



This view of the completed amplifier emphasises the restrictions on the physical size of the output capacitor C6.

They are based on a supply voltage (Vcc) of 35V and a loudspeaker impedance of 8Ω (R_L). Before beginning the calculations it must be remembered that there are two limitations imposed by the active devices used; the supply voltage must be in the range 10 to 40V, and the maximum current through the transistors Tr1, Tr2 must not exceed 4A. We can calculate:

Peak current in transistors is:

$$\frac{V_{cc}}{2R_L} = 2{\cdot}2\text{A}\ (I_{pk})$$

If this value is above 4A we must use either a lower supply voltage or higher load impedance. To provide current limiting of this value and assuming no voltage drop across R7, R10 we calculate the values of R6 and R11 as:

$$R6 = R11 = \frac{650\text{mV}}{I_{pk}} = \frac{0{\cdot}65}{2{\cdot}2} = 0{\cdot}296\ \Omega$$

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The nearest preferred value of resistor, which must be lower in value than the calculated value, is 0·27Ω. The basis of the working of the power limiting facility is difficult to explain in such a short article but works on the principle that both a high voltage across or a high current through a transistor and its network of resistors (Tr1, R6, R7 and R8) will tend to turn off the transistor. The resistor network acts to sense the power dissipation in the transistor and to limit this dissipation. The value of R7 and R10 is 56Ω. In all cases the value of R8 and R9 is:

$$R8 = R9 = \frac{V_{cc}}{6mA} = 5{\cdot}8k\Omega$$

The next highest preferred value, 6·2kΩ, is rather difficult to obtain and the value has been increased to 6·8kΩ. The voltage gain of the circuit is 100 and although this may be altered by changing the value of R4, the effect of such a change on the stability of the amplifier is difficult to predict. Under d.c. conditions the capacitor C3 represents an open circuit and the d.c. gain becomes zero, the voltage at the emitters of the two transistors, determined by the ratio of the values of R1 and R2, being at half the supply voltage.

★ components list

Resistors

R1 4·7kΩ	R5 10kΩ	R9 6·8kΩ
R2 4·7kΩ	R6 0·27Ω ± ·02	R10 56Ω
R3 10kΩ	R7 56Ω	R11 0·27Ω ± ·02
R4 100Ω	R8 6·8kΩ	VR1 5kΩ log

All ½W 5% except R6 and R11

Capacitors

C1 1·6µF 40V	C4 10pF
C2 6·4µF 25V	C5 2000pF
C3 50µF 35V	C6 500µF 50V

Note: C6 should not be over 2½" long and 1" dia.

Semiconductors

Tr1 MJ4000 Tr2 MJ4010
(both with mica washers and bushes)
IC1 NE540L
Available from SCS Components, POB 26, Wembley, Middlesex

Miscellaneous

Diecast box, 4½" x 3½" x 2". Veroboard 2·9" x 2·2", 0·1" matrix. Input socket, Output jack socket.

CONSTRUCTION

The complete circuit is constructed in a diecast aluminium box using the lid to hold all the components and the rest of the box as the cover. Fig. 2 shows the lid marked out for drilling, after which the power transistors are mounted (the NPN transistor Tr1, MJ4000 on the left as seen in Fig. 2) **using mica washers with bushes.** It is best at this stage to check whether the collectors of the transistors have been accidentally shorted to the box lid. The remainder of components should be fixed to the box lid, a tag washer under the input socket nut providing the main connection to the lid.

The component board is a 2·9in. x 2·2in. piece of 0·1 matrix veroboard, with the copper strips running along the 2·9in. length of the board, Fig. 3. After cutting the strips below the i.c., drilling the mounting holes and cleaning up the rough edges, a few moments should be spent with a meter checking that no lines are shorted together and that the strips below the i.c. are completely severed.

There should be no difficulty in constructing the board, but it is advisable to use different coloured wires for the flexible connections as this assists in the final wiring. The capacitor C6 is held in place by its wire leads, the positive end of the component being connected to the emitter of Tr1. The circuit board is held above the transistors on four 4BA screws with either two sets of nuts and washers or 1in. long spacers. The nut heads are stuck on the box lid with epoxy resin adhesive.

The final stage of wiring consists of connecting all the leads from the board to their respective terminations, wiring a negative supply earth lead to the earth end of the output socket, the negative supply socket, and the solder tag on the input socket. Lastly a wire is taken from the centre of the input socket to one side of VR1, the remaining potentiometer connection being taken to earth (the slider goes to the input on the board).

A power supply capable of delivering the maximum requirements of the amplifier must be used. In the author's case a supply of 35V at 2·5A. Under these conditions the amplifier was able to deliver nearly 15W r.m.s. into an 8Ω load. ■

CQ! CQ! CQ! CQ! CQ!

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...Practical Wireless No. 5 Vol. 47—1971—E. Blackham, 89 Myatt Avenue, Parkfields, Wolverhampton, Staffs, WV2 2DN.

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...P.W. Oct. 1971 Wall chart circuit building bricks. December 1971 issue of PW and Oct 1972 Aerial Data Wall Chart of P.W.—Loong Kok Choong, 1477, Main St. Jinjang North K. Lumpur, West Malaysia.

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...P.W. December 71, January & February 72 on loan. Will be returned.—S. G. Christian, Mulginagar Colony, Block ii/B. Nizampura, Baroda, Gujarat State, India.

...P.W. containing the article on the Double Conversion Communications receiver. R. Thorneycroft, 12 Orchard Mead, Hatfield, Herts.

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...March 1972 "Television" with the servicing of the Bush TV103/TV105.—M. V. Gardner, 180 Clonkeen Crescent, Dun Lasghair, C. Dublin, Ireland.

...issues of P.W. about ten years ago that covered an article on an oscilloscope. I have been given a scope but do not know the function of the controls.—P. Leyser, 17 Lapal Lane North, Lapal, Halesowen, Worcs.

...all back issues of P.W.—F. Murphy, 10 Upton Court, Upton, L49 6LS. Wirral, Cheshire.

...issues of P.W. that contained details of capacitive discharge systems:—J. Smith, 9 Amherst Avenue, Handsworth Wood, Birmingham. B20 2LH.

...P.W. Jan. 1972. April 1972, E.E. Nov. 1971. Feb. 1972, March 1972. Will pay face value plus postage and packing. All replies answered, Redwood, 45A Lulworth Avenue, Poole, Dorset, BH15 4DH.

...P.W. February and April 1972.—Ramesh Udyawar, C/O Post Box 610, Bombay 1. India.

...P.W. February 1972 issue containing details of the "Transistor Scope".—Mr. A. Chaplin, 26 Wakering Avenue, Shoeburyness, Nr. Southend-on-Sea, Essex.

...P.W. January 1972—T. Fresson, Fernilee, Churt, Farnham, Surrey.

...May 1972 edition of Television or a photostat of the second part of the colour television project.—C. A. Wilson, 23 Friars Oak Road, Hassocks, Sussex.

...P. W. February, March, June and July 1968.—D. Applegord, 34, Dennistead Crescent, Headingly, Leeds.

...wanted P.W. November 71 to March 72. Mr. C. S. Hodgson, 18 Kensington Avenue, Normanby, Teesside.

...January 1972. PW. or circuit and data for B.F.O.—E. Caines, 13 Bates Close, Pennywell Road, Bristol 5.

...November and December 1971 of P.W.—G. J. Dummett, 67D Shooters Hill Road, Blackheath, London, S.E.3.

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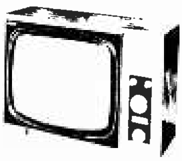

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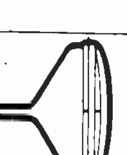

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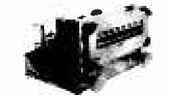

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HOTLINES

ON RECENT DEVELOPMENTS

FOR some time now, weather satellites have been happily orbitting the earth some 800 miles up. These animals transmit a picture of the earth and a suitably equipped station below can receive these pictures. They show cloud distribution which is useful in helping to guess whether it will rain or not on the following washday.

3D RAIN?

Now comes news about a satellite built by the RCA. It is equipped with special sensors and boasts the distinction of being the very first operational satellite to provide a three-dimensional picture of the earth's weather. It is equipped with some very impressive sounding equipment; a scanning radiometer, a very high resolution radiometer and a vertical temperature profile radiometer.

The very high resolution radiometer (v.h.r.r.) has two channels and offers images from both the visible and infra-red regions. It can sense the thermal energy given off by objects below, down to half a mile in area.

Resolution is far better than the pictures provided by television cameras or the radiometers used in earlier satellites. The solar cells in the satellite, NOAA-2, generate some 500 watts and over 10,000 individual cells are used to achieve this power. Who knows—television announcers of the future may be forecasting that three dimensional rain is on the way.

LIQUID CRYSTALS

It now seems a certainty that liquid crystal displays will have a big impact on the electronics market. I reported these as being already built into a multi-digit display being marketed at the Electronica exhibition in Germany late last year. Now, the U.S. giant, North American Rockwell is reported to be mass-producing liquid crystal devices.

The liquid crystal phenomenon was first discovered way back, as long ago as 1888. The basic principle is that certain liquids become opaque when they are subjected to an electric field. With no field present, they are transparent. The North American Rockwell displays consist of two small plates of glass. Although these are bonded together, they are separated by a tiny gap—about a thousandth of an inch. This tiny gap is filled with the special liquid which is affected by an electric field. The cell is thus completely transparent.

However, when a small electric field is applied (this takes about 25V to achieve the desired effect) the cell becomes opaque. Without a field, the molecules in the liquid are uniformly and regularly oriented. The application of the electric field causes this molecular structure to become disoriented and the molecules thus scatter the light giving an opaque effect.

The voids or spaces into which the liquid is put can be formed into figures or letters for the purposes of forming a display. Conductors to the liquid are formed from tin oxide which is a transparent conductor. The liquid crystal display draws almost no power—about 10mW or one hundredth of a watt. Perhaps we will have windows some day which will be clear until we press a button?

OZONE SPEEDS UP RESIST REMOVAL

Integrated circuits (i.c.'s) are delicate little beasts especially during their manufacture. Part of this process is a photographic one. There is a particular stage in the printing of each mask where unwanted photo-resist has to be removed. Considering the size of elements on individual i.c.s this removal is a delicate business. The General Electric Company in the U.S.A. have come up with a new method of removing unwanted photo-resist. It consists of exposing the resist to ultra-violet rays in the presence of air. It takes about 40 minutes for a typical film of resist to be removed. The depolymerisation of the resist happens at a rate of about a thousand angstroms per minute. By injecting 2% ozone gas into the chamber with the specimen the process is speeded up some ten times.

Earlier, I talked of liquid crystals and many have leapt in claiming that the solid state flat tube television screen is here. One British manufacturer, however, is obviously unimpressed. Mullard has opened a new factory in County Durham. The sole purpose is to manufacture shadow mask colour television tubes.

Although only officially opened in December last year, pilot production was already said to be running at the rate of 100,000 tubes delivered from this plant. By the end of this year, production is estimated to be in the region of 500,000 tubes and by the end of this present decade, production will be running at some 900,000 tubes/annum. All this adds up to a lot of colour television receivers—have you got yours yet?

LASERS ARE BACK

Lasers are back in the news again, this time in America where the Optical Physics Division of the National Bureau of Standards is applying one to monitor pollution. A major contributor to atmospheric pollution is nitrous oxide. It is found lurking in such jolly jollop as flue gases and in the exhaust fumes from motor vehicles.

The laser beam is directed through a magnet whose coils are driven by an audio amplifier and is detected by an infra-red device. The amplifier generates a modulating magnetic field which has the effect of sweeping the absorption line through the laser line. The detector produces a signal which has a direct relationship to the amount of nitrous oxide in the sample being investigated.

Concentrations of nitrous oxide as low as 20 parts per million (p.p.m.) can be detected but workers believe that concentrations right down to 0·1 p.p.m. will be detectable as the method is improved.

FLYING SPOT

Useful things oscilloscopes. Have you ever wondered just how fast that tiny spot of light travels across the cathode ray tube? Before you start to make calculations, think of the latest fast writing oscilloscope, the HP 184A. The writing speed for this unit is so fast that the spot travels 400cm in one millionth of a second.

Ginsberg

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NAUTICAL RADIO AIDS

IAN SINCLAIR

EVER since the day when Marconi equipped the yacht *Elettra* with radio to act as a mobile test-bed, electronics and boats have been closely associated. The first really extensive use of radio was at sea, and after the Titanic disaster all ships were required to keep radio watch continuously for distress signals. The requirement for ships to be fitted with radio and staffed with trained operators did not, however, extend to small boats at that time, and it is only fairly recently that radio and electronic aids for pleasure craft have become more of a necessity for serious boating.

MARINE HAZARDS

Electronic devices for use at sea present some design problems which do not appear in land-based equipment. The most obvious hazard is moisture, not the fresh water moisture of a foggy day on land but the salt-laden moisture which corrodes its way through soldered joints, cable terminations, plugs and sockets, and most other metal-to-metal joints in a remarkably short time. As well as the corrosion problem, which can be completely solved only by total encapsulation, there is the problem of insulation resistance.

Salt spray is quite a good conductor and in valve equipment in particular, operating at high voltages, protection of equipment from saline elements is a problem to designer and operator alike.

It was largely the water-spray problem, as well as the cost factor, which has kept electronics out of small craft for so long. In large vessels, the radio and radar equipment could at least be mounted in an enclosed space at a reasonable height above the deck, well away from the direct spray except in the most extreme conditions. In small boats, such spray-free havens cannot be found, and there is little chance of keeping the equipment free of water by heating coils, as were once used on bridge-mounted radio and radar.

The advent of solid state equipment has opened up a new dimension in marine applications, especially with the possibility of cutting down on interconnections by using integrated circuits. Vibration is one of the most pressing problems in small craft, where the rumble of even a small diesel engine is enough to loosen plugs from sockets or wires from soldered joints.

Some of the most up-to-date equipment used for pleasure craft can be seen at the annual Boat Show, held each year in London in January. This year you would have found amongst other more glamorous displays, several kinds of communications equipment.

One stand showed a "triple-standard" television receiver, complete with inverter for use with ship batteries, for use in most yachting centres in the world. But for those who insist on wind in their sails, there was a complete analogue computer, taking information on wind speed and direction, water speed, currents, intended course, and displaying the optimum trim on a model.

RADIO AIDS

Radio is still the mainstay of marine electronics, and it is hardly surprising that there should not be many advances in this direction as there are in instrumentation. The latest ranges of transmitter/receivers are geared to the most recent International regulations, which call for s.s.b. working in the marine bands between 250kHz and 4·1MHz and the use of all solid state equipment has resulted in very compact apparatus.

A large number of v.h.f. and u.h.f. radiotelephones were also shown, and one interesting new development is the Marconi "Pocketphone" intended for communication on large vessels, such as tankers, and during docking and cargo handling operations.

The v.h.f. and u.h.f. equipment uses frequency modulation, and most make provision for the reduction of channel spacings to 25kHz, which will soon be a Post Office requirement. The bands used are within the range 148MHz to 174MHz in v.h.f. and 440MHz to 470MHz in u.h.f. Communications equipment was being shown by (among others) Marconi Marine, Electronic Laboratories (Marine), Ajax Electronics and S.P. Radio A/S of Denmark.

The latter firm was showing a receiver operating under the spray from a waterfall, whose salt content I did not sample, and also showed the "Dual-watch" facility on receivers. This enables the operator to fulfil the requirements of listening for distress signals along with normal working. The distress frequency is preset, so that the set is tuned permanently to that frequency in the watching circuits.

Working can be continued on other channels, and if a signal is received on the distress frequency (or any other being watched) the receiver output is instantly and automatically switched to the watched frequency. A lamp indicator also shows when a call is being received on the watched channel, and flashes during normal operation to show that the watch is being carried out.

DIRECTION INDICATOR

An interesting device for the small boat is the "Seafix", a hand-held radio direction indicator by Electronic Laboratories (Marine). This consisted of a t.r.f. transistor receiver with "autodyne" detection

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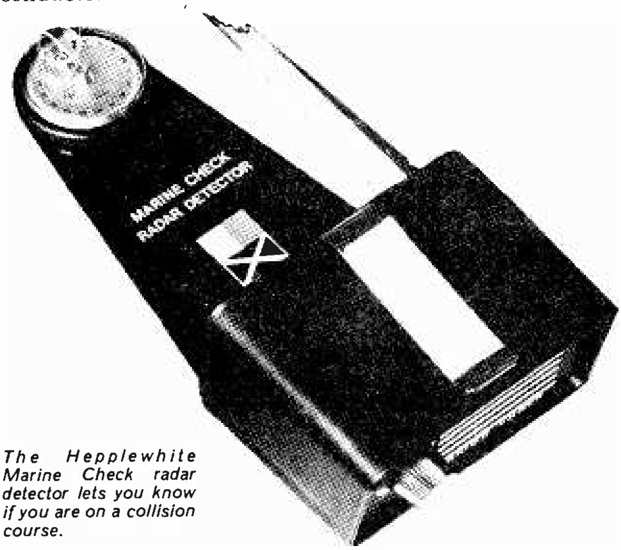
over the range 200 to 400kHz, with the calibration most accurate at 300kHz, the centre of the Marine Beacon band.

Switched to NAV, the autodyne circuit is used to receive beacon transmissions, and the highly directional ferrite rod aerial can be used for finding the bearing of the beacon within 2° (at half rated range). Switched to BC, the "Seafix" can be used to pick up the long-wave shipping forecasts broadcast on this band. A stethoscope headset was used in preference to loudspeakers or conventional phones, and water sealing was by the conventional compressed rubber gaskets.

RADAR

Radar has for a long time been one of the most important navigational aids for larger vessels, but is seldom seen on smaller craft. There are several reasons for this: the cost of any radar installation is high, since it must include the cost of modifications to the vessel as well as the provision of the apparatus.

Radar equipment is often unavoidably large, heavy and dependent on high voltages, since the cathode-ray tube and the magnetron must use high voltages, although it is now possible to replace the klystron local oscillator by Gunn diodes or other semiconductor devices.



The Hepplewhite Marine Check radar detector lets you know if you are on a collision course.

Manufacturers are not dragging their heels over these problems, but are commendably cautious, since they know only too well how much the readings of a radar receiver come to be relied on. Any compression of size or cost must therefore not be made at the expense of accuracy of plotting if we are not to have a rash of "radar-assisted" collisions. All the big names in marine radar (Decca, E.M.I., Marconi Marine) showed small radar outfits, but these were not really intended for the amateur.

The Hepplewhite "Marine Check" is a continuous scanning self-powered instrument designed to minimise risk of collision with other vessels, whose radar may not pick up small boats in bad weather or low visibility—the "Marine Check" will however, detect the other vessel's radar transmission and allow you to take avoiding action.

The scanning head is a miniature, precision, solid-state detector and amplifier of continuous, pulsed and modulated X-band radar transmission (9,000 to 11,500MHz) with electronics mounted in a shock-proof case and will receive radar transmissions at sighting distance.

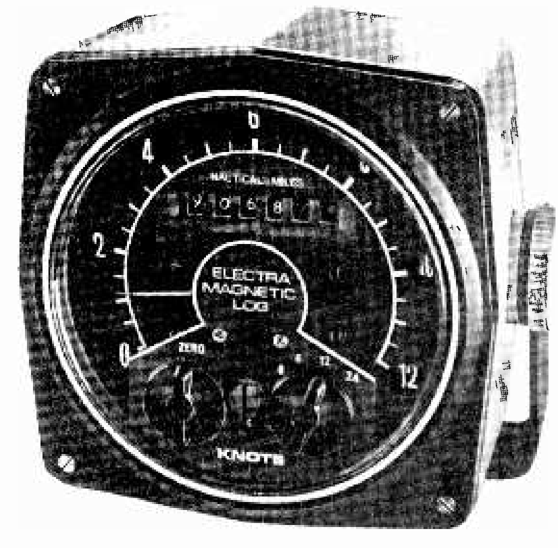
As the sensitivity is reduced, the directional power of the antenna is proportionately increased to a point where the bearing is located on a narrow sector. If this bearing, which is indicated on a compass scale, remains constant, you may be on a collision course, also as the pulse length increases as the distance decreases, it is possible, within limits to determine if the transmitting vessel is approaching or receding.

The "Seascan" radar by Electronic Laboratories (Marine) is designed for the amateur, and has a power consumption of only 48W from 12V, 24V or 48V battery supplies. The only vacuum devices used are the display tube and the magnetron, the local oscillator being a Gunn diode whilst the magnetron modulator uses a thyristor. Unfortunately no circuit details were available and all the units on the stand were dummies.

One interesting new development in radar for the small craft is a passive radar detector by Hepplewhite Marine. This picks up the X-band (9,000 to 11,500MHz) transmissions from other vessels, and has a small directional aerial consisting of a Perspex "horn" on which waves are guided (along the surface) by the effect of the permittivity of the material. The received radar signals are mixed with the output of a local oscillator, and the beat note amplified. The point of strongest signal can be identified by altering the mixer bias so that only a signal of the maximum strength will produce a beat note; this enables the operator to find the bearing of the craft carrying the radar.

SPEED MEASUREMENT

Water and wind speed instruments have for a long time been a weak point in the instrumentation of boats. The traditional methods of measuring speed have depended on anemometers for wind speed and submersible "logs" for water speed. The anemometer is the device using three or four cups at the ends of radial rods pivoted so that the effect of wind is to revolve the assembly about its axis. The



The Electra Magnetic Log is an impellerless speed and distance indicator.

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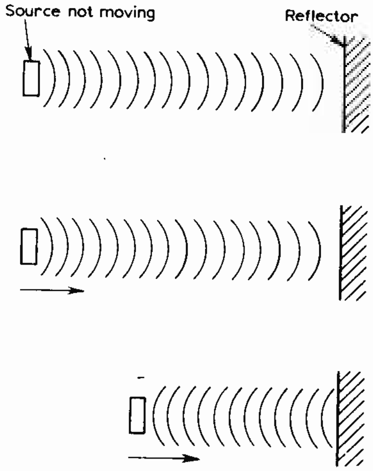

Fig. 1: The Doppler Principle.
Imagine a transducer giving out sound waves. These waves travel in water at a speed of about 1,000 metres per second. Speed equals frequency multiplied by wavelength.
If the transducer moves at a speed "V", the speed of the waves towards the reflector is now 1,000+V metres per second. We have not changed the frequency of transmission, so the wavelength must now be less.
($1{,}000+V=f\times$ new wavelength.)
The waves are now reflected to a moving object, so that more waves per second hit the receiving transducer. The frequency is now higher by a factor $\frac{c+V}{c}$ where c is the normal wave speed and V is the speed of the transducer and boat. The final effect is to receive waves of shorter wavelength and higher frequency.

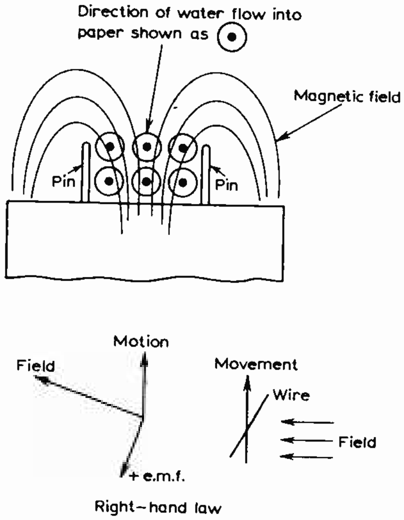

Fig. 2: An e.m.f. is produced between two metal contacts, providing the direction of flow is at right-angles to the line joining the contacts.

speed of rotation, which depends on the wind speed, is measured by counting the number of switching operations of a reed switch under the influence of a magnet on the rotating shaft. This count is converted into an analogue signal which drives a meter. Wind direction is found by using a vane coupled to a potentiometer to show the angular position by voltage detection on a meter.

The traditional submersible "log" consists of a small propeller whose shaft is held in a casing containing a reed switch. The rotation of the propeller as the "log" is towed behind then registers relative water speed just as the anemometer registers relative wind speed. The snag is that the propeller of the log is easily jammed by anything encountered in the water from jellyfish to seaweed, and this can have the effect of making calculation of speed and distance incorrect.

SPEED-LOGS

Two novel speed-logs were shown, each representing refreshingly different thinking about the problem. Space Age Electronics showed their Doppler speed log. This uses a ceramic transducer to project a 1MHz sound beam ahead of the ship. Most of the beam is dissipated in the water, but a small part is reflected from the layer of relatively still water (the boundary layer) close to the boat.

When the boat is moving, the reflected frequency is not the same as the transmitted frequency (Doppler Effect). If the boat is moving ahead, the reflected frequency is higher than the transmitted frequency; if the boat moves astern, the reflected frequency is lower.

Referring to Fig. 1, the transmitter, because of its movement, "packs in" more waves between itself and the still layer than it would if it were not moving. Because more waves are travelling, the wavelength seems shorter. Also, when the waves reflect from the boundary layer, the receiver has also moved towards them, making the frequency of the received waves seem higher.

When the reflected wave is detected, the shorter wavelength appears as a higher frequency (speed = frequency × wavelength), whose value depends on the difference between the speed of sound in water and the speed of the boat. By beating the transmitted frequency against the reflected frequency, a measure of speed can be obtained.

The method is dependent on obtaining a reflection from relatively still water, and so the transmitting/receiving head must be located where such a layer is within range. Precise location varies from boat to boat. To allow for variations in installation, the calibration is adjustable, so that the distance log can be checked against accurately known distances (between two land-marks, for example). The circuitry uses three integrated circuits, 17 transistors and eight diodes. A "log" accuracy of better than $\pm 1\frac{1}{2}\%$ (typical) is claimed.

The "Electra" magnetic log, produced by E.M.I. marine uses the magnetohydrodynamic principle for its operation; this is the generation of a voltage by induction when a conducting liquid flows past a magnetic field.

By arranging a magnetic field to cut the direction of water flow at right angles, an e.m.f. is induced between two metal contacts in the moving water, provided that the direction of flow is at right angles to the line joining the contacts (Fig. 2)

The Electra Magnetic Log operates on this principle, but with some ingenious modifications. The magnetic field used is an alternating field. In this way, the voltage generated is also alternating, which disposes of two problems at once. One problem is polarisation; when a steady voltage exists between two contacts in sea water, an electrolysis action takes place causing corrosion of the metal. The use of a.c. avoids polarisation problems and makes it easy to amplify and display the output from the contacts. As with the previous method, the positioning of the measuring head is critical.

ECHOSOUNDERS

Echosounders have been used for a considerable time, and changes have been in detail rather than in concept. Basically, a marine echosounder consists of a pulse generator working at ultrasonic frequencies in the region 20kHz to 150kHz (the higher frequencies are used for inshore work). A transducer converts the electrical pulses into sound waves directed from the bottom of the boat into the sea, and a receiver, using the same transducer, detects the pulse reflected from the bottom of the sea.

The shape of the received pulse provides a guide to the nature of the sea bed, for example, a muddy

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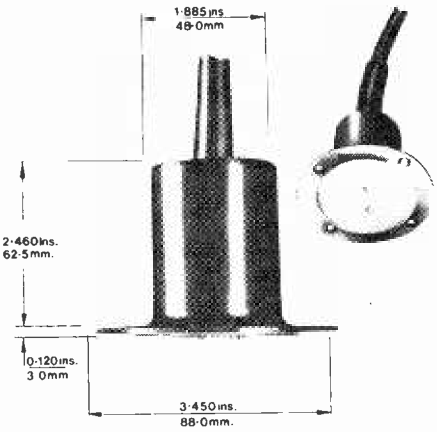
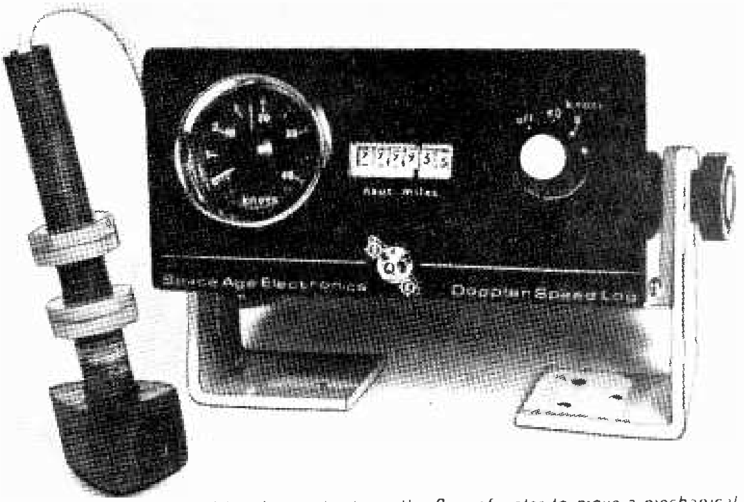


The electro-magnetic transducer for the magnetic log. As the boat moves along, a small e.m.f. is produced and sensed by two probes. This signal is then amplified and displayed in speed and distance units.



