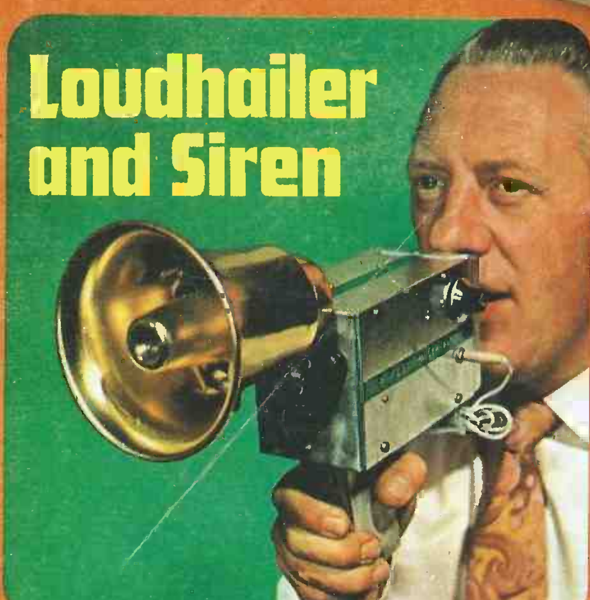
PRACTICAL WIRELESS

DECEMBER 1972
20p

FREE COMPETITION ▶ 10 HEATHKIT 'SCOPES MUST BE WON!

amateur bands RECEIVER



Loudhailer and Siren

The 'MUSIC MAKER'

R.S.C. STEREO PACKAGE OFFERS

PACKAGE PRICE FOR ILLUSTRATED UNITS

ONLY **£39·95** Carr. £1·00

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

Individual Rec. Retail Prices:

LINEAR 505 5 + 5 Watt Amplifier	£17·50
GARRARD 2025 Autochanger + KS40A Cartridge ..	£13·58
Teak Veneer Plinth with Transparent Plastic Cover.. ..	£ 6·10
Pair A55 LOUDSPEAKERS (Inc 8" × 5" 10,000 Gauss) ..	£11·00
TOTAL ..	£48·18

SEND S.A.E. FOR FREE COLOUR BROCHURE

SAVE £31·60 ON HIGH FIDELITY UNITS

PACKAGE PRICE FOR ILLUSTRATED UNITS

ONLY **£99·95** Carr. £1·75

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

Individual Rec. Retail Prices:

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

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

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

COMPLETE KIT £23 Carr. 65p

★ Performance comparable with units costing considerably more.

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

DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUDSPEAKER UNITS

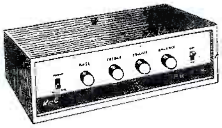
Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

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

MONARCH Size 19×10×9in. approx. Rating 10 watts. Inc. 13×8in. speaker with highly flexible P.V.C. cone surround, long throw voice coil and 10,000 line magnet. High flux pressure tweeter. Handsome Scandinavian 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**

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

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



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

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

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

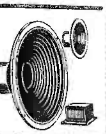
FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL

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

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

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

AUDIOTRINE HI-FI SPEAKER SYSTEMS



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

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

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

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

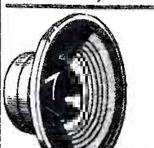
JE8 Size 16 × 11 × 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

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

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

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

AUDIOTRINE HIGH FIDELITY SPEAKERS



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

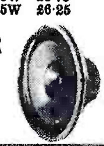
Exceptional performance at low cost.

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

R.S.C. BATTERY/MAINS CONVERSION UNITS

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

FANE 807T HIGH FIDELITY SPEAKER



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

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

200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9¼×2¾×5¼in. Attractive brushed silver finish facia plate 10¼×3¼in. and matching knobs.
Complete kit of parts with full wiring diagrams and instructions. **£7·75** Carr. 40p.
OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £10·95

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

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

MIDGET CLAMPED TYPE 2⅝×2⅝×2¼in.

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

FULLY SHROUDED UPRIGHT MOUNTING

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

TOP SHROUDED DROP-THRO' TYPE

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

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 49p; 6·3v. 2a. 54p; 6·3v. 3a. 76p; 6·3v. 6a. £1 30; 12v. 1a. 55p; 12v. 3a. or 24v. 1·5a £1·35; 0·9-18v 1¼a £1·10; 0-12-25-42v 2a £1·76..

CHARGER TRANSFORMERS 0-9-15v. 1¼a. 99p; 2½a. £1·10; 3a. £1·25; 5a. £1·45; 6a. £1·65; 8a. £2·00

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

OUTPUT TRANSFORMERS

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

SELENIUM RECTIFIERS F. W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a, 25p. 2a, 35p. 3a, 50p. 4a, 65p. 6a, 80p.

SMOOTHING CHOKES

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

R.S.C. Mk III SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

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

Only high grade components by leading manufacturers. **£25** Carr. 65p
COMPLETE KIT OF PARTS

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

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

Printed Circuitry Twenty Silicon Transistors, Four Diodes, Four Rectifiers

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

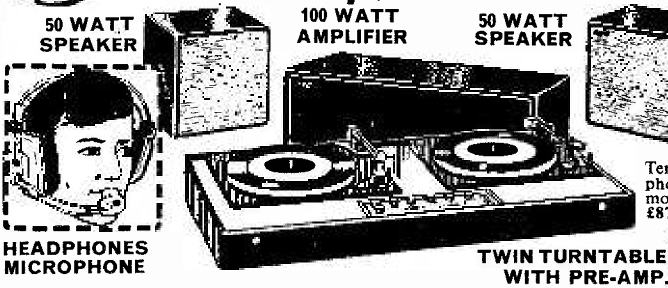
OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.
HUM & NOISE —75dB Min. Vol. —65dB Full Vol.
HARMONIC DISTORTION 0·1% at 1000 Hz 10 Watts

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

FREQ. RESPONSE: —3dB 7Hz to 70kHz **BASS CONTROL:** +17dB to—16dB at 40Hz
TREBLE CONTROL: +16dB to —12dB at 14kHz **CROSS TALK** —58dB
SENSITIVITIES: Disc Mag. 2·5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

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

RSC GROUP/DISCO UNITS



PACKAGE OFFER
Units listed below
(a) 100w POWER AMPLIFIER
(b) PAIR OF HI-FI HEADPHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to headphones)
(d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets
Size approx. 18″ × 18″ × 8″
(a)(b)(c)&(d) **£72·85** Carr. £1·25

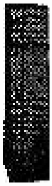
Terms on Amps. Speakers and Headphone/Mike. Deposit £15 and 18 monthly payments of £4·00 (Total £87·00).

RSC TDI-DISCO CONSOLE

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

Carr. £1·25 **£67·10**
Or Dep. £13·25 and 9 mthly pymts £6·88 (Total £75·17) or Dep. £15 and 18 mthly payments £3·62 (Total £80·16).

R.S.C. COLUMN SPEAKERS
IDEAL FOR VOCALISTS AND PUBLIC ADDRESS



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

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

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

TYPE C4100 100 WATTS inc. four 12″ 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58 × 16 × 10″ Acoustically filled and pressurised. Terms: Dep. £11 and 12 mthly. pyts. £5·18 (Total £73.16). **£65** Carr. £1

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

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

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

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

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

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

Highly sensitive. Push-Pull high output, Hum level—70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86 EF86, ECC83, EL34, EL34, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For **Clubs, Schools, Theatres, Dance Halls, Outdoor Functions**, etc. For **Electronic Organ, Guitar, String Bass, etc.** Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. for mixing purposes, 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Twin-handled perforated cover £1·90. 12 MONTHS' GUARANTEE. Carr. 65p **£19·75**
TERMS: Deposit £4 and 9 monthly payments of £2·10 (Total £22·90). Send S.A.E. for leaflet.

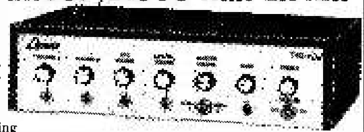
FANE SPEAKERS 'POP' 25/2 12 in. 25 WATT

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

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

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

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

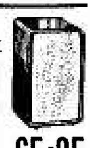
£49·50 Carr. free
Or Deposit £7·50 and 9 monthly payments £5·37 (Total £55·83)

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.

HIGH QUALITY LOUDSPEAKER UNITS

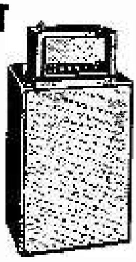


ALL TWO TONE REXINE AND VYNAIR FINISH
L125 50 WATT Fitted pair of 12″ 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£33·50**
Or deposit £4·50 and 9 monthly payts. of £3·70. Total £37·80

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

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

RSC BASS-REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit optional horizontal or vertical mounting.
★ Two extra heavy duty 12in. 50w L'spkrs.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes". Bass and Treble controls.
Credit Terms: Deposit £15 & 9 monthly pyts of £6·25 (Total £71·25) Carr. £2 **£65** Send S.A.E. for leaflet.

RSC GP30 HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group

A 4 input, 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. 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

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

NOW FOUR NEW BRANCHES
OPENING SHORTLY

COVENTRY
19/19A MARKET STREET

NOTTINGHAM
5 MARKET SQUARE

SUNDERLAND
8 LITTLE UNDERBANK

STOCKPORT

New premises at See Addresses **HULL & NEWCASTLE**

RSC HI-FI CENTRES LTD.

MAIL ORDERS & EXPORT ENQUIRIES TO:—
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.
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Suitable for application of Loudspeakers impedances between 8 and 30 ohms. Combinations not to measure less than 6 ohms across both speaker output jacks simultaneously.

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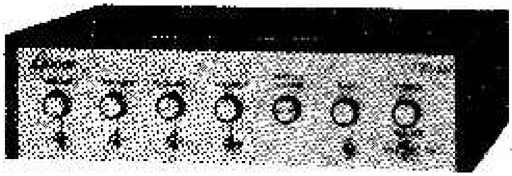

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Model T80/100 70 – 100 Watts Output Power

Four individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'.

Compact size, robust construction. Ideal for clubs, hotels, restaurants, schools etc.
Inputs for almost any type of microphone

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Three individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'.
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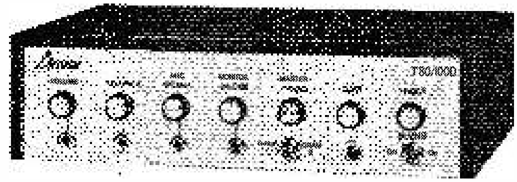

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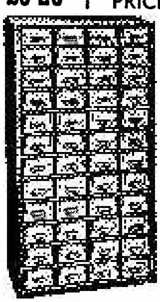

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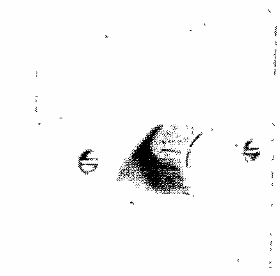

The DIMMASWITCH is an attractive and efficient dimmer unit which fits in place of the normal light switch and is connected up in exactly the same way. The white mounting plate of the DIMMASWITCH matches modern electric fittings. Two models are available, with the bright chrome knob controlling up to 300 w or 600 w of all lights except fluorescents at mains voltages from 200-250 v, 50Hz. The DIMMASWITCH has built-in radio interference suppression:

600 Watt **£3·20.** Kit Form **£2·70**
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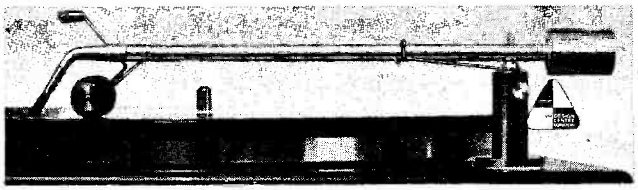
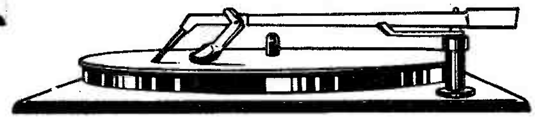
GROOV-KLEEN modern automatic record cleaners – now a choice of models



The de-luxe Model 42 GROOV-KLEEN

- Removes and collects dust without using liquid.
- Improves reproduction.
- Reduces record & stylus wear. Counterweight ensures lightweight tracking.
- Operates silently.
- Armrest incorporated.
- Beautifully finished in Chrome, bright anodised Aluminium & shiny black.

Model 42 £1.95



The popular priced Model 50 GROOV-KLEEN

has all the features of the Model 42 but is made in high quality plastic. The base is finished in matt black and the cranked arm is white.

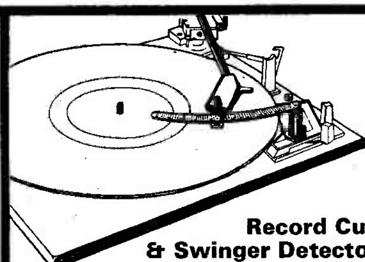
Model 50 £1.26

NEW!

HI-FI Stereo Test Cassette

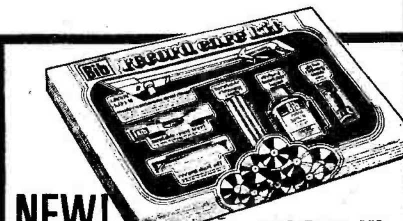
How to get the best Stereo and Mono reproduction and recording. Devised by Bib. Recorded by Decca.
Includes channel identification, balance control, speaker phasing, adjusting record volume controls, reducing tape hiss and eliminating hum, wow and flutter, and sounds you can record yourself. 523 musicians · 6 Symphony Orchestras · D'Oyly Carte Opera Co. · Grand Organ · Brass Band 6 individual instruments.

Ref 53 £2.25



Record Cue & Swinger Detector

Identifies selected items on records. Fitted easily to all turntable decks. Scale moves clear of records, cannot touch pick-up cartridge. Detects swingers for improved reproduction when rectified.
Patent No 2460/72. **Ref 47 £1.45**



NEW!

Record Care Kit

Ideal gift. Contains GROOV-KLEEN in sparkling all-chrome finish, Record Dust Off, Spirit Level, Stylus & Turntable Cleaner.

Ref 43 £2.49

Cassette Head Cleaning Tape

For all cassette machines. Removes oxide and dirt from heads.
Packed in plastic "library" case. **Ref 31 57p**
Packed in attractive bubble pack, without "library" case. **Ref 31a 47p**

¼" Recording Tape Splicer

Fitted with clamps for holding tape for diagonal or butt splices. On non-slip base, complete with tape cutter and instructions.

Model 20 £1.24

8 Track Cartridge Tape Head Cleaner

Maintains tape heads in clean condition. Recommended use after every 5 hours playing. Complete with dust cover.

Ref 41 99p

Cassette Tape Recorder Care Kit

To clean tape heads safely and easily, and for joining and editing tapes precisely. Packed in plastic box.

Ref 26A £2.10

HI-FI Stereo Hints and Tips

How to make the most of your equipment by John Borwick BSc., Technical Editor of "The Gramophone". 48 Pages of useful information with 54 invaluable reference charts and illustrations for Hi-Fi enthusiasts.

Ref 56 32p 2nd Edition completely revised

Tape Editing Kits – in Wallets

Tape splicer, cutter, marker, splicing tape. Reel or cassette labels.
For ¼" tape. **Ref 23 £1.40**
(for cassettes) **Ref 24 £1.56**

Stylus Balance

Precision built. Calibrated. Measures stylus pressure within ¼ gramme. In plastic container. **Ref 32A £1.45**

Other Lines include:

Item	Ref	Price
Record Care		
Indexa Record	A	£1.58½
Stylus & Turntable Cleaning Kit	B	38p
Record & Stylus Cleaning Kit	36A	25p
Record Sleeve Protectors	44	44p
Spirit Level	46	56p
Record Dust-Off	48	20p
Roller & Brush for Ref 42	42S	18p
2 Self-adhesive Bases and Cleaning Brush for Models 42 and 50	42P	15p
Pad Base Sticker and Brush for Model 50	50S	20p
Tape Care		
Tape Head Cleaning Kit	J	54p
Recording Tape Cutters	M	20p
½" Tape Splicer	Model 21	£9.00
Cassette Title Labels (Pack of 108)	T/5	39p
Cassette Salvage Kit	29	46p
Splicing Tape	33	26p
Cassette Case	34	£1.34
Cartridge Case	35	£1.59
Cassette Wallet	39	58p
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ALPHA 212 by Highgate	37·75	25·50
AMSTRAD Stereo 8000 Mk 2	27·95	14·50
AMSTRAD I.C. 2000	42·95	27·50
AMSTRAD Integra 4000	32·95	21·95
ARMSTRONG 521	59·00	44·75
DULCI 207M	32·00	19·50
FERROGRAPH F307 Mk. II (cased)	64·00	44·75
GOODMANS Maxamp	54·00	34·95
H.L. Audio Phoenix 707	29·00	15·95
JVC Nivico MCA 104Z	85·00	70·95
MCA 105E	130·50	109·95
MCA V5E Quadraphonic	89·00	74·95
MCA V9E Quadraphonic	148·00	124·95
LEAK Delta 30 (cased)	69·90	46·95
LEAK Delta 70 (cased)	85·90	57·95
METROSOUND ST20E	39·50	25·95
METROSOUND ST60	70·00	45·90
PHILIPS RH521	109·00	89·95
PHILIPS RH590	55·00	38·50
PHILIPS RH580	30·50	21·50
PIONEER SA500A	47·10	32·95
PIONEER SA600	95·48	61·50
PIONEER SA800	126·55	79·95
PIONEER SA900	133·83	86·95
PIONEER SA1000	155·82	99·95
PIONEER QL600 Quadraphonic converter	76·60	48·50
QD 210 Quadraphonic decoder	42·85	29·95
QA 800 Quadraphonic	188·60	122·95
QC 800 Quadraphonic pre-amp	129·98	84·95
QM 800 Quadraphonic pow. amp.	160·84	104·95
Reverberation 202W	54·95	35·95
RANK Rotel 210	34·90	23·95
RANK Rotel 310	47·50	30·95
RANK Rotel 610	74·50	48·25
ROGERS Ravensbourne	64·50	49·25
ROGERS Ravensbourne (cased)	69·50	53·95
ROGERS Ravensbrook Mk. II	50·50	38·95
ROGERS Ravensbrook (cased) Mk.II	55·50	40·95
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SOLARVOX AM318 2 x 18 watts. plus MATRIX 4 channel	41·38	26·95
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GA202 15 watt RMS Per Chan.	45·75	28·95
WHARFEDALE Linton Amplifier	65·00	41·95

All take both ceramic and magnetic cartridges.

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TUNERS		
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*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	17·50
DULCI FMT.7S Stereo	32·89	24·50
GOODMANS Stereomax	75·74	46·95
JVC Nivico		
MCT V5E AM/FM	86·89	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	39·95
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	53·38	37·95
RANK ROTEL 620	86·33	63·95
ROGERS Ravensbourne chassis	57·95	43·95
ROGERS Ravensbourne in teak case	62·63	47·95
ROGERS Ravensbrook chassis	42·14	31·95
ROGERS Ravensbrook (cased)	48·00	36·95
SINCLAIR 2000	45·00	29·95
SINCLAIR 3000	45·00	29·95
SINCLAIR Project 60 tuner (stereo)	25·00	17·50
TELETON GT202	46·75	30·95

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 AA 8500	228·34	175·00
AKAI 6600	145·26	109·00
AKAI 6300	125·83	94·95
AKAI 6200	97·09	74·95
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
CARLTONE M4000 AM/FM with 8 track player and speakers	69·95	39·95
GOODMANS Module 80, 35w. RMS	89·02	66·50
GOODMANS Module 80 Compact	160·38	122·95
GOODMANS Module 110 FM/MW/LW/SW 100W RMS	131·22	99·95
JVC Nivico VR 5501 AM/FM	96·96	81·95
VR 5521L AM/FM and SEA	175·00	146·95
4VR 5414 Quadraphonic	212·00	179·95
LEAK Delta 75	175·00	129·95
MIDLAND 19/542	49·56	36·75
PHILIPS RH 790	134·00	74·95

	Rec. Retail Price	Comet Price
TUNER/AMPLIFIERS—*continued*		
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
QX8000 Quadraphonic	286·24	199·95
ROGERS Ravensbrook Chassis	96·57	73·95
ROGERS Ravensbrook (cased)	105·35	78·45
ROTEL RX200	89·02	60·95
ROTEL RX150	67·93	48·95
SOLARVOX TAM1105 2 x 5 watts RMS AM/FM Multiplex comp. with 2 speakers and featuring Matrix 4 channel	38·50	29·95
TANDBERG 1171 MPX	103·03	84·95
TANDBERG TR200 MPX	106·00	85·95
TANDBERG TR1000 FM MPX(teak)	156·00	129·60
TELETON CR55	125·26	68·50
TELETON R8000 AM/FM	42·16	21·95

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

	Rec. Retail Price	Comet Price
TURNTABLES		
GARRARD SP25 Mk III	16·17	10·50
GARRARD 40B	13·63	10·95
GARRARD SL65B	20·93	13·75
GARRARD SL95B	49·21	32·25
GARRARD 401	39·04	25·95
GARRARD SL72B	32·60	21·95
GARRARD AP76	28·44	17·95
GARRARD Zero 100A	57·42	38·95
GARRARD Zero 100S	52·83	36·95
GARRARD WB4 base Mk IIZ to fit Zero 100 & Zero 100S	6·55	4·95

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

GARRARD SP25 Mk III with Goldring G.800	**Special Price £17·95**
McDONALD MP60 with Goldring G800	**Special Price £17·50**
McDONALD MP60 with SHURE M 44/7	**Special Price £19·50**
McDONALD MP60 with SHURE M 44/E	**Special Price £20·25**
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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**
THORENS 150 AB with TX11 cover Shure M55E cartridge	**£60·35 £49·95**

	Rec. Retail Price	Comet Price
Base and Cover to fit GARRARD SP25, SL55, SL65B	Spec. Price	3·60
GOLDRING G101P/C	29·64	20·50
GOLDRING GL69 MKII	26·86	18·50
GL69P Mk. II	35·23	25·25
GOLDRING GL72 Chassis	31·39	20·95
GL72P	40·81	27·50
GL75	41·86	26·95
GL75P	51·62	35·25
GL85	61·03	41·95
GL85P/Cover	87·19	56·95
Covers for 72P	4·71	3·25
Cover for 75P Deluxe	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	9·95
610	18·75	12·95
HT70	20·63	14·50
HT70 inc. plinth and cover	29·84	20·95
Base and Cover for MP60 and 610	Spec. Price	3·95
PHILIPS GA212 Electronic	69·00	57·50
PHILIPS 308 transcription unit complete with base and cover	36·55	28·50
PHILIPS GA 105 with base, cover and cartridge	21·00	13·95
PIONEER PL12AC with base & cover	47·86	33·95
PIONEER PL61 with base and cover	176·83	119·95
THORENS TX25 cover	8·85	6·95
THORENS TD125	76·73	56·95
THORENS TD125 Mk. II	82·63	66·50
THORENS TD125AB	115·69	89·95
THORENS TD 125AB Mk. II with TP 16 arm	124·54	99·95
THORENS TD 160/c including base and cover	69·80	56·95
THORENSTD150 Mk. II	36·30	28·95
THORENS TD150A Mk. II	46·33	35·95
THORENS TD150AB Mk. II	50·17	39·95
THORENS TX11 Cover	4·49	3·60
WHARFEDALE Linton with base and cover and Shure M44-7 cartridge	37·50	26·95

	Rec. Retail Price	Comet Price
PICK UP ARMS AND HEADS		
AUDIO Technica AT1005 Mk. II	18·78	14·25
AUDIO Technica L2 lifts	2·61	1·95
GOLDRING Lenco 75	13·96	9·25
GOLDRING Lenco L69	10·46	6·50
GOLDRING PH6 Head Shell	2·97	1·99
SME 3009 with S2 Shell	32·34	23·95
SME 3009 HE with S2 Shell	33·71	24·95
SME 3012 with S2 Shell	34·44	25·50
SME 3012 HE with S2 Shell	35·81	26·50
SME S2 Headshell	2·59	1·95
SPEAKERS		
AMSTRAD 138 (pair) 13"×8" twin cone teak	26·00	13·95
AKAI SW 155	59·50	41·50
B & W Model 70	159·50	111·95
B & W DM2	60·76	46·95
B & W DM3	63·00	43·95
B & W DM1 (pair)	75·20	53·95
CELESTION COUNTY (pair)	47·94	35·95
CELESTION Ditton 120 (pair)	56·40	40·50
CELESTION Ditton 15	37·40	27·95
CELESTION Ditton 25	65·00	43·50
CELESTION Ditton 44	54·00	37·95
CELESTION Ditton 66	99·00	70·95
FERROGRAPH S1 inc. stand	95·00	69·95
GOODMANS Minister (pair)	50·62	35·95
GOODMANS Havant (pair)	54·42	39·95
GOODMANS Magister	65·63	44·95
GOODMANS Double Maxim	64·14	48·50
GOODMANS Mezzo 3	35·70	22·95
GOODMANS Magnum K2	46·20	29·50
GOODMANS Dimension 8	72·44	46·95
GOODMANS DIN 20NT kit	12·19	8·50
KELETRON KN400 2-speaker System (pair)	15·86	11·95
KN600 3-speaker System (pair)	26·46	16·95
KN800 3-speaker System (pair)	31·80	19·95
KN1100 4-speaker System (pair)	40·80	26·90
KN1600 3-speaker System	25·20	15·50
KN2100 3-speaker System	30·60	19·95
LEAK 150 (pair)	50·00	36·95
LEAK 250 (pair)	63·00	46·95
LEAK 600	49·50	33·95
LINEAR 10 watt teak (pair)	Sp. Price	13·50
METROSOUND HFS 103 (pair)	29·21	20·95
METROSOUND 202	21·50	14·75
METROSOUND Duplex 15	32·00	21·95
METROSOUND Duplex 25	56·00	37·95
PHILIPS RH411 (pair)	21·80	18·25
PHILIPS RH412 (pair)	35·00	29·50
PHILIPS RH405 (pair)	70·00	47·95
PIONEER CS53	46·72	29·50
SINCLAIR Q16	8·98	6·50
STE-MA 450	25·00	16·95
TANDBERG Tan 7	29·50	24·95
TANDBERG Tan 11 (pair)	40·00	32·95
TANDBERG Tan 12 teak (pair)	44·00	35·95
TANDBERG Tan 25 teak (pair)	71·50	58·95
TANDBERG Tan 50 teak	68·00	52·95
TELETON 8000 (pair)	21·08	11·95
THORPE Grenville TG 100 (pair)	28·95	17·95
Grenville TG 200 (pair)	41·95	25·95
Grenville TG 300 (pair)	55·95	31·95
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Denton Mark II (pair)	42·00	27·95
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Melton Mark II	35·00	23·50
Dovedale 3 Mark II	47·50	31·95
Rosedale	69·00	46·95
Unit 3 Speaker Kit	12·50	8·95
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Unit 5 Speaker Kit	27·50	18·75
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GOODMANS Twin-Axiom 8	8·65	6·95
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Audiom 10P	5·67	4·50
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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
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AMSTRAD 900 EX	11·00	8·75
AUDIO TECHNICA AT66	6·47	3·45
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*GOLDRING CS90 Stereo	4·88	3·95
*GOLDRING CS91/E	7·33	5·50
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	Rec. Retail Price	Comet Price
EMPIRE 999E/X	15·57	10·95
EMPIRE 909E/X	12·12	8·50
EMPIRE 90EE/X	9·37	6·95
ORTOFON M15E	27·60	22·75
SHURE M3DM	6·10	3·75
SHURE M31E	11·63	6·95
SHURE M32E	10·73	6·50
SHURE M44-G	8·30	4·95
SHURE M44-7	7·90	4·90
SHURE M-44C	7·90	4·90
SHURE M44E	8·60	5·25
SHURE M55E	9·70	5·80
SHURE M75G	14·70	8·40
SHURE M75-6	13·60	7·60
SHURE M75EJ	15·40	8·95
SHURE M75E	19·00	10·75
SHURE M75 ED	19·00	10·75
SHURE M75E/95G	20·80	12·95
SHURE V15-11	39·40	24·95
*SONOTONE 9TAHC Diam/Saph.	3·75	1·45

*Starred cartridges above are ceramic. All others are magnetic.

BASES AND COVERS

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

BLANK TAPES

	Rec. Retail Price	Comet Price
SCOTCH DYNARANGE CASSETTES		
C60	0·71	0·40
C90	0·99	0·50
C120	1·49	0·75
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1·10	0·65
C90	1·45	0·85
SCOTCH Low Noise 8—TRACK BLANK CARTRIDGES		
40 mins	1·50	0·90
80 mins	1·80	1·10
SCOTCH LONG LIFE SPOOLED TAPES		
5" L.P. 900	1·41	0·85
5¾" L.P. 1200	1·76	1·10
7" L.P. 1800	2·52	1·50
SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
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AMSTRAD HPS5A	6·95	3·95
HPS6A with volume control	9·95	6·75
HPS7A bass and treble controls	12·95	9·95
AKAI ASE9	6·90	4·70
AKAI ASE22	11·50	7·95
AKG K180	28·00	16·95
AKG K60	15·00	8·95
AKG 100	8·00	4·95
AKG 120	10·00	4·50
DULCI SH650D	Sp. Price	2·50
KOSS HV1	20·00	15·95
KOSS ESP-9 Electrostatic	69·00	52·95
KOSS ESP-6 Electrostatic	45·00	34·95
KOSS PRO 5L/C	30·00	23·95
KOSS PRO-4AA	28·00	21·90
KOSS KO-727B	16·50	12·45
KOSS 747	20·00	15·90
KOSS K-711	10·00	7·90

HEADPHONES—*continued*

	Rec. Retail Price	Comet Price
KOSS K6	12·50	9·90
KOSS K6/LC (with volume control)	14·00	11·10
PIONEER SE50	21·90	14·20
PIONEER SE30A	12·60	8·75
PIONEER SE20A	7·88	5·15
PIONEER SEL20	10·53	6·80
PIONEER SEL40	17·43	11·30
ROTEL RH630	6·50	4·50
ROTEL RH700	9·95	6·75
WHARFDALE DD1	12·50	8·75

HI-FI STEREO SYSTEMS—COMPLETE

	Rec. Retail Price	Comet Price
ALBA UA552	47·75	29·95
BUSH A1005	69·89	53·25
DANSETTE Consort Stereo	34·43	23·95
DANSETTE 4005	71·45	52·95
DANSETTE 4020	47·99	31·95
DECCA Sound 613	Special Price	46·95
DECCA Sound 614	Special Price	52·95
DECCA Sound 1204	Special Price	70·95
DECCA Compact 2	Special Price	78·95
DECCA Compact 3	Special Price	98·95
DECCA 403	Special Price	44·95
EKCO ZU4	152·00	114·00
FERGUSON 3425	136·35	102·75
FERGUSON 3450 with Radio	74·20	55·95
FERGUSON 3451 with Radio	101·70	79·95
FERGUSON 3454	41·50	32·95
FIDELITY UA1 Music Master with Radio	100·00	69·95
FIDELITY UA2 Music Master	43·50	30·95
FIDELITY UA3 Music Master	63·00	45·95
FIDELITY Stereo Nine	38·50	22·95
GOODMANS Module 80 compact (Less L/S)	165·00	125·75
HMV 2450 with Stereo Radio	138·00	104·95
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HMV 2452	66·00	49·95
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KB1025 with 657 speakers	48·25	37·95
KB 1250 with KS 653 Speakers	71·00	53·95
KB 2010 with 658 speakers	101·50	77·95
KB 2250 with 658 speakers	124·00	95·95
MURPHY 902 Studio 1, AM/VHF Radio	84·50	64·95
MURPHY 903	84·42	64·95
PHILIPS 808	105·00	76·95
PHILIPS GF824	65·30	49·65
PHILIPS 825	49·50	38·95
PHILIPS 826	75·00	52·95
PHILIPS 835	69·50	49·55
PHILIPS 836	95·00	69·95
PYE Black Box unit stereo 1022	90·93	68·95
RIGONDA Party Time	28·50	20·95
STEEPLETONE stereo system	41·75	25·95
ULTRA 6028	59·95	45·95
ULTRA 6450	74·20	57·95
ULTRA 6451	79·50	61·50
ULTRA 6455	41·35	31·95
ULTRA 6454	38·85	29·95

TAPE RECORDERS AND TAPE DECKS

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AKAI 1720L 4-track Stereo	87·36	58·75
AKAI 4000D 4-track stereo deck	93·65	64·50
AKAI CR80D 8-track stereo tape deck	85·02	58·25
AKAI CR80 8-track stereo recorder	106·39	74·00
AKAI CR80T 8-track stereo recorder and tuner/amplifier	149·84	89·95
AKAI X200D	157·93	99·95
AKAI GX220D	223·00	164·95
AKAI 1800SD	162·79	101·95
AKAI 2000SD	289·07	223·30
BSR TD8S 8-track deck	23·58	17·25
FERGUSON 3247 4-track	47·95	34·95
FERGUSON 3248 4-track	53·75	39·95
FERGUSON 3252 4-track	98·00	74·95
FERGUSON 3258 4-track	70·45	51·95
FERROGRAPH 702/704 Dolby	264·38	224·50
FERROGRAPH 702H Dolby	274·95	233·50
FERROGRAPH 722/724 Dolby	301·98	255·95
FERROGRAPH 722H Dolby	312·55	264·95

TAPE RECORDERS—*continued*

	Rec. Retail Price	Comet Price
FERROGRAPH 702/704	224·43	170·65
FERROGRAPH 704/W 4-track deck	224·43	170·65
FERROGRAPH 722	262·03	190·15
FERROGRAPH 724	262·03	190·15
FIDELITY BRAEMAR 4-track	34·75	19·95
GRUNDIG TK 121 twin track	56·25	38·95
GRUNDIG TK 141 4-track	62·10	44·95
GRUNDIG TK 146 4-track Auto	66·95	48·95
GRUNDIG TK 147 4-track Auto	98·65	74·95
GRUNDIG TK 148 (4-track auto 2 speed)	74·10	56·95
GRUNDIG TK 246 4-track Stereo Deck	131·85	99·95
GRUNDIG TK 3200 Hi-Fi (Battery)	141·10	105·95
PHILIPS 4303 Twin-track	39·46	24·95
4307 4-track	50·00	35·95
4308 De luxe 4-track	59·00	42·95
4404 4-track stereo recorder	89·25	65·95
4407 4-track stereo recorder	108·50	73·95
PHILIPS 4414 4-track stereo recorder	120·00	99·95
PHILIPS 4416 4-track stereo recorder	145·00	122·95
4418 4-track stereo	200·00	145·95
4450 4-track stereo	295·00	214·95
4500 4-track stereo tape deck	124·30	91·65
PHILIPS 4510 4-track stereo tape deck	185·00	154·95
TANDBERG 2041 4-track (Stereo)	130·50	108·50
TANDBERG 1841 4-track stereo deck	66·00	49·95
TANDBERG 3021X twin track stereo	113·00	89·95
TANDBERG 3041X 4-track stereo	113·00	89·95
TANDBERG 4021X twin track stereo	179·00	145·95
TANDBERG 4041X 4-track stereo	179·00	145·95
TANDBERG 6041X 4-track stereo	199·30	159·95
TANDBERG 6021X twin track stereo	199·30	159·95

TAPE RECORDERS (CASSETTE)

	Rec. Retail Price	Comet Price
AKAI CS 50 recorder	125·83	92·95
AKAI CS 50D Deck	104·46	77·50
AKAI GXC 40D Tape Deck	92·26	66·95
AKAI GXC 40	111·75	82·25
APCO Batt./Mains with AM/FM Radio	35·00	22·95
BUSH Discassette DC70	20·62	15·95
BUSH TP60	27·62	19·95
BUSH TP 66 Batt./Mains	28·18	21·50
BUSH TP 70 battery/mains	28·13	18·95
CARLTONE LCR500	Sp. Price	11·95
DANSETTE DCT105	20·62	13·95
DECCA 2000 (batt./mains)	Sp. Price	22·95
DECCA CR1000 with VHF Radio	Sp. Price	32·95
EKCO 350 Bt./Mns. VHF/MW Radio	37·42	28·75
EKCO 351 Battery/Mains	23·23	18·45
FERGUSON 3240 with case	24·90	15·95
FERGUSON 3253	43·55	31·95
FERGUSON 3262 Battery/Mains	30·15	22·95
GRUNDIG C200 De Luxe	37·55	26·95
GRUNDIG C210 batt./mains	48·75	36·95
GRUNDIG C410	41·55	29·95
HARVARD Elite with AM/FM radio batt./mains	44·75	23·95
JVC NIVICO 9420 L/S with AM/FM radio batt./mains	61·45	45·95
JVC Nivico 1710 Radio/Casette, AM/FM	61·00	42·95
PHILIPS R.R. 392 with MW/VHF Radio Cassette	49·95	37·95
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2204 battery/mains	29·10	24·95
PHILIPS 2205 Battery/mains	42·50	31·95
PHILIPS 2211 built in micro	29·00	23·95
2400 stereo less L/S	70·00	52·95
PHILIPS 2405 Stereo with 2 RH401 L/S	72·00	54·95
PHILIPS 2506 Stereo deck with DNL	65·00	48·95
3302	21·50	15·95
PYE 9109	20·37	14·95
PYE 9116 Stereo	66·10	49·95
PYE 9118	29·11	22·95
TELETON STC 106 Stereo Deck	46·45	30·95
TELETON TC110 battery/mains	27·50	18·50

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OA200	7p	OC83	25p	2N1306	25p	AC127	25p	BSY29	25p	SD94	21p
OA202	10p	OC83B	15p	2N1307	25p	AC128	20p	BU100	£1·80	SD98S	46p
OA210	25p	OC84	25p	2N2147	64p	AC176	20p	BYZ13	25p	V405A	40p
OA211	30p	OC122	50p	2N2411	£1.50	ACY17	25p	BYZ16	63p	Z2A51CF	78p
OAZ200	55p	OC139	25p	2N2904A	25p	ACY28	17p	CRS1/10	25p	ZR11	33p
OAZ201	50p	OC140	40p	2N2989	£4.00	AD149	50p	CRS1/20	38p	ZR21	46p
OC16	50p	OC170	25p	2N3053	20p	AD161	35p	CRS1/30	40p	ZR22	42p
OC22	50p	OC171	30p	2N3054	50p	AD162	35p	CRS1/35	43p		
OC25	40p	OC172	37p	2N3055	64p	AF118	50p	CRS1/40	48p		
OC26	25p	OC200	40p	2N3730	50p	AF127	20p	CRS3/05	30p		
OC28	60p	OC201	75p	2N3731	£2·75	AF139	30p	CRS3/20	38p	**ZENER**	
OC29	60p	OC206	95p	2N4172	50p	AF178	48p	CRS3/30	43p	**DIODES**	
OC35	50p	IN21B	30p	S2303	50p	AF186	40p	CRS25/025	55p	All preferred voltage	
OC36	56p	IN25	60p	3F100	62p	ASY26	25p				
OC38	42p	IN43	10p	3FR5	32p	ASY28	25p	CRS3/40	50p	¼W	0·17
OC44	17p	IN70	7p	3N128	87p	ASY67	48p	CS2A	65p	1W	0·37
OC45	12p	1N677	12p	3N139	£1·75	BAW19	28p	CV102	25p	1·5W	0·25
OC70	12p	IN702-725	36p	3N140	97p	BC107	10p	GET103	23p	7W	0·40

QQVO3-10	£1·25	UAF42	55p	UY85	40p	3S4	35p	6AK8	32p	6BG6G	55p
QQVO6-40A	£5·40	UBC41	46p	VR105/30	35p	3V4	45p	6AL5	15p	6BJ6	45p
R17	48p	UBF80	40p	VR150/30	35p	5B254M	£2·20	6AL5W	40p	6BQ7A	40p
R19	37p	UBF89	35p	Z801U	£2·00	5B/255M	£2·00	6AM6	30p	6BR7	85p
STV280/40	£3·40	UCC85	40p	Z803A	£1·25	5R4GY	75p	6AN8	50p	6BW6	85p
STV280/80	£9·00	UCF80	55p	Z900T	95p	5U4G	35p	6AQ5	35p	6BW7	80p
TT21	£3·00	UCH42	70p	IL4	15p	5V4G	45p	6AQ5W	50p	6C4	30p
U25	72p	UCH81	33p	IR5	40p	5Y4G	40p	6AS6	37p	6C6	25p
U26	72p	UCL82	35p	1S4	40p	5Y3GT	35p	6AS7G	80p	6CH6	55p
U27	50p	UCL83	60p	1S5	30p	5Z3	55p	6AT6	30p	6CL6	49p
U191	70p	UF41	50p	IT4	22p	5Z4	75p	6AU6	25p	6D6	20p
U801	80p	UF80	36p	1X2A	40p	5Z4GT	40p	6AX4GT	60p	6EA8	55p
UABC80	35p	UF89	40p	1X2B	50p	6AB7	30p	6AX5GT	70p	6F23	75p
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		UL84	60p	3A4	35p	6AH6	50p	6BK7	60p	6H6M	20p
		UU5	55p	3D6	15p	6AK5	30p	6BA6	25p	6J4WA	75p
		UY41	43p	3Q4	45p			6BE6	30p	6J5	40p

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. P. & P. Up to £1 12p, £1-£2 17p, £2-£3 22p. Over £3 post free. C.O.D. 20p extra.

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ALL valves guaranteed

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6J7M	40p	20P4	£1·00	8020	£2·25
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6K7G	20p	30C17	80p	9003	50p
6K8GT	40p	30C18	70p	9004	15p
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6SL7GT	32p	30P12	80p	VCR517C	£7·50
6SN7GT	32p	30P19	77p		
6SQ7	39p	30PL1	75p	5FP7	£1·32
6SQ7GT	35p	30PL13	92p	88D	£9·00
6V6G	17p	30PL14	90p	88J	£9·00
6V6GT	40p	35L6GT	50p	88L	£9·00
6X4	30p	35W4	35p		
6X5G	30p	35Z4GT	45p	**Photo Tubes**	
6X5GT	37p	50C5	50p	CMG25	£2·75
6Y6G	60p	50CD6G	60p		
6-30L2	80p	50EH5	60p	931A	£4·00
6Z4	36p	75	40p	6097C	£17·50
7B7	45p	76	40p		
7Y4	60p	78	40p		
9D6	37p	80	50p		
11E2	£2·80	723A/B	£7·00	**Special Valves**	
12AT6	30p	803	£3·25	CV2339	£20·00
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TEXAS INTEGRATED CIRCUIT SN 76131N Stereo pre-amp **£0·65. VACUUM CONDENSERS** 12, 50, 55pF each 20,000v. **£1·50.** P. & P. 20p. **4, 5 and 8 bank 25 way uniselectors,** 24V, guaranteed perfect, **£3·75; £4·50; £6·87** respectively. **MODULATION TRANSFORMERS** made by **COLLINS.** Freq. resp. 200-5000 CPS; Pri. 6000zCT 3000 TV Sec. 60000z 3000 TV Audio power 20W. **£1·25.** Post and packing 25p.

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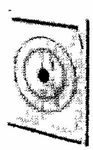
20-Watt Full Range Speaker



Completely replaces the conventional cone speaker Super-thin construction permits new installation ideas.

Power capability: 40 watts peak. **Frequency range:** 40 Hz–20 KHz **Sensitivity:** 85 dB/M for 1 watt electrical input. **Input impedance:** 8 ohms. **Operating temperature range:** —20°F to +175°F. **Size (WxDxL):** 1·7/16" x 11·3/4" x 14·11/16". **Weight:** 19 ounces.

£6·50 each Stereo pair £12·50 post free

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Type	Size	Price	Type	Size	Price
N	8x6x2"	£1·00	W	12x7x7"	£2·50
N	6x6x3"	£1·05	W	15x9x8"	£3·15
N	4x4x2"	80p	Y	8x6x6"	£2·25
U	4x4x4"	95p	Y	12x7x7"	£2·80
U	5½x4½x4½"	£1·15	Y	13x7x9"	£3·15
U	8x6x6"	£1·45	Y	15x9x7"	£3·35
U	9½x7½x3½"	£1·55	Z	17x10x9"	£4·15
U	15x9x9"	£3·00	Z	19x10x8½"	£4·35
W	8x6x6"	£1·90			*Height

Type N has removable bottom. Type U removable bottom or back. Type W removable front. Type Y all screwed construction. Type Z removable back and front. *Plus p.& p.*

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FOUR-SIDED 16 SWG ALUMINIUM

Size	Price	Base	Size	Price	Base
6x4x2"	34p	17p	10x8x2½"	66p	30p
7x4x1½"	33p	18p	12x7x2½"	66p	33p
7x5x2"	40p	19p	12x9x2½"	76p	38p
8x4x2"	38p	19p	13x8x2½"	76p	38p
8½x5½x2"	44p	21p	14x7x3"	80p	36p
9x7x2"	50p	26p	14x10x2½"	88p	47p
10x4x2½"	50p	21p	15x10x2½"	92p	50p
12x4x2½"	55p	22p	17x10x3"	£1·10	55p
12x5x3"	66p	26p	*Plus post and packing*		

TO FIT OUR CASES

7x5½x1½"	38p	21p	12x6½x2"	60p	33p
7x5½x2"	43p	21p	14x8½x2"	74p	44p
11x6½x1½"	48p	30p	15½x9½x2½"	94p	52p
11x6½x2"	55p	30p	17½x9½x2½"	£1·05	59p

Plus post & packing

PANELS: Any size up to 3ft. at **36p** sq. ft. 16 s.w.g. (18 s.w.g. 32p) *Plus postage and packing*

now YOU can CATCH SHOALS OF BIG FISH with new electronic miracle

special introductory offer **£2·50**

First time marketed in England, this exciting electronic instrument the "Decoytronic" is the one responsible for starting the electronic fish-lure rage in the U.S.A. just recently. Uses ingenious double-action method of attracting all kinds of fish from hundreds and hundreds of feet away . . . saltwater or freshwater. Why this device is so fantastically successful is because it *actually imitates the sound of wet insects milling about the surface.* These sound waves spread out hundreds of feet in all directions. Although this peculiar sonic frequency won't sound like much to you—to all the fish in the area it's their dinner bell! **But that's not all** . . . *electroluminescence neon tubes cunningly flicker intermittently*, penetrating the area for hundreds of feet around, at a frequency fish are unable to resist. The fish mistake this flickering glimmer for the soft phosphorescence glow given off by Plankton . . . a favourite delicacy of most fish!!! All you do is switch on, lower into the water (it's completely water resistant) allow around 5 minutes—then start reeling 'em in. We'll bet you won't be able to reel 'em in fast enough. Self-contained batteries last ages—cost pence. Kit of all parts including special easy as a.b.c. directions only £2·50 + 25p. P. & P. (Parts available separately).

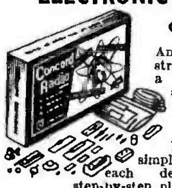
the amazing "Phototron" SOUND OPERATED FLASH

ONLY £4·50

Take flash pictures at the exact instant of the bursting of a balloon. A champagne cork leaving the bottle. The split second a hammer strikes a light bulb. *The mind boggles at the possibilities of the "Phototron" . . . the only limit is your imagination.* Now that inexpensive flash guns are on the market in quantity, it has made possible, with the help of electronics the production of a wide variety of exciting photography effects, once strictly limited to the professionals. The duration of an electronically produced flash is extremely brief and normally measured in Milliseconds. Now, providing the camera shutter is left open in a dark or subdued light, it is the timing of the flash that determines what is imprinted on the film—not necessarily anything done by the camera. As electronic flash guns are fired by making a switched connection then it becomes obvious that one of the latest Silicon Controlled Relay's can be used. If we make this S.C.R. operate by sound (with variable sensitivity control for soft/loud sounds) some real "way out" photography effects can be captured forever on film. Easily built in a couple of hours or so, the "Phototron" is fully solid sate, uses self contained PP3 battery. No soldering necessary using our special terminal board (pat. Applied for). All parts including special pictorial step-by-step plans, transistors, microphone, S.C.R., potentiometers, switches, test lamp, case, nuts, screws, etc. etc. ONLY £4·50 + 25p P. & P. *Made up must be worth at least £10* (parts available separately).

BUILD 5 RADIO AND ELECTRONIC PROJECTS

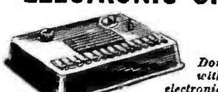
ONLY £2·45



Amazing Radio Construction set! Become a radio expert for £2·45. A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all you need. Presentation box 45p extra as illus. (if required) (parts available separately) no soldering necessary. Send £2·45 + 20p p. & p.

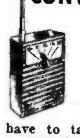
ELECTRONIC ORGAN

ONLY £3·25



Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc Fully transistorised. **SELF-CONTAINED LOUDSPEAKER.** *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.* **ONLY £3·25** + 25p. p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making yourself, finish with an exciting gift for someone.

Eavesdrop on the exciting world of Aircraft Communications—V.H.F. AIRCRAFT BAND CONVERTER ONLY £2·85



Listen in to **AIRLINES, PRIVATE PLANES, JET-PLANES.** *Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower, Hear for yourself the disciplined voices hiding tenseness in talk downs.* Be with them when they have to take nerve ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK, ETC. ETC. CLEAR AS A BELL.** This fantastic fully transistorised instrument can *be built by anyone over nine in under two hours.* No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even tiny portables). **NO CONNECTIONS WHATEVER NEEDED. SEND ONLY £2·85** + 20p. p. & p. for kit including case, nuts, screws, wire, etc. etc. (Parts available separately).

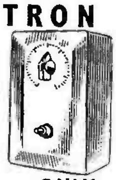
FIND BURIED TREASURE!

Transistorised Treasure Locator

ONLY £2·85

This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** *Extremely sensitive will signal presence of certain objects buried several feet below ground.* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards,* with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2·85** + 25p. p. & p. (Sectional handle as illustrated 95p. extra). Parts available separately. Made up looks worth £15.