The Doppler speed-log does not rely on the flow of water to move a mechanical part like an impeller or paddle wheel. A small streamlined transducer, mounted flush with the underside of the hull, transmits a high frequency ultrasonic signal 70cms ahead. A small part of this signal is reflected back from the boundary layer between the hull and the water.

sea bed is indicated by a broad pulse, a sandy bed by a narrow pulse, a rocky bed gives multiple reflections. Pulses received from intermediate depths can indicate shoals of fish. The time delay between transmission and reception is proportional to the depth of sea.

Because the pulses are travelling in the water at the speed of sound (around 1,000 metres per second) rather than at the speed of radar waves in space (some 30 million metres per second), scanning rates have to be lower than the 1,000Hz commonly used in radar. Scanning rates of once per second are common, although this is rather too low for display on a long persistence cathode ray tube screen.

The display method traditionally used is a rotating wheel carrying, or illuminated by, a neon which flashes on transmission of the pulse and again when the echo is received. The stationary bezel round the wheel is then calibrated in metres of depth (now replacing fathoms on the latest charts).

The large number of echo sounders at the show demonstrated several novel points of design. Most interesting was the use of electro-luminescent diodes to replace neons, so avoiding the need to generate a high voltage supply (Brookes & Gatehouse). A common feature of all the echo sounders was the use of high scan rates for the shallow water ranges (up to six pulses per second) so giving better definition in critical conditions.

Lead zirconate titanate crystals were in evidence as transducers, encapsulated in various plastics. For professional use, chart recording echosounders were shown (these, of course, have been around for a long time). The Marconi Marine chart-maker used electrosensitive paper which changed colour when a small voltage was applied between the front of the paper and the back.

WATER-LEAK AND WATCH

In addition to the displays of electronics for communication and navigation, there were some interesting exhibits in the "miscellaneous" class. Space-Age Electronics were showing their water-leak and watch alarm, and judging by the sound which could be heard all over the first floor of Earls Court, almost every chandlery firm was demonstrating it.

The instrument is basically a conventional leakage detector using stainless steel pins as probes. If the pins are immersed in water for more than four seconds, an alarm is given, but only if the immersion is for longer than four seconds, a time carefully chosen to avoid continual false alarms in heavy seas. When there is no conductivity between the pins, all transistors are biased off, so ensuring practically no standby current. The sound given out is a rising frequency note which is most easily distinguished amongst other sounds.

The watch facility also provided on this instrument gives an alarm note of gradually increasing amplitude every three minutes. If an alarm button is pressed during the alarm, or before it, the instrument remains silent until another three minutes has passed. If the helmsman is asleep and does not press the alarm button, the alarm warning increases to maximum intensity.

GAS ALARM

The Electra gas alarm, from E.M.I. Marine, is of considerable interest. Unlike previous gas alarms, which used heat conduction from a hot wire to detect changes in the air composition, the Electra gas alarm uses semiconductor sensors. No details were given, but it is possible that the sensors consisted of infra-red electroluminescent diodes and detectors. Any change in the air composition caused by petrol vapour, butane or propane gas, carbon monoxide, smoke, paraffin fumes, diesel fumes is indicated by two visual warnings in the form of a meter reading and a red warning lamp.

In addition, a loudspeaker gives out a 2·5kHz note when the gas concentration exceeds the safe limit. In this way, no panic is caused by small concentrations of gases, since only the discreet visual warning is given, but dangerous amounts operate the audible alarm so that evacuation or other measures can be taken. Remote warnings can also be fitted.

All in all, the Boat Show is developing considerable interest from the point of view of electronic aids. It is unfortunate that so few exhibitors were able to cope with technical queries, but all of them were most helpful. ■

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practically wireless commentary by HENRY

No. 98 First in the Field

I HAD a chap in the shop today, searching for an SP4. It is true: even in the glitter of a hi-fi establishment, where every prospect teases and only valves are vile, we still get enthusiasts with thirty-year-old equipment, hopeful of our being able to provide the missing link.

Which leads us, philosophically, to a contemplation of some of the 'firsts' we nowadays take for granted.

Example: the quasi-complementary transistor amplifier circuit, which has given us so much trouble since its inception. I have come across the September 1956 copy of *Electronics*, a McGraw-Hill publication, in which R. C. Lin, then of RCA, Princeton, first propounded his output circuit in which, to quote: '. . . the two upper transistors conduct during the negative half-cycle and the two lower transistors conduct during the positive half-cycle.'

In his summary, he gave amplifier distortion at 100cps (sic) and 400cps as below 1 per cent at six watts, and though he admitted that the distortion might be expected to rise at 5,000cps, he made no mention whatsoever of its fierce spikiness at a fraction of a watt, which is the mariner we've had wrapped around our necks ever since.

The mariner wrapped around our necks.

Inventions, especially world-shaking innovations such as the transistor proved to be, have a habit of spawning themselves much more prosaically than we would like to imagine. No technologist runs screaming through the corridors of the M.I.T. with 'Eureka' echoing behind him. More likely, something as laconic as the 12/29/39: 4.15 p.m. entry in William Shockley's notebook may be handed down to posterity: 'It has today occurred to me that an amplifier using semiconductors rather than vacuum tubes is in principle possible.'

In principle: hardly in practice. He was thinking of a Schottky-barrier FET kind of device, with copper-oxide as the semiconductor. And, as Henry could have told him*, it didn't work. Instead, the experiments of the team included covering metal points with wax and pushing them down on to p-type silicon treated to give an n-type surface. They surrounded the point with water and found they could obtain power amplification.

To quote Brattain: '. . . the group was jubilant that day.'

Trouble was that the water would evaporate. Maybe it was all that heavy breathing. So they switched to glycol borate to reduce evaporation. One trouble: amplification was obtainable only below 8Hz—hardly hi-fi yet.

There were lots more experiments, culminating in evaporated gold spots and germanium, and then, on Dec. 23rd 1947, two gold contacts less than two-thousandths of an inch apart were made to the same piece of germanium and the first transistor happened.

No sudden breakthrough—no inspirational brainchild—and no immediate christening, I may add. It was a month later that a chap called John R. Pierce of the Bell technical staff mooched into Brattain's office and pointed out that the 20dB point-contact amplifier they had made was the

Runs screaming through the corridors.

'. . . dual of a vacuum-tube, circuit-wise.' He mentioned the important valve parameter, transconductance. Then he went on to talk about its electrical dual, transresistance. To quote Brattain once more: '. . . then he said 'transistor', and I said, 'Pierce, that is it!!'

What about a few more firsts in our field? Who developed the first p-n junction? Bet you can't even say his name, let alone remember it. Well Henry can, with the benefit of some help from Edward A. Torrero, who is Associate Editor of *Electronic Design*. He was William Pfann (with the aid of a chap called Jack Schaff; let's give credit where it is due). They also worked for Bell Laboratories.

But Bell eschewed silicon for germanium, because the impurities, back in the early 1940's, were easier to control. It was left to Texas Instruments to develop silicon types of transistor, and to Motorola to introduce the diffused base transistor.

So I could continue. Henry hasn't the space to name those to blame.

But the "first" we are all concerned with is that original all-transistor radio. And who made that? A firm called Regency, in 1954. How's that for a significant 'first'?

* With the benefit of hindsight. Ed.

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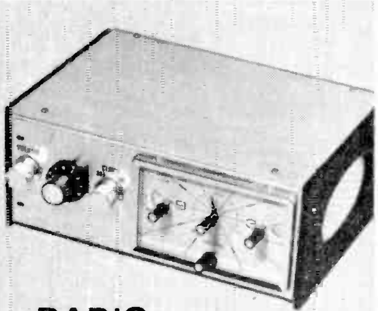
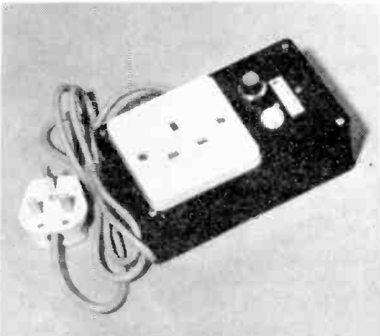
SIMPLE PROJECTS FOR THE HOME

8 PAGE SUPPLEMENT

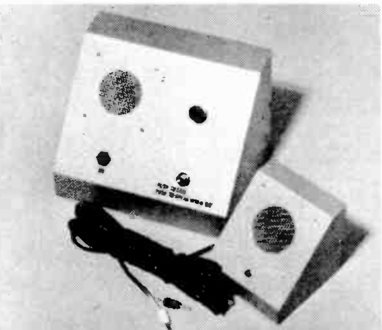
P.W's reputation for plenty of simple and straightforward constructional projects is excelled next month by an extra large issue. In addition to the usual constructional articles and features, the May issue will include a special extra 8-page coloured supplement describing eight easy projects for the home, designed and described by one of our top designers; you are bound to find *at least* one of these of interest. This supplement is fully illustrated with all the details on how to build these projects.



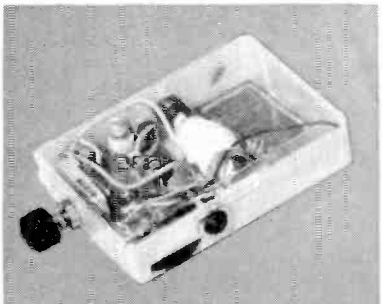
RADIO ALARM CLOCK



LAMP DIMMER

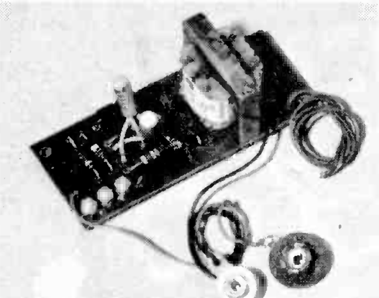


INTERCOM AMPLIFIER

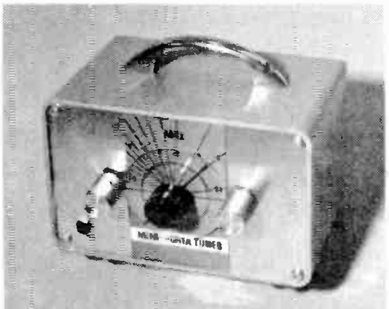


LIGHT POWERED RADIO

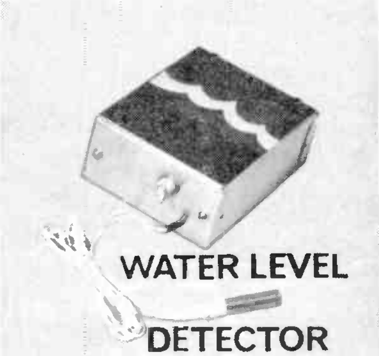
BABY ALARM



TWO TONE DOOR BELL



TAPE TUNER



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Following the success of the Texan amplifier published in this magazine during May to August 1972, the applications laboratory of Texas Instruments Ltd. have developed exclusively for *P.W.*, a compatible unit for the control of Psychedelic lights from a sound source. The initial design features zero voltage control. A more sophisticated design incorporating lamp dimming facilities will also be covered in this series of articles. For stereo operation two *P.W. Tricolour* units are required.

PW TRI

IF I had been asked, a couple of years ago, what 'psychedelic lights' were, I could only have made a wild guess: was it perhaps a medical term referring to some sort of ultra-violet treatment for disorders of the mind? Or, possibly, the latest in pet food, some extra tantalising form of offal? The truth, however, dawned slowly. What my "trendy" young friends were talking about was the latest innovation, the offspring of a marriage between light and music. It was not simply a question of a 'pop' version of 'son et lumière' but a more intimate relationship between the two media. Light could be made to respond directly to sound; flashing furiously for a fanfare, discreetly dimmed for Debussy. It is, however, unlikely that psychedelic lights will be installed in the Royal Festival Hall, but those of our readers who occasionally frequent the discotheque or dance hall will be familiar with this innovation. It is probable, too, that many have given thought to the incorporation of this feature into their own domestic lighting systems. What, it might be asked, does this involve?

In essence a 'psychedelic' light system works like this: sound controlled modulators convert bass, middle and treble frequencies into corresponding bursts of light thus adding a new "visual" dimension to the beat of the music. This is achieved by taking a signal from across the loudspeaker terminals and feeding it into a filter circuit whose output provides pulses which correspond to the sound spectrum—bass, middle and treble and any combinations of these three channels. These pulses then pass through an interface circuit and energise appropriate triacs. The latter, as will be seen, act as electronic switches and turn on the lamps.

This article will attempt to explain fully the construction of psychedelic light control units for both mono and stereo equipment. It is aimed at the home constructor who possesses nothing more than an average amount of skill.

Zero Voltage Switching

As stated, the lights are turned *on* and *off* by utilising a device called a triac, i.e. a semiconductor bidirectional switch (Fig. 1). This replaces two thyristors connected back to back, thus controlling the positive and negative cycle of the supply voltage. Whereas the thyristor requires a positive gate to cathode voltage and will turn *on* only when the anode voltage is positive with respect to the cathode, triacs will turn *on* when the gate voltage polarity is the same as voltage between mt2 and mt1 (main terminal 2 and 1), i.e. positive for the positive half cycle and negative for the negative half cycle. In addition a triac will turn *on* with the gate negative with respect

MONO/STEREO CAPABILITY

ZERO VOLTAGE SWITCHING

NEGLIGIBLE RADIO INTERFERENCE

LAMP OVER-RIDE CONTROL

OPTIONAL LAMP DIMMING

Mood

PART ONE

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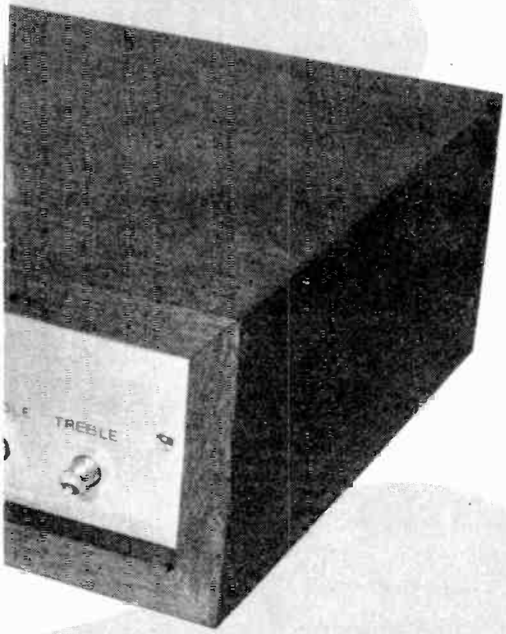
COLOUR



Lighting System

JUREK BUDEK*

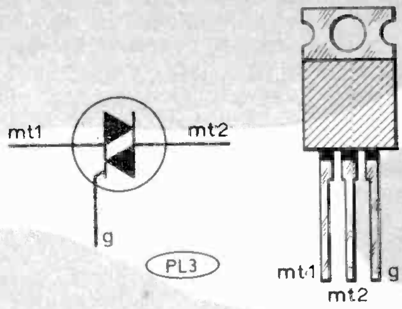


Fig. 1: The TIC226D bidirectional switch

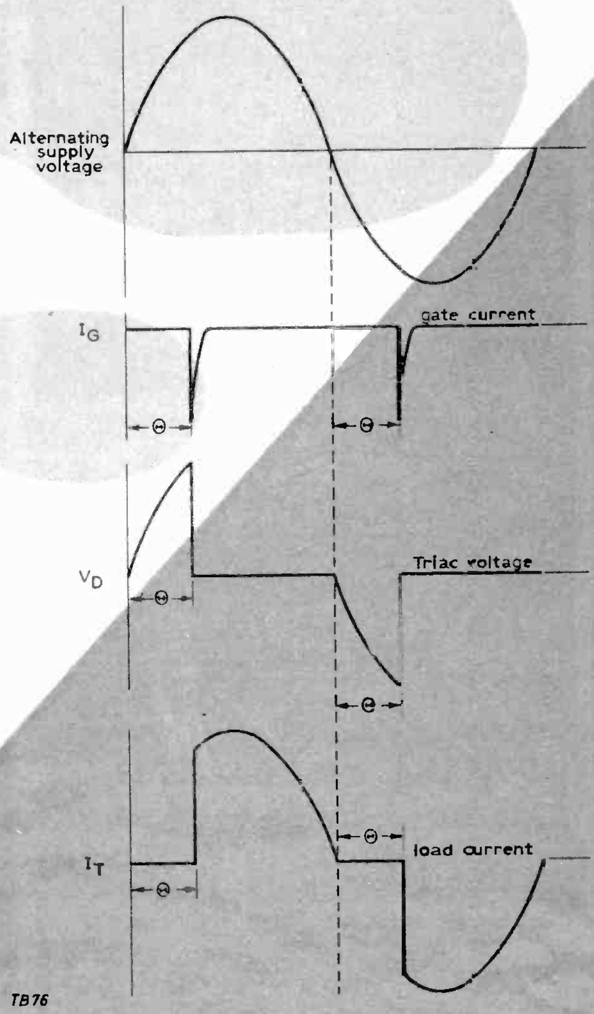
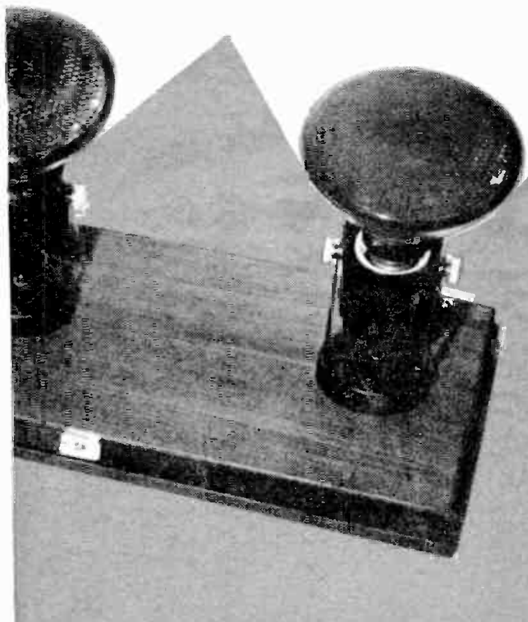


Fig. 2: Waveforms associated with triac switching. Refer to the text for clarification



to the mt1 terminal for either polarity of mt2. It is the latter factor which accounts for the techniques used in the circuits to be discussed in this article.

A further point about the triac is that there is only 2-3 volts between the gate and terminal 1, whereas there may be many hundreds or even a thousand volts between terminal mt2 and mt1.

Triacs used in a phase control mode, as shown in Fig. 2, produce considerable radio frequency inter-

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ference (r.f.i.) due to the step change in current. The noise thus generated is spread by means of conduction through the wiring system or by radiation. Suppressing r.f.i. becomes more difficult and expensive as the load increases. Uncontrolled switching of "psychedelic" lamps *on* and *off* will have a similar effect and will also introduce additional noise in the loudspeakers. A simple solution to this problem is to arrange the switching so that it always takes place at the point where the mains supply voltage crosses zero, as shown in Fig. 3.

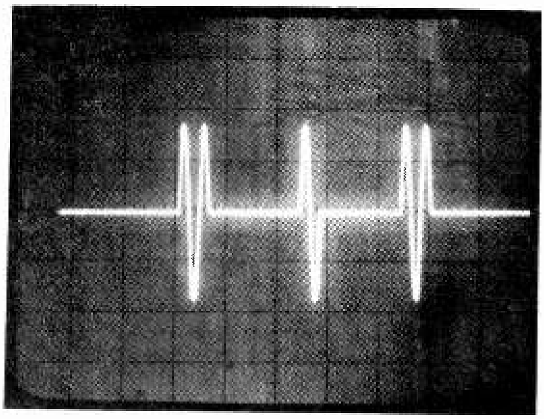

Fig. 3: Waveform depicting zero voltage switching.

This technique is called 'zero voltage switching' or 'burst firing.' In this way isolated numbers of half or full cycles will pass through the lamps and thus avoid step change in currents, which also has the additional advantage of increasing the life of the lamp.

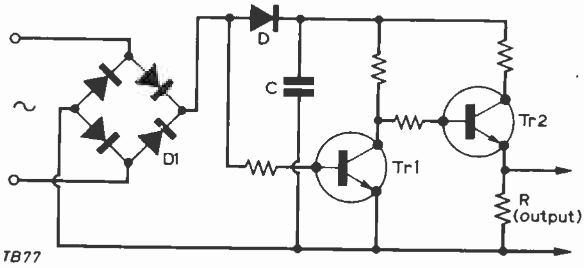

Fig. 4: Basic circuit which generates the pulses at the point of zero voltage crossing.

Fig. 4 shows the circuit used to generate the pulses at the point of zero voltage crossing. Transistor Tr1, whose base is connected to the unsmoothed supply from the bridge rectifier D1 is *on* most of the time.

However, each time the mains voltage crosses zero, its base voltage is taken below the holding on voltage and it thus turns *off*, giving positive pulses on its collector. In order to reduce the loading on transistor Tr1, transistor Tr2 has been added. Positive pulses appear as an output across resistor R each time the mains voltage crosses the zero point.

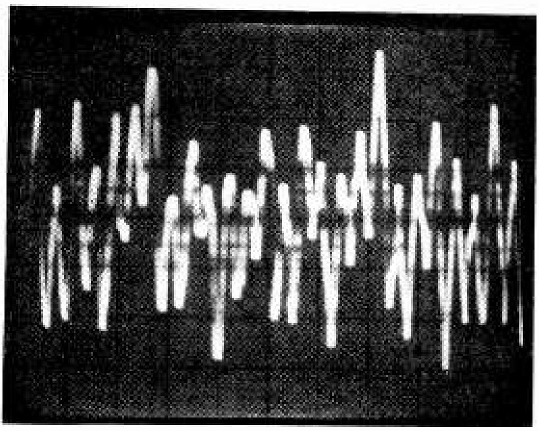

Fig. 5: Typical music voltage waveform at the terminals of a loudspeaker.

In order to control the lamp switching with respect to the frequency bands, we need a circuit which will separate out the low, middle and high frequencies from the voltage waveform appearing at the terminals of a loudspeaker. A typical voltage waveform appearing at this point is shown in Fig. 5.

Filter

A circuit which separates frequencies into bands is called a filter. There are various types of filters which could be employed; e.g. one commonly used is a resistor/capacitor (r.c.) network for high and low pass filters and an inductor/capacitor (l.c.) network for middle frequencies. The elegant way, however, specially developed for the *P.W. Tricolour* is to employ integrated circuit (i.c.) operational amplifiers, in a positive fixed-gain configuration, as the active filter element and resistors and capacitors as passive elements. By choosing suitable component values a sharp separation between bass, middle and treble frequencies can be obtained.

The shape of the filter response is determined by a factor known as the damping ratio (ζ). The lower this ratio, the sharper the cut-off and there is a *peaking* effect. This *peaking* effect is of no importance in our application. As approximately 1·5 volts is required to turn *on* the interface circuit, and thus to switch on the appropriate lamps, the filter characteristics are expressed in volts against frequency and not in the more usual decibels against frequency.

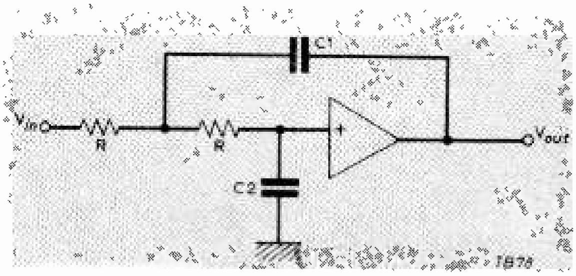

Fig. 6: Basic low pass filter as used in the P.W. Tricolour.

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The theory of filter design is quite extensive and complex. We will however only outline the necessary basic concepts and give some simplified formulae.

Let us first look at a basic low pass filter (i.e. one which will stop all frequencies except those below a chosen frequency). The circuit of such a filter is shown in Fig. 6.

Here the angular cut off frequency, $\omega 0 = \dfrac{1}{R\sqrt{C1\ C2}}$

and the damping factor $\zeta = \sqrt{\dfrac{C2}{C1}}$

Critical damping occurs when $\zeta = \dfrac{1}{\sqrt{2}}$

and, for the reason explained before, i.e. to improve the sharpness, this value is reduced to 0·5. From these equations, the filter component values can be established.

The high pass filter (passing all frequencies above a chosen one) is shown in Fig. 7 and again requires only one operational amplifier, two resistors and two capacitors.

Here the angular cut-off frequency, $\omega 0 = \dfrac{1}{C\sqrt{R1\ R2}}$

and the damping factor $\zeta = \sqrt{\dfrac{R1}{R2}}$

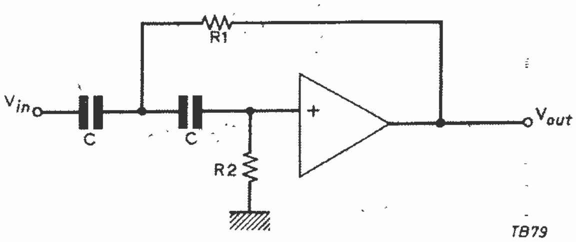


Fig. 7. Basic high pass filter. ▲

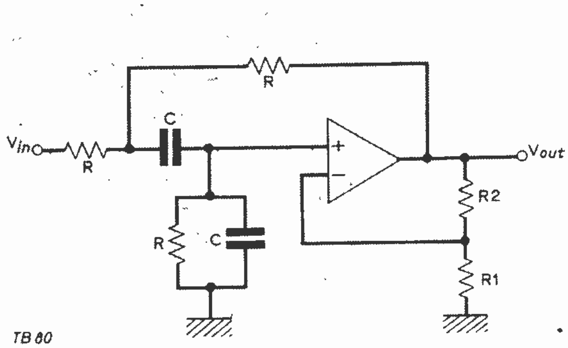


Fig. 8: Basic band pass filter.

Once more from these equations, the filter components values can be established. Finally, the band pass filter; which, of course, as its name suggests, passes a band of frequencies. This, as can be seen from Fig. 8, is a little more complicated than the other two.

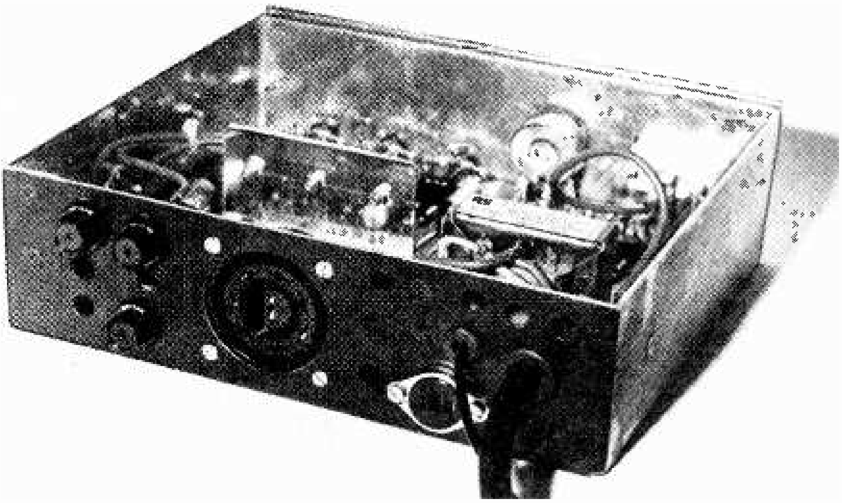
The centre angular frequency $\omega 0 = \dfrac{\sqrt{2}}{RC}$

and the quality factor $Q = \dfrac{\sqrt{2}}{4 - \dfrac{R2}{R1}}$

$Q = \dfrac{2\Delta f}{fo}$, where $2\Delta f$ is the difference between two frequencies at which the voltage output of the filter is $\dfrac{1}{\sqrt{2}}$ of its maximum value. From the above formulae, relevant component values can be obtained.