SOOTHE YOUR NERVES RELAX WITH THIS AMAZING RELAXATRON

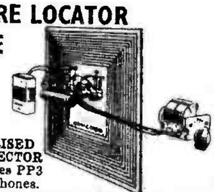


ONLY £2·25

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES!—The RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. £2·75 + 25p p. & p. (Parts available separately).

TREASURE LOCATOR MODULE

ONLY £4·50



FULLY TRANSISTORISED METAL DETECTOR MODULE. Uses PP3 battery and phones. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC.** *So sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN.** Send only £4·50 + 30p carriage for kit (High quality Danish Stethoscope headphones £2·75 extra if required).

INGENIOUS ELECTRONIC SLEEP INDUCER

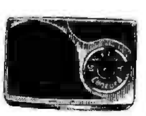
ONLY £3·25

Do you wake up in the night and can't get off to sleep again? Would you like to be gently soothed off to satisfying sleep every night? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* All transistor. No knowledge of electronics or radio needed. Step-by-step instructions included. *No soldering necessary.* Kit includes case, nuts, wire, screws, etc. SEND £3·25 + 25p p. & p. (Parts available separately).

SHORTWAVE TRANSISTOR RADIO

ONLY £2·75

Anyone from 9 years up can follow the step-by-step, easy as ABC, fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins.—**RUSSIA, AFRICA, USA, SWITZERLAND, ETC.** Experience thrills of world wide news, sport, music, etc. **Eavesdrop** on unusual broadcasts. Uses PP3 battery. Size only 3" x 4½" x 1½" Only £2·75 + 20p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).



UNIQUE RADIO FOR BEDROOM OR OFFICE No batteries, no electricity, never wears out ONLY £1·70

Tune in your favourite programmes or the news, or sports in the Office or in your bedroom. Uses sensitive, germanium diode originally evolved from Wartime radar. Never buy a battery. Never use electricity. Never replace. Covers all medium waves. Clear beautiful tone. Size 4½" x 2¾" x 1½" in beautiful case. ONLY 7 CONNECTIONS AND IT'S WORKING. No soldering necessary. **CAN BE BUILT ALMOST BLINDFOLD IN UNDER 15 MINUTES!** Ideal for absolute beginner from 8 years of age upwards. **SPECIAL PRICE TO CLEAR STOCKS OF COMPONENTS, ONLY £1·70** + 20p. P. & P. for all parts including beautiful case. Germanium semi-conductor, tuning condenser, personal phone, wire, nuts screws. **SIMPLE AS A.B.C. INSTRUCTIONS** (Parts available separately).

AMAZING MAGIC MUSIC BOX

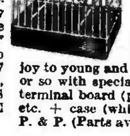
make electronic music waving your hands about

only £2·75 Everyone's heard the weird, wonderful, but beautiful music used in Science Fiction Films, Horror Films etc., also on Radio and Television. This unearthly, eerie music is almost always produced by a little known electronic device measuring only a few inches . . . called a Theremin. All you have to do is switch on your radio (almost any type will do) and place the Theremin close by. Switch on the Theremin and proceed to wave your hands mysteriously in the air like a magician. The most fantastic musical sounds are then produced, and with a little practice people can learn to play all the well known tunes. Apart from it's musical value, it's small size allows it to be used to best advantage at parties, gatherings of friends etc., where it attracts tremendous interest. Provides hours and hours of pleasure to young and old. Uses standard PP3 battery which lasts ages. The 3 Transistor circuit, though fairly advanced is simple to build with our pictorial step-by-step plans. No soldering necessary. Easily built in an hour or so using our special *terminal* board (Pat. Applied For). All parts including nuts, bolts, case etc., **ONLY £2·75** + 25p P. & P. (Parts available separately).

"READ PEOPLE'S MINDS"—TEST THEIR NERVES—BEAT THEM AT CARDS, ETC. WITH THIS ASTONISHING ELECTRONIC BRAIN BOX Only £2·87

With this "Brain-box" you will be able to *perform mind-boggling feats.* **THE MIND READING DEVICE** will make people swear you have "telepathic" powers. **THE AMAZING CARD TRICK UNIT** completely mystifies and baffles from one to six people. *You correctly "guess" the two cards each person has selected at random from a pack they themselves shuffled.* **THE ELECTRONICS NERVES TESTER** puts your friends to a very lively test. It gives out fail and finish signals (the winner is the person with lowest number of fail signals.) *Can be adjusted from the weakest to strongest person.* **THE ELECTRONIC MAZE** *tests the mental ability of the player* because it uses psychology with an electronic twist to it. You can change the maze pathways in seconds to prevent the maze becoming too stale after lots of use. Completely safe and foolproof. Size 18" x 12" x 6" (Max.). You can play all these games and more beside after building the "Brain box". No soldering, you get pictorial, easy as a.b.c. step-by-step simple instructions. **ONLY £2·87** + 33p. p. & p. for all parts including chassis, switches, stylus, signalling lights, wire, nuts, screws, etc. etc. Uses standard battery. Presentation Box 33p. extra as illus. if reqd. (PARTS AVAILABLE SEPARATELY) FULL OPERATING DIRECTIONS WITH EACH OF THE PROJECTS.

INGENIOUS ELECTRONIC SINGING & WARBLING CANARY only £4·50



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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.

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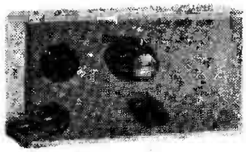

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6AQ5	38	6F32	25	6V6GT	40	12Q7GT	40	30PL14	90	AZ31	55	EBC41	55	EF92	35	ML4	88	PL36	55	U78	35	VR150/30	35
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2N404	20	2N2926	10	ASY26	25	MJE520	37	OAZ207	47	OC81D	20
2N697	15	2N3055	75	BC107	10	MJE2955		OAZ210	32	OC82	25
2N706	10	2N3702	10	BC108	10		£1·37	OAZ222	45	OC82D	20
2N1132	25	2N3819	35	BC109	10	MJE3055	37	OAZ224	45	OC84	25
2N1305	22	2N4289	15	BC169C	15	NKT212	27	OAZ241	22	OC170	25
2N2147	75	AAZ12	30	BFS98	28	NKT214	15	OAZ242	23	OC171	30
2N2160	60	AC126	20	BFY50	22	NKT223	33	OAZ246	23	OC200	40
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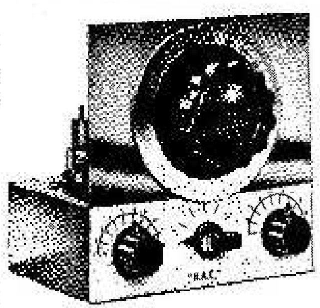

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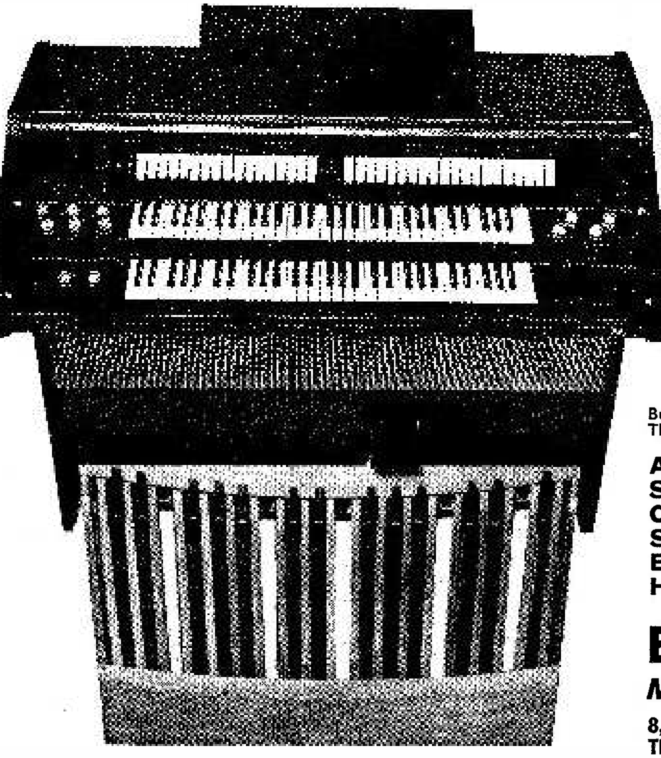

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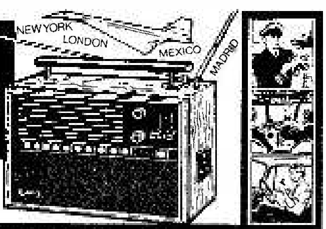

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AC107	0·20	AD162	0·33	BC148	0·10	BD137	0·45	BF188	0·40	OC19	0·35	2G371	0·16	2N2219	0·20	2N3054	0·46	2N4059	0·10
AC113	0·20	AD161 &		BC149	0·12	BD138	0·50	BF194	0·12	OC20	0·63	2G371B	0·12	2N2220	0·22	2N3055	0·50	2N4060	0·12
AC115	0·23	AD162 (MP)		BC150	0·18	BD139	0·55	BF195	0·12	OC22	0·38	2G373	0·17	2N2221	0·20	2N3391	0·14	2N4061	0·12
AC117K	0·20		0·55	BC151	0·20	BD140	0·60	BF196	0·14	OC23	0·42	2G374	0·17	2N2222	0·20	2N3391A	0·16	2N4062	0·12
AC122	0·12	ADT140	0·50	BC152	0·17	BD155	0·80	BF197	0·14	OC24	0·56	2G377	0·30	2N2368	0·17	2N3392	0·14	2N4284	0·17
AC125	0·17	AF114	0·24	BC153	0·28	BD175	0·60	BF200	0·45	OC25	0·38	2G378	0·16	2N2369	0·14	2N3393	0·14	2N4285	0·17
AC126	0·17	AF115	0·24	BC154	0·30	BD176	0·60	BF222	0·95	OC26	0·25	2G381	0·16	2N2369A	0·14	2N3394	0·14	2N4286	0·17
AC127	0·17	AF116	0·24	BC157	0·18	BD177	0·65	BF257	0·45	OC28	0·50	2G382	0·16	2N2411	0·24	2N3395	0·17	2N4287	0·17
AC128	0·17	AF117	0·24	BC158	0·12	BD178	0·65	BF258	0·60	OC29	0·50	2G401	0·30	2N2412	0·24	2N3402	0·21	2N4288	0·17
AC132	0·14	AF118	0·35	BC159	0·12	BD179	0·70	BF259	0·85	OC35	0·42	2G414	0·30	2N2646	0·47	2N3403	0·21	2N4289	0·17
AC134	0·14	AF124	0·30	BC160	0·45	BD180	0·70	BF262	0·55	OC36	0·50	2G417	0·25	2N2711	0·21	2N3404	0·28	2N4290	0·17
AC137	0·14	AF125	0·25	BC161	0·50	BD185	0·65	BF263	0·55	OC41	0·20	2N388	0·35	2N2712	0·21	2N3405	0·42	2N4291	0·17
AC141	0·14	AF126	0·28	BC167	0·12	BD186	0·65	BF270	0·35	OC42	0·24	2N388A	0·55	2N2714	0·21	2N3414	0·15	2N4292	0·17
AC141K	0·17	AF127	0·28	BC168	0·12	BD187	0·70	BF271	0·30	OC44	0·15	2N404	0·20	2N2904	0·17	2N3415	0·15	2N4293	0·17
AC142	0·14	AF139	0·30	BC169	0·12	BD188	0·70	BF272	0·80	OC45	0·12	2N404A	0·28	2N2904A	0·21	2N3416	0·28	2N5172	0·12
AC142K	0·17	AF178	0·50	BC170	0·12	BD189	0·75	BF273	0·35	OC70	0·10	2N524	0·42	2N2905	0·21	2N3417	0·28	2N5457	0·32
AC151	0·15	AF179	0·50	BC171	0·14	BD190	0·75	BF274	0·35	OC71	0·10	2N527	0·49	2N2905A	0·21	2N3525	0·75	2N5458	0·32
AC154	0·20	AF180	0·50	BC172	0·14	BD195	0·85	BFW10	0·60	OC72	0·14	2N598	0·42	2N2906	0·15	2N3646	0·09	2N5459	0·40
AC155	0·20	AF181	0·45	BC173	0·14	BD196	0·85	BFX29	0·27	OC74	0·14	2N599	0·45	2N2906A	0·13	2N3702	0·10	2S301	0·50
AC156	0·20	AF186	0·45	BC174	0·14	BD197	0·90	BFX84	0·22	OC75	0·15	2N696	0·12	2N2907	0·20	2N3703	0·10	2S302A	0·42
AC157	0·24	AF239	0·37	BC175	0·22	BD198	0·90	BFX85	0·30	OC76	0·15	2N697	0·13	2N2907A	0·22	2N3704	0·11	2S302	0·42
AC165	0·20	AL102	0·65	BC177	0·19	BD199	0·95	BFX86	0·22	OC77	0·25	2N698	0·24	2N2923	0·14	2N3705	0·10	2S303	0·55
AC166	0·20	AL103	0·65	BC178	0·19	BD200	0·95	BFX87	0·24	OC81	0·15	2N699	0·35	2N2924	0·14	2N3706	0·09	2S304	0·70
AC167	0·20	ASY26	0·25	BC179	0·19	BD205	0·80	BFX88	0·22	OC81D	0·15	2N706	0·08	2N2925	0·14	2N3707	0·11	2S305	0·84
AC168	0·24	ASY27	0·30	BC180	0·24	BD206	0·80	BFY50	0·20	OC82	0·15	2N706A	0·09	2N2926 (G)		2N3708	0·07	2S306	0·84
AC169	0·14	ASY28	0·25	BC181	0·24	BD207	0·95	BFY51	0·20	OC82D	0·15	2N708	0·12		0·12	2N3709	0·09	2S307	0·84
AC176	0·20	ASY29	0·25	BC182	0·10	BD208	0·95	BFY52	0·20	OC83	0·20	2N711	0·30	2N2926 (Y)		2N3710	0·09	2S321	0·56
AC177	0·24	ASY50	0·25	BC182L	0·10	BDY20	1·00	BFY53	0·17	OC84	0·20	2N717	0·35		0·11	2N3711	0·09	2S322	0·42
AC178	0·28	ASY51	0·25	BC183	0·10	BF115	0·24	BPX25	0·85	OC139	0·20	2N718	0·24	2N2926 (O)		2N3819	0·28	2S322A	0·42
AC179	0·28	ASY52	0·25	BC183L	0·10	BF117	0·45	BSX19	0·15	OC140	0·20	2N718A	0·50		0·10	2N3820	0·50	2S323	0·56
AC180	0·17	ASY54	0·25	BC184	0·12	BF118	0·70	BSX20	0·15	OC169	0·25	2N726	0·28	2N2926 (R)		2N3821	0·35	2S324	0·70
AC180K	0·20	ASY55	0·25	BC184L	0·12	BF119	0·70	BSY25	0·15	OC170	0·25	2N727	0·28		0·10	2N3823	0·28	2S325	0·70
AC181	0·17	ASY56	0·25	BC186	0·28	BF121	0·45	BSY26	0·15	OC171	0·25	2N743	0·20	2N2926 (B)		2N3903	0·28	2S326	0·70
AC181K	0·20	ASY57	0·25	BC187	0·28	BF123	0·50	BSY27	0·15	OC200	0·25	2N744	0·20		0·10	2N3904	0·30	2S327	0·70
AC187	0·22	ASY58	0·25	BC207	0·11	BF125	0·45	BSY28	0·15	OC201	0·28	2N914	0·14	2N3010	0·70	2N3905	0·28	2S701	0·42
AC187K	0·20	ASZ21	0·40	BC208	0·11	BF127	0·50	BSY29	0·15	OC202	0·28	2N918	0·30	2N3011	0·14	2N3906	0·27	40361	0·40
AC188	0·22	BC107	0·09	BC209	0·12	BF152	0·55	BSY38	0·18	OC203	0·25	2N929	0·21	2N3053	0·17	2N4058	0·12	40362	0·45
AC188K	0·20	BC108	0·09	BC212L	0·11	BF153	0·45	BSY39	0·18	OC204	0·25	2N930	0·21						
ACY17	0·25	BC109	0·10	BC213L	0·11	BF154	0·45	BSY40	0·28	OC205	0·35	2N1131	0·20						
ACY18	0·20	BC113	0·10	BC214L	0·14	BF155	0·70	BSY41	0·28	OC309	0·40	2N1132	0·22						
ACY19	0·20	BC114	0·15	BC225	0·25	BF156	0·48	BSY95	0·12	P346A	0·20	2N1302	0·14						
ACY20	0·20	BC115	0·15	BC226	0·35	BF157	0·55	BSY95A	0·12	P397	0·42	2N1303	0·14						
ACY21	0·20	BC116	0·15	BCY30	0·24	BF158	0·55	Bu105	2·00	OCP71	0·43	2N1304	0·17						
ACY22	0·16	BC117	0·15	BCY31	0·26	BF159	0·60	C111E	0·50	ORP12	0·43	2N1305	0·17						
ACY27	0·18	BC118	0·10	BCY32	0·30	BF160	0·40	C400	0·30	ORP60	0·40	2N1306	0·21						
ACY28	0·19	BC119	0·30	BCY33	0·22	BF162	0·40	C407	0·25	ORP61	0·40	2N1307	0·21						
ACY29	0·35	BC120	0·80	BCY34	0·25	BF163	0·40	C424	0·20	ST140	0·12	2N1308	0·23						
ACY30	0·28	BC125	0·12	BCY70	0·14	BF164	0·40	C425	0·50	ST141	0·17	2N1309	0·23						
ACY31	0·28	BC126	0·18	BCY71	0·18	BF165	0·40	C426	0·35	TIS43	0·30	2N1613	0·20						
ACY34	0·21	BC132	0·12	BCY72	0·14	BF167	0·22	C428	0·20	UT46	0·27	2N1711	0·20						
ACY35	0·21	BC134	0·18	BCZ10	0·20	BF173	0·22	C441	0·30	2G301	0·09	2N1889	0·32						
ACY36	0·28	BC135	0·12	BCZ11	0·25	BF176	0·35	C442	0·30	2G302	0·19	2N1890	0·45						
ACY40	0·17	BC136	0·15	BCZ12	0·25	BF177	0·35	C444	0·35	2G303	0·19	2N1893	0·37						
ACY41	0·18	BC137	0·15	BD121	0·60	BF178	0·30	C450	0·22	2G304	0·24	2N2147	0·72						
ACY44	0·35	BC139	0·40	BD123	0·65	BF179	0·30	MAT100	0·19	2G306	0·40	2N2148	0·57						
AD130	0·38	BC140	0·30	BD124	0·60	BF180	0·30	MAT101	0·20	2G308	0·35	2N2160	0·60						
AD140	0·48	BC141	0·30	BD131	0·50	BF181	0·30	MAT120	0·19	2G309	0·35	2N2192	0·35						
AD142	0·48	BC142	0·30	BD132	0·60	BF182	0·40	MAT121	0·20	2G339	0·20	2N2193	0·35						
AD143	0·38	BC143	0·30	BD133	0·65	BF183	0·40	MPF102	0·42	2G339A	0·16	2N2194	0·35						
AD149	0·50	BC145	0·45	BD135	0·40	BF184	0·25	MPF104	0·37	2G344	0·18	2N2217	0·22						
AD161	0·33	BC147	0·10	BD136	0·40	BF185	0·30	MPF105	0·37	2G345	0·16	2N2218	0·20						

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

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C 2	200	Capacitors mixed values approx. count by weight	0·50
C 3	50	Precision Resistors ·1%, ·01% mixed values	0·50
C 4	75	⅛th W Resistors mixed preferred values	0·50
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C 6	2	Tuning Gangs, MW/LW VHF	0·50
C 7	1	Pack Wire 50 metres assorted colours	0·50
C 8	10	Reed Switches	0·50
C 9	3	Micro Switches	0·50
C10	15	Assorted Pots & Pre-Sets	0·50
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Types	0·50
C12	40	Paper Condensers preferred types mixed values	0·50
C13	20	Electrolytics Trans. types	0·50
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0·50
C15	4	Mains Toggle Switches, 2 Amp D/P	0·50
C16	20	Assorted Tag Strips & Panels	0·50
C17	10	Assorted Control Knobs	0·50
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C19	3	Relays 6—24V Operating	0·50
C20	4	Sheets Copper Laminate approx. 10″ × 7″	0·50

Please add 10p post and packing on all component packs, plus a further 10p on pack Nos. C1, C2, C19, C20.

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Modual Tested and Guaranteed. Qty. 1—9 £2·63; 10—25 £2·28 Price each. Larger quantities quoted on request. Full hook-up diagrams and complete technical data supplied free with each modual or available separately at 10p each.

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Each Kit contains two Amplifier Modules, 3 watts RMS, two loudspeakers, 15 ohms, the pre-amplifier, transformer, power supply module, front panel and other accessories, as well as an illustrated stage-by-stage instruction booklet designed for the beginner.
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	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

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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
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T3	8	D1216	OC81D
T4	8	2G381T	OC81
T5	8	2G382T	OC82
T6	8	2G344B	OC44
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Q31	6	Silicon switch transistors 2N708 NPN	0·50
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·50
Q33	3	Silicon NPN transistors 2N1711....	0·50
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·50
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·50
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UIC04	= 12 × 7404	0·50	UIC51	= 12 × 7451	0·50	UIC93	= 5 × 7493	0·50
UIC05	= 12 × 7405	0·50	UIC53	= 12 × 7453	0·50	UIC94	= 5 × 7494	0·50
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UIC07	= 8 × 7407	0·50	UIC60	= 12 × 7460	0·50	UIC96	= 5 × 7496	0·50
UIC10	= 12 × 7410	0·50	UIC70	= 8 × 7470	0·50	UIC100	= 5 × 74100	0·50
UIC13	= 8 × 7413	0·50	UIC72	= 8 × 7472	0·50	UIC121	= 5 × 74121	0·50
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UIC30	= 12 × 7430	0·50	UIC74	= 8 × 7474	0·50	UIC151	= 5 × 74151	0·50
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Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
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PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	30p	27p	25p
TSO 16 „ „	35p	32p	30p
LOW COST No.			
BPS 14	15p	13p	11p
BPS 16	16p	14p	12p

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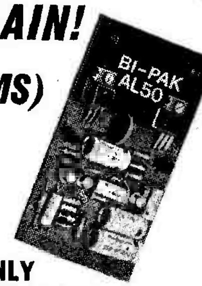

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THE AL50

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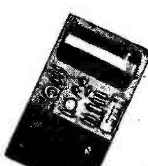
- ★ Frequency Response 15Hz to 100,000—1dB.
- ★ Load—3, 4, 8 or 16 ohms.
- ★ Distortion—better than ·1% at 1KHz.
- ★ Signal to noise ratio 80dB.
- ★ Supply voltage 10–35 Volts.
- ★ Overall size 63mm × 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and ALSO was conceived to fill the need for all your A.F. amplification needs.
FULLY BUILT — TESTED — GUARANTEED.

STABILISED POWER MODULE SPM80

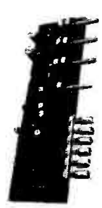


AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs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

TRANSFORMER BMT80 £1·95 p. & p. 25p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market. tne 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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4 speed
Automatic Single Player
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SPC4 Mk. II cover...	£4·25
Price together	£8·70
WB1 Plinth	£3·70
SPC1 cover	£3·60
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Garrard Module Series

Modules are complete wired units with cartridge, plinth and cover.

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SP25 Mk. III with SHURE M75/6 cart. £23·95

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AP76 with SHURE M75/6 cartridge £33·95

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Single play version of SL95B with SHURE M75/6 cartridge ... ... £38·75

Zero 100S Module
ZERO . 100S with SHURE M93/E cartridge ... ... £52·75

CARRIAGE—all units
DECK ONLY 50p. PLINTH & COVER ONLY 25p.
DECK WITH PLINTH AND COVER 75p.

BSR McDONALD MP60

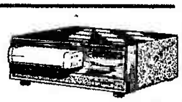
High precision low-mass counter-balanced pick-up arm, heavy balanced turntable, simple to operate controls, viscous cueing device, slide in cartridge carrier, 4 pole motor.
LASKY'S PRICE **£10·40** C & P 50p

BSR McDONALD UNITS & PACKAGES
A. Chassis only. **B.** Complete with Lasky's plinth cover and AD76K cartridge. **C.** As B but with Shure M55E cartridge. **D.** McDonald TPD/1 package. **E.** As D plus Goldring G800 cartridge.

MODEL	A	B	C	D	E
MP.60	10·40	18·95	21·00	16·95	19·60
HT.70	14·75	22·95	25·50	21·50	23·95
610	13·75	22·75	24·50	20·70	—

210 Complete with plinth, cover & BSR cartridge		
MP.60 TPD2 Styrene base	17·50	21·00
810 transcription model		£33·50
810 with BSR plinth and cover		£45·00

BSR TD8S



8 TRACK STEREO CARTRIDGE PLAYER
The TD8S is suitable for use with most modern stereo amplifiers and delivers a pre-amp output of 125mW. C & P 35p
Power requirements: 210/250V AC, 50Hz. Frequency response: 50Hz-10KHz. 4 pole dynamically balanced synchronous motor. Black and woodgrain plastic cabinet. Size: 8¼(W) X 3¾(H) X 10¼ (D) in.
List Price £24·20 LASKY'S PRICE **£17·95**

AUDIO·TRONICS

1973 JUST PUBLISHED

The 1973 edition of Laskys famous "Audio-Tronics Pictorial" is now available. Bigger, brighter and better than ever. Laskys brand new catalogue now contains 48 pages packed with all the latest Hi-Fi and electronics equipment—everything for the layman and enthusiast alike. All the goods shown in the "Audio-Tronics Catalogue" are available from any of our branches or by Mail Order to any address in the U.K. or overseas. Free on request. Just send your name, address and 15p for post and inclusion on our regular mailing list.

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

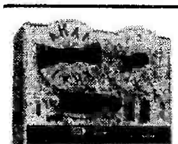
P & P 5p extra per reel, 4 reels and over Post Free. Special quotes for quantities.

LASKY'S NEW LOW NOISE CASSETTES FROM THE USA

Type	Single	5	10	15
C60	26½p	£1·29	£2·53	£3·71
C90	38p	£1·85	£3·62	£5·33
C120	47p	£2·29	£4·48	£6·59

Each cassette individually boxed in Philips, type plastic library.
C & P: each 7p, 5—25p, 10—40p, 20—68p.

AKAI TAPE RECORDER SCOOP!



(C & P 75p on all Tape Decks.)

AKAI 4000D illustrated List Price £93·65 ...	Lasky's Price £61·50
AKAI 1720L List Price £87·36 ...	Lasky's Price £58·95
AKAI X1800SD List Price £162·79 ...	Lasky's Price £111·50
AKAI X200D List Price £157·93 ...	Lasky's Price £106·50
2 CSS-8 Speakers List Price £25·00 ...	Lasky's Price £15·95 C & P 50p

2 ADM 11/8 mics. Suitable for use on all Akai tape recorders. List Price £11·90. **Lasky's Price** £7·50. C & P 15p.

BSR TAPE DECK SCOOP

Reels not supplied

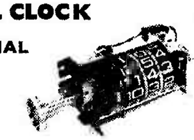
BSR TD2

FANTASTIC VALUE, ONLY Lasky's can offer you a tape deck at such an amazing price. The BSR TD2 tape deck operates by a simple reliable mechanism. Available with ½ track or ¼ track mono or stereo heads. Incorporates fast wind and fast rewind, records at 3¾ ips. giving up to 3 hrs playing time, takes up to 5¾in. spools. Size 13in. x 8¾in. front to rear, 2$\frac{13}{16}$in. below plate, 1$\frac{15}{16}$in. above plate.
ALSO SUITABLE FOR USE AS A TAPE TRANSPORTER
LASKY'S PRICE **£8·95** C & P 35p

SINCLAIR PHASE LOCK LOOP STEREO FM TUNER

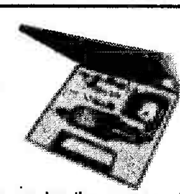
Incorporates varicap diodes, printed circuit, coils, squelch circuit I.C. Decoder, etc., supplied completely built and tested and ready to be mounted into any cabinet you choose. It may be used with any High Fidelity Amplifier. Power requirements 25/30V DC. Size 8¼" x 1¼" x 3¾".
LIST PRICE £25·00 LASKY'S PRICE **£15·75** C&P 25p
PZ5 power supply £4·15 extra.

NEW DIGITAL CLOCK



NOW WITH ILLUMINATED DIAL EXCLUSIVELY FROM LASKY'S
The clock measures 5¾ W x 2¾ H x 3in D (overall from front of drum to back of switch). SPEC.: 210/240V a.c. 50Hz operation; switch rating 250V, 3A. Complete with instructions. ● **COMPLETE WITH KNOBS. FEATURES:** ● **MAINS OPERATION** ● **12-HOUR ALARM** ● **AUTO "SLEEP" SWITCH** ● **HOURS, MINUTES AND SECONDS READ-OFF** ● **FORWARD AND BACKWARD TIME ADJUSTMENT** ● **SILENT OPERATION** ● **SHOCK AND VIBRATION PROOF** ● **BUILT IN ALARM BUZZER**
SPECIAL QUOTES FOR QUANTITIES LASKY'S PRICE **£6·50** C & P 25p

NEW WELLER MINI-SHOP KIT · 600K



Powered by a 25,000rpm, 115 volts, 75 amp Universal motor.
This small versatile, easy to handle, power tool is ideal for handymen, and professionals.
The wide selection of bits helps you grind, sharpen, drill, rout, cut etc. Perfect for delicate work. The complete kit is housed in a strong plastic case.
MODEL 600K 37 piece Kit contains:
● Model 600 Power Unit ● Accessory Caddy ● 8 Grinding/Sharpening Bits ● 3 Polishing Wheels ● 4 Cleaning Bits ● 8 Abrasive Discs ● 3 Abrasive Bands ● Expanding Drum ● Drill Bit ● Mandrell ● Chuck Wrench ● Dressing Stone ● Plastic Polish ● Jewellers Rouge ● Complete with owners manual ● Size of power unit only 7½".
LASKY'S PRICE
£17·95 C & P 35p

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PRACTICAL WIRELESS

VOL 48 NO 8
Issue 790

DECEMBER 1972

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

COMPETITION

THE JANUARY ISSUE WILL BE PUBLISHED ON DECEMBER 1st

Happy Anniversaries

IF you have been orbiting in space, trekking across the Gobi Desert or drifting down the Amazon for the past few months, it is possible that the news of the great event about to be celebrated has not filtered through. Otherwise, you will be aware that this month the BBC notches up the 50th Anniversary of broadcasting in the UK.

Special programmes are being broadcast on radio and television, exhibitions are being mounted by the BBC and others, the Post Office has issued a special set of postage stamps, the IEE is staging a series of lectures. After such a welter of words, pictures and sounds, what is there left to say? Not a lot, really, except for Practical Wireless to add its tribute to all those on the engineering, programme and administrative sides, who over the past 50 years have made a contribution towards what is still (despite its lovable faults) the best broadcasting service in the world.

But while we are indulging in flag-waving, let us not forget the unsung heroes who have also played a part in the development of broadcasting—the component makers, the set makers, the performers, the backroom boys and those overlooked but staunch martyrs, the listeners themselves!

There is yet another group who, collectively, deserve a modest pat on the back—our colleagues, past and present, who presumably through some inherited defect (or sheer masochism) decided to devote their life to the career of technical journalism! In the early days of broadcasting, and even before it, the technical journals generated and sustained the interest in the subject. The famous magazines of the day, such as *Popular Wireless, Wireless Magazine* and *Amateur Wireless* have long been but memories, but three of the pioneer publications are still with us—*Wireless World, Practical Wireless* and *Television* (which started life as *Practical Television* as early as 1934).

At the risk of being dubbed chauvinistic, this seems to be the right occasion to mention (with a becoming blush) that during the BBC festive season of celebrating their 50th Anniversary, readers may like to raise a flag or two in recognition of the fact that this year *Practical Wireless* is a contender in the Anniversary Stakes, having now reached its 40th birthday—a period of time during which, like the famous Windmill, we never closed!

W. N. STEVENS—*Editor.*

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

Bristol '73

The Bristol Group of the R.S.G.B. are now privileged to announce their plans for participation in the 1973 anniversary celebrations of the granting of the Royal Charter to the City and County of Bristol.

One aspect will be the operation of an amateur radio exhibition station on the S.S. *Great Britain,* now being restored in dry dock at Bristol.

The Ministry of Posts and Telecommunications, as the licensing authority, has agreed to the special call sign "GB2GB" for a station to be operated from the vessel and will permit the station to be operated by persons holding current Amateur (Sound) Licences A who visit the vessel during the month of August, 1973.

The general public will hear contacts being made with amateur radio stations, both local and long distance, and information will be available from the operators on the hobby of amateur radio and the role it plays in promoting international understanding.

With the co-operation of the S.S. *Great Britain* Project, receiving tests already carried out from the vessel have indicated that the site is suitable for reception and therefore transmission is not considered to present any problems.

It is anticipated that the station will make contacts with stations in other Bristols and the cities of Hanover and Bordeaux. Contact will also be attempted with amateur radio stations in the Falkland Islands where the vessel lay in Sparrow Cove for many years.

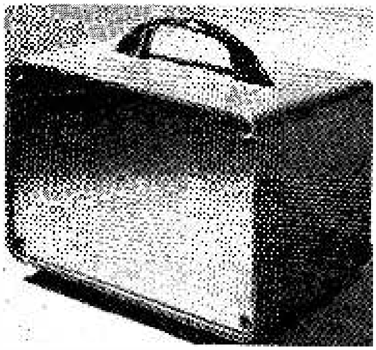
Specially designed cards depicting the S.S. *Great Britain* will be sent to amateur radio stations contacting GB2GB and these are being donated by a famous firm of Bristol wine merchants who have also agreed to present cases of sherry as awards in a Bristol Amateur Radio Activity Contest to be held in 1973, details of which will be announced in a few months' time.

As 1973 is also the Diamond Jubilee of the Radio Society of Great Britain, local members are pleased to announce that a convention will be held at a local hotel. This is to be on the 26th May, 1973, and details are now being planned.

It is hoped that these events—GB2GB on the S.S. *Great Britain,* and radio contest, and the convention, will make 1973 a memorable year for Bristol and radio amateurs.

Further gen from *G. Mather G3GKA, 8 Hills Close, Keynsham, Bristol.*

The "Elf"



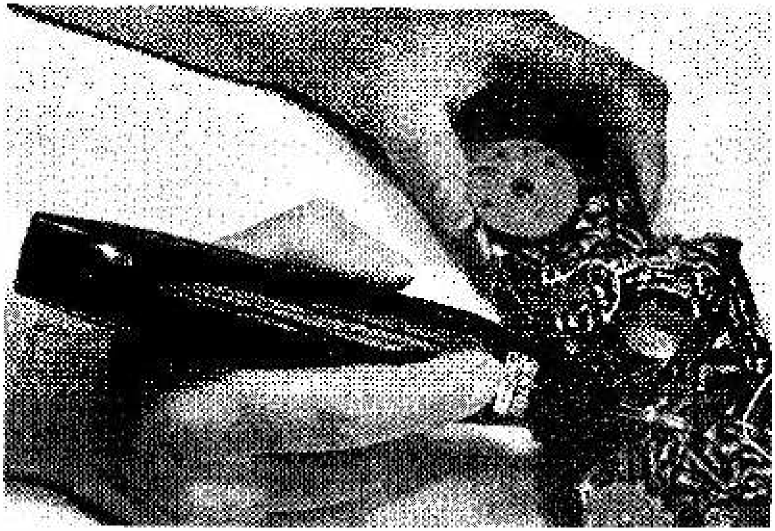
West Hyde announce the Contil "ELF". Only 6in. x 4in. x 4in., they are offered at five cases for £6 including postage and packing. (£1·25 ea. + 10p p.p.)

Glass polyester dough moulded in grey or blue, the price includes a chromium plated handle, an aluminium chassis, a protectively coated aluminium front panel and four fitted feet.

Two printed circuit boards can be fitted in the slots provided internally, making the case ideal for the increasing number of applications requiring miniature cases, in step with the firm's well known policy this tough smart little case is available by return of post. *West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Northwood, Middx.*

Portable rechargeable soldering iron

Soldering with the new 8in. long portable, lightweight soldering iron—which is rechargeable and can be used far from a power source—launched by the Van Dusen Aircraft Supplies Company in the UK and Europe. The "Iso-Tip" soldering iron, weighing less than 6 ounces, has been designed to handle, with speed and efficiency, every industrial or domestic soldering requirement. Price of unit and stand is £8·75. *Van Dusen Aircraft Supplies Co., Oxford Airport, Kidlington, Oxford.*



Picture shows the iron in use.

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

Pictures on the phone

EMI has entered the facsimile communications market with a document transceiver for sending clear, accurate copies of documents in minutes to anywhere in the world. Known as the EMIfax HF146, this compact, desk-top system transmits and receives any type of document up to A4 size (220 x 305 mm), including invoices, lists, graphs, sketches and handwritten notes, over public or private telephone networks.

A unique cost-saving advantage of the EMIfax machine is that normal office stationery is used for reproducing transmitted copies, eliminating the need for expensive coated papers which create both cost and supply problems. The document transceiver is priced at £900. Leasing and rental facilities are also available.

A quick NIP

NIP Electronics, mentioned in our October News . . . pages have asked us to say that two of the readers who have written to them asking for information on NIP-E-BOARDS omitted to give their full addresses.

If they would please communicate with NIP again, giving their full addresses, they will be pleased to supply the items they require.

The readers are: Mr. A. M. Coppin, 128 Fernside Avenue and Mr. Christopher Jones of Coventry.

NIP Electronics, P.O. Box 11, St. Albans, Hertfordshire.

Texan Reprints

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

They may be obtained by sending 35p (30p + 5p postage/packing) to *Practical Wireless Editorial, Fleetway House, Farringdon Street, London, EC4A 4AD*

Paramo Handyvice

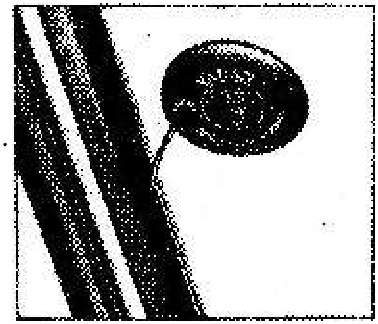
Latest addition to the Paramo range of tools is a new design of vice. The vice is manufactured from die cast high strength aluminium alloy, designed to give comparable strength to the standard cast iron product, but with considerable savings in weight.

The vice is available in three forms, a 3in. fixed base mechanics vice (HV1), a 3in. swivel base mechanics vice (HV2), a 3in. swivel base mechanics vice with table clamp (HV3).

The vice is finished in hammer blue enamel with chrome plated moving parts. It is supplied with hardened file cut steel jaws and a steel anvil for light metal forming. On the swivel base versions a simple single handed locking lever enables the vices to be swivelled through 360°.

Prices are: HV1, £2·45; HV2, £2·95; HV3 (illustrated), £3·45.—*F. Parramore & Sons (1924) Ltd., Caledonian Works, Chapeltown, Sheffield, Yorkshire.*

Disc car aerial



A new car radio aerial is being introduced by Valan Electricals to complement their wide range of conventional aerials.

Named the Valan Disc Aerial, it combines the function of an aerial with that of the road tax licence holder or a club card holder, and is fitted on the windscreen.

It can be fitted in minutes by anyone. The fitting instructions are simple and are on the reverse of the pack. It works equally well in all makes of car and commercial vehicles.

The recommended retail price is £1·20. The Valan Disc Aerial is available from Halfords and leading garage and accessory shops. *Valan Electricals, 1034 Yardley Wood Road, Birmingham B14 4BW.*

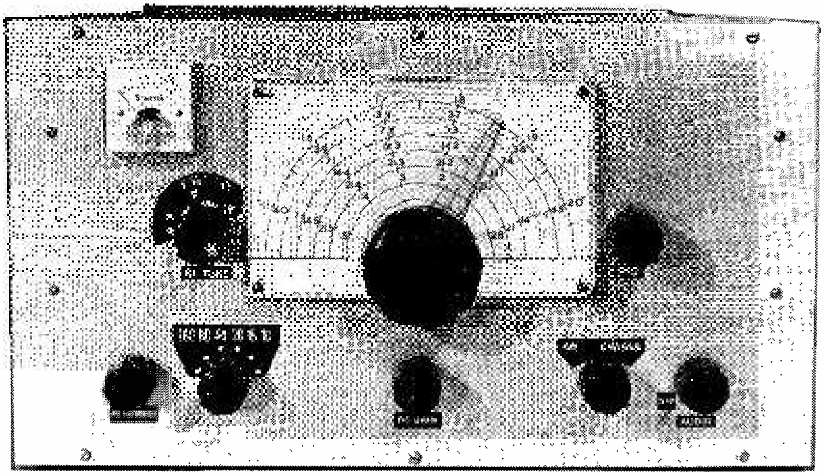
QSL from the BBC

This month there will be an opportunity for listeners to the BBC World Service programme, World Radio Club, to possess one of the BBC's QSL cards verifying reception of the Club's 50th Anniversary Edition.

There are 12,000 members of the Club, spread all over the world. The programme is broadcast on Thursdays at 1330, Fridays at 2345, and Sundays at 0815 GMT in the World Service. Any member who reports accurately on reception of the Anniversary Edition on November 9th, 10th or 12th will be able to receive this QSL.

If you are not a member, write to World Radio Club, BBC, Bush House, London.

AMATEUR BANDS RECEIVER



1·8-30MHz•AM-CW-SSB•BANDSWITCHED•EASY CALIBRATION

PART 1

F. G. RAYER G3OGR

THIS receiver possesses high stability coupled with excellent sensitivity, selectivity and adequate bandspread covering the Amateur bands from 10 to 160metres. On all bands, except 80m, the receiver employs double conversion with a crystal controlled first oscillator. It is easy to tune and to hold a.m., c.w. or s.s.b. signals on all bands.

Those who may not be familiar with the method of operation of this type of receiver should find the block diagram of Fig. 1 helpful in conjunction with the description that follows.

CIRCUIT

Referring to Fig. 1 stage (1) is an r.f. amplifier followed by the first mixer (2) both working on all bands except 80m. Each Amateur band, except 80m, employs a crystal (3) chosen so that the output of the mixer (2) falls in the range 3·5 to 4MHz whatever the band in use. This tuning range 3·5 to 4MHz is covered by the tunable r.f./i.f. amplifier (4) and is followed by the second mixer and tunable oscillator (5) forming the tunable i.f. part of the receiver on all bands, except 80m. On 80m signals fall in the range 3·5 to 4MHz and are switched to stage (4).

The output frequency of the second mixer (5) is 455kHz which goes to the crystal filter (6) which is a bandpass filter with 2kHz crystal separation. When using a single filter for a.m., c.w. and s.s.b. this is about the highest degree of selectivity which can be tolerated without excessive cutting of the sidebands of a.m. signals.

Stages (7) and (8) are 455kHz i.f. amplifiers followed by the a.m. diode detector (9), its output going to the a.f. amplifier and output stages (10) and (11) and thence to the speaker. For c.w. and s.s.b. reception the beat frequency oscillator (12) and product detector (13) are switched into circuit. Both tunable oscillators (5) and (12) are fed from a voltage regulated source (14).

As the first i.f. is 3·5 to 4MHz the second channel interference, which can be troublesome on the h.f. bands with a lower i.f., is virtually eliminated. The use of a crystal controlled oscillator also gives an enormous improvement in overall stability.

The tuning coverage of each band is a constant 500kHz with fixed 100kHz calibration points which completely eliminates any calibration problems on the h.f. bands. One disadvantage is that because the 10m band is so wide only a small portion of it can be covered but this can be overcome by providing two or more 500kHz sections with very little extra circuitry, as explained later.

CONVERSION FREQUENCIES

As stated the tunable i.f. covers 3·5 to 4MHz and is calibrated at 100kHz intervals. The crystal frequency for the 160m band is 5·5MHz the difference or signal frequency selected by stages (1) and (2) thus extending from 1·5 to 2MHz (5·5-3·5 and 5·5-4). In this case the oscillator frequency is on the high side of the tunable i.f.

Band	Crystal	Calibration MHz					
80	None	3·5	3·6	3·7	3·8	3·9	4·0
160	5·5	2·0	1·9	1·8	1·7	1·6	1·5
40	11	7·5	7·4	7·3	7·2	7·1	7·0
20	10·5	14·0	14·1	14·2	14·3	14·4	14·5
15	17·5	21·0	21·1	21·2	21·3	21·4	21·5
10	24·5	28·0	28·1	28·2	28·3	28·4	28·5

For 40m an 11MHz crystal is used giving coverage of 7 to 7·5MHz the crystal again being on the high side. Crystal frequencies for the remaining bands are shown in the accompanying table and it will be noted that they are all below the signal frequency. Calibration points are shown, the direction being reversed on 160 and 40m because these crystals are above the signal frequency.

Since stages (1) and (2) cover 28 to 30MHz three 500kHz segments can be obtained by simply selecting the appropriate crystal with a three way switch, crystals on 25 and 25·5MHz adding bands 28·5 to 29MHz and 29 to 29·5MHz.

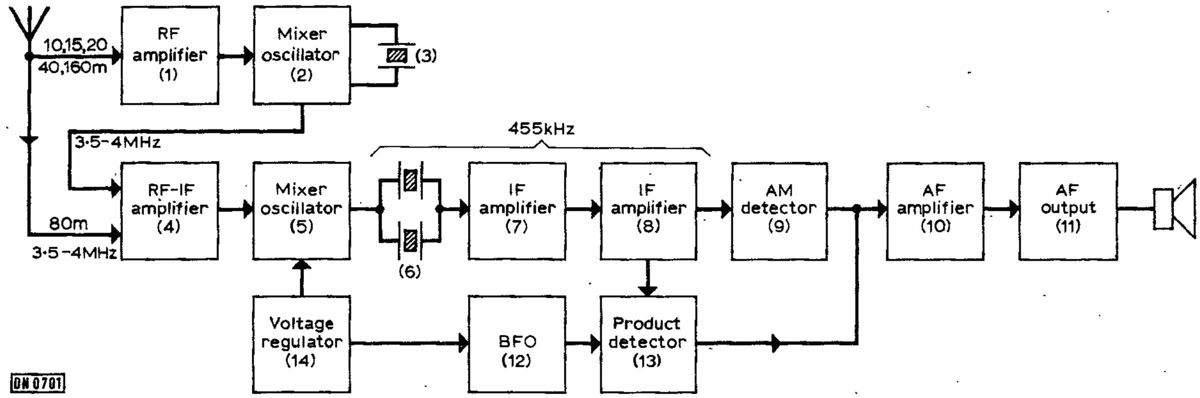


Fig. 1 : Block diagram to illustrate the function of each stage in a double conversion communications receiver.

PROGRESSIVE CONSTRUCTION

The constructional work involved is naturally not simple but it can be carried out and tested in sections. This method has much to recommend it as the location of a wiring fault or error is then much easier. The audio stages together with the power supply can be wired and tested with a pick-up or audio oscillator as a signal source. Stages (4) and (5) with one i.f. stage and the a.m. detector can be added thus forming a complete 80m receiver.

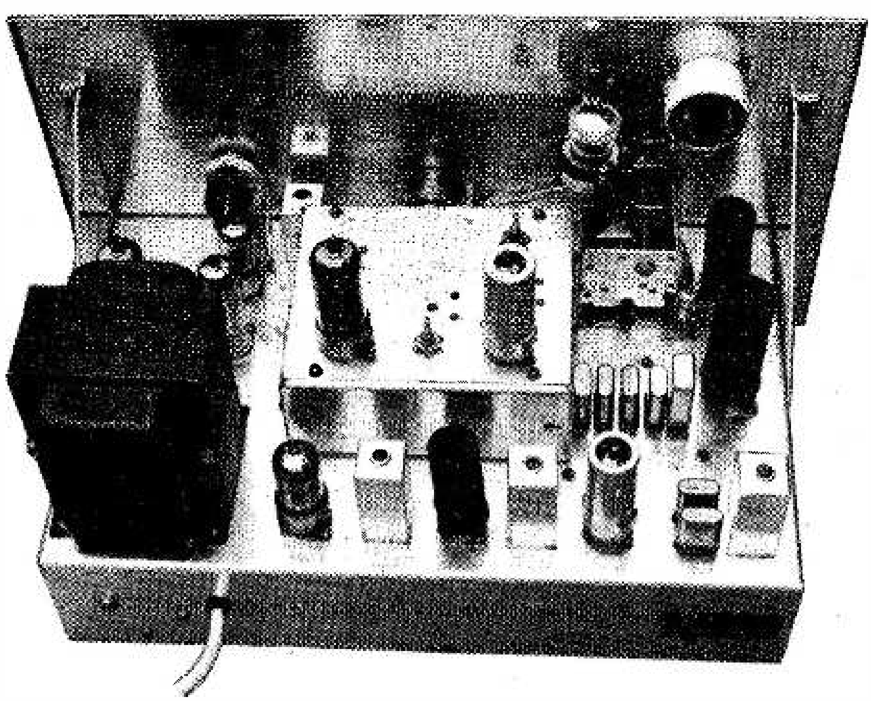
Next the additional i.f. stage and filter together with the b.f.o. and product detector will provide additional selectivity and c.w. and s.s.b. facilities. Stages (1) and (2) should then be wired for one additional band and checked after which the other bands can be added one by one. This general plan will be followed in the articles that follow.

AF/POWER SUPPLY

In Fig. 2D showing this part of the circuit VR1 is the usual audio volume control, followed by a 2-stage amplifier, the output section of the ECL86 providing about 3 watts of audio. An output jack connected to the secondary of the speaker transformer T1 permits the use of phones or an external speaker automatically silencing the phones. This facility can be useful when operating the receiver with a transmitter.

The mains transformer T2 and rectifiers D1 and D2 supply 250V for the triode anode, pentode screen grid and earlier stages of the receiver. The OA2 voltage regulator provides a stabilised 150V supply for the tunable i.f. oscillator and beat frequency oscillator.