Musically oriented readers will recall the 'unisono' note played on the oboe during the orchestra's tuning-up time, just before the concert begins. This note is middle 'A' with a frequency of 440Hz; a frequency which has been chosen as the centre frequency for the middle band-pass filter in

Rear view of the P.W. Tricolour. ▶



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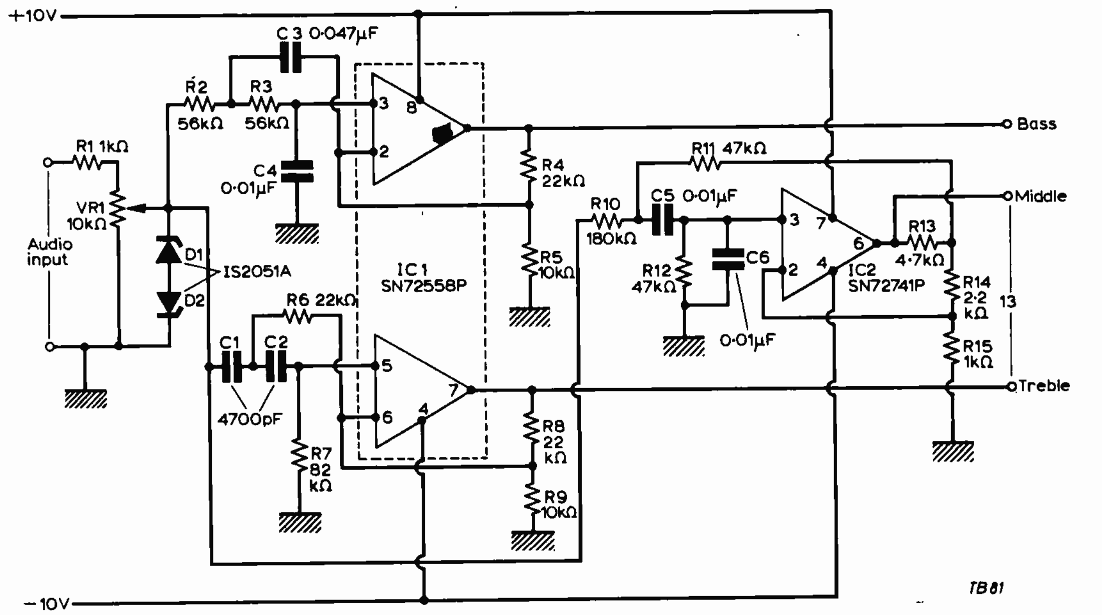

Fig. 9: Complete P.W. Tricolour filter circuit. This unit is used without modification, with either the zero voltage switching unit (Fig. 12) or with the lamp dimming unit, to be described later in this series.

this design. Cut-off frequency for the low pass filter has been chosen to be around 200Hz and that of the high pass filter (treble) about 1kHz.

Based on the above assumptions, a complete filter has been developed with the component values as shown in Fig. 9. The alert reader will notice that some of the component values differ from the figures obtained using the formulae. This has been done intentionally in order to improve the separation between the various frequency ranges.

The input to the filter circuit has been limited to 5 volts peak to peak by using two 5 volt zener diodes connected back to back. Three i.c. operational amplifiers are used. Two of which are contained in one 8 pin package, SN72558P and the other i.c. is contained in a second 8 pin package, SN72741P.

Fig. 10 shows output voltage response of the three filters plotted against frequency for a peak input signal of 0·5 volts. The effectiveness of the filters are obvious. The solid state switches—triacs—turn on their corresponding lamps at filter output voltages equal to and higher than 1·5 volts.

Figs. 11a to 11d show four oscilloscope photographs. These show traces with the vertical axes representing voltages and the horizontal one time. In each instance the four traces were taken simultaneously (i.e. they have a common time axes). In the oscillograms the top trace corresponds to the voltage at the loudspeaker terminal. The other three traces were taken at the outputs of the respective filters.

Fig. 11a was taken at a time when the treble

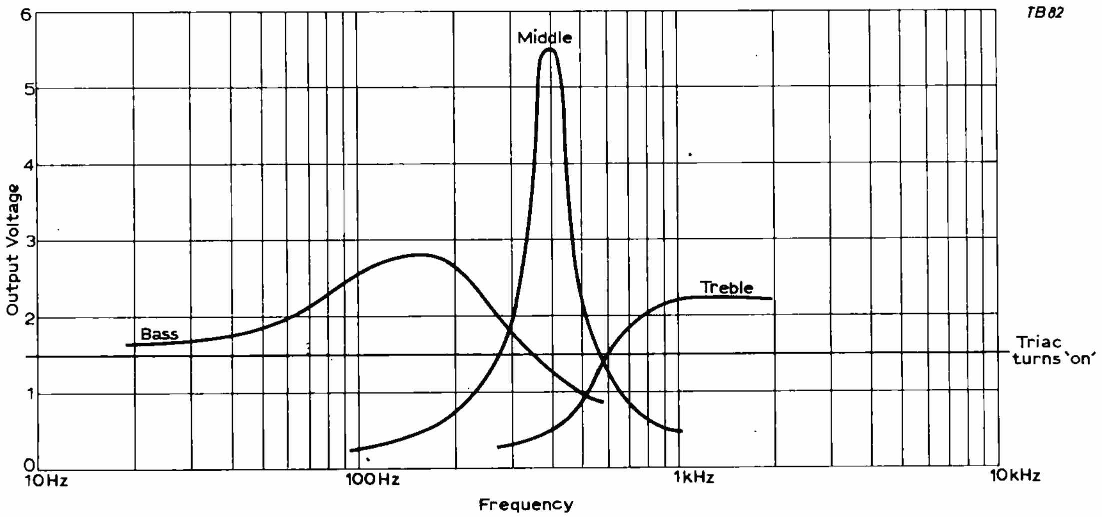

Fig. 10: Output voltage/frequency response of the filter circuit shown in Fig. 9.

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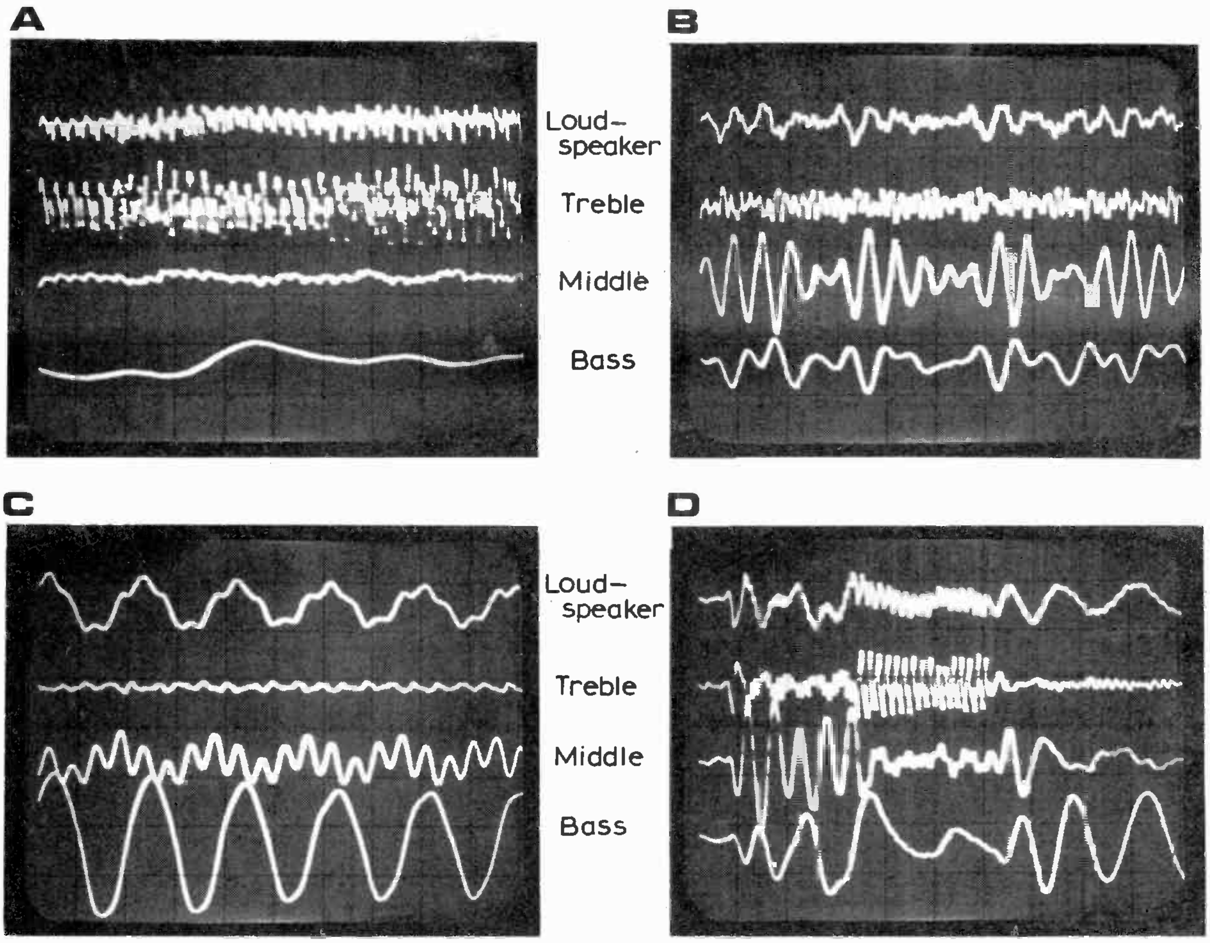


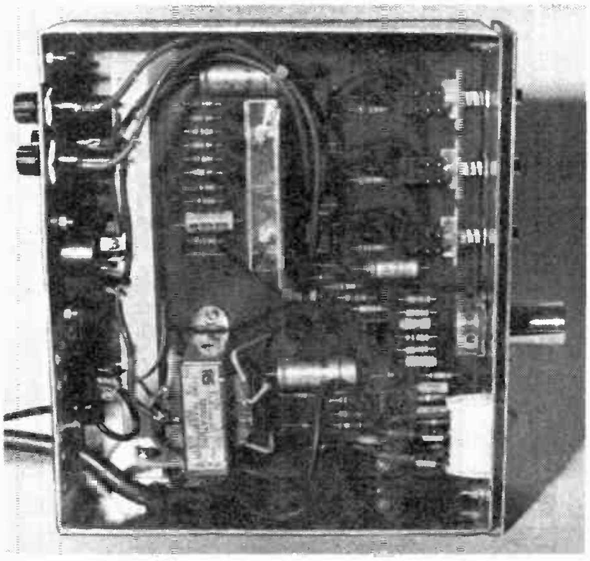
Fig. 11 : (a–d) A full explanation of these waveforms is given in the accompanying text.

frequency was predominant. In Fig. 11b the middle frequency is the strongest signal, while in Fig. 11c it is the bass. Fig. 11d shows some interesting combinations of all three frequencies. The middle frequencies predominate at the beginning of the trace, then the treble takes over at the centre of oscillogram and towards the end of the trace it is the turn of the bass to predominate.

A 10kΩ potentiometer has been added at the input to the filter circuit to allow the voltage level at which the lamps are switched to be controlled. In this way it is possible to establish the best effect for 'soft' or 'party' type music.

The *P.W. Tricolour* is suitable for use with 4 to 15Ω loudspeakers. The load represented by the filters is negligible compared to the loudspeaker impedance.

It should be noted that the simple filter circuits illustrated at the beginning of this article used operational amplifiers. An operational amplifier has high input impedance, very high gain, and low output impedance, enabling the filter component values to be determined independent of the amplifier parameters. The amplifiers used were shown having a voltage gain of unity. This means that the output voltage of the high and low pass filters can never



Underside view of the P.W. Tricolour *with zero voltage switching.*

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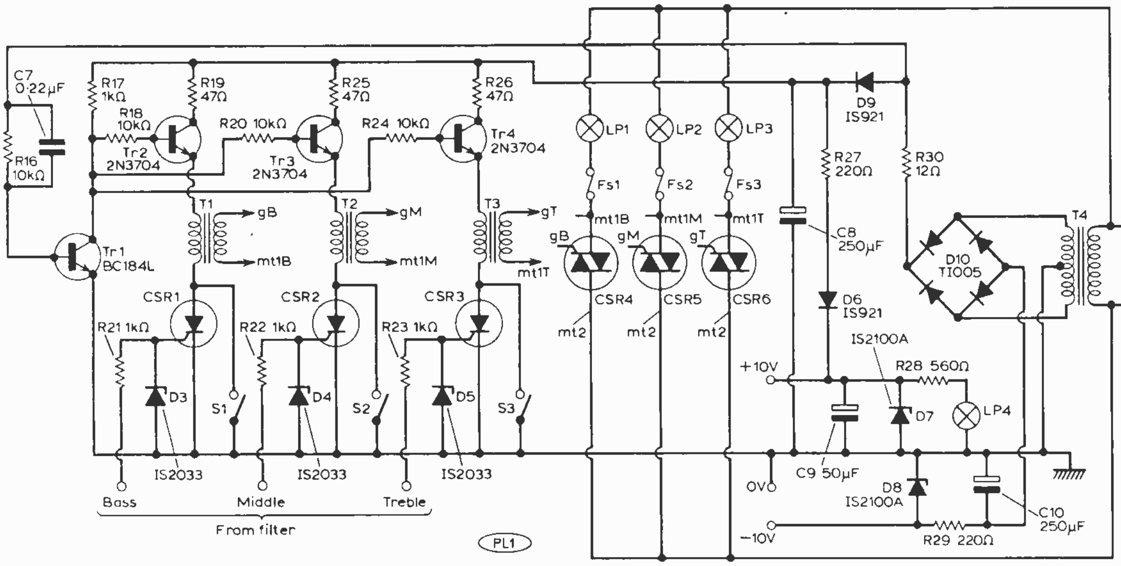

Fig. 12: Zero voltage switching control unit. The positive and negative 10V supply lines are the d.c. supplies to the filter unit (Fig. 9).

be more than the input voltage. In order to achieve voltage gain so that sufficient output can be obtained to drive the interface circuit at low volume levels, the basic circuit must be modified. This involves reducing the proportion of output voltage from the amplifier that is used as feedback to the filter capacitors and resistors. This is achieved by the use of a resistive potential divider at the output of the amplifier. This is shown in Fig. 9. The resistor ratio determines the gain of the filter in the pass-band.

The *P.W. Tricolour* is suitable for either mono or stereo record playing. In the case of the stereo system, the lights will flash in accordance with the signals appearing at the terminals of one of the speakers. However, for stereo enthusiasts who wish to use two units, the interconnecting arrangement will

★ components list

Resistors:

R1	1kΩ	R16	10kΩ
R2	56kΩ	R17	1kΩ
R3	56kΩ	R18	10kΩ
R4	22kΩ	R19	47Ω
R5	10kΩ	R20	10kΩ
R6	22kΩ	R21	1kΩ
R7	82kΩ	R22	1kΩ
R8	22kΩ	R23	1kΩ
R9	10kΩ	R24	10kΩ
R10	180kΩ	R25	47Ω
R11	47kΩ	R26	47Ω
R12	47kΩ	R27	220Ω
R13	4·7kΩ	R28	560Ω
R14	2·2kΩ	R29	220Ω
R15	1kΩ	R30	12Ω ½W

All 10% ¼W unless otherwise specified

Capacitors:

C1	4700pF
C2	4700pF
C3	0·047μF
C4	0·01μF
C5	0·01μF
C6	0·01μF
C7	0·22μF
C8	250μF 25V
C9	50μF 25V
C10	250μF 25V

Transformers:

T1, T2, T3 — Pulse transformer, type PT-ATA ITT Ltd.
T4 — Miniature mains transformer 240V primary 0-12V, 0-12V r.m.s. 6VA, type 12V R.S. Components

Integrated Circuits

IC1 SN72558P
IC2 SN72741P
} Texas Instruments Ltd.

Semiconductors:

Tr1	BC184L
Tr2	2N3704
Tr3	2N3704
Tr4	2N3704
D1	IS2051A
D2	IS2051A
D3	IS2033
D4	IS2033
D5	IS2033
D6	IS921
D7	IS2100A
D8	IS2100A
D9	IS921
D10	TI005 Bridge rectifier
CSR1	TIC44
CSR2	TIC44
CSR3	TIC44
CSR4	TIC226D
CSR5	TIC226D
CSR6	TIC226D

} Texas Instruments Ltd.

Miscellaneous:

VR1	10kΩ linear potentiometer
FS1, FS2, FS3	5A fuses and panel mounting holders
LP1, LP2, LP3	Colour flood lamps, 240V 100W
LP4	TIL 209 Indicator lamp Texas
S1, S2, S3	Push on-push off
S4	Single pole mains on-off rocker

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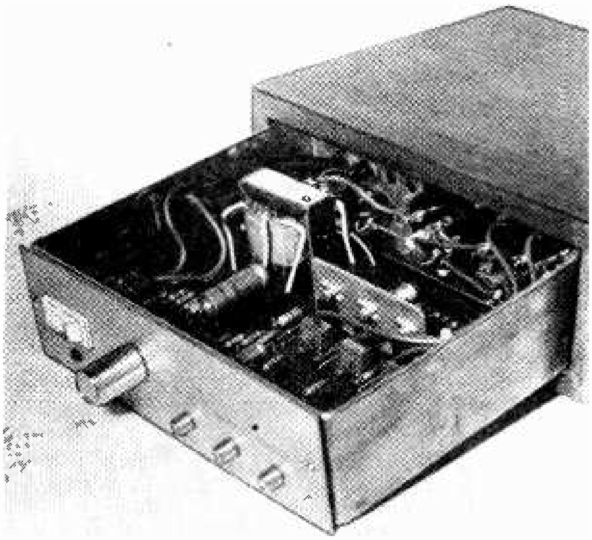

Internal view of the P.W. Tricolour.

be explained later.

Fig. 12 shows the circuit which operates the flashing lights according to the frequency ranges.

Switch S4 controls the mains supply to the unit from a 13A domestic socket. When the a.c. mains power is on the gallium arsenide device LP4 lights. A smoothed d.c. supply for transistors Tr1-Tr4 is obtained from a single phase bridge D10, resistor R30, diode D9 and capacitor C8. The ± 10V power supply for the filter circuit is taken from zener diodes D7, D8 and capacitors C9 and C10.

As described previously, the zero voltage crossing pulses are generated at the collector terminal of transistor Tr1. These pulses turn *on* transistors Tr2, Tr3 and Tr4 via base resistors R18, R20 and R24. When a voltage signal from the filter circuit appears at the input terminals, the corresponding thyristors CSR1, CSR2 or CSR3 will turn *on* allowing pulses to be present at the respective gate of CSR4, CSR5 or CSR6 which turn them and thus their lamps *on*. Pulse transformers T1, T2 and T3 are used only for electrical isolation.

Zener diodes D3, D4 and D5 limit the thyristors gate voltages to 3·3V in the positive direction and to under 1 volt during the negative half cycles.

Facilities are provided for 'by-passing' the psychedelic control by closing switches S1, S2 or S3 to allow the lamps to be used as normal lights. The centre tap of the 12-0-12V mains transformer is connected to the chassis and is earthed. Note that the three triacs are mounted on a common heat-sink, which is at the supply line voltage, i.e. 240V.

The author has made arrangements for the supply of all components for the *P.W. Tricolour* with Henry's Radio Ltd. We understand that a detailed price list will be available from them upon receipt of a stamped addressed envelope.

TO BE CONTINUED

CHARLES MOLLOY

THE Medium Wave Column

J. KING (Edinburgh) asks for the times and frequencies of English speaking foreign stations on the medium waves. Among the stronger there are Radio Sweden which is on 1178kHz every night at 2245hrs; Radio Portugal on 755kHz and 1161kHz. also at 2345hrs and the Vatican Radio on 1529kHz at 2100hrs. There are also the American Forces Network (AFN) outlets on 872kHz, 935kHz and 1142kHz. Try for CJON St John's, Newfoundland on 930kHz—it can be found on the low frequency side of AFN on 935kHz after 2330hrs. CJON has been a strong and consistent signal all winter and it has even been heard when conditions have been poor and no other North American could be heard.

Harold Emblem (Mirfield, Yorkshire) has received a QSL card (verification) from Radio Zagreb Yugoslavia which transmits on 1133kHz. The address is Radio Televizija Zagreb, PO Box 818, Zagreb Yugoslavia and reports in English are answered. Harold mentions hearing PJA6 Radio Victoria on 925kHz, which is located in the Netherlands Antilles in the Caribbean. It broadcasts religious programmes in English and other languages and is usually heard in this country after midnight.

Harry Kenyon (Leeds) has been looking for a published list of medium wave stations. "Broadcasting Stations of the World" published by Iliffe is available in many bookshops price 50p. It covers medium wave stations in Europe and North Africa plus a number of more powerful outlets in other parts of the world, that are usually heard in Europe. There is also a comprehensive list of short wave stations.

Karl Ritz (Bicester) sends a programme schedule of BBC Radio Oxford which is now on 1484kHz. Frequencies in use by BBC local radio are 850kHz R. Blackburn, 998kHz R. Solent, 1034kHz R. Medway, R. Sheffield; 1106kHz R. Leeds; 1457kHz R. London, R. Birmingham, R. Newcastle, R. Manchester; 1484kHz R. Brighton, R. Humberside, R. Merseyside. R. Oxford; 1502kHz R. Stoke; 1546kHz R. Bristol, R. Teeside; 1594kHz R. Leicester.

Kenneth Turner (Edinburgh) has logged R. Birmingham, R. Stoke and R. Bristol and he reports hearing Manx Radio (Britain's only commercial radio) on 1295kHz and 1594kHz.

G. H. Esmail (Bradford) enquires about a suitable receiver for use on the MWs. Serious DXers prefer a communications receiver such as the Trio 9R59DS or the Lafayette HA600 but an ordinary transistor portable will pull-in Europeans and North Africans and if the receiver is rotated to make use of its internal directional aerial, it will be possible to reduce quite a lot of interference.

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

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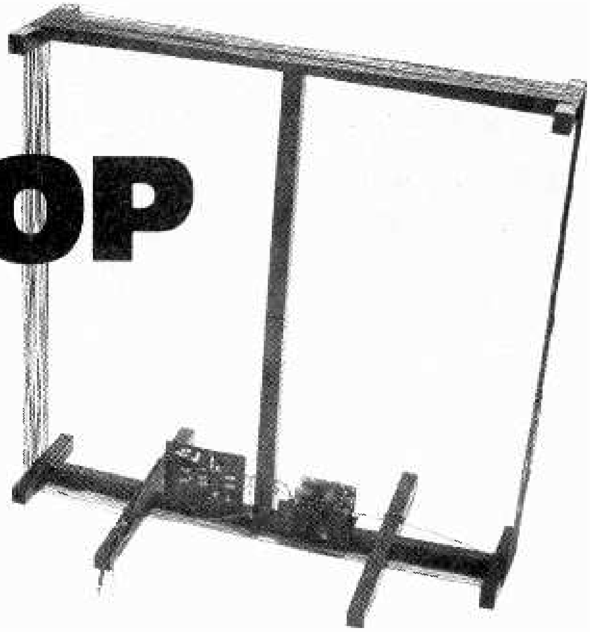
DXers MW LOOP aerial

S. A. MONEY G3FZX



DURING the next two years the minimum of the current sunspot cycle should occur. Although short wave reception usually suffers at the period of the sunspot minimum the conditions will become very favourable for the reception of DX signals on the medium wave broadcast band. Unfortunately, the interference from European stations, many of which now remain on the air all night, is likely to be much worse than it was during the last sunspot minimum. In order to winkle out the weaker DX signals from the QRM it will be important to choose an effective aerial system as well as a good receiver.

In the late 1950's the writer, in collaboration with Reg Dunkley of Havant, Hampshire, carried out a series of tests to investigate the possibility of using a tuned loop aerial for the reception of DX signals on the medium wave band. These tests showed that although the loop aerial is somewhat less sensitive than the usual outdoor wire type aerial it has several advantages which make it attractive for DX work.

Pick-up of background noise and static seems to be rather less on the loop aerial than it is on a wire aerial so that although giving less signal the loop does usually give a better signal to noise ratio.

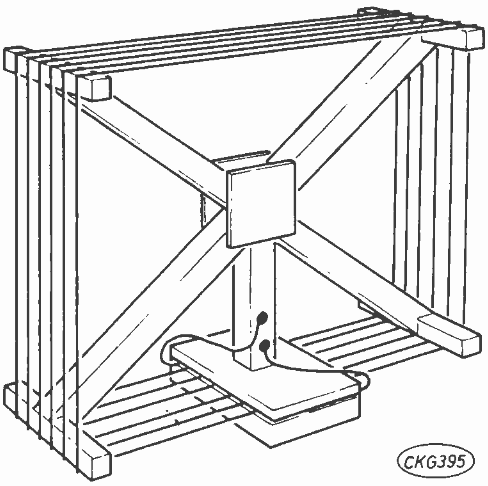


Fig. 1: Configuration of a typical m.w. loop aerial.

By rotating the loop aerial its directional properties can be used very effectively to cut down adjacent channel interference from strong European signals. A further advantage of the loop aerial is that it is very compact and hence attractive to the listener who is unable to use a large outdoor aerial system.

The advantages of the loop aerial have, in the past ten years, made it very popular among the medium wave DX enthusiasts in Britain.

Although the basic loop aerial as used by most of these DX'ers is quite effective it is not the optimum arrangement.

In the past year the writer has experimented with methods of improving the performance of this type of aerial. In this article a system is described consisting of a loop aerial and a matching amplifier capable of giving a performance superior to that of the basic loop aerial.

HOW THE LOOP WORKS

Before going on to describe the improved aerial system it would be as well to consider the make up of the basic loop aerial and the way in which it works. This type of aerial used to be a standard fitting in portable radios before the arrival of the ferrite rod aerial.

The loop aerial usually consists of a number of turns of wire wound in the form of a short coil on a large wooden frame. Typical aerials are square in shape as shown in Fig. 1 although circular or diamond shaped loops will also work. The length of the sides may be from 12in. up to about 4ft. In general the larger size aerials give greater signal output and rather better directional properties.

Normally the turns of the winding are spaced apart from one another to reduce self capacitance. The whole aerial is then tuned to resonance by a variable capacitor connected across the ends of the loop.

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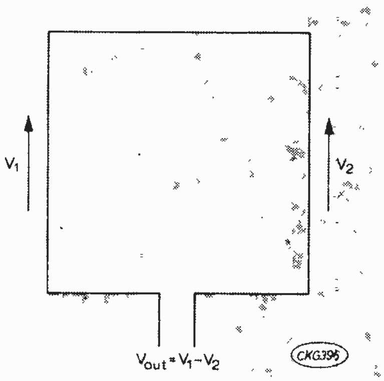

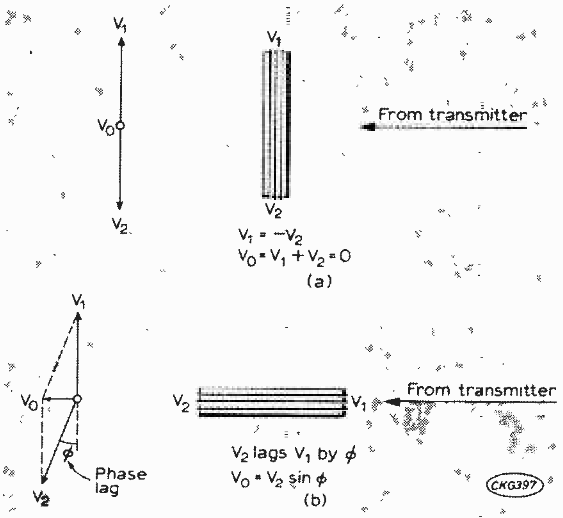

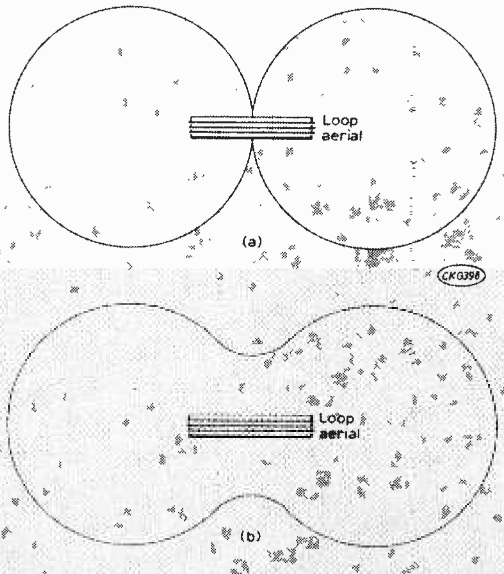

Fig. 2: (top) Voltages induced in a single turn loop. Fig. 3: (centre) indicates how the output of the loop depends on its position relative to the signal source. Fig. 4: (bottom) illustrates the modified pick-up pattern of a loop due to "antenna" effect.