If T2 is not as listed, the h.t. voltage may be



Rear view of the completed receiver with the tunable IF amplifier in its own screened box on top of the chassis with the five crystals for the first mixer stage to the right. The two crystals at the bottom right are part of the fixed IF amplifier.

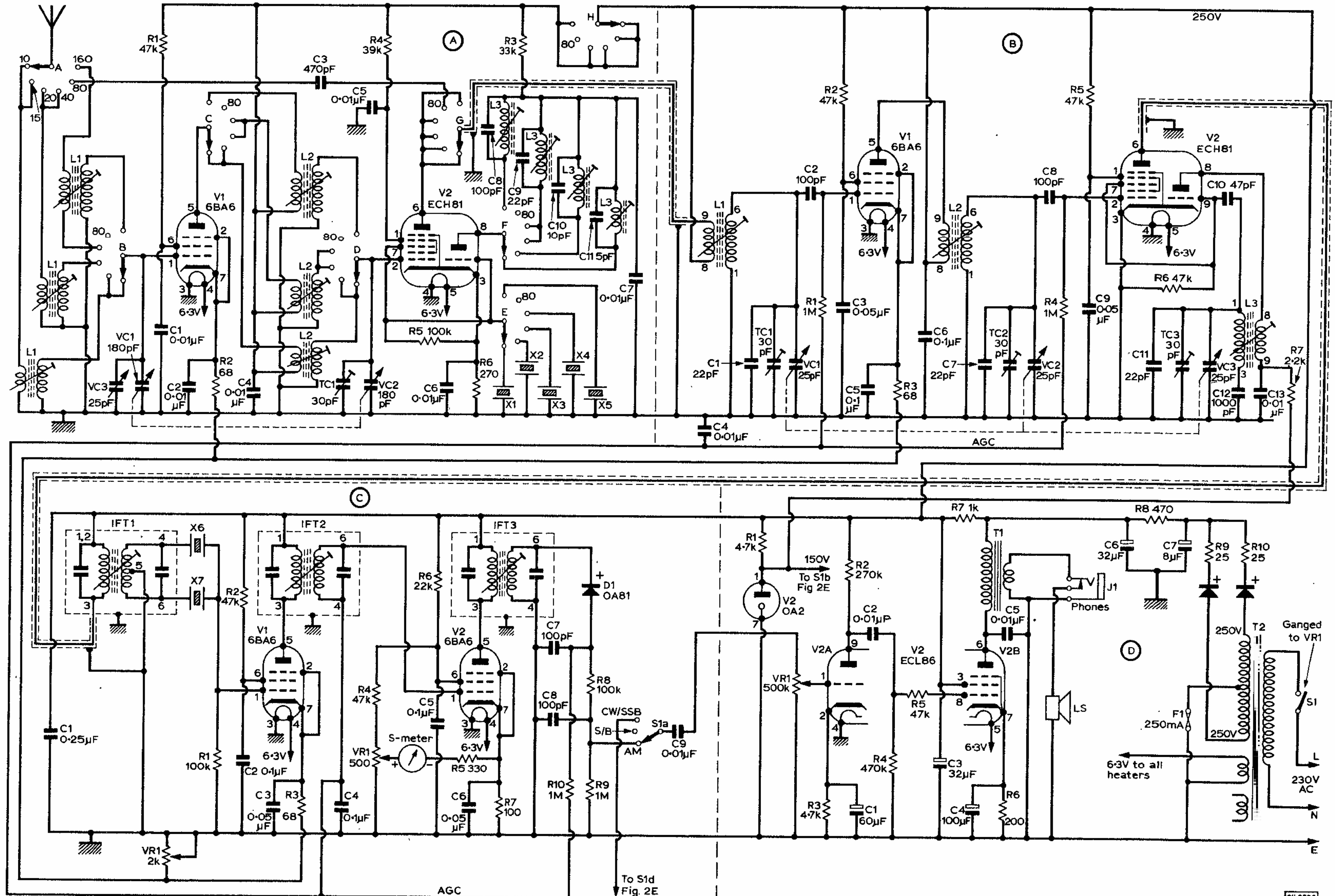


Fig. 2A-B-C-D. Complete circuit diagram of the receiver with the exception of the b.f.o./product detector shown on the next page, Fig. 2E.

different. This has little effect on most stages of the receiver, but if it is found that the OA2 is extinguished or nearly so, with the receiver on any band other than 80m and with no aerial connected and the r.f. gain control at maximum gain, then the h.t. is too low. It is then in order to reduce R7 or R8, or both, to obtain about 250V.

Leads to VR1 run against the chassis and need not be screened but R5 should be soldered directly to pin 8 of the ECL86. A 250mA fuse is placed in a holder on the inside of the chassis, and is in the h.t. circuit from T2 to earth.

The heaters require about 3A and are run from the 6·3V 4A winding of T2. If a transformer is fitted which has two 6·3V windings, rated at less than 3A, use one heater winding to supply some heaters and a separate circuit from the other heater winding to the remaining heaters.

The a.f. amplifier and power supply can be checked by connecting a pick-up, audio signal generator or other source of a.f. to the top of VR1. A 3Ω speaker is connected to or plugged into J1.

IF STAGES

Fig. 2C is the circuit of this section of the receiver which operates at 455kHz. IFT1 is an intermediate frequency transformer with a centre-tapped secondary the centre tap being earthed. Balanced output in opposite phase, from pins 4 and 6, go to the two crystals X6 and X7, which have a frequency separation of about 2kHz. This pass-band can readily be modified, as described later. It is, however, a reasonable degree of fixed selectivity for all general amateur band purposes and avoids the need for an adjustable phasing capacitor.

Valves V1 and V2 are the two i.f. stages at 455kHz both receiving bias from the a.g.c. line (which also passes to some earlier stages). The manual gain control VR1 adjusts the cathode bias of the first i.f. stage.

Diode D1 provides bias for the a.g.c. line and also operates as the a.m. detector.

Switch S1a is one pole of a 3-way switch, and when in the "AM" position feeds audio via C9 to the volume control.

When S1a is in the "CW/SSB" position, audio signals are fed from the product detector, Fig. 2E. The central position of S1 is for "Standby" when h.t. is removed from several stages.

S-METER

Incoming i.f. signals produce negative bias at diode D1, Fig. 2C, fed through R10 and the secondary of i.f.t.2 to V2 control grid. This moves negative with increased signal strength, the current through R7 and R6 falls, so that the screen of V2 becomes more positive, and the cathode more negative. With no signal, potentiometer VR2 allows the circuit to be balanced so that no voltage is present across the S-Meter. Incoming signals cause the meter reading to rise in proportion to the signal strength. R5 reduces the meter sensitivity to a suitable level.

If a steady signal is present, from a transmission or a signal generator, all i.f.t. or other adjustments can be directed towards obtaining the best meter reading. This also applies to any external adjustments, such as to an aerial tuner or to the aerial-earth system.

CRYSTAL FILTER

With the i.f.t.'s aligned at 455kHz, crystal X6 was 454kHz and X7 was 456kHz but it is not necessary that X6 and X7 have exactly 2kHz separation. The specified i.f.t.'s are 465kHz types but they tune easily to 455kHz.

If one crystal only is used, and the other replaced by a 15pF variable phasing capacitor, a sharply resonant peak can be obtained together with a rejection notch which can be moved across the i.f. passband. A filter of this type was described in the December 1971 issue of *Practical Wireless* and is excellent for c.w. in particular.

The lead from the mixer pin 6, Fig. 2B, to pin 3 of i.f.t.1 is screened right up to the i.f.t., otherwise stray coupling round the filter will degrade results.

If an accurately calibrated signal generator is available, set it midway between the crystal frequencies and inject at pin 1 of V2, Fig. 2C, adjusting the

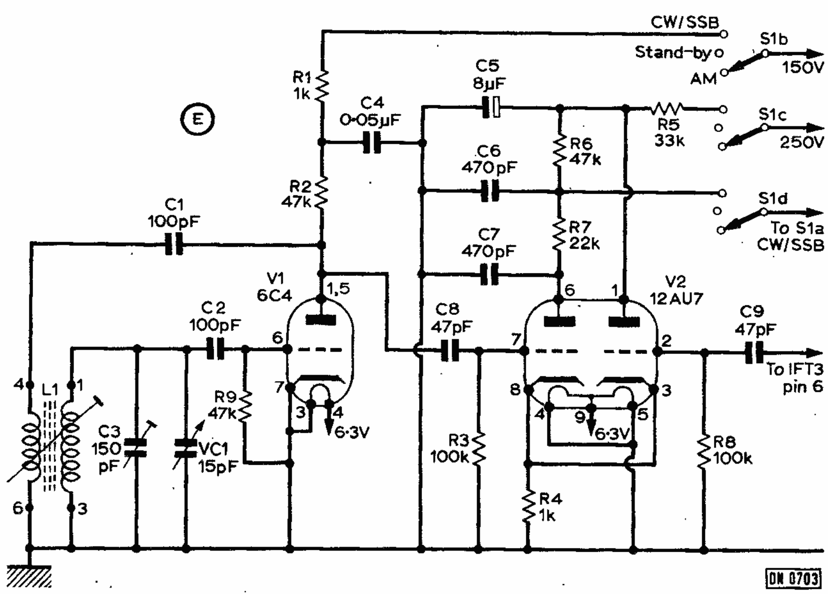


Fig. 2E: Circuit of the b.f.o./product detector, the addition of this unit to the receiver permitting the reception of c.w. and s.s.b. signals. The frequency of the b.f.o. is variable from the front panel to accommodate upper or lower sideband signals.

1ST. RF, MIXER/OSCILLATOR (FIG. 2A)

Resistors
R1 47kΩ 1W   R3 33kΩ 1W   R5 100kΩ ½W
R2 68Ω ½W   R4 39kΩ 1W   R6 270Ω ½W

Capacitors
C1 0·01μF Disc 350VW   C7 0·01μF Disc 350VW
C2 0·01μF Disc 350VW   C8 100pF SM
C3 470pF Mica   C9 22pF SM
C4 0·01μF Disc 350VW   C10 10pF SM
C5 0·01μF Disc 350VW   C11 5pF SM
C6 0·01μF Disc 350VW   TC1 30pF trimmer
VC1-2 2 x 180pF (Jackson L2)
VC3 25pF midget variable (Jackson C804)

Valves
V1 6BA6   V2 ECH81

Miscellaneous
Valveholders B7G (1) skirted, B9A (1) skirted. Formers (7) see text. Crystals X1-5 Type HC6U (see text) with holders. Bandswitch sections A-H, comprising 4 wafers each 2 pole 6 way. Universal chassis flanged members, 6 x 2in. (1), 5 x 2in. (2) (Home Radio).

TUNABLE IF AMPLIFIER (FIG. 2B)

Resistors
R1 1MΩ ½W   R4 1MΩ ½W   R7 2·2kΩ 1W
R2 47kΩ ½W   R5 47kΩ 1W
R3 68Ω ½W   R6 47kΩ ½W

Capacitors
C1 22pF SM   C8 100pF SM
C2 100pF SM   C9 0·05μF 350VW
C3 0·05μF 350VW   C10 47pF SM
C4 0·01μF 350VW   C11 22pF SM
C5 0·1μF 350VW   C12 1000pF SM
C6 0·1μF 350VW   C13 0·01μF 350VW
C7 22pF SM   TC1-2-3 30pF trimmer
VC1-2-3 3 x 25pF (Jackson 003)

Valves
V1 6BA6   V2 ECH81

Inductors
L1 Blue Range 3 L2 Yellow Range 3 L3 Red Range 3 (All Denco, miniature, valve type)

Miscellaneous
Universal chassis flanged members, 5 x 2in. (2), 4 x 2in. (2), flat plate 5 x 4in. (1) (Home Radio). Cabinet 15 x 9 x 8in. Type W, chassis 13 x 8 x 2½in. Type K, brackets 4 x 4in. Type C (2) (H. L. Smith). Dial and drive, Type DL6 and ball drive Type 4511 (Home Radio). If not available use combined Jackson dial and drive Type 4103/A.

FIXED IF AMPLIFIER (FIG. 2C)

Resistors
R1 100kΩ ½W   R5 330Ω ½W   R9 1MΩ ½W
R2 47kΩ 1W   R6 22kΩ 1W   R10 1MΩ ½W
R3 68Ω ½W   R7 100Ω ½W   VR1 2kΩ linear WW
R4 47kΩ 1W   R8 100kΩ ½W   VR2 500Ω WW pre-set

Capacitors
C1 0·25μF 350VW   C6 0·05μF
C2 0·1μF 350 VW   C7 100pF mica
C3 0·05μF 350VW   C8 100pF mica
C4 0·1μF 350VW   C9 0·01μF 350VW
C5 0·1μF 350VW

Valves
V1 6BA6   V2 6BA6

Inductors
IFT1 IFT/11/465CT   IFT2 IFT/11/465
IFT3 IFT/11/465 (All Denco)

Miscellaneous
Crystals X6/7 Type HC6U with holders (see text). Valveholders B7G (2) skirted. Diode D1, OA81. Switch S1a-d, 4 pole 3 way wafer switch. S meter, 1mA f.s.d.

AUDIO AMPLIFIER/POWER SUPPLY (FIG. 2D)

Resistors
R1 4·7kΩ 3W   R4 470kΩ ½W   R7 1kΩ 3W
R2 270kΩ ½W   R5 47kΩ ½W   R8 470Ω 5W
R3 4·7kΩ ½W   R6 180Ω ½W   R9 25Ω ½W
R10 25Ω ½W
VR1 500kΩ log. pot. with switch, S1

Capacitors
C1 60μF 6VW   C5 0·01μF 350VW
C2 0·01μF 350VW   C6 32μF 450VW
C3 32μF 350VW   C7 8μF 450VW
C4 100μF 15VW

Valves
V1 ECL86   V2 OA2 (150V)

Miscellaneous
Valveholders B7G (1), B9A (1). D1-2 silicon rectifiers 800 p.i.v. 1A. Closed circuit jack. Fuse 250mA and holder. T1, output transformer Type TO46 (Home Radio). T2, mains transformer Parmeko P2931 or similar (Home Radio) see text.

BFO/PRODUCT DETECTOR (FIG. 2E)

Resistors
R1 1kΩ ½W   R4 1kΩ ½W   R7 22kΩ ½W
R2 47kΩ ½W   R5 33kΩ ½W   R8 100kΩ ½W
R3 100kΩ ½W   R6 47kΩ ½W   R9 47kΩ ½W

Capacitors
C1 100pF SM   C6 470pF mica
C2 100pF SM   C7 470pF mica
C3 150pF SM   C8 47pF SM
C4 0·05μF 350VW   C9 47pF SM
C5 8μF 350VW   VC1 15pF variable

Valves
V1 6C4   V2 12AU7

Miscellaneous
L1, b.f.o. coil (Denco BFO2/465).
Valveholders B7G (1), B9A (1).

cores of i.f.t.3 for best output. Repeat with i.f.t.2, with the signal applied at pin 1 of V1 The signal can then be taken to the second mixer grid and i.f.t.1 aligned.

Assuming no generator is available, tune in any strong, stable signal. It will probably be found that there are two responses, one is relatively broad and arises from the i.f.t.'s while the other is sharper and may be much weaker if the i.f.t.'s are not tuned near to the crystal frequencies. Tune the signal in at the sharper response position which places it in the

continued on page 738

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Kit K/AR-1214 AM/FM Stereo Tuner Amplifier £69.80. Carr.: 80p.

The AJ-1214 Tuner (separate) specifications follow that of the AR-1214. The most dramatic are: FM sensitivity, less than 2µV. FM selectivity, 60 dB. Stereo separation, 35 dB minimum. AM sensitivity, less than 100 µV per metre. AM selectivity, greater than 40 dB.

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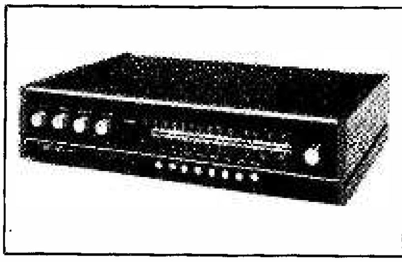

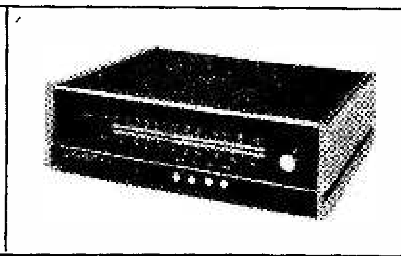

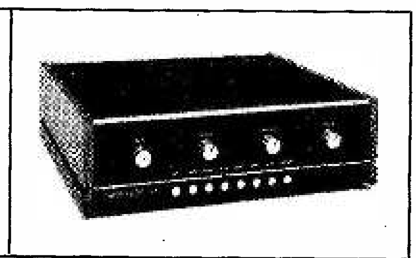

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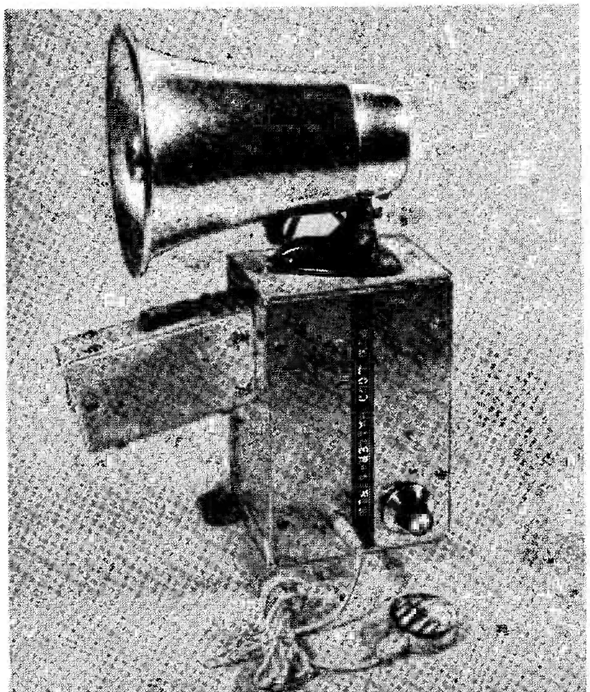
LOUDHAILER AND SIREN

A. LESTER-RANDS

A LOUDHAILER is simply a battery powered, portable public address amplifier complete with its own loudspeaker and has a wide variety of uses in or out of doors e.g., making oneself heard to a crowd of people or to a single person at a distance. The addition of a siren (electrically generated) also enables the hailer to be used as a warning device, for example by yachtsmen in foggy weather or simply to attract the attention of people before making an announcement.

The loudhailer with siren described in this article has an output power of 3 to 4 watts on speech and is battery operated by eight 1·5V cells (U11 or equivalent) providing a total of 12V. The siren sound can be produced at about the same power output and is pitched at around 250Hz to achieve maximum carrying range. The loudhailer can be hand held by its pistol grip type handle or can be self standing for use with a detachable microphone (see right). The main hailer on-off button is a rocker type switch mounted on the front of the pistol grip handle. This permits easy intermittent operation when the hailer is hand held but can be used in a continuous 'on' position when the hailer is used self-standing.



The loudhailer need not be hand held and can be rested as shown with the speaker adjusted to face forwards.

The circuit

This is shown in Fig. 1 and consists of a microphone preamplifier Tr1, which drives the PC5+ power amplifier via S1 and the volume control VR1. The siren generator Tr2/Tr3 is simply a multivibrator with a charge up circuit (C9/R11) that supplies a slowly increasing potential to the base of Tr3. This introduces a slight rise of pitch as the siren is switched on, resulting in a somewhat distinctive sound. The output of the siren is taken to the PC5+ power amplifier via S1.

The power amplifier provides some 3 to 4 watts of power output to an 8Ω speaker and is a printed circuit assembly made by Newmarket Transistors. It was chosen because of its small dimensions which, in turn, permitted the use of a case for the hailer of only 6 x 4 x 3ins but yet still large enough to accommodate the microphone preamplifier, the siren generator, the battery cells and the power amplifier itself.

Note that the 12V supply has both an on-off switch and the rocker switch (hailer control button) in series to the negative supply rail to the amplifier. The on-off switch is optional but could be used merely as a safety precaution against the rocker switch being left

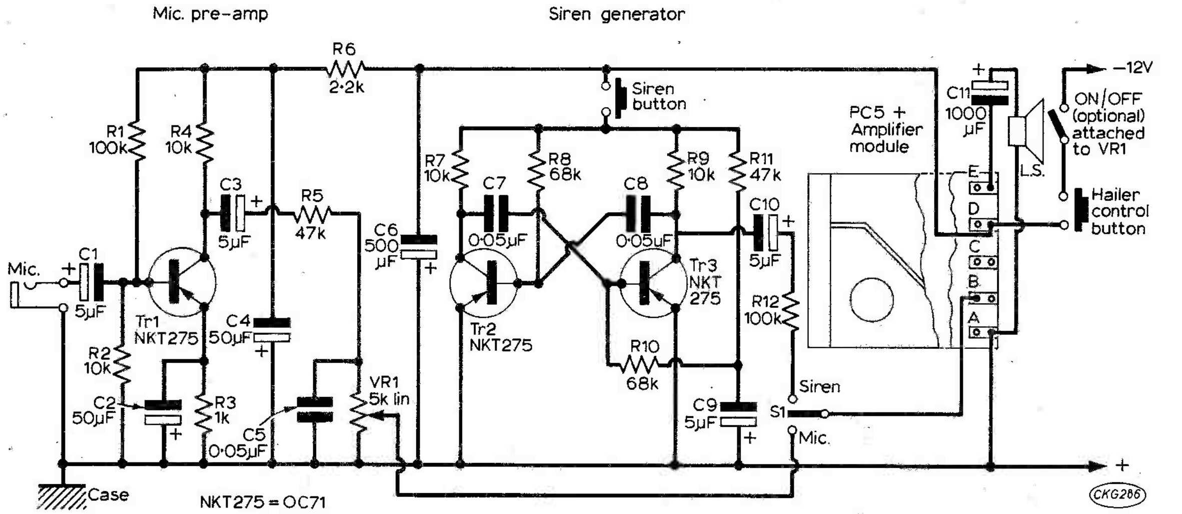


Fig. 1: The circuit of the mic preamp and siren generator. These feed into the main amplifier module to the connections shown on the right.

★ components list

Resistors

R1	100kΩ	R7	10kΩ
R2	10kΩ	R8	68kΩ
R3	1kΩ	R9	10kΩ
R4	10kΩ	R10	68kΩ
R5	47kΩ	R11	47kΩ
R6	2·2kΩ	R12	100kΩ

All resistors ¼W, 5 per cent tolerance
VR1 5k log. pot with switch

Capacitors

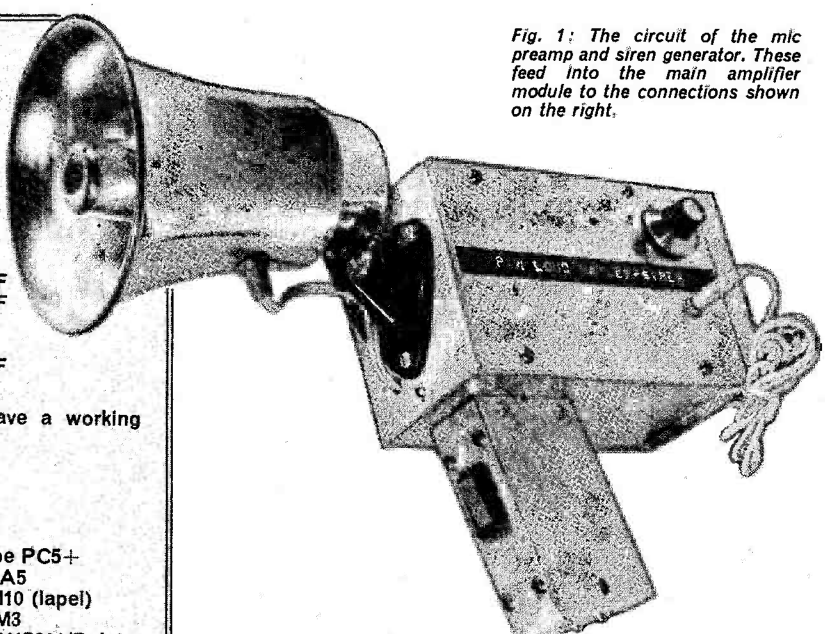
C1	5µF	C7	0·05µF
C2	50µF	C8	0·05µF
C3	5µF	C9	5µF
C4	50µF	C10	5µF
C5	0·05µF	C11	1000µF
C6	500µF		

All electrolytic capacitors should have a working voltage of at least 15V

Transistors
Tr1, Tr2, Tr3 Newmarket type NKT275

Miscellaneous

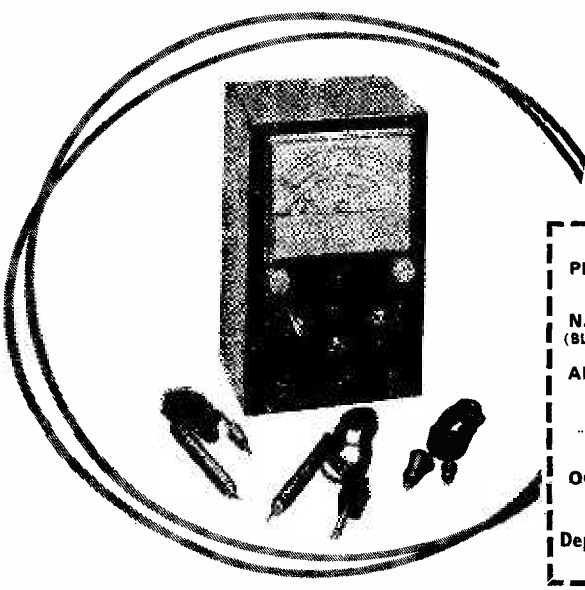
Power Amplifier	Newmarket type PC5+
Loudspeaker	Eagle type HDA5
Microphone	Eagle type CM10 (lapel)
Microphone Socket	Eagle type PJM3
Rocker Switch	Home Radio WS201/Bulgin SIB825
Mic/Siren Switch	Miniature slide type
Siren Switch	Small toggle type
Case	Home Radio Universal Chassis Parts: CU157(2); CU144 (2); CU146 (2)
Sundries	Plain circuit board; Aluminium angle; 16 or 18 s.w.g. aluminium for pistol grip; Stand-off pillars.



on. The siren button may be a small toggle switch on a press (self release) button type switch. (See components list regarding suitable rocker switch and self release button switch).