To see how the loop works let us assume that there is only one turn as shown in Fig. 2. When radio waves pass through the loop a voltage will be induced in each of the vertical sides. These voltages are shown as V1 and V2. The relative polarity of the two voltages is indicated by the arrows. It will be seen that the voltage at the terminals of the loop will be made up of V1 and V2 connected in series. When the two voltages are connected in this way they will be effectively in opposition to one another so that the resultant output voltage at the loop terminals will be the difference between V1 and V2. In practice the two voltages are alternating and therefore the difference voltage will depend not only upon amplitude but also upon the phase of V1 relative to V2.

Suppose the loop is set up so that it is broadside on to the direction from which the received signal is coming. This is shown in Fig. 3(a) which shows a view looking down on to the aerial. Both vertical sides of the loop will be at exactly the same distance from the transmitter aerial so the induced signal voltages V1 and V2 will be of the same amplitude and in phase with one another. At the output terminals the difference voltage produced will be zero since V1 and V2 will cancel out exactly. This is known as the 'null' position for the loop since there will be no signal output.

Now let us see what happens when the loop is turned so that it is in line with the direction of the signal being received as shown in Fig. 3(b). In this case one side of the loop is closer to the transmitter than the other. Since the width of the loop is very small compared with the distance to the transmitter the amplitudes of the induced voltages V1 and V2 will still be virtually equal. The radio wave will, however, take a finite time to travel from the near side of the loop to the far side so that V2 will lag behind in phase relative to V1. This phase shift of V2 will produce a difference signal output at the loop terminals. In fact at this position the loop will give its maximum output signal.

The resultant pick up pattern for a loop aerial will be as shown in Fig. 4(a). If extra turns are now added to the loop so that it forms a short coil the voltages produced by each of the turns will add together at the output terminals. As a result the output from the aerial will be proportional to the number of turns used. For a multi-turn aerial the pick up pattern will be the same as for a single turn. A further increase in output can be obtained if the aerial is tuned to resonance by connecting a variable capacitor across the ends of the loop winding.

"ANTENNA" EFFECT

One of the difficulties which occurs when using a loop aerial is known as the "antenna" or "vertical" effect. Unless the aerial is exactly balanced electrostatically with respect to earth it will act as a normal vertical aerial. A simple vertical aerial picks up the signal at equal strength from all directions in the horizontal plane. Now we get the condition that when the aerial is broadside on to the direction of the signal the voltages V1 and V2 cancel as before but the output due to "antenna" effect remains constant. This results in a pick-up pattern like that in Fig. 4(b) where the nulls are less marked and much broader than for a perfect loop.

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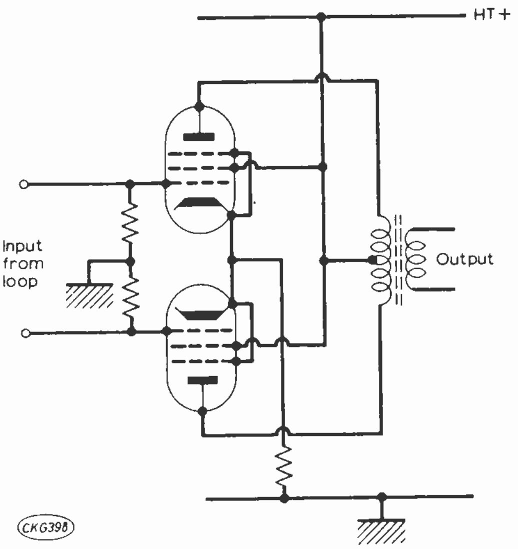


Fig. 5: Basic circuit of an early valve-type balanced input stage.

Perhaps the most obvious method of coupling the loop to the receiver would be to connect it directly across the aerial input terminals of the receiver. This method is rarely successful since the aerial will be unbalanced to earth and "antenna" effect is usually very bad.

For the basic loop aerial used by m.w. DX'ers the usual method of coupling is by means of a link winding. The link usually consists of one turn, or sometimes two, wound on the frame alongside the main winding. This link winding is then connected directly to the receiver input. With a link coupling of this type the aerial usually works quite well except that the link winding itself tends to produce some output due to "antenna" effect.

DIFFERENTIAL MATCHING AMPLIFIER

Wartime d.f. receivers, such as the R1155, made use of a differential or push-pull amplifier at the input. This type of amplifier uses two valves with

★ components list

Resistors

R1	47kΩ	R5	47kΩ	R9	10kΩ
R2	1kΩ	R6	2·2kΩ	R10	470Ω
R3	100Ω	R7	330Ω	R11	100Ω
R4	1kΩ	R8	330Ω	VR1	500Ω preset

All ¼W 5%

Capacitors

C1 4·7nF polyester
C2 0·1μF min. foil
C3 4·7nF polyester

Semiconductors

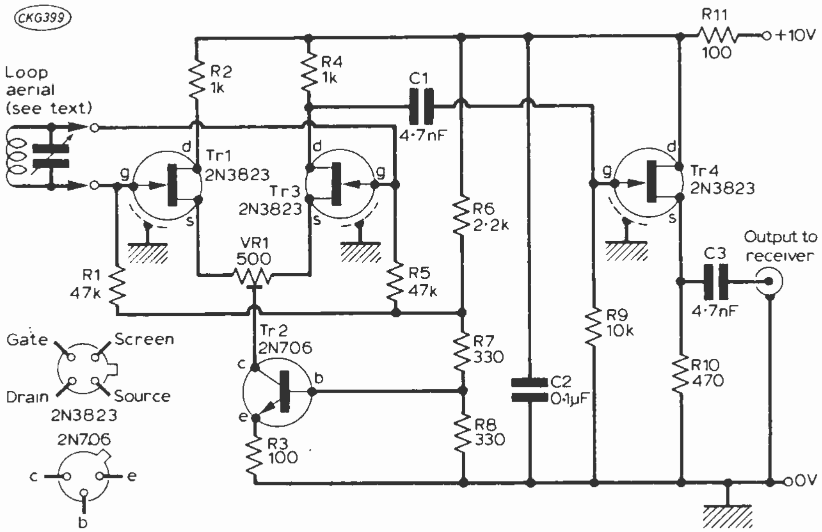
Tr1 2N3823
Tr2 2N706
Tr3 2N3823
Tr4 2N3823

their cathodes connected together as shown in Fig. 5. The resistor in the cathode circuit is made large enough so that it acts as a constant-current source. This type of amplifier responds only to differences in voltages between the two grids and will reject any signal common to both grids such as that produced by "antenna" effect in the loop aerial.

A balanced input amplifier using transistors instead of valves is shown in Fig. 6. In order to maintain a high value of Q in the aerial circuit a pair of field effect transistors is used for the differential input stage. This type of transistor has similar characteristics to a valve and gives a much higher input impedance than a normal bipolar type transistor. In this circuit 2N3823 'N' channel field effect transistors are used.

A differential amplifier works most effectively when the common-tail circuit of the input pair is fed from a constant-current source. In the valve version this is achieved by feeding the common cathode point through a large resistor from a negative supply voltage. In the circuit of Fig. 6 the transistor Tr2 is used to provide a constant current feed.

Characteristics of the 2N3823 may vary widely from one transistor to another. For optimum results the two transistors Tr1 and Tr3 in the input stage should either be matched or at least have similar characteristics. This can be checked by using the



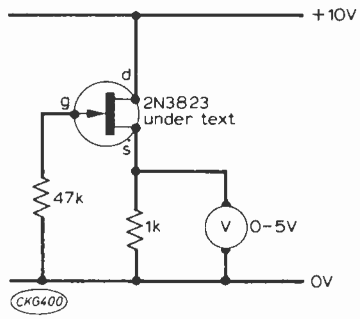


Fig. 6: (left) Complete circuit of the loop matching amplifier. Note that the 2N3823 transistor specified is preferable to the unscreened 2N3823E. Fig. 7: (above) is the circuit of the simple test set-up for checking the characteristics of the f.e.t.'s.

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AC176	16p
AC153/176K	32p
AC187	17p
AC188	23p
AC187/188K	40p
ACY17	27p
ACY18	20p
ACY19	20p
ACY20	20p
ACY21	19p
ACY22	10p
AD140	55p
AD149	50p
AD161	35p
AD162	38p
AD161/162	70p
AF106	24p
AF114	25p
AF115	25p
AF116	25p
AF117	25p
AF118	44p
AF124	25p
AF125	24p
AF126	17p
AF139	30p
AF186	40p
AF239	36p
AF279	47p
ASY26	25p
ASY27	30p
ASY28	22p
ASY29	30p
BA138	15p
BAX16	8p
BB103	16p
BB104	28p
BB105	32p
BC107	10p
BC107/BC177	24p
BC108	10p
BC108/BC178	23p
BC109	10p
BC109/BC179	24p
BC109C	11p
BC140	30p
BC147	10p
BC148	8p
BC149	10p
BC157	12p
BC158	11p
BC159	12p
BC147/157	22p
BC148/158	20p
BC149/159	22p
BC167	11p
BC168	10p
BC169	11p
BC169C	12p
BC177	14p
BC178	13p
BC179	14p
BC182	10p
BC182L	10p
BC183	[illegible]
BC183L	10p
BC184	13p
BC184L	12p
BC212	12p
BC212L	12p
BC238	10p
BC238/308	20p
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BC258	8p
BC259	9p
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BZY88C8V2	13p
BZY88C9V1	13p
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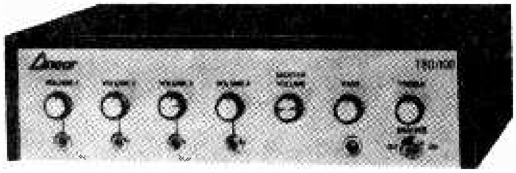

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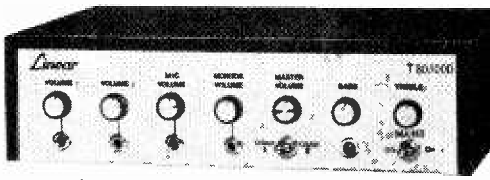

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CARTRIDGES all with standard fittings and stylii. Stereo-compatible Mono GP91/SC **98p**; STEREO GP93 **£1·35**, Stereo Ceramic GP94 **£1·75**. (All at 7p each.) Comparatives shown in List, with more types inc. Sonotone 9TAHC, Stereo Ceramic Diamond **£1·70** (7p). **DIAMOND STYLII:** single tip types: Acos GP37, GP59, GP65/67, GP71, BSR TC8/LP/ST: COLLARO O.P. and DC284, GARRARD GC2, GC8, GC810, GCE12, RONETTE BF40, O.P. and T. PHILIPS 3301 (3060, 3066, 3302, 3304), 3010/12/13/16, SONOTONE 19T/20T ALL AT **36p** each (7p). SAPPHIRE **16p** (7p) DIAMOND DOUBLE TIP TURNOVER TYPES (78 sap. on other side). For ACOS GP73, GP91 (for cartridges GP93, GP94 etc.) GP91SC (for stereo compat. types) GP104 BSR ST4 (ST3, ST5), ST9 (ST8), ST12/14/15, SONOTONE 8TA, 9TA, 9TAHC. PHILIPS 3306 3310, 3224, 3228/22 GP280. GARRARD GCM21, and 22, GC823, GK825 and 26, GCM21T and 22T, GCM24T GC823. GK825T and 26T, GCM31, GC836, GC835, GC838, K840A. K841B ETC. ALL AT **68p** (7p). SAPPHIRE **32p** (7p). **DOUBLE DIAMOND STYLII:** same dia ST/LP tip each side: no 78) All types **£1·35** (7p). SAPPHIRE DOUBLE ST/LP, TIPPED **32p** (7p). **PICK-UP WIRE:** super thin flex screened, sheathed, TWIN **7p** per yard, 4-core **13p** per yard (either up to 6 yds. 7p). Over, charges paid. **MICROPHONES:** CRYSTAL: LAPEL 1¼", clip/hand, lead 3·5mm jack plug **39p** (9p). CM20 Cream Plastic hand **58p** (9p); CM70 "PLANET" Metal, tapered with neck cord, adaptor for stand **£1·65** (11p); "MIC 45". Curved metal hand grip **£1·10** (11p) ALL with leads. DYNAMIC: 209 Cardioid Ball. 50K/600 Ω built in volume control, on/off switch, special 20ft lead, the best value anywhere at **£6·60** (33p); UD130, uni-dir mesh ball 50K/600 Ω jack plug, cable, adaptor, **£5·28** (22p); DM160, omni-dir, Ball mesh, 50K, cable adaptor, jack plug, **£4·29** (33p each). **SPEAKERS:** Very popular 12" ROUND, fitted tweeter, 3, 8 or 15 ohms (state which) **£2·06** (33p) or pair for stereo **£4·65**, charges paid. **SMALL** 2½", 3 Ω, 8 Ω or 64 Ω (state which) **36p** (9p). More speakers in List. **HEADPHONES:** High resistance 2000 Ω adjustable **£1·10** (11p). **EARPIECES:** with lead and min. 2·5mm or 3·5mm (state which) jack plug. MAGNETIC **11p**. CRYSTAL (3·5mm plug only) **28p** (up to 6 for 9p any size). **SOLDERING IRON:** Slim, modern, British high speed, 8½", all parts replaceable, highest quality, fully guaranteed **£1·29** (11p) **TRANSFORMERS:** Sub-min 11 × 11 × 12mm. OUTPUT (3 Ω for OC72, etc.) **16p** or DRIVER **17p** (Up to 12 for 7p). **CONNECTING WIRE:** Packs of 5 coils, each coil 5yds. Asstd. cols. SOLID CORE **16p** (7p.) FLEXIBLE CORE **18p** (9p). SUPER THIN flexible for transistor wiring, etc. **18p** (7p) **RETRACTABLE FLEXIBLE LEADS** (CURLIES): With phono plug, each end, 6ft **26p**, 12ft **44p**. With phono plug/phono socket other end 6ft. **29p**, 12ft **50p** (6p lead any type). **VIBRATORS:** 12v/4 pin non-synch. 12HD4, 2¾" ex. pins, **33p**. SAME but 3½" ex. pins, USA **16½p**. 12v/7 pin synch. (12SR7) 2¾" ex. pins, **72p** (9p any type). **MAINS NEONS**, fly leads **11p**. **NEON SCREWDRIVER** (pocket tester) **19½p** (7p either). **MAINS BATTERY ELIMINATOR.** Input 240v-AC. Output 3, 4½, 6, 7½, 9 and 12 volt D.C. by switch selector. On/off switch, pilot lamp, leads, plug to suit most cassette recorders, **£4·13** (27p). Highly suitable for all transistor receivers.

SPECIAL NOTICE—BETWEEN FEB. 22nd AND MARCH 14th SOME DELAY IN DESPATCH OR ORDERS AND REPLIES TO CORRESPONDENCE MAY OCCUR DUE TO RECONSTRUCTION. ALL ABOVE PRICES HAVE BEEN ADJUSTED TO INCLUDE V.A.T. BUT FOR ALL ORDERS DESPATCHED BY US UP TO MARCH 31st, PRE-VAT PRICES AS PER LAST MONTHS ADVERTISEMENT WILL APPLY.

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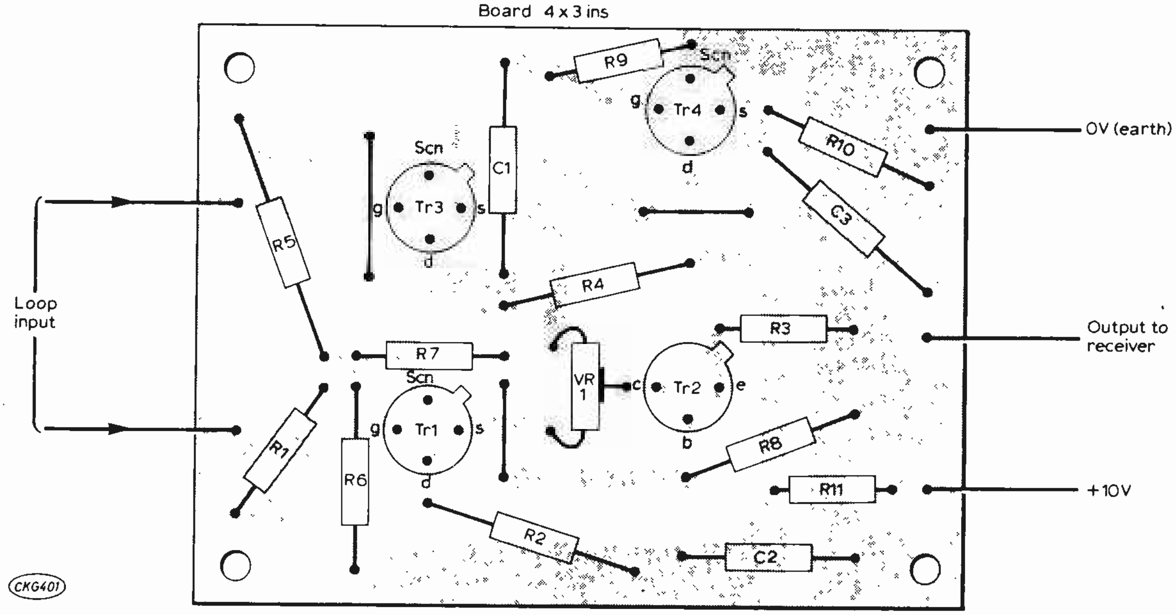


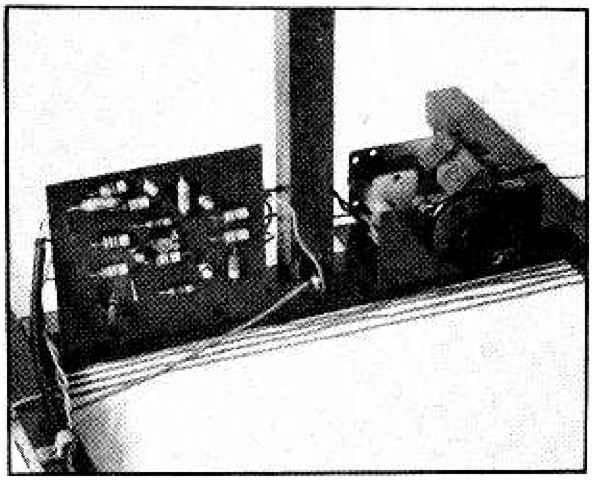
Fig. 8: Full size illustration of the printed circuit board, from the copper side. Small holes are drilled for component leads and the components mounted from the other side of the board.

circuit of Fig. 7 to select two 2N3823 transistors giving a similar voltage drop across the 1kΩ resistor in the test circuit. The balanced amplifier itself will tend to level out small differences between the transistors.

Transistor Tr4 acts as a source follower and is used to match the output from Tr3 into the low impedance of the cable and the receiver input circuit. Capacitive coupling is used to the output so that if the cable is accidentally short circuited the transistor Tr4 in the output stage will not be destroyed.

CONSTRUCTION

It is convenient to build the amplifier on a small circuit board and to mount it close to the tuning capacitor on the main loop frame. A suggested layout for a printed circuit board for the amplifier is given in Fig. 8. As an alternative the amplifier may be built on a piece of Veroboard. It should be noted that the screen leads of the 2N3823 transistors are connected to earth.



Close-up of the matching amplifier and loop tuning capacitor.

To test the aerial system the input amplifier stage should first of all be balanced. Connect a meter between the drains of transistors Tr1 and Tr3 and adjust the preset resistor VR1 until the voltage is zero. The two transistors will now be drawing equal currents.

Tune in a fairly strong signal from a known direction and rotate the aerial to obtain maximum pick up. At this point the loop should be tuned to resonance by means of the tuning capacitor as indicated by a further increase of signal when resonance is reached.

If the aerial is now rotated so that it is roughly broadside on to the direction of the station being heard a point should be found where the signal falls to a low level. A further small adjustment of VR1 may enable the signal to be reduced even lower.

THE LOOP

The loop aerial used by the writer has 12 turns on a 24in. square frame. To reduce self-capacitance and give more turns for the same inductance the turns are spaced 3/8in. apart. For the winding 14/0·0076 p.v.c. covered flexible wire is used. Tuning is by a 365pF air spaced variable capacitor across the ends of the loop winding.

Signal pick-up for this loop with its amplifier was found to be some 20dB up on the signal from a 30ft. outdoor wire aerial. Using a Lafayette HE30 receiver the signal reading on the 'S' meter varied from S9+60dB at the maximum pick up point to about S3 when the loop was rotated to the null position. The null point itself is sharp and extends over perhaps only two or three degrees. ■

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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

"Mobile" dog sledge

In the February 1973 issue of Practical Wireless on page 890 you have a little note about working amateur radio from a dog sledge, stating that this might have been the world's first QSO from a dog sledge mobile installation. I would like to point out to you that there have been a number of radio amateur contacts from dog sledges over the past years. My first contact from a dog sledge installation was made in 1938 and I am quite sure that that was not the first one in the world.

The UK expedition which some years ago tried to reach the North Pole from Alaska also carried amateur radio equipment and had a number of contacts with the outside world. A Norwegian expedition which also some years ago tried to reach the Pole from the northern part of Greenland had practically all their contacts with the outside world made by amateur radio. Both these expeditions relied on dog sledges for their transportation.

In Norway and no doubt also in other countries with similar snow conditions amateur operations from dog sledges are not infrequent, and I myself have done it many times. I thought you might be interested in knowing this. **Lars R. Heyerdahl,** LA6A, *(Oslo 2, Norway).*

Don't get knotted!

A serious error was made by somebody when he knotted the mains input cable, as illustrated and described in the text on the battery eliminator (on pages 920 and 921).

This can be very dangerous and is specifically outlawed by the Institute of Electrical Engineers in their published regulations.

If a cable is rapidly bent from a straight to a highly twisted configuration, as often occurs when an item is knotted and the knot pulled tight rapidly, the core material may suffer from local fatigue causing cracking of the material. The cracking acts as a resistance to the current flowing through the appliances, hence local heating occurs.

The error, though dangerous is so common that M. Wallis could be excused it, provided the suggested warning is printed.

I would suggest that one of the plastic cable clamps, to secure mains leads, should be used. **S. A. East,** *(Enfield, Middlsex).*

Midget radio phones

Over the Christmas holiday I assembled the *Practical Wireless* midget radio, lashed it to the head-band of some wartime crystal 'phones and got good listening for radios 2 and 4 and others between.

The hospital wards being quietish, I set off on some market research; men and women patients listened and all said that such lead-less headphones would be much appreciated, since they currently roll about and pull out the lead, and also cannot use 'phones when sitting out in the middle of the ward. They need to be lighter than my prototype, perhaps built onto a stethophone; and as not a few are hard of hearing, a bit more volume is needed. If we want Radio Humberside or television sound (the ward set provides vision only) we should need something more sophisticated I suppose. Also an experienced Charge Nurse said if 'phones are not on leads I shall need to put them on chains!

Incidentally, when walking home across the common in the fog the wireless 'phones directionality helps personal alignment!—Dr. H. F. Barnard, Pathologist *East Riding Group Laboratory, Westwood Hospital, Beverley, Yorks. HU17 8BU.*

25 years of transistors

I was especially interested in Mr. R. Collins's article, 25 Years of the Transistor, because he attributed the research and development that led to it to the Bell Company's need for a substitute for the valve in the telephone service, in the 1940's.

I think that there must have been a lot that went before because men were looking for a substitute for the valve as early as 1920, and soon after, in the "Amateur Wireless" of those days, an account was published of a Russian scientist who was experimenting in making *crystals* perform all the functions of valves.

I remember this well because, as a schoolboy, I put this down as my own scientific basis for an application for an Experimenter's Licence.

Unfortunately, I went to New Zealand afterwards, and lost touch with radio, but I wonder if any other reader can recall what, if any further developments there were in those experiments.—John Pinches (*London, N.W.7*).

[A semiconductor substitute for the valve is now in production. It has improved characteristics and longer life and uses field effect transistor principles. This device, called a FETRON, will be described in full in next month's Practical Wireless.]—Editor

CQ! Gambia

We have been asked by the General Manager of the RSGB to publicise the following letter received by him:—

Whilst on a visit to West Africa recently, I was able to visit the transmitting station of Radio Gambia. I was asked to make an appeal to British S. W. listeners to report to them any reception of Radio Gambia in Britain.

The point is that they have received reports and QSL cards from Australia and America, but would very much like to hear from any British listener. I understand that the transmissions are as follows:—

Radio Gambia, 4·82MHz in the 60metre short wave band.