Construction

The 6 x 4 x 3inch case was constructed from Home Radio Universal Chassis parts (see components list). The loudspeaker is an Eagle type PA speaker



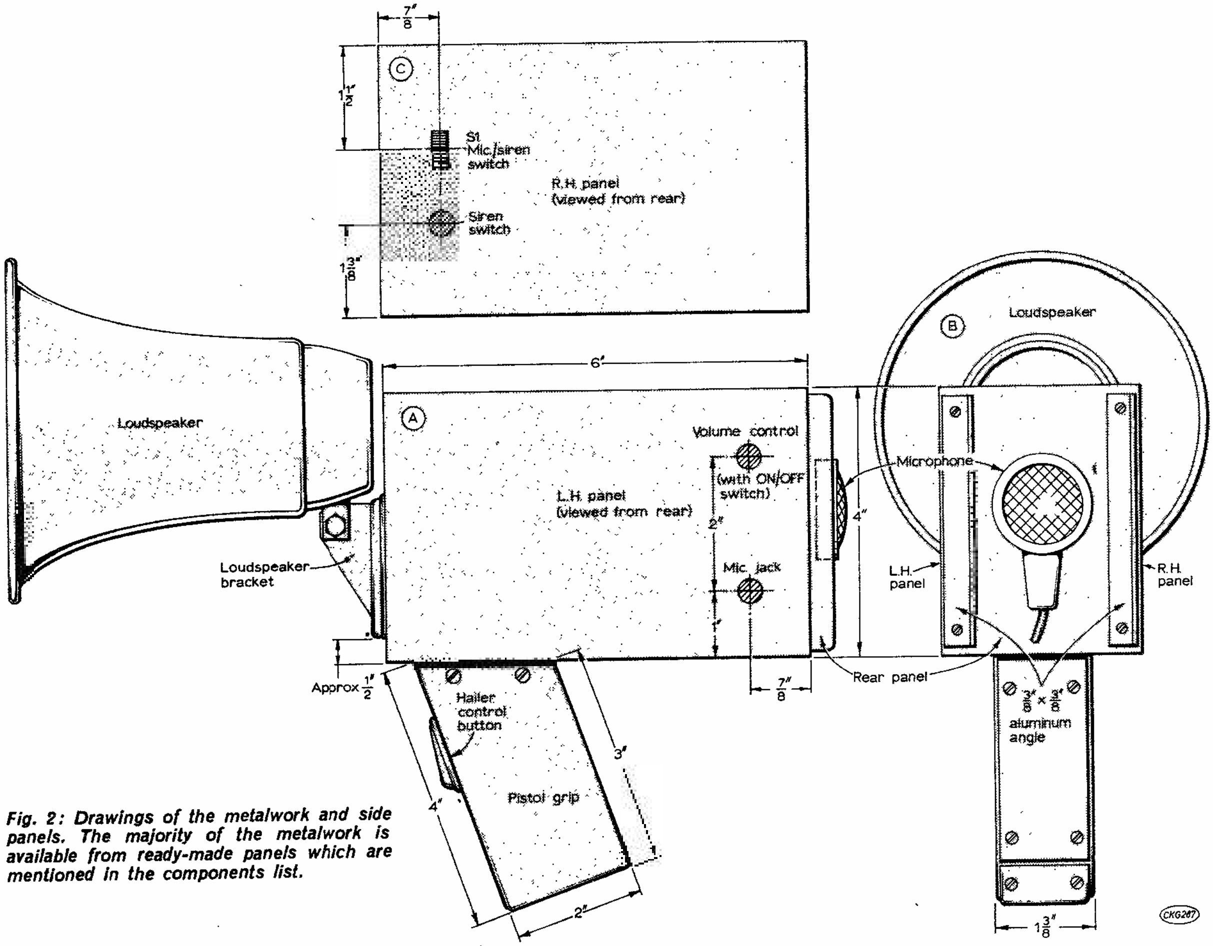


Fig. 2: Drawings of the metalwork and side panels. The majority of the metalwork is available from ready-made panels which are mentioned in the components list.

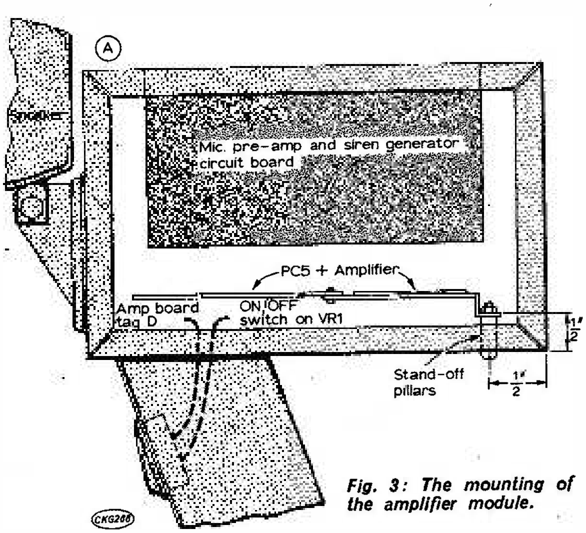
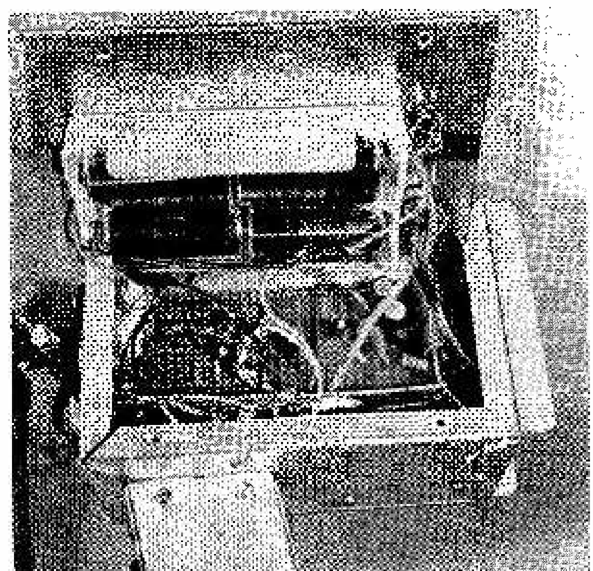


Fig. 3: The mounting of the amplifier module.

type HDA5 which is supplied complete with fixing bracket and is mounted on the front end of the case as in Fig. 2a. The rear end of the case is fitted with two aluminium angle pieces as in Fig. 2b which allow the unit to stand evenly when used self-standing. The pistol grip is hollow, being made from aluminium to the dimensions given in Fig. 2a and b and which, in turn, is secured centrally to the underside of the case. The hailer control rocker switch is mounted on the front of the pistol grip as in Fig. 2a.



One of the side panels unscrewed. The components board can be seen clearly while at the extreme bottom is the main amplifier module. One of the battery holders can also be seen; there is another on the other side panel.

The mic/siren switch S1 and the siren control button (or switch) is mounted on the right hand panel of the case (looking from the rear end) whilst the volume control (with integral on-off switch) and

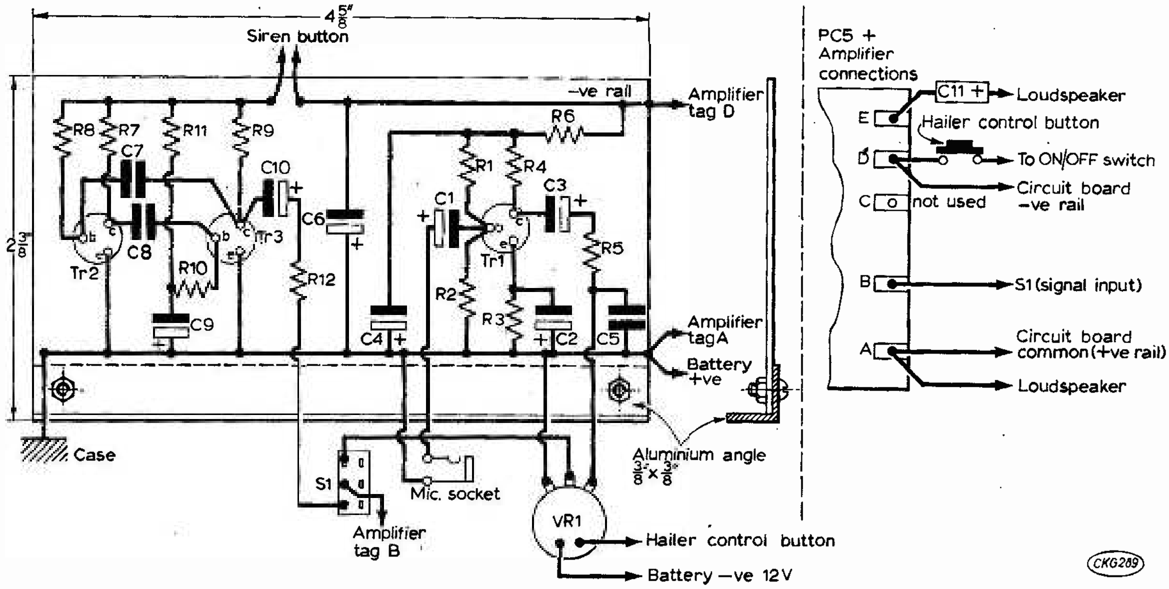
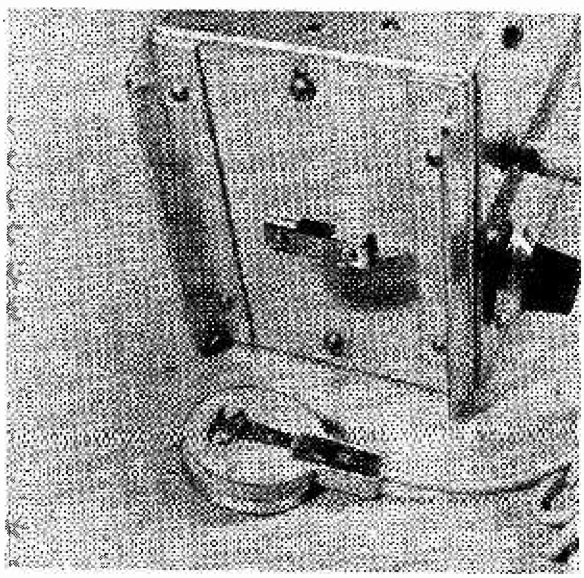


Fig. 4: The component layout and wiring. The connections to the module are shown on the right.



For operation as a loudhailer, the microphone is fitted to the small clip shown.

microphone socket, are mounted on the left hand panel (looking from rear end). The positions of these components are shown in Figs. 2a and 2c. The microphone used for the prototype was an Eagle lapel type CM10 which is fitted with a screened lead and miniature jack plug and also has a small clip on the back. It can therefore, be clipped onto the rear of the hailer as shown in Fig. 2b. The support for the microphone clip is simply a small brass strip about ¼in. wide bolted onto the rear panel but raised about ⅛in. by spacers. Any small crystal microphone can be used with the loudhailer.

The loudspeaker leads are taken into the case and thence to the amplifier through a hole in the front panel. Before attaching the pistol grip, fit a pair of wires to the rocker switch long enough to go through into the case and thence to a) the on-off switch and b) to tag D on the PC5+ power amplifier.

The position of the microphone preamplifier and siren generator circuit board is shown in Fig. 3. It is mounted slightly off centre within the case to be clear of the battery boxes when they are in situ. The PC5+ amplifier is mounted as shown in Fig. 3 centrally and at the bottom of the case but is raised up on stand-off pillars by about ½in.

The battery boxes (Eagle type BH411) are mounted one on each side panel (see photograph) and in the positions shown so as to be clear of both the circuit board and power amplifier when the panels are fitted. Changing batteries means only removing each side panel.

Layout and wiring of the circuit board containing the microphone preamplifier and the siren generator is shown in Fig. 4. The plain 0·15in. matrix circuit board is mounted on a piece of aluminium angle which, in turn, is secured to the upper panel of the case. Connections to the mic/siren switch S1, the mic socket, the volume control (VR1) and to the power amplifier etc., are all shown in Fig. 4.

Checking out

Current consumption should be about 10 to 12mA *with no signals* and can be checked with a meter in series with the 12V negative lead from the battery. With the hailer switched to 'mic', adjust the volume control so that no feedback occurs i.e., no howling due to sound from the speaker coming back to the microphone. The supply current should rise to about 100mA or a little over on speech peaks. With the switch S1 to 'siren', operate the siren button (or switch). The sound should rise slightly in pitch once it starts but if left on will stay at constant pitch. Intermittent use of the siren button should produce a sound with a slight 'whoop' pitched at about 250Hz (around middle C). The current consumption of the hailer will rise to around 100mA when the siren is operated.

These tests should be made with the side panels open to ensure that operation is satisfactory. Make sure that when the side panels are fitted (with the battery boxes now inside) that no short circuits occur which is quite possible as there is little space between the circuit board and battery containers etc. ■

Transistors in Transmitter PA STAGES

R. DOWLING C.Eng MIEE G3NKH

THERE has been no shortage, in recent years, of designs for transistorised transmitters. In the majority of cases, however, the transmitters have been running at inputs of maybe a fraction of a watt. In some cases, modulation appears to have been something of an afterthought. Often, emitter or base modulation has been used in a desperate attempt to obtain the magical 100% modulation—the reason being, one suspects, that the more familiar high-level modulation has not been found to give the desired results.

The purpose of this article is to try to clear away some of the misconceptions surrounding the transistor power amplifier stage, and to outline the way in which amplitude modulation may most effectively be achieved.

THE BASIC CIRCUIT

Fig. 1 shows the basic circuit arrangement for valve and transistor p.a. stages. Superficially, the circuits look very similar, but there are some important differences. First, one must remember that, unlike valves, transistors are current-operated devices. This means that there is no point at all in feeding a huge signal into the base of a p.a. transistor in an attempt to run it at high power. All that one is likely to achieve is the destruction of the transistor as the result of excessive reverse base-emitter potential.

What the base really requires is current, and this can only be achieved if the driver stage can supply adequate power at the correct impedance to match into the p.a. This brings us to the second important difference between valve and transistor p.a.'s. Being current devices, the latter operate at much lower input and output impedances, typically under 20ohms. One must therefore pay careful attention to the problem of matching the transistor accurately to the load it is to feed.

CLASS C OPERATION

In any Class C p.a. stage, we are basically trying to switch the stage into conduction for only a brief portion (typically 140°) of the signal cycle. The resulting burst of current causes the p.a. tank circuit to ring at a frequency determined by the LC of the tuned circuit, the oscillations being fed to the aerial via either a link coupling or some form of pi-network.

In a valve p.a. it is necessary to provide a negative bias on the grid in order to restrict conduction to the desired 140°, but the situation with transistors is (for once!) much simpler as a transistor will not conduct at all in the absence of an input signal. This immediately provides Class B operation, but there is a further bonus in that owing to the existence of the base-emitter diode the input signal has to exceed a certain minimum value (approximately 0·6V for silicon transistors) before conduction begins at all. This is ideal, as it means that Class C operation can be achieved with transistors with no special bias arrangements whatsoever. All we need to do is feed a signal with a positive excursion something in excess of 0·6V between base and emitter of the p.a., from a driver stage capable of supplying adequate base current to give the desired mean collector current.

As a guide, a well-designed p.a. stage will provide a power gain of up to 17dB (approximately 15 times). Thus, a 10watt transmitter running at 70% efficiency will require a drive power of at least half a watt.

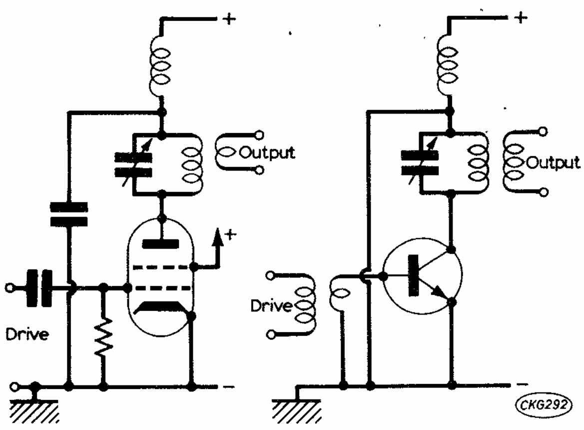


Fig. 1: Circuits illustrating the similarity in valve and transistor p.a. stages.

MATCHING

With valve transmitters, it has become almost standard practice to use a pi-network to match the p.a. to a 75ohm aerial system. The same principles apply to transistor p.a.'s but owing to the lower impedances involved component values can become somewhat inconvenient at the lower frequencies. For this reason, a tapped p.a. tank coil is often used, as a worked example will illustrate.

Assuming a p.a. efficiency of 70%, the approximate p.a. output impedance can be calculated from:

$$R_{pa} = \frac{V_c}{2I_c} \text{ ohms}$$

where V_c is the collector voltage and I_c is the collector current.

Thus, a p.a. with a collector voltage of 20V and a d.c. input of 0·5A will present an output impedance of

$$\frac{20}{2 \times 0{\cdot}5} = 20\text{ohms}$$

The problem is now one of matching the 20ohm p.a. to the 75ohm aerial system. As mentioned earlier, the most suitable technique consists of initially converting the low p.a. impedance to a more convenient value by means of a tapped p.a. coil, and then transforming down to aerial impedance by means of a link coupling. In this way, a reasonable working Q can be obtained with components of a more sensible value than would have been necessary for a pi-network.

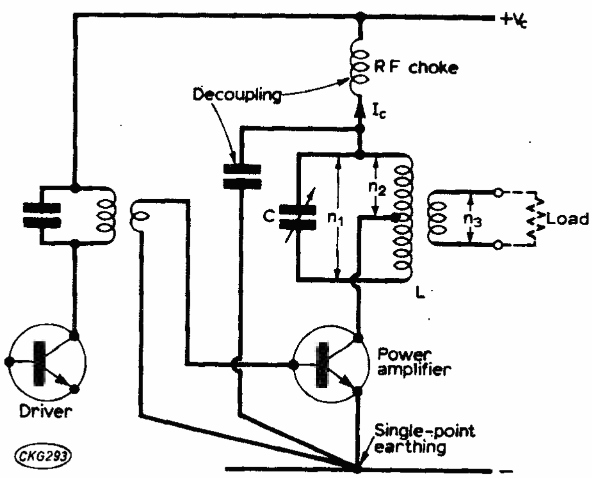


Fig. 2: Typical transistor p.a. stage and the matching problems involved.

The general arrangement is shown in Fig. 2. To establish a starting point in our calculations, we begin by assuming a convenient value for the tuning capacitor C. The value of L is then given in the normal way by:

$$L(\mu H) = \frac{25{,}000}{f^2 \times C}$$

where f is frequency (MHz) and C is tuning capacitance (pF).

We next decide on the required operating Q. As with valve p.a.'s, this is usually somewhere between 5 and 15 as a compromise between harmonic suppression and tuned circuit loss. Now, Q is given by:

$$Q = \frac{\pi \times f \times C \times R}{500{,}000}$$

where R is the effective shunt resistance across the tuned circuit. From this, we can obtain an expression for R:

$$R = \frac{500{,}000 \times Q}{\pi \times f \times C}\text{ohms}$$

Thus, in order to obtain the required operating conditions, the p.a. output resistance must be transformed to look like this shunt resistance R.

Example: Suppose our p.a. is to work at 2MHz and we choose C=500pF as a convenient value for the tuning capacitance. Hence,

$$L(\mu H) = \frac{25{,}000}{2^2 \times 500} = 12{\cdot}5\mu H$$

If we now choose an operating Q of 10, the effective shunt resistance R will need to be:

$$\frac{500{,}000 \times Q}{\pi \times f \times C} = \frac{500{,}000 \times 10}{\pi \times 2 \times 500} = 1{,}590\text{ohms}$$

It is now necessary to determine the turns ratio for the tapped p.a. coil. This is given by:

$$\frac{n_1}{n_2} = \sqrt{\frac{R}{R_{pa}}}$$

Thus if in our example 30 turns were required to give the required inductance of 12·5μH, n_2 could be obtained from:

$$\frac{30}{n_2} = \sqrt{\frac{1590}{20}}$$

from which n_2 = Approx. $3\frac{1}{2}$ turns.

The number of turns required for the aerial link coupling can now be calculated in a similar manner from:

$$\frac{n_1}{n_3} = \sqrt{\frac{R}{R_{ae}}}$$

For a 75ohm aerial system, the above example would therefore require a value for n_3 given by:

$$\frac{30}{n_3} = \sqrt{\frac{1590}{75}}$$

from which n_3 = Approx. $6\frac{1}{2}$ turns.

It is vital that the p.a. stage be adequately decoupled. This can be accomplished by means of an r.f. choke and decoupling capacitor as shown. The impedance of the choke should be no more than ten to fifteen times the p.a. output impedance, to discourage low frequency parasitics.

MODULATION

Undoubtedly the best way to modulate a transistor transmitter is by collector modulation of the p.a. and driver stages. The audio power required will be equal to half the p.a. input power; that is, 5watts for a 10watt p.a.

'Efficiency' modulation systems modulating emitter or base of the p.a. with only a few milliwatts of audio can give satisfactory results if carefully set up, but even at their best will never have the 'talk-power' of a high-level modulated system. This is a matter of fundamental fact, not of design.

MODULATOR MATCHING

In order to effectively modulate any p.a., it is essential that it be correctly matched to the modulator. The calculations are very simple. A transistor p.a. with a collector voltage of V_c volts and a collector current of I_c amperes will present a load to the modulator of $\frac{V_c}{I_c}$ ohms. If we call this load impedance R_p it can be correctly matched to a modulator of output impedance R_m by means of a modulation transformer with a turns ratio:

$$\frac{N_1}{N_2} = \sqrt{\frac{R_p}{R_m}}$$

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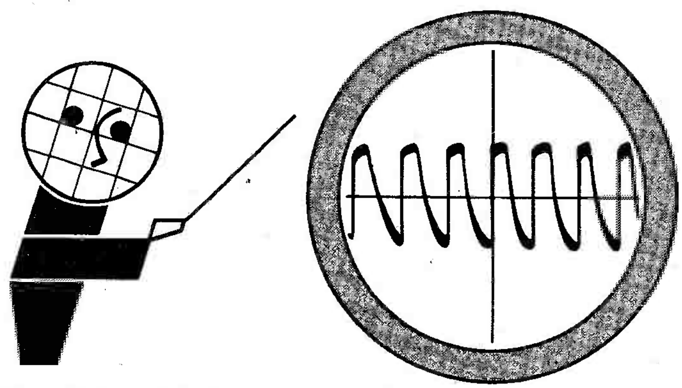

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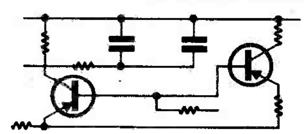

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Example:—Suppose we wish to modulate a p.a. having a collector voltage of 20volts and a collector current of 0·5 amperes by means of a modulator with an output impedance of 1000ohms. From the formula, the modulator load R_p will be

$$\frac{20}{0\cdot5} = 40 \text{ ohms}$$

To match this to a modulator output impedance of 1000ohms, we shall require a modulation transformer with a turns ratio:

$$\frac{N_1}{N_2} = \sqrt{\frac{40}{1000}} = \frac{1}{5}$$

i.e. a step-up ratio of 1:5 between the p.a. and the modulator. The general arrangement is shown in Fig. 3.

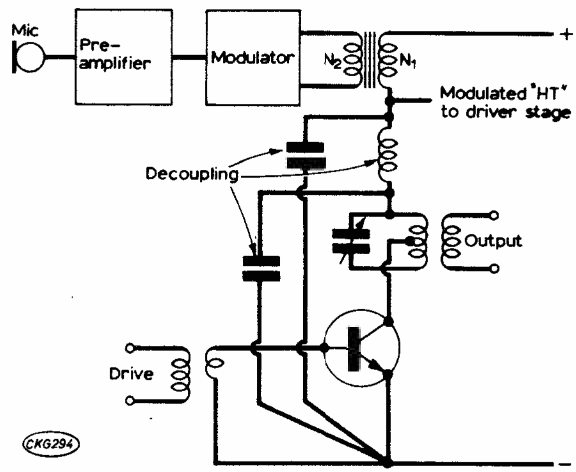

Fig. 3: Circuit showing how the use of formulae given in the text can ensure correct matching between the p.a. and the modulator.

It is not possible, because of internal feedback, to fully modulate a transistor transmitter by means of collector modulation of the p.a. alone. For this reason, it has become established practice for the driver stage also to be collector modulated to a depth best determined by practical tests.

CHOICE OF TRANSISTORS

This article would not be complete without a brief survey of suitable p.a. transistors available for amateur use at a reasonable cost.

When selecting a type of transistor to meet a particular requirement, there are a number of important parameters to bear in mind.

The first of these is transition frequency f_T. This is the frequency at which the forward current gain in common emitter mode h_{FE} (also known as β) has dropped to unity. But more important, it is also the gain-bandwidth product for the transistor: a transistor with an f_T of 200MHz will have a gain of 100 at 2MHz and 50 at 4MHz.

From this one might conclude that one should aim for as high an f_T as possible, but in practice this can result in excessive low-frequency gain and consequent instability. It is therefore best to select a transistor with an f_T no more than ten to fifteen times higher than the proposed operating frequency.

Another important transistor parameter is its total dissipation P_{tot}. A Class C p.a. stage is generally no more than 70 per cent efficient, the remaining 30 per cent of input power is wasted as heat which must be adequately dissipated by the transistor and its heat sink if the device is to remain within the temperature limits stipulated by the manufacturer.

Finally, it tends to be expensive to pay too little attention to the manufacturer's 'absolute maximum' voltage and current ratings (the writer speaks from rueful experience!). A p.a. fed from a 12volt supply will have a peak r.f. voltage on its collector of up to 24volts on c.w. and up to 48volts on a.m. A valve p.a. will withstand a fair degree of overload without complaining, but the risk is not worth taking with transistors. It is therefore good sense to choose a transistor with a collector-emitter voltage rating at least three times the proposed supply voltage for c.w. and at least six times the proposed supply voltage for a.m.

A list of readily available transistors suitable for amateur p.a. use is given in the accompanying table.

P_{tot} (W)		f_T (MHz)	V_{CBM} (V)	V_{CEM} (V)	I_{CM} (A)
3	2N1893	50	120	80	0·5
	2N1613	60	75	30	0·5
	2N1711	70	75	30	0·5
4	2N4030	100	−60	−60	1·0
	2N4031	100	−80	−80	1·0
	2N4032	150	−60	−60	1·0
	2N4033	150	−80	−80	1·0
5	2N3053	100	60	40	0·7
	BSY81	100	40	18	1·0
	BSY83	100	80	35	1·0
	BSY85	110	120	64	1·0
	BSY84	120	80	35	1·0
	BSY82	120	40	18	1·0
	BSY86	130	120	64	1·0
	2N3866	700	55	30	0·4
11·5	BD106A	100	36	36	2·5
	BD106B	100	36	36	2·5
	BD106C	100	64	64	2·5
	BD106D	100	64	64	2·5
15	BD124	60	70	45	4·0
45	BD123	85	90	60	5·0
	BD121	95	60	35	5·0

CONCLUSIONS

The writer concludes with a few recommendations which are the outcome of considerable experimentation and not a few traumatic experiences.

DO... bring up the voltage and drive to a transistor p.a. gradually to avoid any possible overloads.

DO... use single point earthing.

DO... keep leads short. There are high circulating currents in a transistor p.a. and stray inductance from over-long leads can ruin performance.

DO NOT... over-drive a transistor p.a. with voltage.

DO NOT... forget to decouple the stage properly.

DO NOT... run the p.a. even slightly off-tune or without a proper load. ■

TAKE 20

JULIAN ANDERSON

No. 43 AUDIO MIXER

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

THERE are several occasions when audio signals have to be mixed; public address systems frequently have several sources such as a microphone, tape recorder and record player and of course pop groups need an audio mixing facility to bring all the sources together before feeding the main amplifier. Some audio mixers are very complex and sophisticated in that they will handle signals varying from the tiny output from a tape head to more than half a volt produced by a crystal pickup and, as well as providing a mixing system, they equalise the inputs. It is more common however that the signals needing to be added together are of roughly the same level and to mix these is fairly simple as can be seen from the circuit in Fig. 1.

This circuit has facilities for three inputs, two medium level and one high level. One important feature of a mixer is that the level of each of the sources can be controlled individually and so a potentiometer is needed for each. If we simply connected the sliders of the pots together there would be considerable interaction between them. For instance, if one of the pots was set at minimum the slider would be at virtually chassis potential and thus the wanted signals would also be shorted. This interaction can be reduced to negligible proportions by inserting a resistor in series with each slider before taking them all to a common point; in our circuit these are represented by R2, R3 and R4.

The adding of the signals in this way does, however, cut down the level considerably, so much so that the combined signals need amplifying to recover the level and so Tr1 is necessary. In fact this not only recovers the gain but amplifies the signal by about 20 times.

The high level input is that marked in Fig. 1 as **A** and this will handle signals of more than 1V without causing distortion. The signal available across VR1 is only one seventh that of the input using the 68kΩ resistor shown but the value of R1 can be altered to suit the particular requirements. Inputs **B** and **C** do not have any initial attenuation and will handle signals up to about 150mV without trouble. For this input the output is nearly 3V which is more than sufficient and in most cases will be far too much; few amplifiers need more than 600mV. Working backwards, we shall then find that this amplifier stage will give 600mV out for inputs of 30mV. There is no minimum level at which it will work and signals of 1mV could be mixed, though of course the output would then be only about 20mV.

Three inputs have been shown but the final number is up to the constructor. Only two may be required, in which case one can be left out but several more can be added simply by duplicating Input **A** or or one of the others.

No separate power supply is shown as the mixer will usually be powered from the main amplifier but it will work from a 9V battery and, since the current drain is tiny, a PP3 type may be used.

The components may be built in any convenient form but for those using Veroboard a layout diagram is shown in Fig. 2; no breaks are necessary in the conductor strips. ■

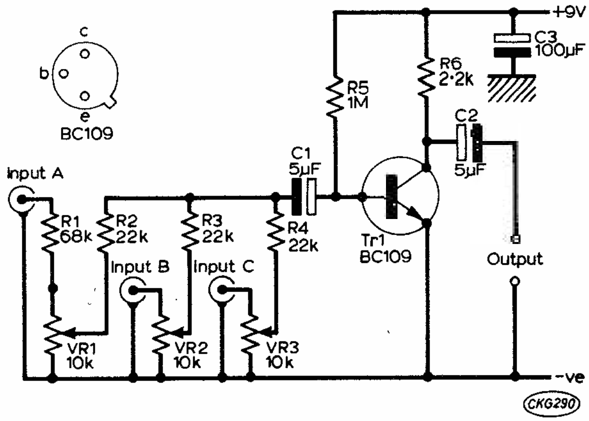

Fig. 1: Circuit of the audio mixer providing for three inputs.

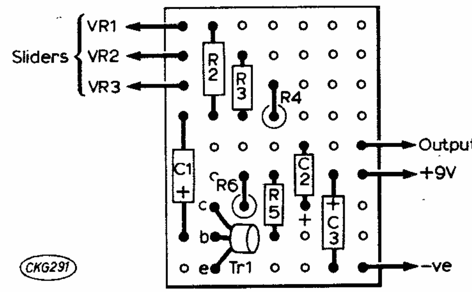

Fig. 2: A suggested component layout; no breaks in the conductor strips are necessary.

★ components list

Components list

R1	68kΩ 5%, ¼W	1p
R2	22kΩ 5%, ¼W	1p
R3	22kΩ 5%, ¼W	1p
R4	22kΩ 5%, ¼W	1p
R5	1MΩ, 5%, ¼W	1p
R6	2·2kΩ 5%, ¼W	1p
VR1	10kΩ log. pot.	12p
VR2	10kΩ log. pot.	12p
VR3	10kΩ log. pot.	12p
C1	5μF, 12V min.	5p
C2	5μF, 12V min.	5p
C3	100μF, 12V min.	6p
Tr1	BC109	12p
		70p

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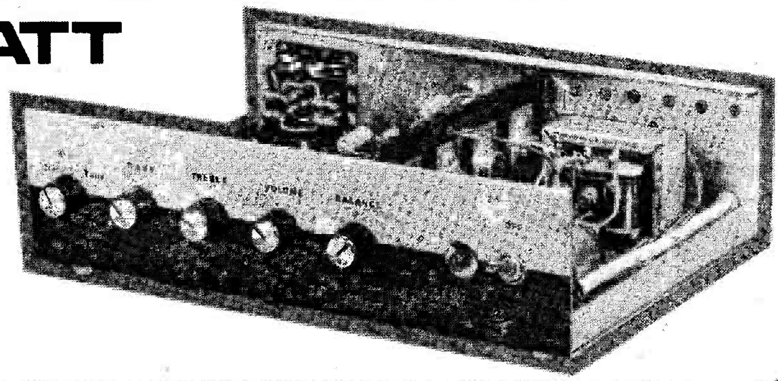
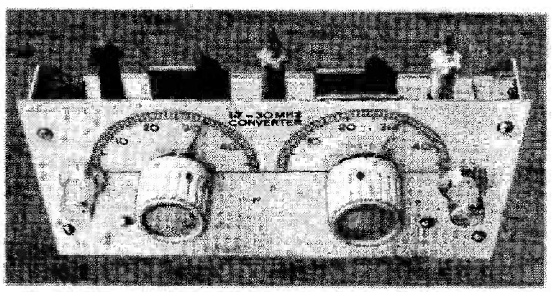


Five years ago W. Cameron described his "Low Cost Hi-Fi" system in P.W.—and a rip-roaring success it was too! Now the same author describes the Mk II. The amplifier uses conventional wiring (for those who hate p.c. boards) and has an output very conservatively rated at 10W per channel. All the usual facilities are provided including inputs for magnetic and ceramic pickups, radio and tape, all with the correct equalisation, of course.



Short Wave Converter

Do you sometimes wish that you could receive short wave stations on your domestic radio instead of being confined to the medium and long wavebands? This simple three transistor unit will convert that radio into an efficient receiver for the short wave bands, capable of world-wide reception. Full information is given for the construction and alignment of the converter.

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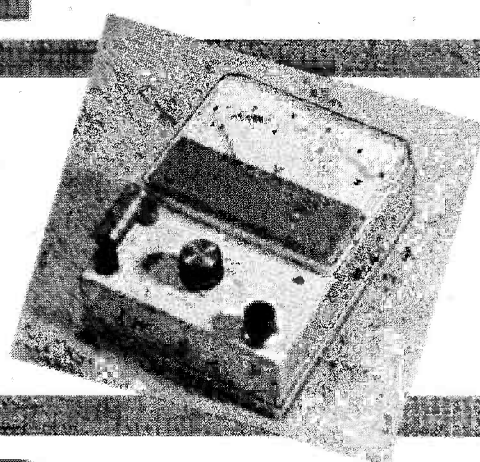

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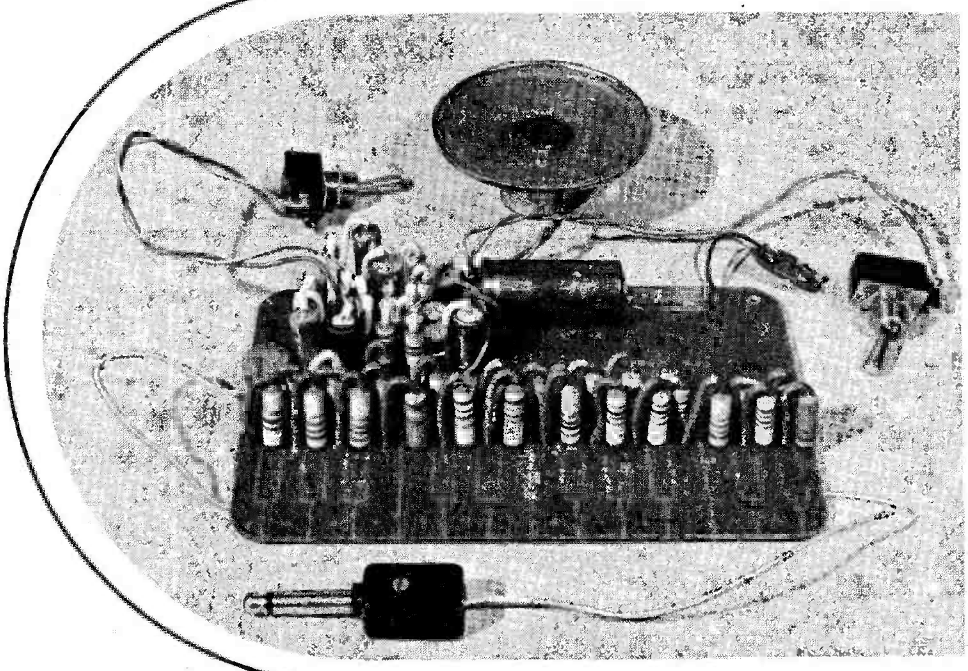

THE Music

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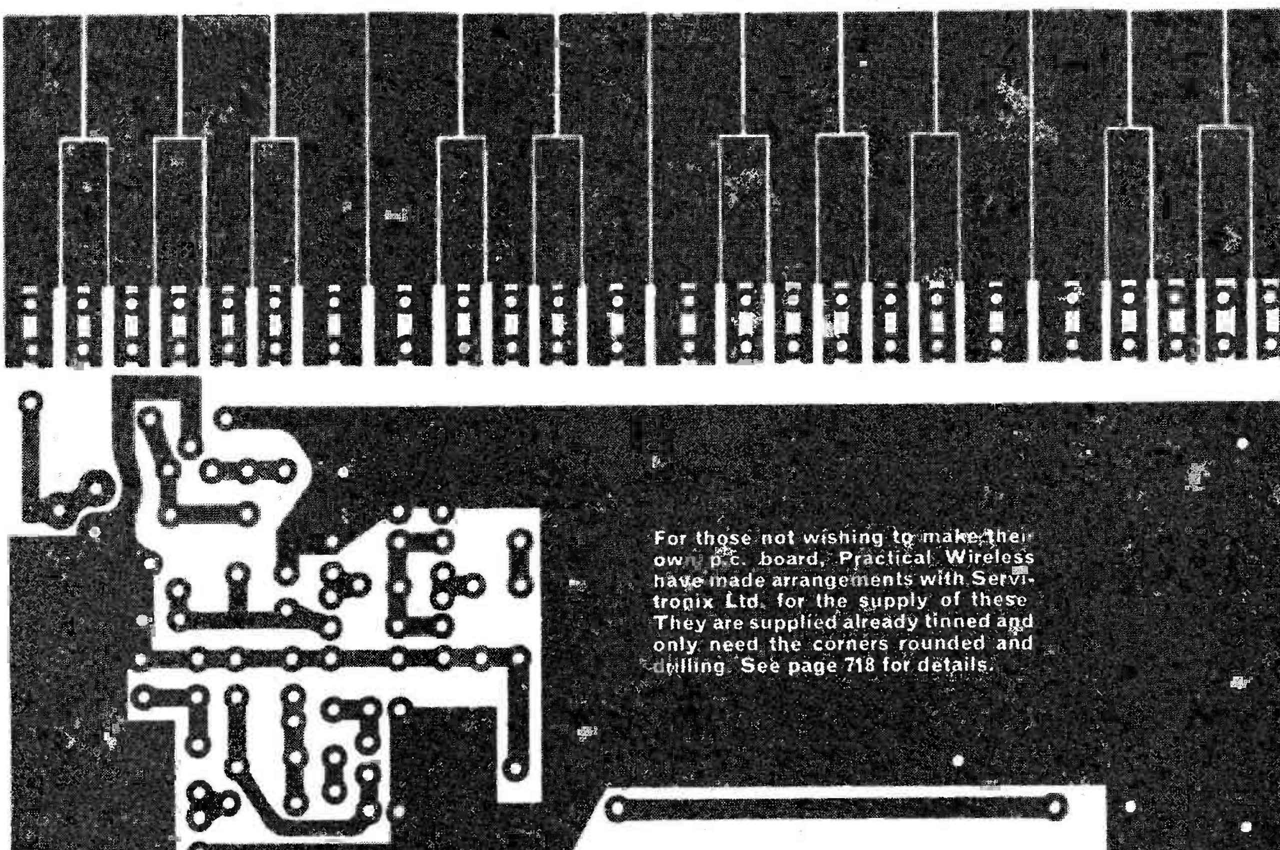
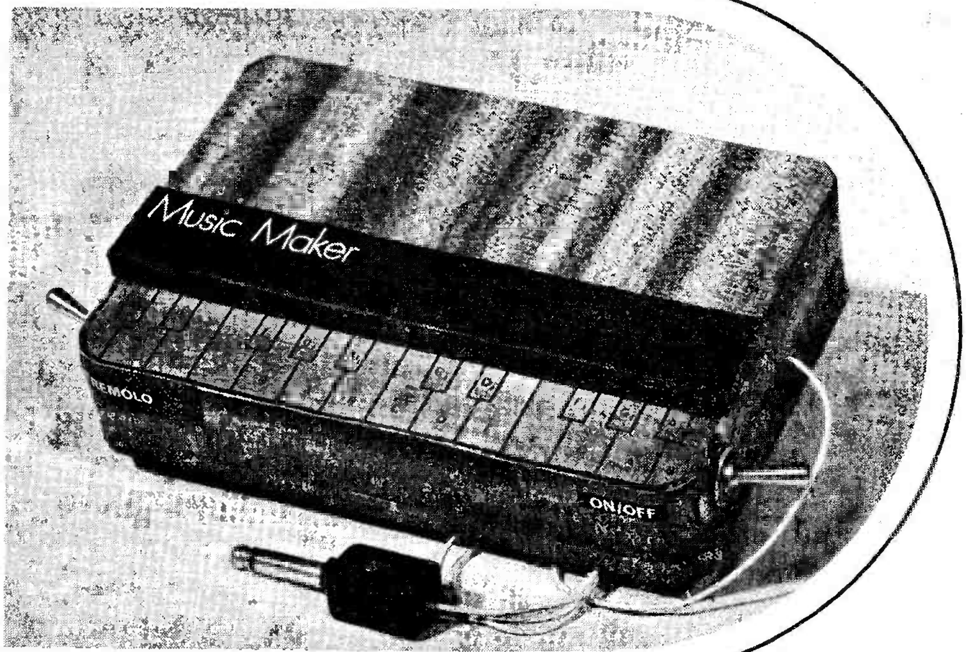


Full size pattern of the p.c. board layout. This drawing may be cut out for those wishing to make their own boards; as this page backs onto details of next month's features, your copy will not be spoilt.

Maker

ronic

D. SMITH



THE Music Maker electronic organ was originally conceived as a toy for the author's young daughter but, after the rigours of field trials of the kind that young children seem to be so well endowed to inflict, it was realised that the organ was more than just a toy.

It turned out to be a very robust and reliable musical instrument, very simple to construct and economic in both manufacture and battery consumption.

The complete instrument is housed in a plastic sandwich box, measuring 6⅞in. x 4⅝in. x 1⅝in. of the type offered for sale in most large chain stores for just a few pence. For those who are unable to obtain this, special arrangements have been made for the supply of this; see overleaf.

The organ is monophonic and played with a probe on a printed circuit keyboard laid out in conventional manner. The keyboard covers two full octaves, centred around middle C, including sharps and flats and gives sufficient notation to play almost any tune.

The notes, although not exactly the correct frequencies are close enough to pass the scrutiny of all but the trained musical ear. The accuracy of the notes was checked on a frequency meter and errors of no more than 10Hz were found in the worst case.

The organ may be built without the tremolo circuit, if even greater simplicity is desired, but it is a very worthwhile addition.

circuit description

The circuit diagram is shown in Fig. 1. The notes are generated by a relaxation oscillator Tr1 which is a unijunction transistor. The frequency of the notes is determined by C1 and R7 to R30. Tr2 is a simple audio amplifier feeding the output pair Tr3 and Tr4.

★ components list

Resistors

R1	100Ω	R20	1·5kΩ
R2	15kΩ	R21	1·5kΩ
R3	1kΩ	R22	1·5kΩ
R4	1·5kΩ	R23	1·3kΩ
R5	10kΩ	R24	1·2kΩ
R6	10kΩ	R25	1·2kΩ
R7	3kΩ	R26	1·1kΩ
R8	3kΩ	R27	1·1kΩ
R9	2·7kΩ	R28	1kΩ
R10	2·7kΩ	R29	910Ω
R11	2·7kΩ	R30	10kΩ
R12	2·7kΩ	R31	8·2kΩ
R13	2kΩ	R32	6·8kΩ
R14	2kΩ	R33	4·7kΩ
R15	2kΩ	R34	1kΩ
R16	2kΩ	R35	82kΩ
R17	2kΩ	R36	10kΩ
R18	1·8kΩ	R37	4·7kΩ
R19	1·8kΩ		

All resistors ¼ or ⅛W, 5 per cent types.
See note below on the supply of component packs.
VR1 5kΩ lin. skeleton preset pot.

Capacitors

C1	0·05μF	C6	100μF 12V min.
C2	0·22μF	C7	250μF 12V min.
C3	5μF 12V min.	C8	2·5μF 12V min.
C4	25μF 12V min.	C9	2·5μF 12V min.
C5	100μF 12V min.	C10	2·5μF 12V min.

C8–C10 may be 2·2μF

Semiconductors

Tr1	2N2646 or UT46	Tr4	AC127
Tr2	OC71	Tr5	AC128
Tr3	AC128		

Miscellaneous

Case: Plastic lunch box, see overleaf; LS1 30-80Ω loudspeaker, miniature type, preferably 3in. but 2¼in. or 2½in. will suffice. SW1, SW2; On-off toggle switches; Probe, see text; PP3 battery.

The output stage has not been designed for quality but cross-over distortion is not important. The prime consideration here is low battery consumption. The quiescent current is only a few milliamps, giving long battery life.

The circuit diagram for the tremolo oscillator is shown enclosed on the circuit diagram. It consists of a simple oscillator working on the principle that a 180° phase change occurs through the feedback capacitors C8 to C10, applying positive feedback from the collector to the base of Tr5, thus forming a low frequency oscillator.

The output of the tremolo circuit is mixed with the output of the note generator at the base of Tr2 when the switch SW2 is made.

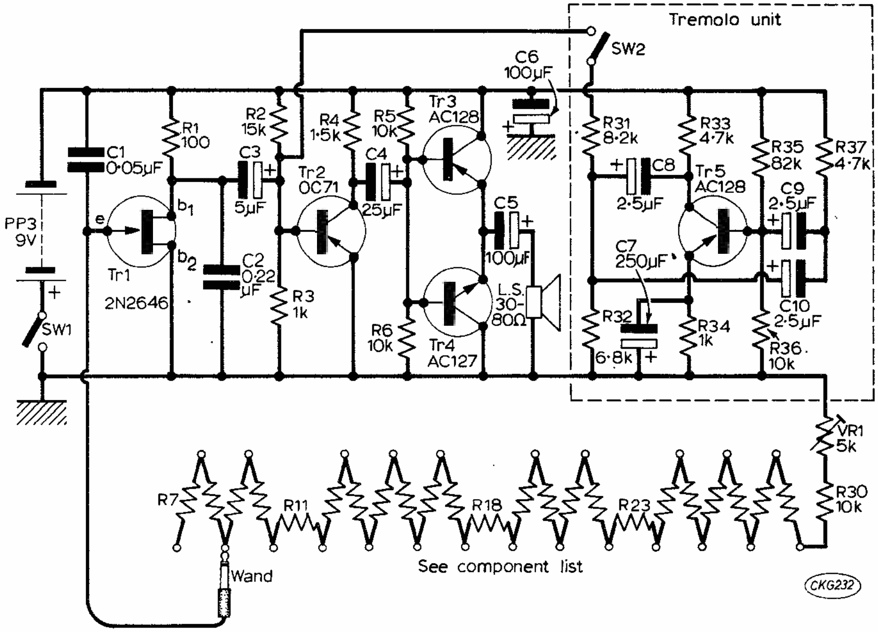


Fig. 1: The complete circuit of the Music Maker. The tremolo section, which is optional, is shown inside the dotted box. See the components list for the values of the note resistors.

The output power is quite sufficient to allow the organ to be heard in an average sized room and no volume control was considered necessary.

circuit board construction

The printed circuit board is shown full-size on page 716. (For those not wishing to make their own boards, arrangements have been made for the supply of these.) Firstly, the board is cut to size and the corners shaped to fit the case. After checking that the board will fit the case easily, it is then etched and drilled. The components are then soldered in, starting from R1, C1 and Tr1 and progressively through each component shown on the circuit diagram as far as the loudspeaker.