They tell me the best time for a reception would be between 10.30 p.m. and 11.30 p.m. **George Wallace, M.P.** *(House of Commons).*

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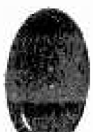

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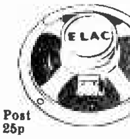

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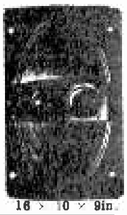

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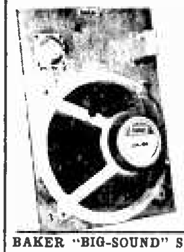

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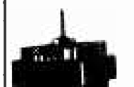

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6AQ5	0·42	6EJ7	0·35	6X4	0·40	25L6GT	0·50
6AQ6	0·70	6EW6	0·70	6X5GT	0·45	25Z4G	0·35
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30C1	0·30	50L6GT	0·60	DM160	0·68	ECC91	0·30
30C15	1·00	85A2	0·55	DY51	0·55	ECC189	0·65
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30FL14	0·90	813	4·00	EABC80	0·38	ECH81	0·30
30L1	0·40	866A	0·85	EAF42	0·60	ECH83	0·45
30L15	0·95	5642	0·70	EBC33	0·60	ECH84	0·45
30L17	0·95	6080	1·75	EBC41	0·65	ECL80	0·50
30P12	1·00	6146	1·60	EBC81	0·33	ECL81	0·50
30P19	0·95	6146B	2·50	EBF80	0·40	ECL82	0·35
30PL1	0·95	6360	1·25	EBF83	0·40	ECL83	0·70
30PL13	1·10	6939	2·25	EBF89	0·32	ECL84	0·55
30PL14	1·25	7199	0·85	EBL31	1·50	ECL85	0·55
35A3	0·60	7360	2·20	EC53	0·50	ECL86	0·40
35A5	0·75	7586	1·50	EC86	0·60	ECLL800	
35B5	0·65	7895	1·50	EC88	0·60		2·20
35C5	0·60	A2293	2·20	EC90	0·35	EF37A	1·00
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50A5	0·80	DF96	0·50	ECC83	0·33	EF89	0·28
50B5	0·70	DK92	0·70	ECC84	0·30	EF91	0·37
50C5	0·60	DK96	0·60	ECC85	0·40	EF92	0·35

EF95	0·40	GZ31	0·40	PF818	1·00	U301	0·55
EF97	0·65	GZ32	0·50	PFL200	0·65	U403	0·70
EF98	0·75	GZ33	0·75	PL33	0·40	U404	0·70
EF183	0·30	GZ34	0·60	PL36	0·55	U801	0·80
EF184	0·35	HABC80		PL81	0·50	UABC80	
EF804	1·25		0·55	PL82	0·45		0·40
EK90	0·32	HK90	0·50	PL83	0·45	UAF41	0·70
EL33	1·50	KT66	2·35	PL84	0·40	UAF42	0·60
EL34	0·50	KT88	2·25	PL302	0·95	UB41	0·65
EL36	0·50	N78	1·60	PL504	0·75	UBC41	0·55
EL37	1·70	PABC80	0·40	PL508	0·90	UBC81	0·45
EL41	0·75	PC86	0·60	PL509	1·10	UBF80	0·40
EL81	0·55	PC88	0·60	PL801	1·00	UBF89	0·40
EL83	0·50	PC92	0·05	PL802	0·95	UBL1	0·70
EL84	0·25	PC97	0·50	PM84	0·60	UBL21	0·70
EL85	0·43	PC900	0·48	PY31	0·35	UC92	0·45
EL86	0·40	PCC84	0·40	PY33	0·63	UCC85	0·45
EL90	0·42	PCC85	0·40	PY80	0·40	UCF80	0·70
EL95	0·35	PCC88	0·55	PY81	0·30	UCH21	0·60
EL821	0·60	PCC89	0·55	PY82	0·35	UCH42	0·70
EL822	1·40	PCC189	0·60	PY83	0·38	UCH81	0·40
ELL80	0·75	PCC805	0·95	PY88	0·40	UCL81	0·60
EM34	1·00	PCC806	0·95	PY800	0·47	UCL82	0·35
EM71	0·80	PCF80	0·30	PY801	0·50	UCL83	0·65
EM80	0·45	PCF82	0·35	PZ30	0·38	UF9	0·65
EM81	0·60	PCF84	0·60	QQVO2-6		UF11	0·60
EM83	0·50	PCF86	0·60		2·25	UF41	0·65
EM84	0·35	PCF87	1·10	QQVO3-10		UF42	0·65
EM85	1·00	PCF801	0·50		1·25	UF43	0·65
EM87	0·70	PCF802	0·50	QQVO3-20A		UF80	0·35
EN91	0·40	PCF805	0·90		5·25	UF85	0·40
EY51	0·40	PCF806	0·75	TT21	3·40	UF89	0·40
EY80	0·75	PCF808	0·90	TT22	3·50	UL41	0·65
EY81	0·40	PCH200	0·70	U18/20	0·75	UL84	0·43
EY83	0·55	PCL81	0·50	U25	0·85	UM84	0·30
EY86	0·40	PCL82	0·35	U26	0·85	UY1N	0·50
EY87	0·43	PCL83	0·65	U31	0·70	UY11	1·00
EY88	0·43	PCL84	0·45	U37	6·50	UY41	0·48
EZ40	0·50	PCL86	0·45	U52	0·40	UY82	0·50
EZ41	0·75	PCL88	1·25	U76	0·40	UY85	0·40
EZ80	0·28	PCL800	1·10	U78	0·40	W729	0·75
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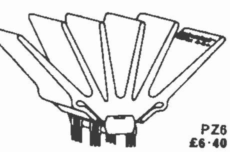

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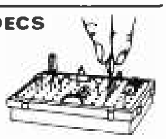

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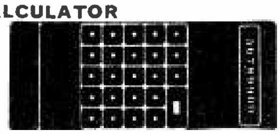

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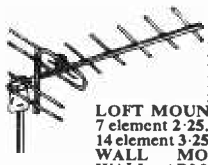

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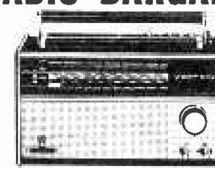

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ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

WE are running out of frequencies. I know we have certain "Amateur Bands," but some of these are on a shared basis, i.e. we can only use them provided we are not a nuisance to other non-amateur stations using the band.

Many will remember when 40 metres was 300kHz wide—it's now 100kHz wide and intruders still try to drive us off this remaining r.f. island. The only real answer to amateur radio survival is intelligent activity. With a band full of active enthusiasts, intruders will think twice about taking on our "QRM". Those that do would find a few hundred amateurs from dozens of different locations and countries, all suddenly doing tests on that particular frequency. Whether amateur radio loses any more of its r.f. spectrum or indeed a complete amateur band, is entirely up to the people who practise and enjoy our hobby.

A topical example is 4 metres or 70MHz. This band is greedily looked at by many people (non-amateurs) who would like to use the small piece of 4 metres which we still have. Activity on 70MHz is very low from an amateur's point of view, and if activity is not increased, then the authorities may well award the entire 4 metre band to "other services". The argument could well be (and it is a valid one) that since there is so very little amateur activity on 4 metres, then you do not really need that band. So how about some logs for 4 metres?

A 4 metre converter is not a difficult thing to build and would offer a very useful intermediate step in construction practice between the h.f. bands and 2 metres. Constructing a converter for 70MHz is not difficult but needs a little more care than units constructed for the lower frequencies. One excellent idea would be to use 70MHz as a local net band, which would avoid the interference suffered on 160 metres top band, would keep us clear of Loran, which plagues 160, and would increase the level of 4 metre activity dramatically. We have to start somewhere or we could well lose this band. So, 4 metre enthusiasts forward. Let's hear what you hear.

A letter from **Paul Petty** (Canterbury) tells of a useful information service for European stations which transmits on 80 metres between 2100 and 2200 GMT. There is a controller station which is changed daily. Monday's controller is DA1LA. On Wednesdays it is DK8FZ. The purpose of the net is to assemble and disseminate information on DX stations, i.e. future skeds.

Top band enthusiasts will be delighted to hear that G3SZA has been heard on 160 metres in Australia by a VK3 station. Alas callsigns are still changing. MP4 stations have been heard using a new call sign—A4FA. When will we have some callsign stability? And why change from MP4M to A4FA?

Another strange change is that CT1 stations are to use the prefix CT4 during the CQWPX contest this month. Why is not made clear. First class licence holders in Japan now have two-letter suffix calls and second class licensees will use a JM suffix followed by three letters.

Old hands will be pleased to hear VR6TC on again from Pitcairn Island, and DX enthusiasts who enjoy hearing/working island stations should listen for VQ9HCS who radiates on 15 metres in the afternoons from Aldabra Island.

Robert Harpur (Shenfield) tells of two VP8 stations located in South Georgia which can be heard some evenings between 14·125kHz and 14·130kHz. This page commonly informs of stations heard by other short wave listeners and amateurs. The gear is quoted, i.e. receivers, a.t.u. preselectors etc., in this way readers can gauge how their own performance is by direct comparison especially if the report is from someone using similar equipment. It has been suggested it would be nice to actually see some of these stations. Photographs of individual set ups would be of interest to others. Anyone got any really good, sharp photographs of the gear plus themselves. Think of the satisfaction of seeing your trusty old CR100 smiling back at you from the pages of *PW*.

Peter Franklin (Skegness) received a UNR30 receiver for Christmas and is busily spoiling the brute with a diet of 100ft. end fed. A preliminary listen on eighty metres brought forth a high level of G activity. Peter queries the callsign G4GJ heard testing a transmitter on 3·8MHz one afternoon. Will the real G4GJ please stand up?

Another eighty metre enthusiast is **Peter Reed** (Brighton) who is the proud possessor of an FTDX401 receiver which apparently has a Japtick UFP. Sorry Peter, I know of no ointment which can cure that. Perhaps you could scrape it off with a bent screwdriver. Peter's log for eighty reads; FL8OM, HS4AGM, I5FLN, JW9QH, M1C, M1I, VE1AIH, VE1IE, VS6DO, VQ9R, W1AA, W1KET, W2APU, W2PV, W3WJD, YA1AH, ZL4KE, ZS1MH, ZS3GH, 5X5N, 9G1DY, 9H1C, 9H5D, all on s.s.b.

Stephen Mayer (Poole) has a CR70A receiver fed with a 90ft. wire. This set up brought in stations from most European countries. From further afield; PY2ZAT, W4AG, W5QGZ, all on eighty metres.

Great rejoicing in South Yardley where **David Sharred** has found that his blood pressure and country score have increased in direct proportion to the arrival of a new CR150/2. This, together with sharp ears (no, he's not Mr. Spock) and a 140ft. end fed raised these on 3·8MHz; CT2BG, FP8CT, K1DQV, VE1ADV, VE3CDP/W9, VE7SV, W1CF, W4CC, W5SR, W5SW, WA9PRO, ZL3GS, 4X4UF, 5X5NK, 5X5XM, 9HIC.

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

www.americanradiohistory.com

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE first topic for this month is that of aerial wire. In the February column I asked if anyone knew of a good source for aerial wire. The number of replies was very pleasing and I must apologise for not being able to answer them all personally.

In general, your answers seem to bear out my opinion that it is becoming more difficult to find supplies of good quality aerial wire. The wire which I have always used in the past is that manufactured by a firm called 'Aerialite'. This wire consists of seven strands of copper with very strong insulation which is ideal for the purpose.

Mr. **A. E. Halladay** informs me that this is still available from a shop called 'Al Radio Components' of 14 The Borough, Canterbury, Kent. The wire is available in lengths of 25, 50 or 75 feet and is very reasonably priced at 14p, 22½p and 29p respectively. A charge of 6p is made for post and packing.

Mr. **David Porter** writes to say that a firm called Chas. H. Young Ltd of 170-172 Corporation Street, Birmingham, B4 6UD sells Stranded 7/·029 and 32/0·2mm Insulated wire in 140 foot lengths for £1·87. This firm is also a good source for aerial insulators and dipole centre pieces.

Mr. **A. A. Smith** of Preston in Lancashire suggested the use of a particular type of G.P.O. Telephone wire. This consists of a single strand of steel wire which is covered with a film of copper and then a layer of insulation. It is usually supplied as a twin cable, similar to lighting flex, but this is easily split into two separate wires. The advantage of this wire is the superior strength of the steel core. No supplier is known but the wire should be available from Surplus Stores.

A preselector is basically an r.f. amplifier and, as such, it will improve the performance of almost any receiver. Many receivers do not have an r.f. amplifier stage, the first stage being the mixer and it is with these sets that the most significant improvement in performance will be obtained. If the receiver has one or more r.f. stages incorporated the improvement will not be so marked.

The preselector usually provides a gain of 30dB, which in simple terms is a gain of 32 times, this gain being very useful in the reception of weak signals.

It is worth noting that the most common source of lost efficiency in a receiving system is a mismatch between components of the system. The three common components are the aerial, the preselector and the receiver. In the simplest case of aerial and receiver it is essential to have a good match between the two. If a preselector is added there must be a good match between the aerial and the preselector and also between the preselector and receiver.

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

READERS' LOGS

The first log comes from **Raymond Mowll,** who enquired about preselectors, his equipment is a Trio 9R59DS and 100 feet of wire. The lack of a preselector did not prevent him from hearing:

5047 *Togo,* French news and music at 2250.
7120 *Kiev,* with Mailbag programme at 0045.
7180 *BBC, Tebrau, Malaysia* relay at 1720.
9655 *R. Damascus, Syria,* in English at 2040.
11710 *RAE, Argentina* with music at 2330.
11955 *FEBA, Seychelles* in English at 1745.
15140 *R. Havana, Cuba,* commentary at 2100.
15375 *R. Nederland, Bonaire,* English at 1830.

R. M. Witney of Braintree has been active again with his Skywood CX-203 receiver and 110 foot long-wire hearing the following stations:

11730 *Radio Ceylon* at 0140.
11815 *Trans World Radio, Bonaire* at 0055.
15165 *Radio Denmark* at 2000.
15448 *Radio Nacional de Brazilia* in Spanish at 0225.

Peter North of Southport has sent in his first report to the column using his Heathkit RG-1 receiver and 24 foot long-wire to hear:

4979 *R. Rumbos, Venezuela* in Spanish at 0430.
4995 *R. Brazil Central* in Portuguese at 0030.
5075 *R. Sutatenza, Colombia,* Spanish at 0130.
9550 *RTB, Belgium* in English at 0050.
9730 *ETLF, Ethiopia* in English at 0400.
9745 *R. Baghdad, Iraq* in English at 1930.
11710 *RAE, Argentina* in English at 2300.
11720 *R. Nacional de Brazilia* in English at 2230.
11805 *R. Globo, Brazil* in Portuguese at 0030.
11860 *R. Canada International,* English at 2115.
11880 *R. Ankara, Turkey* in English at 2200.
11930 *WIBS, Grenada* in English at 2030.
11955 *FEBA, Seychelles* in English at 1730.
15300 *HCJB, Quito, Ecuador* in English at 1900.
15345 *R. Kuwait* in English at 0500.

Reports should arrive by the 15th of the month and be addressed to me at 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

NEXT MONTH

ON THE AIR

Our specialist team will present news, views, comment and of course YOUR LOGS on the Broadcast Bands (Short Wave and Medium Wave). The Amateur Bands (Short Wave) and

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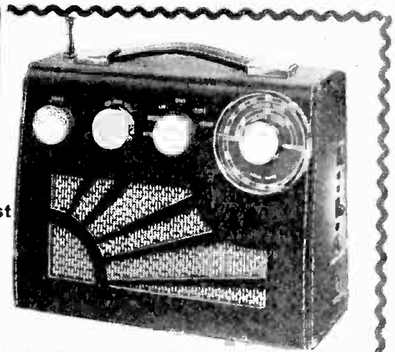
Build yourself a TRANSISTOR RADIO



ROAMER 10 WITH VHF INCLUDING AIRCRAFT

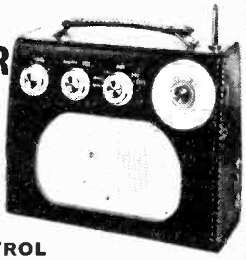
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS ALSO AIRCRAFT BAND

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

Total building cost £8·50

P. P. & Ins. 50p

(Overseas P. & P. £1)



ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building cost £6·98 P. P. & Ins. 45p.
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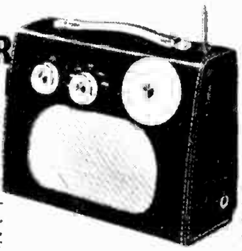

ROAMER SEVEN MK IV

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

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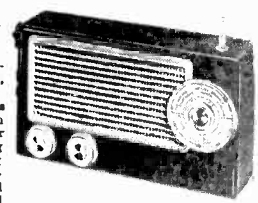
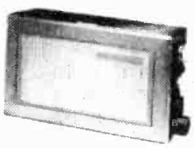


ROAMER SIX

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler, band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 25p (FREE with parts).

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



POCKET FIVE

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

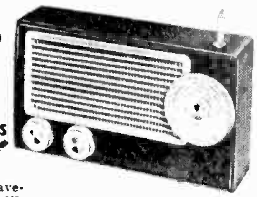
Total building costs £2·29 P. P. & Ins. 23p
(Overseas P. & P. 63p)

TRANSONA FIVE

5 TRANSISTORS AND 2 DIODES

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

Total building costs £2·50 P. P. & Ins. 24p
(Overseas P. & P. 63p)



TRANS EIGHT

8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

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(Overseas P. & P. £1)

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PW52

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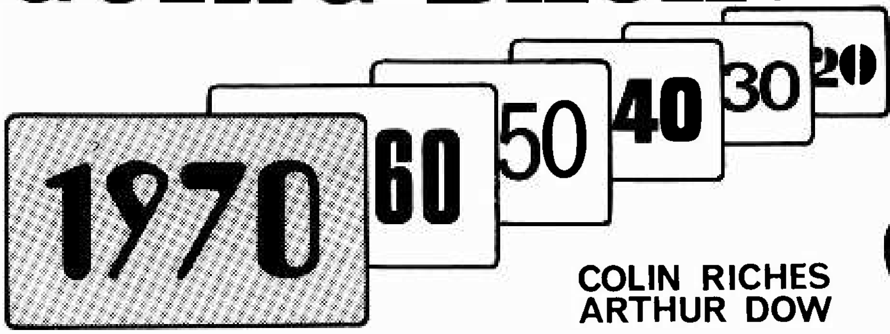
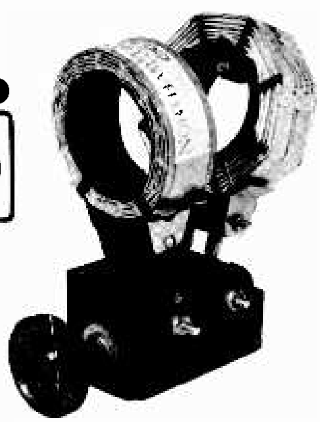
GOING BACK...





COLIN RICHES
ARTHUR DOW

THE other month we received a letter from one of our New Zealand readers who informed us that he is an ardent vintage radio equipment collector. He told us that he decided one day to cart all his gear out on to his back lawn (it's baking hot over there at this time of the year) and take some pictures for us to show in the Going Back column.

The reader, **George A. Weston**, says that he would be grateful if anyone could supply him with the exact dates of the British-made sets, so, if anyone wants to contact him, the address is 179 Rosebank Road, Avondale, Auckland, New Zealand.

The items we show in our pictures have all been fully restored by Mr. Weston and where components had to be substituted, he used parts of the same vintage. Likewise, any valves used were of the same period and not later replacement types.

Picture No. (1) is a set made by McMichael. It has MH on the panel and is an all-wave superhet. There are five valves inside the unit and one outside. Date is about 1927.

Next, in picture (2) is a Philips 2516 with valves 506, E415, B443 and date of manufacture is about 1930. The matching speaker is a Baby Grand model 2028 balanced armature cone type that can either hang on the wall or sit on the table as shown.

Set No. (3) is an American "Radiola" model 12/20. Dated about 1925 it has UX199's in all stages except a UX120 as output valve. Case is walnut veneer.

The Gecophone shown in photograph (4) is a 1924 model containing 2 valves and working from batteries. There is one r.f. stage with variometer and a detector stage with condenser-controlled reaction. The valves used are "R" types and the receiver is shown sitting on top of a 2-valve amplifier.

Picture (5) shows a 1924 "B.T.H." crystal set with matching phones. The "driving instructions" are shown in the lid. Also shown is a "Polar Twin" 2-valve battery receiver about 1924 vintage and a Gecophone crystal set c1924 in mahogany case.

The "B.T.H." is called "Radiola"—a name generally associated with RCA in America, indicating a tie-up between manufacturers.

An "Atwater-Kent" model 30 c1926 6-valve set is shown in picture (6). It uses grid stoppers (Cossor system) in lieu of neutralizing. This was the first single-dial model made by this company. Valves are UX201A's in all stages.

No. (7) is an American 1926 "Grebe" MV1 synchrophase 5-valve neutrodyne battery set. Valves used are UX201A's. The cabinet is mahogany.

A Philips Dutch 2510 1930 vintage 5-valve mains t.r.f. is shown in picture (8). Valves 2 x E442 screen grid, detector E415, output C443 with a 506 rectifier. The case is a metal frame enamelled black with insert panels mottled rich deep red.

Picture (9) shows an American "Gilfillan GN1 c1926 5-valve neutrodyne battery set. This is a de-luxe model with walnut veneer case. It is 3ft long to accommodate "B" batteries. There is a meter for battery checking and three covers on the front drop down. In 1926, this set cost £35.

No. (10) shows a "Claritone" re-entry horn speaker (rear left) made by Automatic Telephone Co., England. It has a heavy cast-iron case and was made in 1924. A B.T.H. horn speaker (rear right) can be seen (c1926). This model has a brown flare with a transfer in black and gold.

Also shown are a "Brown" H4 (front left) (c 1926) a Burndept "Peter Pan" (c 192??) and a "True Music Minor" (front left)—date not known and no information available.

Photograph No. (11) shows an American cone speaker with a balanced armature. It is made from pressed steel and painted gilt. No. (12) is a cone speaker with a reed unit. It is called a "Mellotone" and the cone is made entirely of cardboard. The stem and base are wooden and the date is April 1926.

In some future Going Back articles we hope to show some more of our readers' collections of vintage radio gear.

A reader remembers

R. J. Hall, 7 Darlington Road, Longrock, Penzance, Cornwall, comments on his early days in radio . . .

"In those days the enthusiast enjoyed winding his own solenoid coils and basket coils, building up variable capacitors from threaded brass rod, brass or aluminium plates and nuts and bolts, and even winding transformers, both r.f. and a.f. I myself have wound more than one mains transformer by hand at 7 turns per volt on a sq. inch core and made speech coil formers and wound them.

It was common practice in the early days to plan a set and build it on a 'breadboard' layout when it usually worked perfectly but on being tidied up and put into a cabinet it invariably refused to function. In those days radio was a fascinating hobby but since it has become an exact science half the fun has gone".

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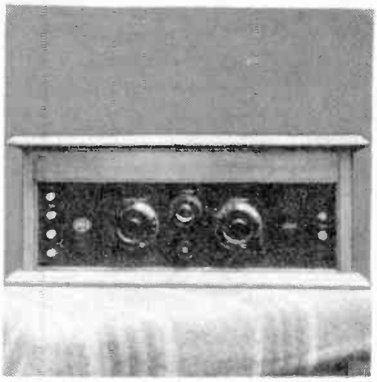
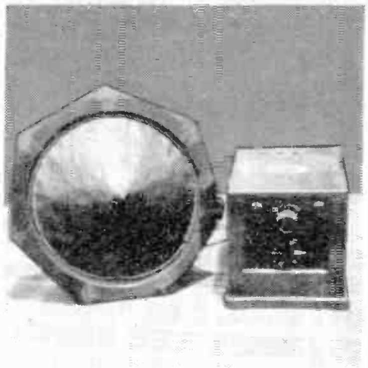
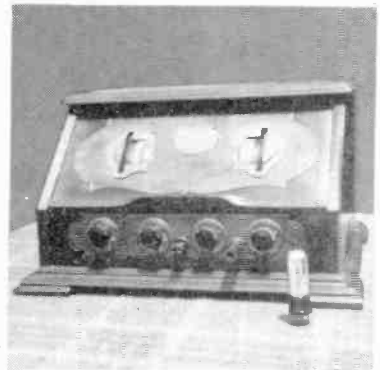


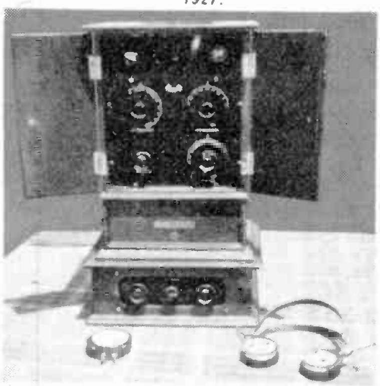
1 McMichael "MH" receiver dated about 1927.



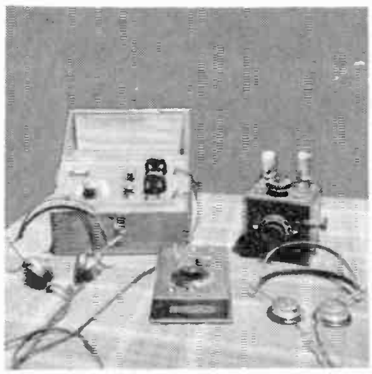
2 The Philips 2516 dated about 1930 and Philips 'Baby Grand" speaker



3 R.C.A. model 20 Radiola of 1925.



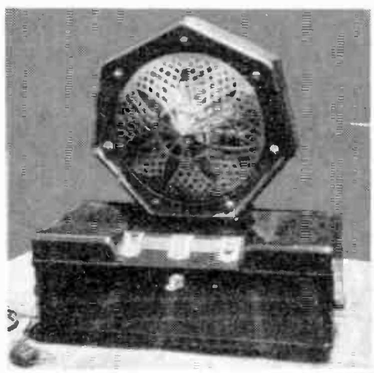
4 Gecophone 1924 vintage sitting on a 2-valve amplifier.



5 B.T.H. crystal set (1924) with Polar Twin and Gecophone set

6 The Atwater-Kent model 30.

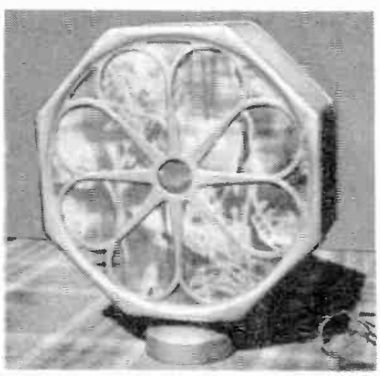
7 American Grebe MV1 (1926).



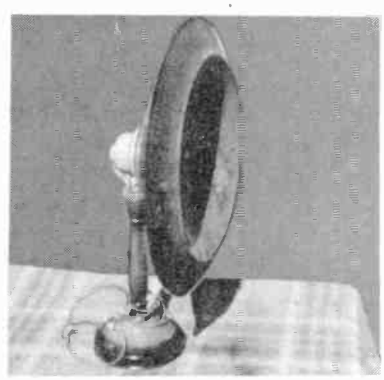
8 Philips 2510 receiver (1930).

9 American Gilfillan GN1 c1926.

10 A selection of vintage speakers.



11 American cone speaker with balanced armature.



12 Cone speaker with a reed unit.

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TAKE 20

JULIAN ANDERSON

No. 47
VARICAP TUNED B.F.O.

WHEN a diode is reverse biased it becomes a low value capacitor. Integrated circuits make use of this effect as in this technology it is far easier to incorporate this than a more conventional component. What is more, the actual value of the capacitance depends on the voltage applied. Special diodes are made to make the best use of this effect and are known as *Varicaps* but as we have mentioned, all diodes exhibit this affect, the higher the current rating, the better the affect. We can make use of this effect where a small capacity change is sufficient such as in a b.f.o. and it is this which forms the subject of our project this month. Instead of using a variable capacitor, which would be expensive, we are using a simple potentiometer to alter the tuning.

The complete circuit is shown in Fig. 1. The tuned circuit, which operates round about 465kHz, is made up from C4 and L1. This is coupled to Tr1 to form an oscillator, C2 providing the feedback to maintain oscillation.

L1 is the Repanco DRX1 crystal set coil which has both long and medium wave windings, we only use the medium wave winding in our circuit and the connections should run to the common connection of both windings and to the tag that goes to the start of the smaller winding. In the normal state this would be tuned somewhere in the medium wave band and to increase the inductance (and also to give some control over the operating frequency) we fit a dust core into the centre of the coil.

The tuning side is accomplished by VR1, R1, D1 and C1. If a low value capacitor is connected from the collector of the transistor to the negative line this will alter the frequency. We cannot connect the diode directly here as we would affect the d.c. operating conditions of the transistor and so we have to d.c. block this; C1 performs this function.

To alter the capacity of the diode we have to apply d.c. bias to it and this has to be varied. VR1 can be almost any potentiometer from 5kΩ to 500kΩ; all we need is a variable voltage at the slider. R1 has to be included to prevent funny things happening at the extremes of the track.

As regular readers of this column will know, we often use Veroboard but this is of less use at r.f. frequencies and straightforward drilled s.r.b.p. board is better and a layout is shown in Fig. 2. This should cause few problems; the wiring on the reverse side is shown dotted.

When the unit is switched on, the slider of VR1 should be at the centre of the track and then, with the unit near a receiver, the core in L1 should be turned until a whistle is heard on *all* stations. Whistles may well be heard on one or two stations but this will mean that the frequency, or an harmonic of it, are on top of that station and not on the i.f. When the correct setting has been found VR1 can be adjusted to get the right sort of beat note, it has a fair range both sides of the centre frequency. On the layout a wire is shown marked "To Rx". It will not normally be necessary to make a connection and this wire may not be needed but if the beat note is a bit weak this wire may be dangled among the components of the receiver's i.f. strip. ■

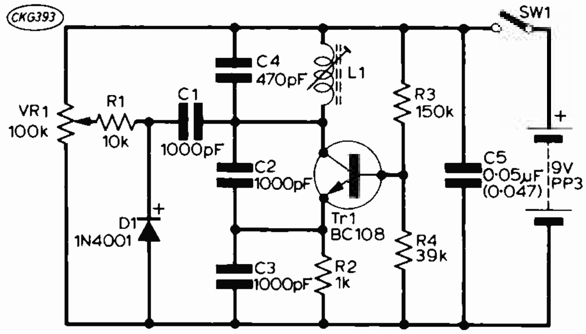

Fig. 1: The circuit: instead of using a conventional variable capacitor, D1 tunes the circuit

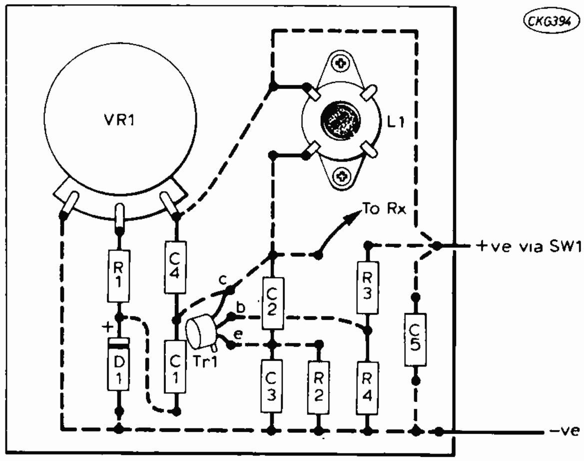

Fig. 2: A suggested component layout on drilled s.r.b.p. board.

★ components list

R1	10kΩ ¼W, 5 per cent	1p
R2	1kΩ "	1p
R3	150kΩ "	1p
R4	39kΩ "	1p
VR1	100kΩ linear pot	12p
C1	1000pF polystyrene	4p
C2	1000pF polystyrene	4p
C3	1000pF polystyrene	4p
C4	470pF polystyrene	4p
C5	0·05µF Mylar etc.	4p
Tr1	BC108	10p
D1	1N4001	6p
L1	DRX1 crystal set coil	18p
Dust core to fit L1		3p
SW1 On-off toggle switch		5p
		78p

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

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IN4004	400	8
IN4005	600	10
IN4006	800	12
IN4007	1000	15
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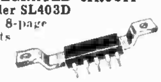

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B1/20	200	30p
B1/60	600	35p
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W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
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1 Amp
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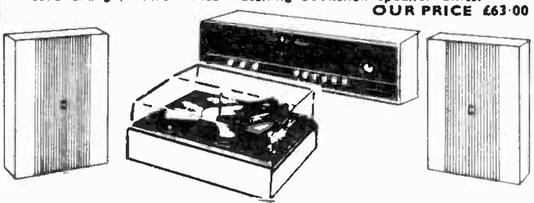

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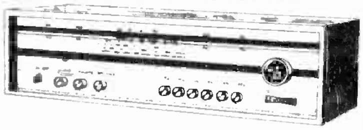

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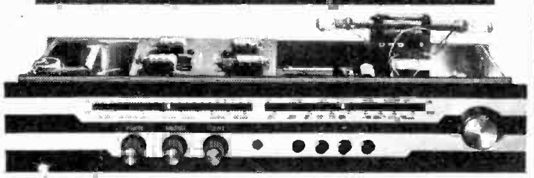

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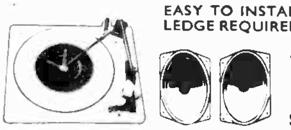

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30C15	·56	EBC33	·38	EF92	·26	PCC84	·27	PY81	·23	W77	·42
30C17	·73	EBC41	·47	EF183	·25	PCC89	·41	PY82	·23	Z77	·18
30F5	·60	EBF89	·27	EF184	·27	PCC189	·46	PY800	·30		
30FL1	·59	ECC81	·15	EH90	·33	PCF80	·25	PY801	·30		
30FL14	·67	ECC82	·17	EL33	·54	PCF86	·44	R19	·27		
30PL1	·58	ECC83	·21	EL41	·52	PCF801	·27	U251	·60		

Post/Packing on 1 valve 7p. plus 3p. per valve on each extra valve. Any parcel insured against damage in transit 3p. extra. Office address, no callers.

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TRANSFORMS YOUR STEREO SYSTEM INTO SENSATIONAL QUADRAPHONIC SOUND

Create a new dimension in sound — sound that engulfs you with natural realism from every corner of your room. Simply wired to your amplifier or Tuner/Amp. speaker outputs and again into 4 speakers. Neat styling with brushed effect console panel. Peak input power 50w into 8 ohms. Front Hi/Low Level 6dB. Phone jacks for input and output. Size: 6" x 3½"d. x 2"h. Guaranteed.

INTRODUCTION PRICE **£7·50** 35 P & P

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DARKROOM EXPOSURE METER

A.P. DONLEAVY

THIS instrument was designed for use with a photographic enlarger, to determine the exposure required for any particular print. It is cheap to build and easy to use, with a range up to about 40 seconds.

THE CIRCUIT

This is shown in Fig. 1. LDR is a light dependent resistor whose resistance varies with the amount of light falling on its face. LDR and VR1 form a potential divider. The potential at point A is determined by the setting on VR1 and on the resistance of the LDR, hence on the light incident on its surface. Tr1 and Tr2 form a Schmitt trigger. The potential at A determines which of these transistors is on and which is off.

Tr2 has a light emitting diode D1 in its collector circuit, which lights when Tr2 is conducting.

To measure the amount of light incident on the meter, VR1 is altered until the extinguishing (i.e. on-off) point of the diode is found. The setting of VR1 is thus a measure of the exposure time required. A knob with a linear calibration around the outside is used to alter VR1.

The unit is sensitive to voltage supply change, hence a zenor diode D2 is used to regulate the power supply.

SW1 is a push button switch which is depressed only when making the exposure, hence eliminating the possibility of forgetting to turn the unit off.

COMPONENTS

Other transistors could be used for Tr1 and Tr2 e.g. 2N2926. VR1 is 50kΩ. Increasing the value increases the range of the instrument but decreases its sensitivity.

D1 does not have its positive lead marked. This must be found by trial and error or by using a meter.

CONSTRUCTIONAL DETAILS

The whole unit can be fitted into a small plastic box 4½in. x 3in. as shown in Fig. 2. Veroboard is used to mount the transistors and resistors. Two small holes can be drilled to take the LDR leads, a dab of glue will hold it in place. Further constructional details are not given since the layout is not critical and most constructors will find it is a simple job to assemble the instrument.

The instrument is now ready for calibrating.

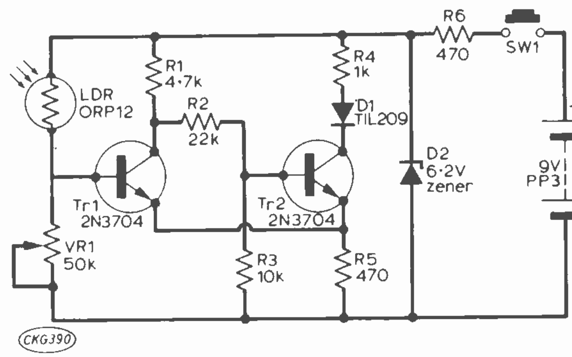

Fig. 1. The complete circuit which is basically a Schmitt trigger.

★ components list

Resistors

R1 4·7kΩ	R4 1kΩ
R2 22kΩ	R5 470Ω
R3 10kΩ	R6 470Ω

All ⅛W, 5% types
VR1 50kΩ lin. pot.
LDR ORP12.

Transistors
TR1 2N3704
TR2 2N3704
D1 TIL209 (light emitting diode)
D2 6·2V zener diode.

Miscellaneous
9V battery; Battery connector; Veroboard; On-off switch, push button type; Plastic box; Calibrated knob or dial.

CALIBRATION

The scale is calibrated in terms of exposure as follows: a piece of clear blank film is put into the

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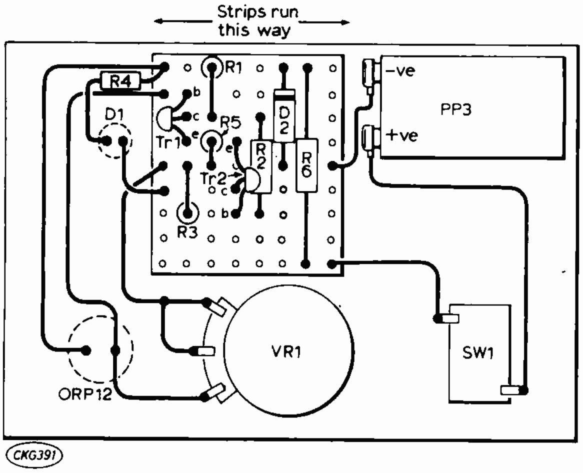


Fig. 2: Constructional details.

enlarger; all lights in the darkroom are put out except for the enlarger light; the instrument is placed on the easel, SW1 is depressed and VR1 is adjusted so that the diode light just goes from on to off. The reading on the scale is noted. (It is important that the scale reading is always taken from on-to-off since the off-to-on reading is different, owing to hysteresis in the Schmitt trigger.)

A narrow strip of paper is then used for a test strip. Parts of the paper are exposed in multiples of two seconds. The developed strip will look like Fig. 3. There is a gradual transition from light to black. The first black stripe can be judged and the corresponding exposure time also. The scale reading and exposure time are then noted.

The procedure is then repeated for different light readings (scale readings) and a graph of scale reading against exposure time is plotted, Fig. 4.

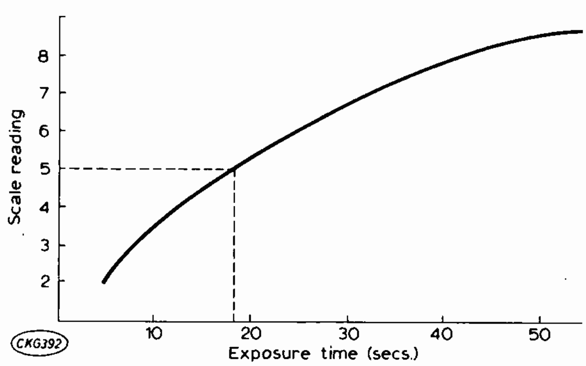


Fig. 4: A calibrated graph relating the knob markings of 1-10 to the time.

For scale readings between 20 and 40 seconds it will be easier if the strips are exposed in multiples of 4 seconds.

A similar calibration graph must be obtained for each different type of printing paper used.

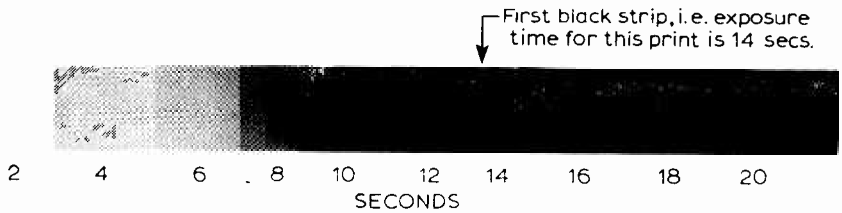
USING THE INSTRUMENT

Having obtained the graphs, the instrument is simple to use. Place it on the easel such that a clear part of the film e.g. the margin between the frames or an unexposed frame, shines onto the LDR. Find the on-off point of the diode DI and note the scale reading. From the graph, read off the required exposure time, if the scale reading is 5 then the exposure time is 19 secs. This will give the correct exposure time for all normal negatives with full tonal reproduction.

CONCLUSION

The instrument is cheap and easy to make, and is reasonably accurate. Its great advantage is the saving in time, since after initial calibration there is no need to make a test strip for every exposure. ■

Fig. 3: An example of the gradations which will appear on the printing paper; the time of each exposure is marked below.



25 YEARS MARCH 1973 page 993. At the foot of column three: The I.E.R.E. is publishing a collection of 20 *papers* in their journal on semiconductor subjects.

DIGITRONIC SOLID STATE DIGITAL CLOCK MARCH 1973 page 1009. The sentence—There is no need . . . harm a LED is to pass too high a *current* through it (most LEDS work operate on *10–15mA*).

Back Numbers

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

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

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2N3055 npn silicon power **60p**
AC153K pnp germanium low power **25p**
AC176K npn germanium low power **23p**
AD161 npn germanium medium power **42p**
AD162 pnp germanium medium power **40p**
AF139 pnp germanium UHF **33p**
BCY 107 **13p**; BC108 **12p**; BC109 **13p**; BC167 **10p**; BC168 **9p**; BC169 **10p** } npn
BC177 **15p**; BC178 **14p**; BC179 **15p**; BC257 **9p**; BC258 **8p**; BC259 **9p** } pnp
Standard groupings available.
BD135 npn med power **26p**
BD136 pnp med power **27p**

DIODES
OA90, OA91, OA95 each **6p**
OA200 **9p**; OA202 **10p**

Other semiconductors
AC128 **21p**; AF117 **24p**
BFY51 **20p**

Full lists and technical data will be found in Catalogue No. 6.

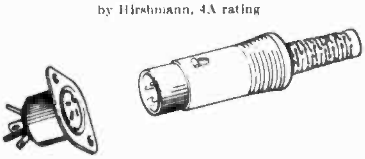
SIEMENS' THYRISTORS

0·8A 400V **56p**, 600V **70p**
3A 400V **60p**, 600V **88p**

ZENER DIODES full range E24 values: 400mW: 2·7V to 30V, **14p each**; 1W: 6·8V to 82V, **27p each**; 1·5W: 4·7V to 75V, **48p each**. Clip to increase 1·5W rating to 3 watts (type 266F) **4p**.

DIN PLUGS & SOCKETS

by Hirshmann, 4A rating

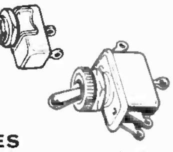


2 way L8—socket **10p**; plug **12p**. 3 way ser. socket **10p**; plug **12p**. 5 way ser. socket **12p**; plug **15p**.

TRANSISTOR ACCESSORIES

To3 cover **7p**
Heat sinks 1°c/w, type 6W1, undrilled **60p**

SWITCHES

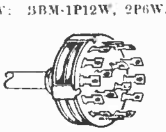


1011C SPST toggle **19p**; 409 DPDT toggle **28p**. (These are chrome plated 2·5A rating)
7201 Sub-miniature DPDT 250V a.c/2A **48p**

ROTARY SWITCHES

Radiospares Miniature Maka-switch (in assembly kit form) Shaft **48p**.
Wafers, MBB-2P5W, 1P11W; BBM-1P12W, 2P6W, 3P4W, 4P3W, 6P2W, each, **6p**.

WAVECHANGE SWITCHES



1P12W, 2P6W, 3P4W, 4P3W, each **24p**

ELECTROLYTIC CAPACITORS

AXIAL LEAD

Rated voltage: / Capacity µF	3V	6·3V	10V	16V	25V	35V	50V	63V	100V
0·47								7p	5p
1·0						7p			5p
2·2					7p			5p	5p
4·7				7p		5p		~~5p~~	6p
10			7p		5p	5p		6p	6p
22			5p	5p		6p	6p	6p	7p
47	5p		5p	5p	5p	6p	6p	6p	7p
100	5p	5p	5p	6p	6p	7p	9p	10p	15p
220	5p	6p	6p	6p	8p	9p	14p	14p	21p
470	6p	7p	7p	8p	10p	14p	19p	19p	34p
1000	8p	10p	10p	14p	16p	19p		33p	
2200	12p	14p	~~18p~~	20p	30p	33p			
4700	19p	22p	30p	33p					
10,000	31p	33p							

Polycarbonate —5% Tolerance

250V up to 0·1µF: 100V/0·1µF and above.
0·01; 0·012; 0·015; 0·018; 0·022; 0·027; 0·033; 0·047; 0·056; **each 4p**.
0·068; 0·082; 0·1; 0·12; 0·15 **each 4p**.
0·18; 0·22; **each 5p**.
0·27; 0·33; **6p**. 0·39 **7p**. 0·47 **8p**. 0·56 **10p**.
0·68 **11p**. 1µF **13p**.

RESISTORS 10%, 5%, 2%

Code	*Power*	*Tolerance*	*Range*	*Values available*	1 to 9	10 to 99	100 up
						(see note below)	
C	1/20W	5%	82 Ω–220K Ω	E12	9	8	7
C	1/8W	5%	4·7 Ω–470K Ω	E24	1	0·8	0·7
C	1/4W	10%	4·7 Ω–10M Ω	E12	1	0·8	0·7
C	1/2W	5%	4·7 Ω–10M Ω	E24	1·2	1	0·9
C	1W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·9
MO	1/2W	2%	10 Ω–1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12	7	7	6
WW	3W	5%	1 Ω–10K Ω	E12	7	7	6
WW	7W	5%	1 Ω–10K Ω	E12	9	9	8

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

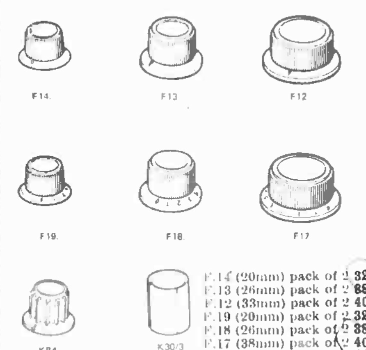
Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions on total value of resistor order).

Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

EVERYTHING BRAND NEW, GUARANTEED TO MAKERS SPEC. NO SECONDS OR REJECTS

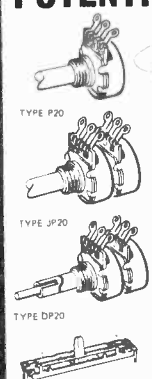
KNOBS

All grub screw fitting for ¼" shafts. Black. For other types—see Catalogue No. 6, P.54



F.14 (20mm) pack of 2 **32p**
F.13 (26mm) pack of 2 **38p**
F.12 (33mm) pack of 2 **40p**
F.19 (20mm) pack of 2 **32p**
F.18 (26mm) pack of 2 **38p**
F.17 (38mm) pack of 2 **40p**
KB.4 (20mm) pack of 4 **40p**
K.30/3 (17mm) aluminium, each **24p**

POTENTIOMETERS



Rotary, carbon track, double wipe SINGLE P20 lin 100 Ω to 2·2M Ω, 12p, JP20 Log, 4·7K Ω to 2·2M Ω 12p; Dual gang lin 4·7K Ω to 2·2m Ω, **42p**; Dual log, 4·7K Ω to 2·2m Ω, **42p**; Log/antilog, 10K, 22K, 47K, 1M Ω only **42p**; Dual antilog, 10K only, **42p**. Any type with 2A D.P. mains switch, **12p extra**.
Only decades of 10, 22 & 47 available in ranges quoted.

DUAL CONCENTRIC DP20 in any combination of P20 values, **60p**; with switch, **72p**.

SLIDER
Lin or log. 10K to 1meg. in all popular values, each **26p**.
Control knobs: blk/white/red/yel/gr./blue/dk. grey/lt. grey, each **5p**.

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Small high quality, PR lin: 100 Ω 220 Ω, 470 Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10M Ω. Vertical or horizontal mounting, **5p each**.

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220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2¼ × 2 × 2in. **£1·50** each.

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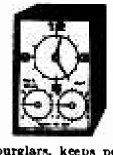
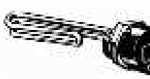


Smith's main's driven clock with 15 amp. programmable switch also notes showing how you can use this to wake up with music playing, kettle boiling or come home to a warm house, warn off burglars, keeps pets warm, halves your heating bills, etc., etc. **£1·75** + 20p p. & p.

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

IMMERSION HEATERS BY REMPLOY



Standard fitting for domestic water tanks, made by the famous Remploy Company. Complete with sealing washers suitable for 200-240 volts A.C. Depth into tank 11". 2kw or 3kw. **£1·50** plus 40p each post and insurance.

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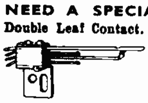
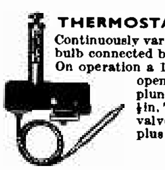


Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic pushrod suitable for operating. **5p** each, **45p** doz.

THERMOSTAT



Continuously variable 30°-90°C. Has sensor bulb connected by 33in. of flexible tubing. On operation a 15 amp 250 volt switch is opened and in addition a plunger moves through approx ⅛in. This could be used to open valve on ventilator etc. **£1·50** plus 23p p. & ins.

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

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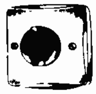
VAT. From April 1st. VAT. MUST be added to total order.

STANDARD WAFER SWITCHES

Standard size 1¼" wafer—silver-plated 5-amp contact. standard ¼" spindle 2" long—with locking washer and nut.

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

THYRISTOR LIGHT DIMMER

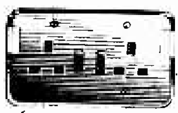


For any lamp up to 250 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price **£2·95** plus 20p post and insurance. Industrial model 5A with control knob but not mounted on switch plate, **£3.**

HORSTMANN "TIME AND SET" SWITCH

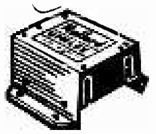
(A 30 amp Switch). Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control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

13 AMP TWIN GANG SOCKETS



Offered at less than wholesale price—your opportunity to replace those dangerous adaptors—brown bakelite flush mounting—standard fitting. Unswitched **20p** each, separately switched **30p** each. Separately switched less 10% ten or more + 20p postage if order under £5.

4 WATT AUDIO AMPLIFIER £1·45



Works off dry batteries, car battery or mains power pack. Only **£1·45.** This low price possible only because the make is over produced. Unrepeatable once stocks are cleared. Made by the famous Mullard company and carries their full guarantee. Complete in dustproof case. Amplifier may be used for Mono or Stereo, music or speech. Hundreds of applications. Frequency response 50H3-16KH3. Supplied complete with connection diagram and operating notes. Postage and Ins. 20p.

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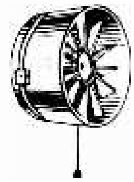

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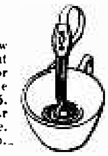

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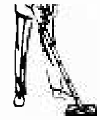

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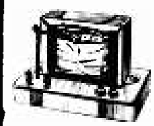

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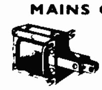

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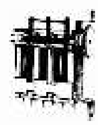

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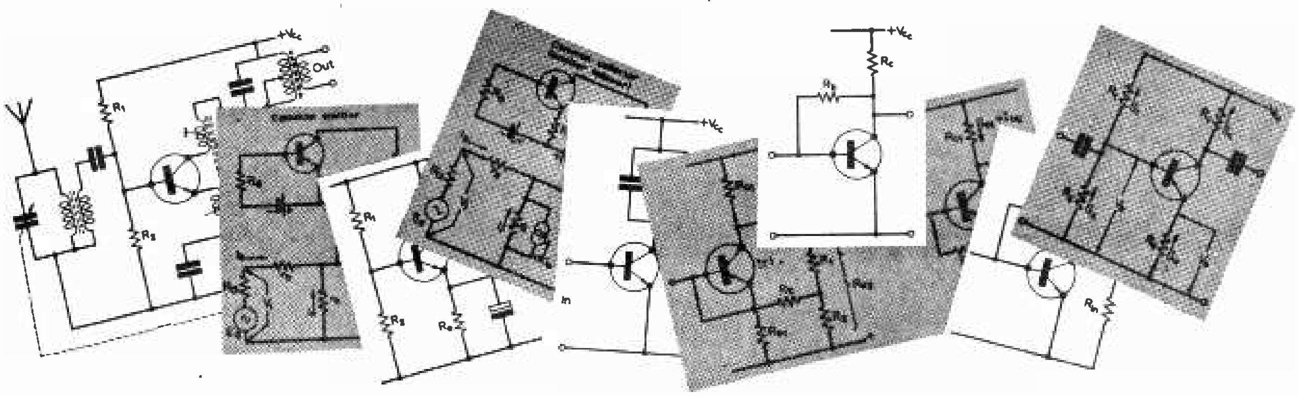

TRANSISTOR CIRCUITRY for beginners

PART 15

H.W. HELLYER & MICHAEL HOLLIER

Tone control circuitry

Toward the end of the last part of this series of articles that was published, we were concerned with frequency-dependent feedback. Without being intentionally devious, we skated over some of the finer points and here shall try to keep our promise of digging more deeply into the matter of tone controls, their design and their limitations.

The utter purist will not deign to acknowledge the need for tone controls! Everything should be flat, he says. There should be, he further asserts, no need to alter the frequency response of an amplifier if all the other parts of the audio system are in order. True, but Utopia has not yet arrived, whatever the politicians promise, and there will be nasty pops and crackles from our records, hiss from our tape, peaks and troughs from many a cartridge and even worse deviations by the time the sound escapes from the loudspeakers.

Even then, we are not finished. If the little woman insists on foot-deep rugs and wall-to-wall drapes, or if your pad is scoured to its functional austerity, man, you will need same trimming of the ideally flat response to compensate for—in the first case, the premature absorption of treble, and in the second, the 'hardness' of the sound. Tone controls may be regarded as necessary evil, but as long as we are obliged to have them, let's make sure they do not detract from the best possible performance. And in so many commercial designs, they do.

First steps

Before delving into the tone control circuit as a whole, we must take a look at the effect of the passive components with a change in frequency. Back in the days when Poppa bought his radiogram because it sounded 'mellow', the tone control was simply a network of passive components, usually across the output stage, with variation of the resistive part of a series capacitor-resistor shunt that drained away progressively more and more of the upper frequencies. It was, in other words, a variable treble-cut device. One or two more enterprising makers

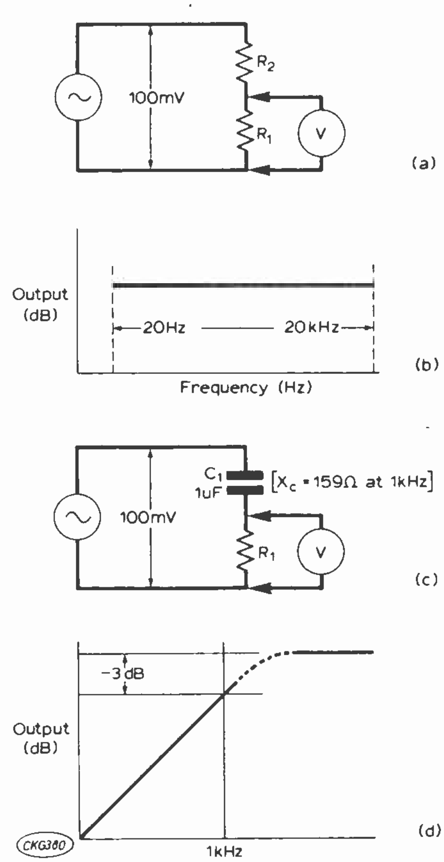

Fig. 74: (a) For a simple resistive network the output shown by the voltmeter is in proportion of the ratio of the resistors to the applied input voltage. In (b) theoretically, the output should not change with frequency, giving a "straight-line" graph. (c) Substituting a capacitor for R2 makes the output frequency dependent while (d) shows an example of the curve we might expect from a simple network such as (c) having a "slope" of 6dB per octave.

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fitted alternative resistor-capacitor combinations in the grid circuit of output valves, and others even went so far as to label these Bass or Treble Boost and Cut, but all such passive networks, i.e., those which do not have inbuilt amplification, must attenuate the overall signal.

The point about the passive tone controls is that the attenuation varies the frequency. Take the case of a simple resistive network, as in Fig. 74(a). If we have two resistors of equal value, fed by a signal generator, the output across the measured one will be half the input signal in amplitude, but will not change in frequency. A graph of the situation would be a straight line, as Fig. 74(b).

But if we now substitute the upper resistor with a capacitor, C1 in Fig. 74(c), we find that the measured output will be exactly half the input **at only one frequency.** Reactance $X_c = \frac{1}{2\pi fC}$ where X_c is in ohms, C in farads and f is the frequency at which the test is made, in hertz.

Working out the reactance of a $1\mu F$ capacitor at 1kHz, we get $\frac{10^6}{6{\cdot}28 \times 1000 \times 1} = 159$ ohms.

But if we now measure the voltage across a similar-value resistor, we find that instead of half the signal input, we have slightly more. Instead of our attenuator dropping the output by 6dB (to half voltage) at 1kHz, it will have dropped the output only 3dB. This is because the voltage across the capacitor is 90° out of phase with the voltage across the resistor. The output voltage ratio is 0·707:1, not 0·5:1. In fact, if we alter the frequency of the generator, we will find that the measured output drops as the frequency falls. The rate of 'slope', as shown in Fig. 74(d), is 6dB per octave, an octave being a frequency change of 2:1.

This 3dB drop has a further significance when we tackle power output stages, for if the drive voltage to the amplifier fell sufficiently for the power output to drop 3dB, this would be the well-known 'half-power-point'. This is the figure normally quoted in amplifier specifications—a point to which we shall return later. Below this −3dB point in Fig. 74(d), the slope of the curve falls away regularly by 6dB per octave, i.e., a ratio of 2:1, a reduction of output by a half each time the frequency is halved.

Making it active

It helps to regard tone control as a method of frequency correction. The introductory remarks we have made, and references to frequency-dependent

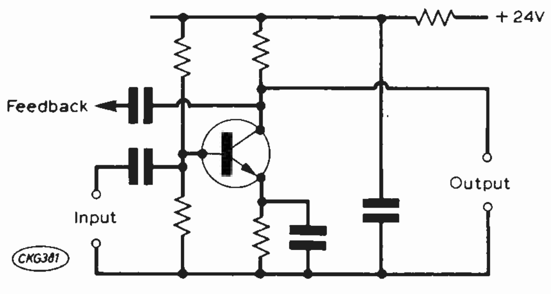

Fig. 75: A collector-follower amplifier arranged so that its output can be measured with and without feedback.

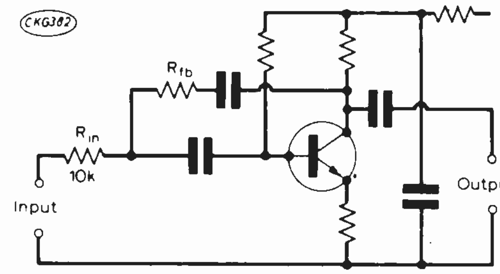

Fig. 76. The basic circuit used for tests.

feed-back in previous articles, should have prepared the regular reader for this approach. Simple tone controls are types of filters. We shall deal thoroughly with filter circuitry later, but at the moment it is necessary to observe that the 'filter' of Fig. 74(c), for example, is called a 'first order filter', having a 'slope' of 6dB per octave. Second order filters have slopes of 12dB/octave and third-order filters, 18dB/octave. As we shall see, **real** filters, used in well-designed audio amplifiers, should ideally have a third-order slope to be effective.

These filters are passive devices. They contain no amplifying stage or stages to put back the signal attenuated by their action. If we make a marriage of the virtual earth circuitry we talked about in Parts 12 and 13 of this series and the fundamentals of tone control circuitry touched upon in Part 11, we get an amplifier with frequency-dependent feedback, which becomes, if we correctly design it, a better tone control circuit.

First, we need what is known as an 'inverting amplifier'. If you take a look at Fig. 75, you will see that this can be a collector-follower circuit, so arranged that we can measure its gain with or without the feedback. In practice, this is a useful circuit, and the component calculation will be discussed as we go along. It is convenient to use the 24-volt supply described in Part 13, December PW. Fig. 76 shows the circuit devised by Mike and used for tests on the prototype.

With an input from the audio generator, and an output measured with a millivoltmeter, we can measure the open-loop gain. This is the gain of the amplifier with no feedback connected. Here, a word of warning is required: in many erudite theoretical articles, 'open-loop gain' is bandied about freely, but an inspection of the circuit will often show that it would be virtually impossible to measure it in practice. Our aim in this case is to show what we mean by the term, then, by applying the feedback we need, to modify the gain and achieve our controlled response, i.e., effect a tone control.

In our prototype, the open-loop gain, (G_0) was 260. It is absolutely essential when carrying out these measurements to mount the circuit in a screened box, use screened input and output leads and make sure our construction is 'solid'. We use Veroboard for convenience: it allows connection of additional components while retaining the versatility of wired circuitry. We use the very convenient Norman Rose aluminium boxes, because they are inexpensive, easily worked for outlet holes, tag-strip mountings, etc., and have a simple lid which not only completes the screening but also affords an easy access for modifications.

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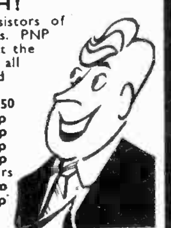

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200µA	£2·35	10V. D.C.	£2·15
500µA	£2·20	20V. D.C.	£2·15
1mA	£2·15	50V. D.C.	£2·15
5mA	£2·15	300V. D.C.	£2·15
10mA	£2·15	15V. A.C.	£2·30
50mA	£2·15	300V. A.C.	£2·30
100mA	£2·15	VU Meter	£2·55
500mA	£2·15		

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Type MR.85P. 4¼in. x 4¾in. fronts

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

Type MR.52P. 2¼in. square fronts

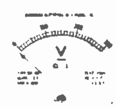
50µA	£3·40	10V. D.C.	£2·20
50–0–50µA	£2·85	20V. D.C.	£2 20
100µA	£2·85	50V. D.C.	£2·20
100–0–100µA	£2·75	300V. D.C.	£2 20
500µA	£2·55	15V. A.C.	£2·30
1mA	£2·20	300V. A.C.	£2·30
5mA	£2·20	8 Meter 1mA	£2·30
10mA	£2·20	VU Meter	£3·50
50mA	£2·20	1 amp. A.C. *	£2·20
100mA	£2·20	5 amp. A.C. *	£2·20
500mA	£2·20	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. x 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

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

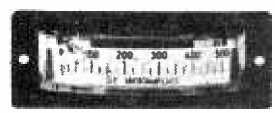
Type MR.38P. 1 21/32in. square fronts



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



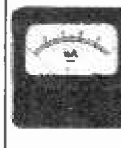
"SEW" EDGWISE METERS

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

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

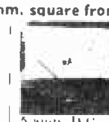
"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts



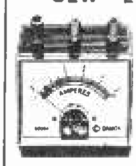
25µA	£3 85	1 amp.	£2 15
50µA	£3·00	5 amp.	£2·15
50–0–50µA	£2 60	15 amp	£2·15
100µA	£2 60	30 amp.	£2·15
100–0–100µA	£2 50	50 amp.	£2 15
500µA	£2 45	5V. D.C.	£2·15
500 0–500µA	£2 15	10V. D.C.	£2·15
1mA	£2 15	20V. D.C.	£2 15
1–0–1mA	£2·15	50V. D.C.	£2·15
5mA	£2 15	150V. D.C.	£2·15
10mA	£2 15	300V. D.C.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

Type S-80 80 mm. square fronts



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

"SEW" EDUCATIONAL METERS



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

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

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8 Amp	£15·90
10 Amp	£22·50
12 Amp	£23·60
20 Amp	£49·00
25 Amp	£58·00
40 Amp	£82·50

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2·5 Amp	£8·05

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0/115/250V. Step up or step down. Fully shrouded.

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150 W	£2·70	P. & P. 18p
300 W	£3·60	P. & P. 23p
500 W	£5·25	P. & P. 33p
1000 W	£7·50	P' & P. 38p
1500 W	£10·20	P. & P. 43p
2250 W	£17·25	P. & P. 50p
5000 W	£35·00	P. & P. £1

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

230 VOLT A.C. 50 CYCLES RELAYS

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

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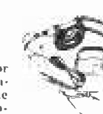


Moving Coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms. **£4 62.** P & P. 15p

240° Wide Angle 1mA Meters

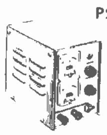
MW 1-6 60mm square	£3 97
MW 1-8 80mm square	£4 97

P. & P. extra

RP214 REGULATED POWER SUPPLY

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

PS.200 REGULATED P.S.U.



Solid state. Variable output 5-20 volt D.C. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240 V. A.C. Size 7¼" × 5¼" × 3¾". **£14·97.** P. & P. 25p.

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

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Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 2 RPH ACW; 30 RRH CW:
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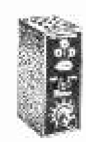
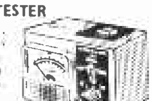
LB4 TRANSISTOR TESTER



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

LB3 TRANSISTOR TESTER



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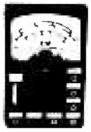
TS60 POCKET MULTIMETER

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

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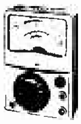
5,000 O.P.V. 0/3/15/150/300/1200 V. D.C. 0/6/30/300/600 V. A.C. 0/300μA/300 MA 0/10K/1 meg Ω Decibels – 10 to +16db **£2·75** each +15p P. & P.

HIOKI MODEL 720X

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

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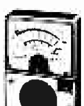
30,000 O.P.V. Overload protection. 6/30/60/300/600/1200 VDC. 12/60/120/600/1200 VAC. 60μA/30 mA/300 mA. 2K/200K/2 megohm. –10 to +63db. **£6·50.** P. & P. 15p.

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

MODEL 500

30,000 O.P.V. with overload protection mirror scale 0/·5/2·5/10/25/100/250/500/1,000v. D.C. 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω **£8·87.** Post paid.

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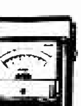
50,000 o.p.v. 43 ranges 0–0·3 to 1,200v D.C. 0–3 to 1,200v A.C. 0–30μA/300mA. 0–3K/30 meg ohms. – 10 to + 17dB. **£8·97.** Post 20p.

HT100B4 MULTI-METER

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

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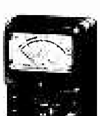
Features A.C. current ranges. 20,000 o.p.v. 0/·5/2·5/10/50/250/500 1000 V. D.C. 0/2·5/10/50/250/500/1000V AC 0/50uA/1/10/100mA/1/10 Amp. D.C. 0/100mA/1/10 Amp AC 0/5K/50K/500K/5 MEG/ 50 MEG. –20 +62db. **£15.** P. & P. 25p.

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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.

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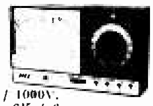
New style 20,000 o.p.v. pocket multimeter. 5/25/50/250/500 / 2500 V. D.C. 10 / 50 / 100 / 500 / 1000V. A.C. 50μA / 250mA. 6K / 6 meg ohms. –20 to + 22 dB. **£3·75.** Post 20p.

MODEL TH-12

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

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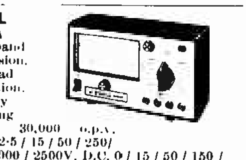
30,000 O.P.V. Mirror scale. overload protection 0/·6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm –20 to + 63 db. **£5·97.** P. & P. 15p.

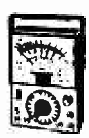
MODEL PL436

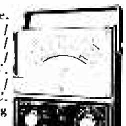
20k Ω/Volt D.C. 8k Ω/Volt AC. Mirror scale. ·6/3/12/30/120/600 V D.C. 3/30/120/600 V A.C. 50/600μA/60/600 mA 10/100K/1 Meg/10 Meg Ω –20 to +46db. **£6·97.** P. & P. 12p.

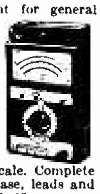
TMK MODEL TW-50K

46 ranges, mirror scale, 50K/Vol. D.C. 5K/Volt A.C. D.C.: Volts ·125, ·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1000V, A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: –20 to +81·5db **£8·50.** P. & P. 17p.

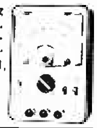
MODEL K228A

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

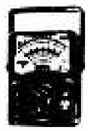
HIOKO MODEL 700X

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

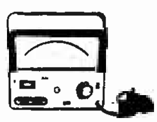
MODEL C-7080 EN

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

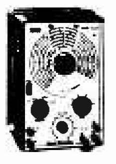
U4312 MULTIMETER

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

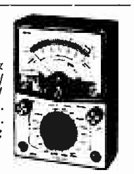
Selected TEST EQUIPMENT

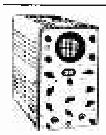
FTC-401 TRANSISTOR TESTER

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

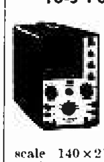
Model S-100TR MULTIMETER TRANSISTOR TESTER

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

MODEL 449A IN CIRCUIT TRANSISTOR TESTER

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

TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s 500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions **£15.** Carr. 37½p. Size 140 × 215 × 170 mm.

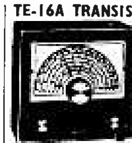
MODEL L-55 FET V.O.M.

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

CI-5 PULSE OSCILLOSCOPE

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

TO-3 PORTABLE OSCILLOSCOPE

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

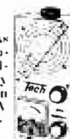
RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

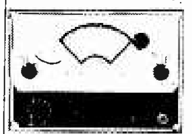
5 mc/s Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. × 4in. C.R.T. Calibrated triggered sweep from ·2 u/sec. to 100 milli-sec. per cm. Free running time base 50 c/s-1 mc/s. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual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

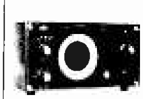
TE-16A TRANSISTORISED SIGNAL GENERATOR

5 ranges 400kHz–30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¼ × 3¼in. Complete with instructions and leads. **£7·97.** Post 25p.

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

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 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 : 1/100. 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.

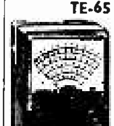
MODEL TE.15 GRID DIP METER

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

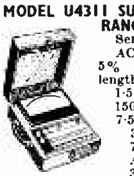
BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR
Sine 18 × 200,000 Hz: Square 18 × 50,000 Hz

Output max. + 10 dB. (10 K ohms) Operation internal batteries Attractive 2-tone case 7¼" × 5" × 2". Price **£17·50.** Carr. 17½p.

MODEL MG-100 SINE SQUARE WAVE AUDIO GENERATOR

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

MODEL AT201 DECADE ATTENUATOR

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

TE-65 VALVE VOLTMETER

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

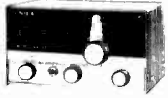
MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER

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

G. W. SMITH & CO (RADIO) LTD.

Also see opposite page and next two pages

www.americanradiohistory.com

UNR-30 RECEIVER



4 Bands covering 550Kc/s – 30Mc/s. B.F.O. Built-in Speaker 220/240v A.C. Brand new with instructions. **£15·75**. Carr. 37p.

UR-1A SOLID STATE COMMUNICATION RECEIVER

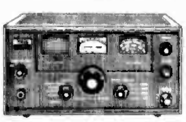
4 Bands covering 550Kc/s–30Mc/s. FET S Meter. Variable BFO for SSB. Built-in Speaker, Bandspread, Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12¾" × 4¾" × 7" Brand new with instructions. **£25**. Carr. 37p.

SKYWOOD CX203 COMMUNICATION RECEIVER

Solid state. Coverage on 5 bands 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning BFO. AVC. ANL. 'S' meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 × 266 × 150 mm. Complete with instructions and circuit. **£32·50**. Carr. 50p.

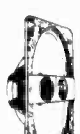
LAFAYETTE HA-600 SOLID STATE RECEIVER

General coverage 150–400Kc/s, 550 Kc/s–30Mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter. S. Meter, Bandspread, RF Gain. 15" × 9¼" × 8¼". 18 lbs. 220/240v. A.C. or 12v. D.C. Brand new with instructions. **£50**, Carr. 50p.



TRIO 9R59DS COMMUNICATION RECEIVER

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



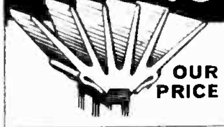
EMI LOUDSPEAKERS

Model 350. 13" × 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. **£7·25** each P. & P. 37p.
Model 450. 13" × 8" with twin tweeter/crossover. 55–13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. **£3·62** each. P. & P. 25p.

HONEYWELL DIGITAL VOLTMETER VT.100

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

SINCLAIR IC-12

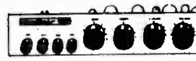


List Price **£2·98**

OUR PRICE **£1·80**

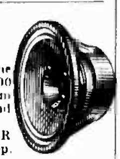
P. & P. 10p

SINCLAIR EQUIPMENT



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

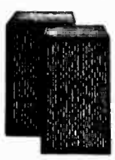
SPECIAL OFFER! GOODMANS AXIOM 301



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

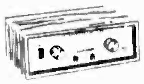
EA.41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7½ × 8 × 4¼in. **£5·97**. P. & P. 15p.



SPECIAL OFFER! STEREO SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14¼" × 9" × 7¼". 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead. **£12·95** pr. Carr. 50p.



HA-10 STEREO HEADPHONE AMPLIFIER

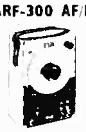
All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. **£5·97**. P. & P. 15p.

SPECIAL PURCHASE ! NEAT G30J STATIC BALANCE PICK-UP ARMS

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

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

ARF-300 AF/RF Signal Generator



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

AKAI BARGAINS

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

1721 Tape Rec.	£73·95		
X5000 Tape Rec.	£99·95		
GX370 Tape Deck	£259·95		
4000DS Tape Deck	£73·95		
4000DS Dust Cover	£4·75	GXC40 Cassette Rec.	£82·95
X200 Tape Deck	£99·95	GXC40D Cassette Deck	£67·95
X201D Tape Deck	£132·95	GXC40T Cassette/Receiver	£123·95
X221D Tape Deck	£169·95	GXC45D Cassette Deck	£89·95
GX220D Tape Deck	£148·50	GXC46D Cassette Deck	£103·50
GX280D Tape Deck	£249·40	GXC46 Cassette Recorder	£115·95
X1810D Tape/8 track Deck	£169·95	GXC60D Cassette Deck	£111·25
GX1900D Tape/Cass Deck	£177·95	GXC65D Cassette Deck	£110·25
X2000SD Tape/Cas/8 Track Rec.	£223·30	CS35D Cassette Deck	£59·50
CR81 8 track Rec.	£80·95	AA6300 Receiver	£79·95
CR81D 8 track Rec.	£65·95	AA8030 Receiver	£106·95
CR81T 8 track/Receiver	£118·90	AA8080 Receiver	£144·95
CR80DSS 8-track	£121·95	AA8500 Receiver	£175·00
CR80SS 8 track system	£145·00	ADM11 Microphones (Pair)	£7·50

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

DOLBY SYSTEM NOISE REDUCTION UNIT

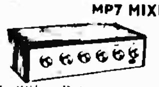
Improves the performance of cassette and semi-professional recorders. Reduces tape hiss by 3dB at 600Hz, 6dB at 1200Hz and 10dB for all frequencies above 3000Hz. Controls for input levels and noise reduction on record and replay. 2 meters for Dolby level. Off tape monitoring. Frequency response: 20Hz to 15kHz ± 1dB 19kHz −35dB. Size 15¼" × 9" × 3¼". AC 200/250V.

OUR PRICE **£32·50** Carr. 50p.

1021 STEREO LISTENING STATION

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

MP7 MIXER PREAMPLIFIER

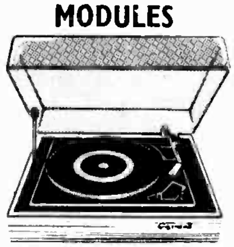


5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9¼" × 5" × 3" Inputs Mics: 3 × 3mV 50K : 2 × 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K.
£8·97. P. & P. 20p.

TE-1035 STEREO HEADPHONES

Low cost high performance stereo headphones. Foam rubber ear cups Adjustable head-band. 8 ohm impedance 25–18,000 Hz. With lead and stereo jack plug. ONLY **£1·97**. P. & P. 12p.

NEW GARRARD MODULES



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

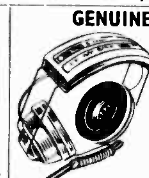
SP25 III Module/M75-6	£23·50
AP76 Module/M75-6	£33·80
AP96 Module/M75-6	£38·75
Zero 100S Module/M93E	£52·60

Carr. 50p extra any item.

HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES

Features unique mechanical 2 way units and fitted adjustable level, controls. 8 ohm impedance 20–20,000cps. Complete with spring lead & stereo jack plug **£7·97**. P. & P. 12p.

GENUINE BARGAIN!



KOSS SP.3XC STEREO HEADPHONES

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

HOSIDEN DH-02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable headband. 8 ohm impedance. 20-12,000 cps. Complete with lead and plug. ONLY **£2·87**. P. & P. 12p.

TAPE CASSETTES

Top quality Hi-Fi Low Noise in Library cases.

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

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

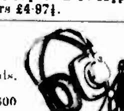
SPECIAL OFFER! ROTEL RH700 STEREO HEADPHONES

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

TRANSISTORISED FM TUNER

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

TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET



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

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Industrial quality in robust metal cases. Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic aerial. Complete carrying cases.

2 channel 300 mW	£52·50	Pair. Post 50p.
3 channel 2 watt.	£79·50	Pair. Post 50p.

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FANTASTIC OFFER!

NIKKO TRM 50 STEREO AMPLIFIER

17 + 17 watts rms stereo amplifier with inputs for Magnetic and Crystal phono, Tuner, Tape, Aux and Tape Monitor. Outputs for two pairs of stereo speakers and Tape. Stereo headphone socket. Full range of controls including loudness control, scratch filter, etc. Size 13" × 9½" × 3¼". Unrepeatable offer—limited stocks!

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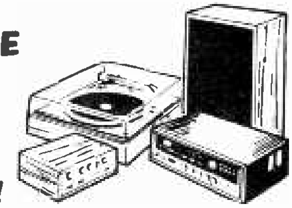

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NIKKO TRM.50 SYSTEM

NIKKO TRM50 17 + 17 watt rms. stereo amplifier, BSR MP60, plinth & cover. Goldring G800 cartridge, pair of Linton 2 speakers and all leads.

OUR PRICE **£104.90** Carr. and Ins. £1·50

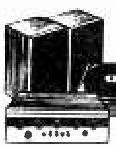
WHARFEDALE LINTON SYSTEM

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

OUR PRICE **£106·00** Carr. and Ins. £1·25

LINTON RECEIVER SYSTEM £155·00. Carr. & Ins. £1·25.

LEAK DELTA 30 SYSTEM



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

OUR PRICE **£123·50** Carr. and Ins. £1·50

AMSTRAD 8000 II SYSTEM

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

OUR PRICE **£48·25** Carr. £1·00

Amplifier only, £16·95. Carr. 50p.

TELETON SAQ206B SYSTEM

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

OUR PRICE **£54·40** Carr. £1·50

Amplifier only, £22·95. Carr. 50p.

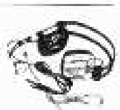
AUDIOTRONIC ACR.3500 MW/LW CAR RADIO

Fully transistorised, dual waveband Size 6¼" × 4¼" × 2". 12v. D.C. Neg. or Pos. earth. Complete with fixing kit, speaker and leads. ONLY £7·50. Post 20p.

SUPER BARGAIN! AUDIOTRONIC ACP.8 8-TRACK CAR STEREO TAPE PLAYER

Tone, volume and balance controls. Track selector. Complete with matched pair of stereo speakers, connections and fittings. ONLY £15·95. Post 30p (Illus is example only).

BH.001 HEAD SET AND BOOM MICROPHONE



Moving Coil. Ideal for language teaching, communications. Headphone Imp. 15 ohms. Micro phone imp 200 ohms. £4·62. P. & P. 15p.

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

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

OUR PRICE **£16·25** Post 50p

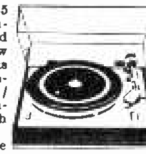
SPECIAL PURCHASE!

FERGUSON 3414 STEREO TUNER AMPLIFIER TURNTABLE UNIT

10+10 watts rms.
Five push buttons with separate scales for pre-tuning to desired FM station. Housed in a handsome walnut finished cabinet with BSR P128/MP60 record deck with Goldring G800H stereo magnetic cartridge. Offered complete with cover and a pair of matching Medway Speakers, size 18"×11"×8". TODAY'S VALUE AT LEAST £125!

OUR PRICE **£75·00**
Carr. & Ins. £1·50.

SAVE £££'s PHILIPS GA308 TRANSCRIPTION TURNTABLE



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

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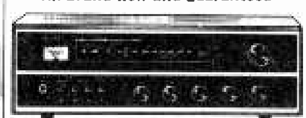
All brand new and guaranteed



RA210 Amp	£22·50
RA310 Amp	£34·95
RA610 Amp	£48·25
RX150 Receiver	£45·95
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RX400 Receiver	£70·95

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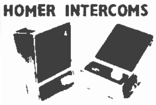
As used in world famous system. 5" dia. Impedance 4/8 ohms. High flux ceramic magnet, 20 watts rms. Brand new £1·50. Carr. 37p.

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.

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THIS MUST BE ADDED TO THE TOTAL VALUE OF GOODS ORDERED (INCLUDING POSTAGE/CARRIAGE) AND ENCLOSED WITH ORDER.

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C129 Mono	£6·50
C137	£8·35
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610	£12·95
810	£31·25
210/TPD3	£8·75
MP60/G800	£12·95
MP60/TPD1	£16·05
MP60/TPD1/G800	£19·50
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610/TPD1	£18·95
510/TPD1	£17·95
HT70	£13·99
HT70/G800	£17·25
HT70/TPD1	£20·35
HT70/TPD1/G800	£23·90
810 Plinth/Cover	£9·25

CONNOISSEUR

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Plinth 69/72	£7·02
LID 72	£3·25
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GA212	£56·75

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AP76/G800	£27·95
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AP76/M55E	£30·50
AP76/M75EJ	£32·50
AP76/G800E	£30·75
AP76/M44E	£30·50
AP76/M75ED	£35·95

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1972 JOYSTICK VFA **£11·40** (A); JOYMATCH ATU 111 or 111A **£11·40** (B); JOYMATCH ATU LO-Z500 **£16·45** (C).

COMMUNICATIONS HEADPHONES £2·60 (D)

(All including postage, packing, accessories & insurance.)

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JR310 receiver	£75·00
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Complete Amateur RX Station	£82·00

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JR599 receiver	£185·00
• Items (A); (B); (D) above	FREE
Complete Amateur RX Station	£185·00

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

BARCLAYCARD — ACCESS — PERSONAL LOANS!!

ALSO: SP5D SPKR. **£4·50**; 2M CAR TRANSCEIVER TR7100 **£99·50**; 2M PERSONAL TRANSCEIVER TR2200 **£62·50**; OA2 MAINS STABILISER **67p.**

NEW: World-wide reception on the amazing "DX—CRYSTAL SET" **£1·75** (+ 25p) including unique aerial.

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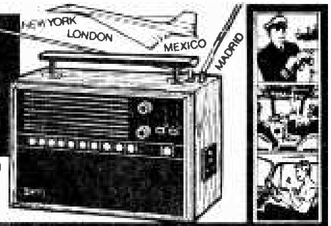

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COMPLETE SYSTEM £64

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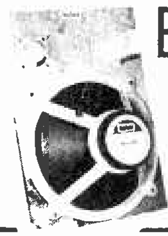
BAKER 12in MAJOR £9



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300 Watt—£17·90 + 85p P. & P.
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All above operate from 12v. battery and give 250v.–50Hz. Output. 24 volt types are also available, alternative outputs or taps can be supplied. Transformers and/or Transistors can be supplied separately.

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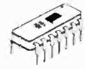

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7400	15p	14p	7450	15p	14p	7492	67p	64p
7401	15p	14p	7451	15p	14p	7493	67p	64p
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7403	15p	14p	7454	15p	14p	7495	77p	74p
7404	15p	14p	7460	15p	14p	7496	77p	74p
7405	15p	14p	7470	29p	26p	74100	1·75p	1·65p
7408	18p	17p	7472	29p	26p	74104	97p	94p
7410	15p	14p	7473	37p	35p	74105	97p	94p
7411	15p	14p	7474	37p	35p	74107	40p	33p
7413	29p	26p	7475	47p	45p	74110	1·25p	1·25p
7420	15p	14p	7476	43p	40p	74111	1·00p	95p
7430	15p	14p	7480	67p	64p	74118	1·00p	95p
7440	15p	14p	7481	97p	94p	74119	1·35p	1·25p
7441	67p	64p	7482	97p	94p	74121	67p	64p
7442	67p	64p	7483	1·10p	1·05p	74141	67p	64p
7446	97p	94p	7486	32p	30p	74145	1·50p	1·40p
7447	97p	94p	7490	67p	64p	74150	1·30p	1·70p
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* Devices may be mixed to qualify for Price Breaks
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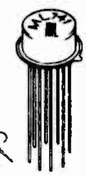

301a	TO99	49p	723c	TO99	87p
301a	DIL	45p	723c	DIL	90p
701c		63p	741c	TO99	38p
702c		63p	741c	DIL	36p
709c	TO99	28p	741c	8 Pin DIL	34p
709c	DIL	31p	747c	DIL	42p
710c		53p	748c	TO99	38p
711c		58p	1437		1·10p
			1458		1·10p

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47µF	6p
100µF	6p
220µF	6p
330µF	6p
1000µF	12p
4700µF	26p

6·3 VOLT

33µF	6p
68µF	6p
150µF	6p
470µF	10p
680µF	12p
1500µF	16p
2200µF	16p
3300µF	24p

10 VOLT

22µF	6p
47µF	6p
100µF	6p
220µF	7p
330µF	9p
470µF	9p
1000µF	12p
1500µF	23p
2000µF	39p

16 VOLT

15µF	6p
33µF	6p
68µF	6p
150µF	7p
220µF	8p
680µF	15p
1000µF	15p
1500µF	23p
2000µF	39p

25 VOLT

10µF	6p
22µF	6p
47µF	6p
100µF	7p
150µF	7p
220µF	9p
470µF	12p
680µF	18p
1000µF	20p
2200µF	36p
5000µF	62p

40 VOLT

6·8µF	6p
15µF	6p
33µF	6p

40 VOLT

47µF	6p
100µF	8p
150µF	9p
220µF	10p
470µF	17p
680µF	23p
1000µF	23p
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All voltages 3·3 – 33 Volt
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1 watt 5%
All voltages 6·8 – 200 Volts
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AC126	14p	BC142	30p	BF329	16p	OC45	13p
AC127	12p	BC143	30p	BF330	16p	OC70	21p
AC128	12p	BC144	26p	BF390	34p	OC71	13p
AC142K	20p	BC145	24p	BFX84	25p	OC72	13p
AC141K	18p	BC147	8p	BFX85	32p	OC81	13p
AC176	14p	BC148	8p	BFX86	22p	OC83	20p
AC187	12p	BC149	8p	BFX87	25p	OC84	25p
AC187K	18p	BC153	15p	BFX88	24p	TIP29A	48p
AC188	12p	BC154	16p	BFY50	19p	TIP30A	58p
AC188K	18p	BC157	12p	BFY51	15p	TIP31A	58p
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ACY18	19p	BC159	12p	BFY64	35p	TIP33A	95p
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ACY20	20p	BC168	10p	BSX20	17p		£1·40
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AF114	14p	BC259	8p	NKT212	25p	2N1711	24p
AF115	14p	BC267	12p	NKT214	23p	2N2904	36p
AF116	14p	BC268	13p	NKT217	50p	2N2904A	
AF117	14p	BC300	36p	NKT261	21p		40p
AF118	82p	BC301	29p	NKT271	18p	2N2905	42p
AF124	24p	BC302	26p	NKT274	18p	2N2924	16p
AF139	36p	BC303	45p	NKT275	23p	2N2926	9p
AF239	37p	BC304	35p	NKT403	65p	2N3053	24p
AL100	68p	BCY70	15p	NKT405	79p	2N3054	50p
AL102	60p	BCY71	33p	NKY603F		2N3055	48p
AL103	49p	BCY72	15p		60p	2N3405	40p
ASY26	27p	BD123	60p	NKT613G		2N3663	52p
ASY27	36p	BD130	45p		30p	2N3702	8p
AU103	90p	BD131	62p	NKT674	24p	2N3703	8p
AU110	97p	BD132	81p	NKT677G		2N3704	8p
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BC116	15p	BF173	26p	OC23	30p	2N3710	8p
BC125	15p	BF177	25p	OC25	25p	2N3711	8p
BC126	22p	BF178	26p	OC28	30p	2N3794	15p
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1S121	14p
1S130	8p
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1S132	12p
1S920	7p
1S922	8p
1S923	12p
1S940	5p
AA119	10p
AA129	10p
AAZ13	10p
AAZ15	12½p
AAZ17	12½p
BA100	15p
BA102	22½p
BA115	7½p
BA144	12½p
BA145	20p
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BAX13	12½p
BAX16	12½p
BAY18	17½p
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BY126	15p
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BYX10	22½p
OA5	17½p
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Single type with D.P. switch 12p extra.

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All valves 100-5 meg ohms.
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Driven by 7447	95p

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100	IN4002 4p	PL4002 8p
200	IN4003 5p	PL4003 9p
400	IN4004 6p	PL4004 9p
600	IN4005 7p	PL4005 12p
800	IN4006 8p	PL4006 14p
1000	IN4007 9p	PL4007 18p

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800	45p	—	—	—

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1 Amp	25	23	37	40	47
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7 Amps	—	87	92	—	1·12

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¼ watt 5% carbon 1p each
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3S4	·26	30FL1	·65	EBC41	·49	EM87	·50	PCL84	·33	UBC41	·45
3V4	·47	30FL12	·69	EBC81	·30	EY51	·36	PCL85	·38	UBF80	·34
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5Z4G	·35	30L17	·70	EBF89	·29	EZ41	·39	PCL805	·38	UCF80	·30
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6AM6	·13	30P12	·69	ECC82	·20	EZ81	·22	PEN36C	·70	UCH81	·30
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6K7G	·12	CCH35	·67	ECL86	·35	PC86	·47	PY33	·52	Transistors	
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6Q7G	·35	DAF91	·22	EF41	·57	PC96	·42	PY82	·25	AC127	·18
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6SN7GT	·32	DF91	·16	EF85	·28	PC900	·29	PY88	·33	AF115	·20
6V6G	·28	DF96	·36	EF86	·30	PCC84	·29	PY800	·31	AF116	·20
6V6GT	·28	DH77	·20	EF89	·26	PCC85	·23	PY801	·31	AF117	·20
6X4	·23	DK32	·33	EF91	·13	PCC88	·38	R19	·30	AF125	·17
6X5GT	·28	DK91	·28	EF92	·27	PCC89	·43	R20	·70	AF127	·17
10P13	·53	DK92	·50	EF98	·65	PCC189	·48	U25	·73	OC26	·25
12AT7	·17	DK96	[illegible]	EF183	·27	PCC805	[illegible]	U26	·65	OC44	·12
12AU7	·20	DL35	·40	EF184	·29	PCF80	·26	U47	·73	OC45	·12
12AX7	·22	DL92	[illegible]	EH90	·36	PCF82	·33	U49	·70	OC71	·12
19BG6G	·75	DL94	[illegible]	EL33	·55	PCF86	·46	U52	·31	OC72	·12
20F2	·67	DL96	[illegible]	EL34	·48	PCF800	·58	U78	·24	OC75	·12
20P3	·75	DY86	·24	EL41	·54	PCF801	·28	U191	·68	OC81	·12
25L6GT	·19			EL84	·23			U193	·31	OC81D	·12
25U4GT	·57	DY87	·24	EL90	·26	PCF802	·39	U251	·61	OC82	·12
30C1	·26	DY802	·33	EL95	·33	PCF805	·72	U301	·38	OC82D	·12
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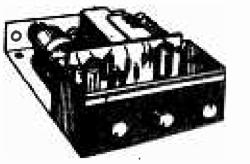

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PRICE £10·50. P. & P. 25p.

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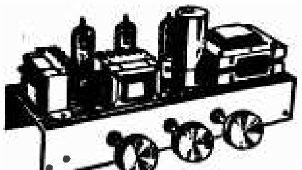

A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **PRICE £8·92** P.& P. 45p.

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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 **£3·95** P. & P. 40p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE **£5·25** 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.

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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

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5in. 3 ohm **£1·05**, P. & P. 15p. 7×4in. 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 with parasitic tweeter 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 cross-over network **£4·20**, P. & P. 30p.

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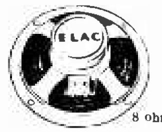

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A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled fibreglass printed circuit board, smart brushed anodised aluminium front panel with matching knob, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to ±12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12"w. x 8"d. x 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

AMPLIFIER KIT	£10·50	P. & P. 15p
(Magnetic input components 30p extra)		
POWER PACK KIT ..	£3·00	P. & P. 30p
CABINET	£3·00	P. & P. 30p

(Post Free if all units purchased at same time)
Full after sales service

Also available ready built and tested **£21·00.** Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi Fi Discotheque use, etc.

3-VALVE AUDIO AMPLIFIER HA34 MK II.
Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4·95.** P. & P. 35p.

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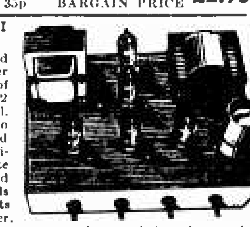
HARVERSON'S SUPER MONO AMPLIFIER
A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
P. & P. 35p BARGAIN PRICE **£2.95**

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier Simple instruction booklet 13p (Free with parts). All parts sold separately. ONLY **£7·97** P. & P. 55p. Also available ready built and tested **£10·97** P. & P. 60p.

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Sinclair Project 60

Now–the Z.50 Mk.2

with built-in automatic transient overload protection

When originally introduced, the Sinclair Z.50 proved how it was possible to design and produce a popularly priced modular power amplifier having characteristics to challenge the world's costliest amplifiers. Many thousands of Z.50's are now giving excellent service day in, day out. But we have also learned that constructors do not always use their Z.50's ideally. That is why we have introduced modifications whereby risk of damage through mis-use is greatly reduced and performance further enhanced. The Z.50 Mk.2 has improved thermal stability, more accurately regulated D.C. limiting to ensure more symetrical output voltage swing and clipping and still less distortion at lower power. Z.50 Mk.2 is compatible with all other Project 60 modules, and may be incorporated to advantage in existing systems. Eleven silicon epitaxial planar transistors are now used, two more than in the original Z.50; circuitry has been re-designed, making this versatile high performance amplifier better than ever.

with free manual
£5.48

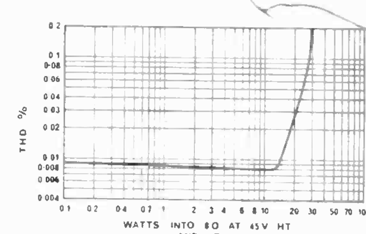
Z.30 the power amplifier for quality and economy

with free manual
£4.48

The Z.30 provides excellent facilities for the constructor requiring a high fidelity audio system of less power than that available from Z.50's. Using a power supply of 35 volts, Z.30 will deliver 15 watts RMS into 8 ohms, or 20 watts RMS into 3 ohms using 30 volts. Total harmonic distortion is a fantastically low 0.02% at 15 watts into 8 ohms with signal to noise ratio better than 70 dB unweighted. Input sensitivity 250mV into 100K ohms. Size 80 x 57 x 13 mm ($3\frac{1}{8}$ x $2\frac{1}{4}$ x $\frac{1}{2}$) Z.30, Z.50 and Z.50 MK.2 modules are compatible and interchangeable.

Brilliant new technical specifications

Input impedance 100 KΩ
Input (for 30w into 8Ω) 400mV
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better
Distortion 0.02% up to 20W at 8Ω. See curve
Frequency response 10Hz to more than 200 KHz ± 1dB
Max. supply voltage 45v (4Ω to 8Ω speakers) (50v 15Ω speakers only)
Min. supply voltage 9v
Load impedance – minimum : 4Ω at 45v HT
Load impedance – maximum : safe on open circuit



Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

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Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc.	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control, etc.	**£9.45**
12W. RMS continuous sine wave stereo amp. for average needs	**2 x Z.30s, Stereo 60; PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60; PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60; PZ.8, mains transformer**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. **(£5.98)** may be added as required.

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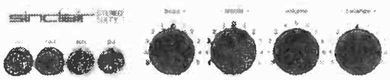
the world's most advanced high fidelity modules

Stereo 60 Pre-amp/control unit



Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV; correct to R.I.A.A. curve ±1dB 20 to 25,000 Hz. Ceramic p.u. – up to 3mV. Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE +12 to —12dB at 10KHz. BASS +12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

Built, tested and guaranteed. **£9.98**

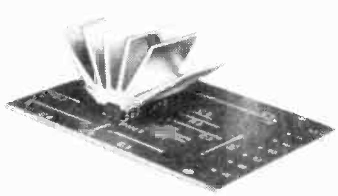
Project 60 Stereo F.M. Tuner

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stero decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz. **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** Typically 20μV. **Signal to noise ratio:** >65dB. **Audio frequency response:** 10Hz – 15KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum. **Operating voltage:** 25–30VDC. **Indicators:** Stereo on, tuning. **Size:** 93 x 40 x 207mm.

Built and tested. Post free. **£25**

Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC 10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC make possible. It is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8Ω. **Frequency Response:** 5Hz to 100KHz ±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0.1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 x 45 x 28mm including pins and heat sink.

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual
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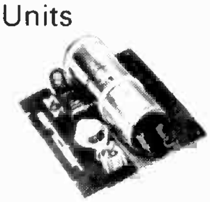
Power Supply Units
The new PZ.8 Mk.3



The most reliable power supply unit ever made available to constructors. Brilliant circuitry makes failure from over load and even direct shorting of the output impossible. This is due to an ingenious re-entrant current limiting principle which, as far as we know has never before been available in any comparable unit outside the most expensive laboratory equipment. Ripple and residual noise have been reduced to the point of almost total elimination. This is, of course, the perfect unit for Project 60 assemblies, particularly where the new Z.50 MK 2 amplifiers are used. Nominal working voltage – 45.

PZ.8 Mk.3—£7.98
(Mains transformer, if required) £5.98
PZ.5 30v unstabilised
(not suitable for Project 60 tuner) £4.98
PZ.6 35v stabilised
(not suitable for IC. 12) £7.98

Project 605

the easy way to buy and build Project 60 without soldering

Project 605 in one pack contains: one PZ.5, two Z.30's, one Stereo 60 and one Masterlink, which has input sockets and output components grouped on a single module and all necessary leads cut to length and fitted with clips to plug straight on to the modules thus eliminating all soldering.

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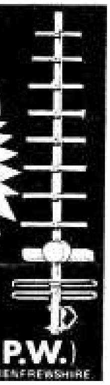

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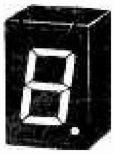

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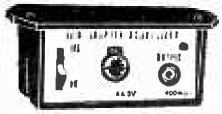

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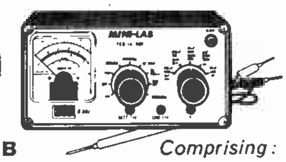

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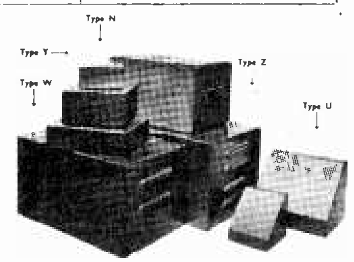

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1R5	0.45	6BE6	0.32	6F25	1.00	10LD11	0.70
1S4	0.30	6BF6	0.55	6F26	0.35	10P13	0.75
1S5	0.30	6BH6	0.75	6F28	0.70	12AB5	0.70
1T4	0.30	6BJ6	0.55	6GK6	0.60	12AC6	0.60
1U4	0.40	6BK7A	0.75	6J4	0.60	12AE6	0.60
1U5	0.75	6BN5	0.43	6J5GT	0.40	12AL5	0.55
1V2	0.55	6BN6	0.60	6J6	0.30	12AQ5	0.50
1X2B	0.55	6BQ5	0.25	6J7	0.45	12AT6	0.40
2D21	0.40	6BR8	0.75	6K4П	0.60	12AT7	0.40
3A4	0.45	6BS7	1.35	6K6GT	0.75	12AU6	0.45
3A5	0.75	6BW6	0.90	6K7	0.43	12AU7	0.33
3BP1	3.50	6BW7	0.90	6K8G	0.45	12AV6	0.45
3S4	0.40	6BX6	0.25	6K25	0.75	12AV7	0.70
3V4	0.65	6BZ6	0.45	6L6GT	0.55	12AX7	0.38
5R4GY	0.75	6C4	0.35	6L7	0.45	12AY7	0.75
5U4G	0.40	6C5GT	0.55	6L18	0.50	12B4A	0.65
5V4G	0.50	6CB6	0.40	6LD20	0.50	12BA6	0.45
5Y3GT	0.45	6CD6GA	1.30	6N7GT	0.55	12BA7	0.50
5Z3	0.75			6P28	0.65	12BE6	0.50
5Z4G	0.45	6CG7	0.60	6Q7	0.50	12BH7	0.50
6/30L2	0.90	6CH6	0.60	6SA7	0.45	12BY7	0.65
6AB4	0.45	6CL6	0.60	6SG7	0.45	12K5	1·00
6AF4A	0.60	6CU6	0·80	6SK7	0.50	12K7GT	0.50
6AG5	0.25	6CW4	0.70	6SL7GT	0.45	12Q7GT	0.45
6AG7	0.45	6CY5	0.50	6SN7GT	0.45	12SR7	0.50
6AH6	0.60	6CY7	0.75	6SQ7	0.50	20D1	0.60
6AJ8	0.30	6D3	0.55	6SR7	0.50	20L1	1.10
6AK5	0.40	6DC6	0.80	6T8	0.38	20P1	0.50
6AK6	0.60	6DK6	0.60	6U4GT	0.70	20P4	1.10
6AL3	0.43	6DQ6B	0.75	6U5G	0·75	20P5	1.20
6AL5	0.22	6DS4	1.25	6U8A	0.48	25C5	0.60
6AM5	0.40	6EA8	0.65	6V6GT	0.45	25L6GT	0.50
6AM6	0.37	6EH7	0.30	6X4	0.40	25Z4G	0.35
6AQ5	0.42	6EJ7	0.35	6X5GT	0.45	25Z6GT	0.75
6AQ6	0.70	6EW6	0.70	6X8	0.65	30A5	0.60
6AR5	0.55	6F1	0.75	6Y6G	0.80	30AE3	0.40

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30C18	0.90	90AV	2.50	DY87	0.36	ECC189	0.65
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30FL1	0.80	90CV	2.40	E80F	1.10	ECF80	0.35
30FL12	1.10	807	0.50	E88CC	0.70	ECF82	0.35
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30L15	0.95	5642	0.70	EABC80	0.38	ECH81	0.30
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30PL13	1.10	6939	2.25	EBF80	0.40	ECL82	0.35
30PL14	1.25	7199	0.65	EBF83	0.40	ECL83	0.70
35A3	0.60	7586	1.50	EBF89	0.32	ECL84	0.55
35A5	0.75	7895	1.50	EBL31	1·50	ECL85	0.55
35B5	0.65	A2293	2·20	EC53	0.50	ECL86	0.40
35C5	0.60	AZ1	0.60	EC86	0.60	EF37A	1.00
35D5	0.75	AZ31	0.55	EC88	0.60	EF40	0.50
35L6GT	0.75	CBL1	0.99	EC90	0.35	EF41	0.65
35W4	0.40	CBL31	1.00	EC92	0.45	EF42	0.70
35Z3	0.75	CY1	0.50	EC93	0.60	EF80	0.30
35Z4G	0.40	CY31	0.50	ECC35	1.00	EF85	0.35
35Z5GT	0.70	DAF96	0.50	ECC40	0.70	EF86	0.30
50A5	0.80	DF96	0.50	ECC81	0.40	EF89	0.28
50B5	0.70	DK92	0.70	ECC82	0.33	EF91	0.37
50C5	0.60	DK96	0.60	ECC83	0.33	EF92	0.35
50CD6G	1.20	DL96	0.55	ECC84	0.30		
50EH5	0.65	DM70	0.60				

EF95	0.40	GZ32	0.50	PF818	1.00	U301	0.55
EF97	0.65	GZ33	0.75	PFL200	0.65	U403	0.70
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EF183	0.30	HABC80	0.55	PL36	0.55	U801	0.80
EF184	0.35	HK90	0.50	PL81	0.50	UABC80	0.40
EF804	1.25	KT66	2.35	PL82	0.45	UAF41	0.70
EK90	0.32	KT88	2·25	PL83	0.45	UAF42	0.60
EL34	0.50	N78	1·60	PL84	0.40	UB41	0·65
EL36	0.50	PABC80	0.40	PL302	0.95	UBC41	0.55
EL37	1.70	PC86	0.60	PL504	0.75	UBC81	0.45
EL41	0.75	PC88	0.60	PL508	0.90	UBF80	0.40
EL81	0.55	PC92	0.05	PL509	1.10	UBF89	0.40
EL83	0.50	PC97	0.50	PL801	1.00	UBL1	0.70
EL84	0.25	PC900	0.48	PL802	0·95	UBL21	0.70
EL85	0.43	PCC84	0.40	PM84	0.60	UC92	0.45
EL86	0.40	PCC85	0.40	PY31	0.35	UCC85	0.45
EL90	0.42	PCC88	0.55	PY33	0.63	UCF80	0.70
EL360	1.15	PCC89	0.55	PY80	0.40	UCH21	0.60
EL821	0.60	PCC189	0.60	PY81	0.30	UCH42	0.70
EL822	1.40	PCC805	0.95	PY82	0.35	UCH81	0.40
ELL80	0.75	PCC806	0.95	PY83	0.38	UCL81	0.60
EM34	1.00	PCF80	0.30	PY88	0.40	UCL82	0.35
EM71	0.80	PCF82	0.35	PY800	0.47	UCL83	0.65
EM80	0.45	PCF84	0.60	PY801	0.50	UF9	0.65
EM81	0.60	PCF86	0.60	PZ30	0.38	UF11	0.60
EM83	0.50	PCF87	1·10	QQVO2-6	2.25	UF41	0.65
EM84	0.35	PCF801	0.50	QQVO3-10	1.25	UF42	0.65
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EM87	0.70	PCF805	0.90	TT21	3.40	UF80	0.35
EN91	0.40	PCF806	0.75	TT22	3.50	UF85	0.40
EY51	0.40	PCF808	0.90	U18/20	0.75	UF89	0.40
EY80	0.75	PCH200	0.70	U25	0.85	UL41	0·65
EY81	0.40	PCL81	0.50	U26	0.85	UL84	0.43
EY83	0.55	PCL82	0.35	U31	0.70	UM84	0.30
EY86	0.40	PCL83	0.65	U37	6.50	UY1N	0.50
EY87	0.43	PCL84	0.45	U52	0.40	UY11	1.00
EY88	0.43	PCL86	0.45	U76	0.40	UY41	0.48
EZ40	0.50	PCL88	1.25	U78	0.40	UY82	0.50
EZ41	0.75	PCL200	0.75	U191	0.75	UY85	0.40
EZ80	0.28	PCL800	1.10	U201	0.50	W729	0.75
EZ81	0.29	PCL801	0.95	U281	0.55	Y63	0·75
GT1C	3.00	PCL805	0.50	U282	0.55	Z759	3.00
GY501	0.70	PD500	1.30			Z803U	1.35
GZ30	0.45	PF86	0.70				
GZ31	0.40						

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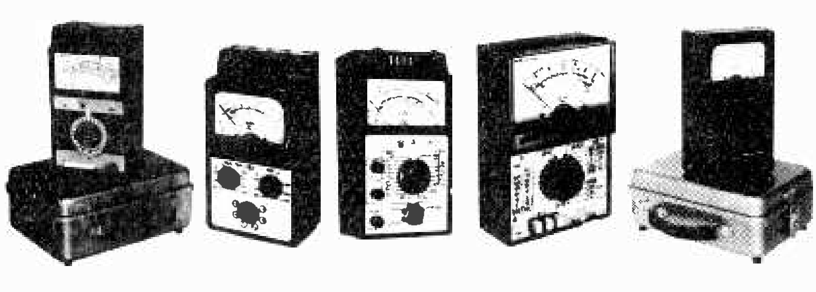
2N696	0.15	AC128	0.15	BD121	0.65
2N697	0.15	AC132	0.35	BD123	0.80
2N698	0.80	AC153	0.20	BD124	0.60
2N705	0.70	AC154	0.15	BD131	0.75
2N706	0.10	AC157	0.17	BD132	0.80
2N708	0.15	AC169	0.10	BF115	0.20
2N753	0.25	AC176	0.17	BF167	0.18
2N929	0.20	AC187	0.25	BF173	0.20
2N930	0.20	AC188	0.25	BF179	0.30
2N987	0.80	ACY17	0.25	BF180	0.30
2N1131	0.25	ACY18	0.20	BF181	0.30
2N1132	0.25	ACY19	0.25	BF184	0.20
2N1184	1.25	ACY20	0.20	BF185	0.20
2N1302	0.17	ACY21	0.20	BF194	0.14
2N1303	0.17	ACY22	0.10	BF195	0.14
2N1304	0.20	AD140	0.50	BF196	0.12
2N1305	0.20	AD149	0.45	BF197	0.12
2N1306	0.25	AD161	0.35	BF200	0.35
2N1307	0.25	AD162	0.35	BFW87	0.25
2N1308	0.25	ADZ11	1.25	BFW88	0.20
2N1309	0.25	ADZ12	1.25	BFW89	0.20
2N1613	0.17	AF114	0.17	BFW91	0.20
2N1711	0.20	AF115	0.17	BFX88	0.20
2N1756	0.75	AF116	0.17	BFY17	0.40
2N2147	0.75	AF117	0.17	BFY19	0.25
2N2160	0.60	AF118	0.30	BFY50	0.20
2N2217	0.25	AF125	0.20	BFY51	0.20
2N2218	0.20	AF127	0.20	BFY52	0.20
2N2219	0.20	AF180	0.35	BSY26	0.17
2N2369A	0.15	AF181	0.35	BSY27	0.15
2N2477	0.65	AF186	0.40	BSY28	0.17
2N2646	0.40	AF239	0.38	BSY65	0.20
2N2905	0.25	AFZ11	0.45	BSY95A	0.12
2N2923	0.12	AFZ12	1.00	OC16	0.50
2N2924	0.13	ASY26	0.25	OC22	0.50
2N2926	0.10	ASY27	0.30	OC23	0.60
2N3053	0.20	ASY28	0.25	OC24	0.60
2N3054	0.50	ASY29	0.30	OC25	0.35
2N3055	0.60	ASY54	0.25	OC26	0.25
2N3133	0.25	ASZ15	0.70	OC28	0.50
2N3134	0.25	ASZ16	0.70	OC29	0.60
2N3391	0.17	ASZ17	0.75	OC35	0.50
2N3392	0.17	ASZ18	0.75	OC36	0.45
2N3393	0.15	ASZ20	0.25	OC42	0.20
2N3394	0.15	ASZ21	0.40	OC44	0.15
2N3395	0.20	AUY10	1·00	OC45	0.12
2N3402	0.15	BC107	0.10	OC70	0.10
2N3403	0.15	BC108	0.10	OC71	0.12
2N3404	0.32	BC109	0.10	OC72	0.12
2N3414	0.20	BC113	0.10	OC73	0.30
2N3415	0.15	BC118	0.20	OC75	0.15
2N3417	0.25	BC134	0.20	OC76	0.15
2N3702	0.10	BC147	0.10	OC78	0.25
2N3703	0.10	BC148	0.10	OC78D	0.20
2N3704	0.12	BC149	0.12	OC81	0.20
2N3707	0.12	BC152	0.15	OC81D	0.20
2N3709	0.10	BC158	0.15	OC83	0.20
2N3710	0.10	BC175	0.20	OC139	0.30
2N3819	0.35	BC186	0.25	OC140	0.35
2N3906	0.25	BCY30	0.25	OC141	0.60
2S702	0.50	BCY31	0.30	OC170	0.25
2S746	0.25	BCY33	0.25	OC171	0.25
AC113	0.15	BCY34	0.30	OC200	0.30
AC125	0.30	BCY72	0.15	OC201	0.60
AC126	0.20	BCZ10	0.30	OC202	0.65
AC127	0.17	BCZ11	0.40	OC203	0.40
				OC204	0.40



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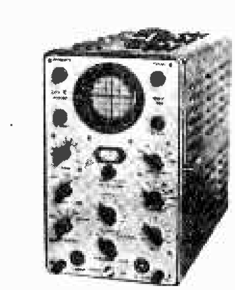

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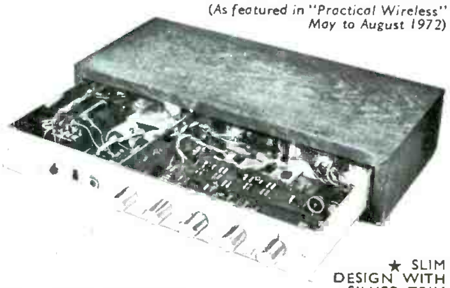

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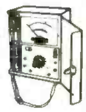

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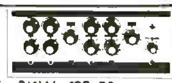

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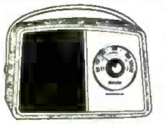

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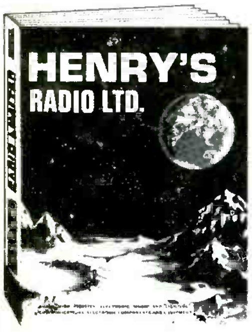

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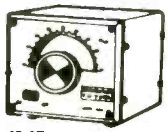

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