Many small transistor speakers have a 6BA tapped hole in the permanent magnet keep at the back of the cone. The speaker may be fixed to the printed circuit board by a 6BA bolt, screwed into this hole. If the speaker does not have this hole, the magnet can be glued to the board.

At this stage the circuit may be tested by injecting an audio frequency signal at C4 (to prove the output stage) and C3 (to prove the audio amp.). If everything is satisfactory, the audio signal will be heard clearly from the speaker.

The relaxation oscillator may be tested by temporarily connecting a 15kΩ resistor from the 'e' of Tr1 to the positive rail and a note should be heard from the speaker. The keyboard components R7 to R30 and VR1 may then be fitted and the scales tried.

It should be mentioned at this stage that the values of some of the resistors R7 to R29 are not normal 10 per cent preferred values, but are 5 per cent or better types and the closer one adheres to the values stated, the closer the notes will be to the desired frequency. Since some of these values fall in the less common E24 series, special arrangements have been made to supply a kit of the scale resistors.

It was found, on the prototype, that the keyboard

special facilities for practical wireless readers

Arrangements have been made for the supply of the following component packs:

Pack 1	Printed circuit board	80p
Pack 2	Plastic box	25p
Pack 3	Set of scale resistors (R7–R29) ..	21p
Pack 4	Complete set of resistors (R1–R37)	35p

Total cost of Packs 1, 2 and 4 .. .. .. £1·35

Total cost of Packs 1, 2 and 3 .. .. .. £1·20

All prices are inclusive of postage etc.

Available from: SERVITRONIX LTD., 26 Killarney Road, Wandsworth, London SW18 2DX (Mail order only).

Personal shoppers: 572 Kingston Road, Raynes Park, London, S.W.20

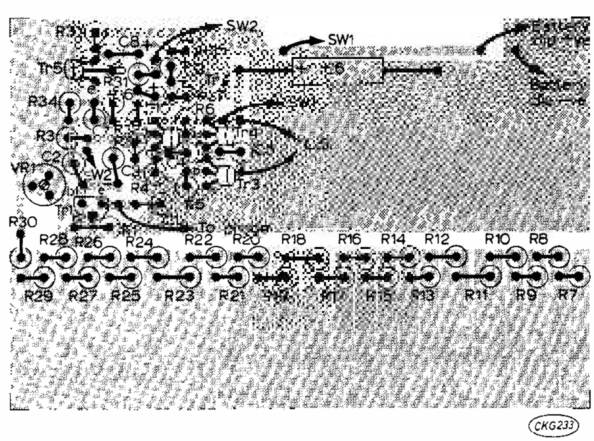
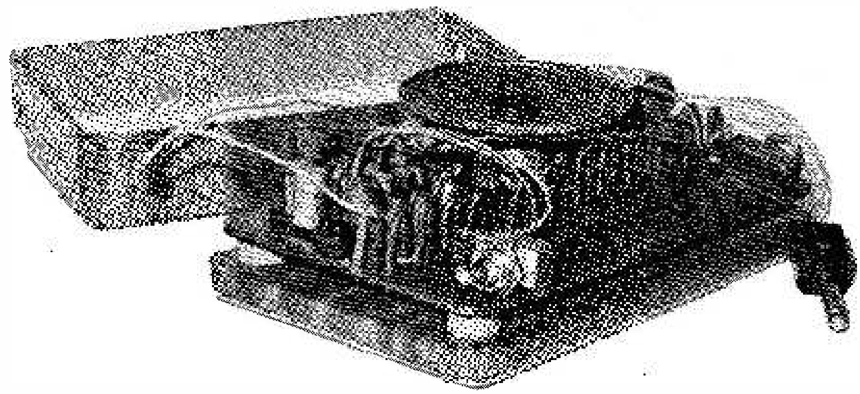


Fig. 2: The component layout on the p.c. board. This is viewed from the components side.



A view of the completed prototype.

must be polished with metal polish before playing because once the surface becomes tarnished the notes change, due to the increased resistance of the copper oxide coating. Several alternatives are possible, either the keyboard may be silver plated or, if the constructor is a soldering expert, the keyboard may be tinned. The ready-made p.c. board which is available is already tinned.

case construction

Next the case is cut as shown in Fig. 3. The best method of cutting the case is with the tip of a hot soldering iron, keeping well within the actual line of cut to allow for the shrinking effect as the plastic melts. After cutting, the edges should be cleaned up with a sharp penknife and finally sandpapered to a clean edge.

It is recommended that the speaker hole be cut first so that the constructor may get some practice before attempting the more difficult keyboard slot.

The printed circuit board fixing bolts are put through the case next, and held by means of nuts inside. The speaker hole can be covered with cloth fret and the case may be covered with Vinyl or similar decorative covering. The printed circuit board is then placed inside and fitted on the mounting screws.

The switches SW1 and SW2 may then be fixed

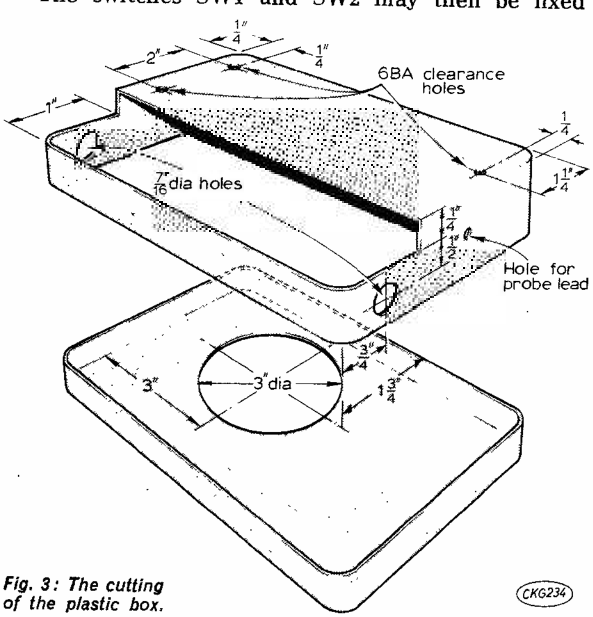
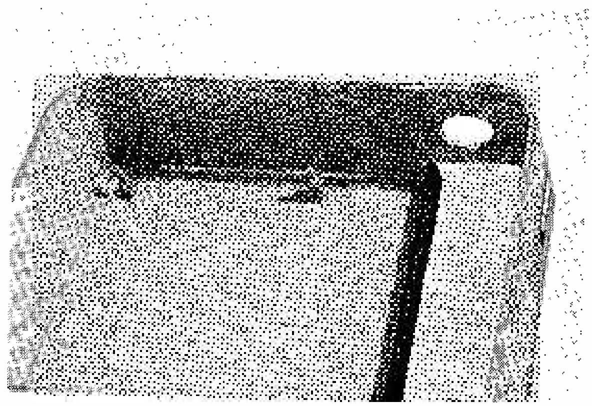
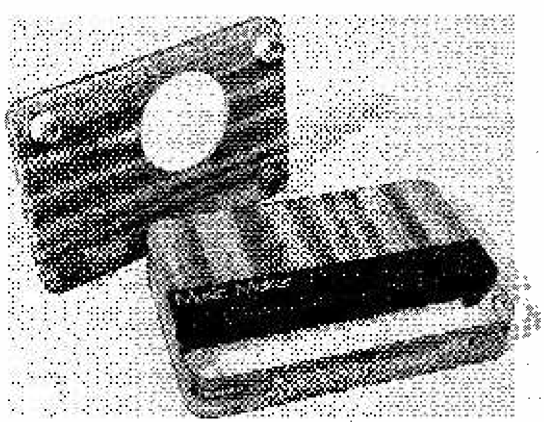


Fig. 3: The cutting of the plastic box.



Inside of the case showing the hole for one of the switches and the mounting screws for the p.c. board.



The case used for the prototype—the black escutcheon can be made from cardboard covered with black, self-adhesive plastic.

and the probe lead passed through the hole in the case and the probe connected. The author used a telephone jack plug for the probe, but it may be made from a variety of items.

Finally the battery is fitted and the probe is held on middle C. VR1 should then be adjusted until the note corresponds to the correct sound; the rest of the notes should then be correct. If R7 to R29 are replaced by skeleton presets, then all the notes will have to be tuned individually, starting with the highest one because the tuning of the higher notes will upset the ones below it. ■

practically wireless commentary by HENRY

No. 94

"Psychological Pservice"

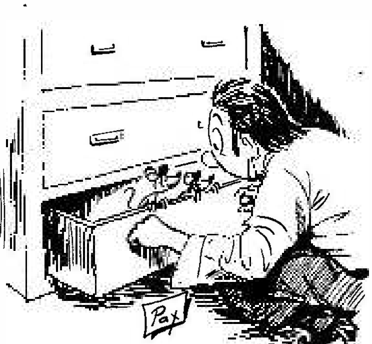
HAVE you ever suffered from mice in your bottom drawer, moths in the cambric and half the local pigeon population perching on your aerial?

You have my sympathy. You can even have my telephone number if you require a quick consultancy service in getting rid of birdies on the f.m. band, rumbles on your autochanger or the depredations of the dreaded alum-worm in your electrolytics.

Some things never age. And Henry is convinced by recent experiences that the problems and vicissitudes of servicing will never change, whatever the 'tomorrow men' may predict about modules, and multi-chips, or 'potent ethos determinants'. I do not need to invent these terms. The foregoing is a quote from Jonathan Benthall's review of *Science and Technology in Art Today,* by Brian Porter.

I remember the intense castigation I received when, as a humble field engineer, I dared to contribute to print the criticism of the first ever 'module-type' television receiver. The several printed circuit boards, according to the maker, would be supplied as immediate replacement spares, and no on-the-spot servicing would be needed.

Henry predicted that engineers would soon circumvent the system



Mice in your bottom drawer.

by their innate curiosity. They would find that certain components caused common faults and find it as easy to change these as nip back to the workshop for a new PC board. Which, in the event, is precisely as happened. In no time at all, the prevalence of common faults had caused a shortage of those printed circuit panels where the troubles most often took effect. And most of the problems we had with that particular set and its immediate successors were not with the printed circuit boards at all, but externals like volume controls.

Henry cannot share Mr. Benthall's regard of computer technology as art, but begins to see what he means when he describes the relevance of error factors. So much art is accidental: so much science is an inspired leap of one step after a determined plod up five hundred. So many of the radio receivers we have seen come off the production lines—computer controlled?—bear the marks of artistic error. Servicing them calls for some of the inspiration of the artist.

The psychology of service comes into it when you have to tackle those strange innovations under the critical gaze of the owner. A discreet tap with the hammer is not to be recommended, and a fierce tug in unstrategic places can result in two separate halves with a mass of disconnected wires. Instead, one holds it wisely to one's ear, give a twiddle to any visible knobs, shakes it gently, frowns and declares: *'Rather tricky I'm afraid. This is a bench job.'*

Depending on his previous experience and the snobbery of modern tech-owning, the reception by the owner of this advice will either be a glow of self-importance or the suspicion of price-rigging. Trouble is, these contretemps are inevitable. No service engineer can keep up with

A fierce tug in strategic places . . .

all the models, nor even all the advances in general trends of technology. And as for the horror of having to order spares—this is where the psychology of service really sorts the professional from the chap round the corner who dabbles in wireless—and who will probably, eventually, do a much better job.

Here, again, the computer has taken over. The philosophy of the pro is to replace C195 with part number XV5600071008 as recommended in the service manual. He is not concerned that C195 is a 1KpF ceramic, available from umpteen makers and a dozen surplus factors under a multitude of names. Superset Ltd., say item XYZ, so that is what he orders, and the receiver sits on the shelf while the part is airlifted from Japan.

But computers are almost human. In fact, take a quote from Benthall's last few lines in the computer section of his book:

'So far, the constraints of working with the computer so dominate anything done with it that they actually appear to oppose the advances of the artist. It is as if the computer were some creature of great sexual attractiveness whose actual anatomy remains elusive, frigid and unexplored.' Henry felt that way when they invented tights. But that's another story . . . !

FREE COMPETITION

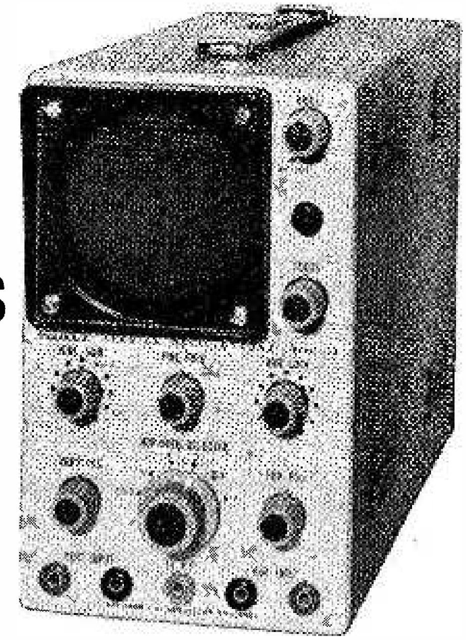
Organised by Practical Wireless and Heath (Gloucester) Ltd.

In this free competition you have two opportunities of winning a Heathkit 3in. portable oscilloscope kit! Our exciting competition will be repeated in the January issue of Practical Wireless, so save this month's coupon until next month's appears and post your two different attempts in the same envelope.

The Heathkit General Purpose Oscilloscope Kit K/OS-2 is a dependable, well-rated design, ideal for the hobby constructor. The small size and light weight make it ideal for the 'shack' while the wide range of facilities make it extremely versatile.

The low price of £29·50 for the kit plus 80p postage and packing (when ordered direct from the Gloucester factory) is an added attraction and of course, coming from Heathkit, the instructions for both assembly and operation are clear and precise, leaving nothing to chance. Even if you already own a 'scope, the OS-2 makes an excellent portable, back-up unit. Just consider the specification: Y Bandwidth from 2Hz to 3MHz; Time base 20Hz-200kHz Automatic sync; P.C. board construction; small size, 12in x 7⅜in x 5in; Switched ext/int Y plate connections; Sensitivity 250mV peak-to-peak per cm.

10 'Scopes to be Won!



HOW TO ENTER:

Listed below are eight important features of the Heathkit OS-2 oscilloscope. All you have to do is place them in what you consider to be their order of importance to the average Practical Wireless reader. For example, if you think *Portability* is most important of all, write D in the box marked 1st on your entry coupon. The key letter of your second choice goes into the box marked 2nd, and so on for all eight. Complete the coupon, all in ink or ball-point pen, with your full name and address, then post in a sealed envelope to: PRACTICAL WIRELESS 'SCOPE COMPETITION, 16 GARRICK STREET, LONDON WC2E 9PR to arrive not later than Wednesday, February 14th, 1973, the closing date. **REMEMBER:** The competition will be repeated next month, so you can keep the first coupon until then, if you wish, and send both attempts together.

RULES

There is no entry fee, but each attempt must be fully completed in ink on the proper printed coupon cut from Practical Wireless, and bear the entrant's own full name and address.

Every accepted entry will be examined and the prizes, as described, will be awarded to the ten entrants who, in the opinion of an expert panel of judges, and in any one attempt, have shown the most skill and judgment in listing the eight features in order of importance.

In the event of a tie or ties for any of the prizes, a further eliminating test will be conducted by post between the tying competitors to determine such winners.

Any entry which does not comply with the printed instructions or is received after the closing date will be disqualified, as will any received mutilated or illegible, incomplete, bearing alterations, or with more than one key letter in each space. No responsibility will be accepted for entries lost or delayed in the post or otherwise.

The judges' decision, and that of the Editor of Practical Wireless in all other matters affecting the competition, is final and legally binding. No correspondence can be entered into.

The competition is open to all readers in Great Britain, Northern Ireland, and the Channel Isles except employees (and their families) of IPC Magazines, the printers of Practical Wireless, and Heath (Gloucester) Ltd., all of whom are ineligible.

The winners will be notified, and the result announced in the earliest possible issue of this magazine.

*

- **A** Good frequency response.
- **B** Simple controls.
- **C** Timebase in four ranges.
- **D** Portability.
- **E** Calibrating source.
- **J** Automatic lock-in synchronisation.
- **K** Switched Ext/Int Y plate connections.
- **L** Low price.

FREE ENTRY COUPON

1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	

PRACTICAL WIRELESS

'Scope Competition **1**

My order of importance for the eight points is given on the left. I agree to the rules as final and legally binding.

(Signed)
Mr./Mrs./Miss ....

Full
Address ....

....

....

Post to: PRACTICAL WIRELESS 'Scope Competition, 16 Garrick Street, London WC2E 9PR.

Closing date: February 14, 1973

please cut out along this line

I.C. OF THE MONTH

L.A.J. IRELAND

Number 34 — Westinghouse Hyreg AR1 Power Regulator

IN general, anyone whose interest in electronics begins with radio and communications is inclined to think primarily in those terms, maybe extended a little to cover audio and data processing. All else tends to be dismissed as electrical engineering. It is similar with integrated circuits. Application to radio, TV and computers is just about the limit. It comes as something of a surprise, then, to be dealing with an integrated circuit—even if it is a thick film hybrid—designed for power control at ratings of up to 2·5 kW., and operating off the mains. That, however, happens to be our topic for this month, the Hyreg type AR1 power regulator, manufactured by Westinghouse and available from Best Electronics (Slough) Ltd., of Michaelmas House, Salt Hill, Bath Road, Slough, Bucks.

Applications

Applications may be domestic—to regulate an electric heater or keep a kettle just on the boil; to dim the lights for an evening at home or for the local hall when films are on, or a show is presented; to set the speed of an electric drill; anywhere, in fact, where it would be an advantage to control a high powered device with the same convenience as the volume of a radio. It will by now be clear that silicon controlled rectifiers are involved, or to be more precise, a triac, consisting of two s.c.r.'s with a common gate for triggering conduction, and capable of use on a.c. circuits.

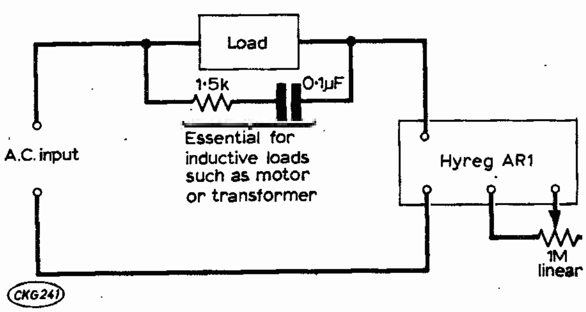
It will be remembered by those who have followed this column for a long time that the application of triacs was discussed once before, when the very useful G.E.(USA.) range of triggering circuits was featured. In the present case, however, the triac itself, together with the triggering components, is incorporated in the hybrid assembly. All these items are then bonded to a ceramic substrate of high thermal conductivity and electrical resistivity. The assembly is potted in epoxy, with the ceramic in good thermal contact with a metal base plate.

In use, only three external components are required, and if the load is purely resistive, such as tungsten lighting or a kettle or bar-type electric heater, this can be reduced to one, a variable resistor, as shown. The unit is mounted on a heat sink with thermal contact established with the metal base plate of the regulator. Due to the properties of the ceramic, however, this plate and the attached heat sink are fully insulated and protected.

It is suggested, however, that the variable resistor should be of the type with a plastic operating spindle, or a solid plastic knob used, for safety in the case of component failure, or accidental reversal of the connections to the mains. The fraction of the power dissipated in the load compared with that drawn directly from the mains is linearly dependent on the setting of the variable resistor. For zero resistance, the power delivered to the load is 100% dropping to zero when the resistance rises to some 800kΩ. It is clear, therefore, that if the application is for lighting, for example, a 1MΩ linear variable resistance will control the illumination, from total darkness to full power.

One cautionary note must be sounded, however, about devices employing small a.c. motors. Most such motors, including those generally used to drive cooling fans, are of the induction or squirrel cage type. Such synchronous motors operate at a single speed or not at all. It follows therefore that it is impossible to regulate the speed of such motors with a triac device. Rather, at a particular point such a motor simply stops; and as the operating temperature of the motor, or of other components, if it is driving a fan, will then rapidly rise, damage may result. If it is intended to use this device in a system incorporatting an electric motor, first check that the motor is of the type using brushes, i.e. non-synchronous. If used with a fan heater, for example, ensure that the fan receives the full mains voltage at all times, while the regulator controls only the power dissipated in the heating element.

The AR1/250-10 (250V r.m.s. 10A r.m.s.) costs £5·87 inc. p/p with present delivery of 6 to 8 weeks. ■



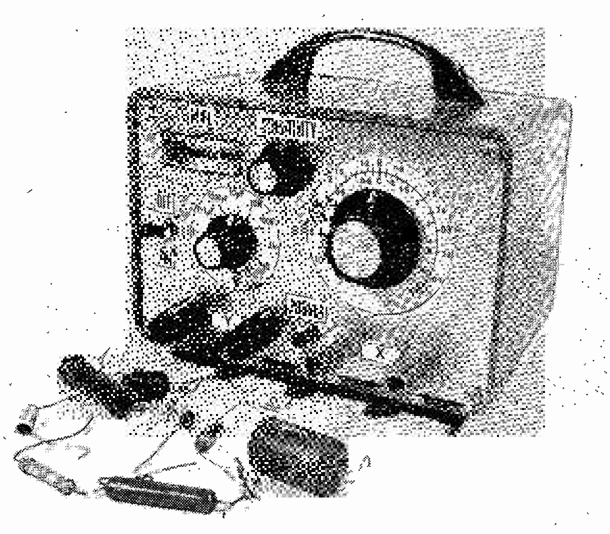
A potentiometer is all that is required for full power control.

HAVE you ever wanted to find out the value of an unmarked capacitor or wondered which was the primary and secondary of a transformer?

The value of a resistor can often be found easily by using a multimeter but how many of us possess one which can accurately measure 1Ω or, at the other extreme, 2MΩ? Capacitors are less easy to measure and an a.c. source is usually required and, the world being the way it is, capacitors tend to have their values erased more easily than most components. Inductors present another problem;

UNIVERSAL BRIDGE

HALVOR MOORSHEAD



granted that this facility is rarely required for most of us but when you *have* to know, what do you do?

The Wheatstone Bridge is the answer; it will rapidly give answers to all the above. In the circuit used here, the values of the components can be read directly off the scale.

THE THEORY

Look at the circuit arrangement in Fig. 1. An audio note (at any reasonable level and frequency, it doesn't affect the operation) is applied across the network made up from VR1, Ca and Cb with headphones connected between the slider of VR1 and the common junction of the capacitors.

Assume that Ca and Cb are of the same value; they will then each have the same reactance at the audio frequency and therefore the signal level between E and F will be half that between E and D.

If the slider of VR1 is at its central position, then the resistance A-B will equal that between B-C and half the applied voltage will appear at the slider. Thus the signal level at B and F are the same: what will be heard in the phones? Nothing of course; since there is no voltage difference across them, no current can flow and so they remain silent. In this state, the Bridge, for that is what this network is called, is in balance and the null position has been achieved.

If the slider of VR1 is at any other position there will be a voltage difference and an audio note will be heard in the phones.

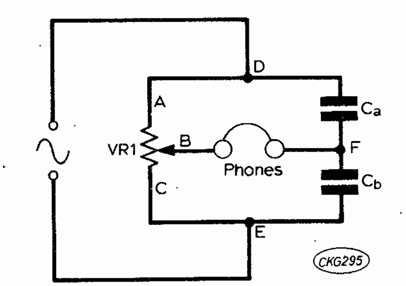


Fig. 1: The Wheatstone Bridge which forms the basis of this project. A full explanation of the theory is given in the text.

Now if Cb is one tenth the value of Ca, its reactance will be ten times greater and we shall only get a null when the resistance B-C is ten times greater than A-B. If we make Ca a standard, we shall obviously be able to find out the value of Cb as long as we know the relationship between the two parts of the track of VR1.

We have dealt with capacitors but the same applies to resistors and inductors with only one difference. The reactance of both of these is directly proportional to their values—in other words the higher their value, the more resistance they exhibit. With capacitors the reverse is true, the higher the value, the lower the reactance and so two scales are needed for the pot, one a mirror image of the other.

THE CIRCUIT

To operate the bridge we require an audio source, a set of standards and also something to detect the null. Headphones are pretty good but they have to be quite sensitive to detect the setting of VR1 which corresponds to the maximum null and so an amplifier is used. In addition to feeding headphones, a cheap meter is also used which will give a visual rather than an audible indication.

The complete circuit is shown in Fig. 2. The audio frequency generator to drive the bridge is represented by Tr1 and the associated components. This is a phase-shift oscillator which provides a pretty good sine wave. R1 and R2 provide the base bias while C2, C3 and C4 together with R3 and R4 take part of the signal from the collector and invert it by 180°, converting it from a negative to a positive feedback and thus sustaining oscillation. As we have already mentioned, the actual frequency of operation is not important but the values given operate at about 700Hz. This frequency can be altered slightly by modifying the value of R4 but only by plus or minus 50 per cent (4·7kΩ to 15kΩ). A transformer is included in the collector of Tr1; this is a transistor output transformer type LT700 which is widely available. This has a tap on the primary but this is not required for our purposes. The metal case of the transformer should be connected to the negative line. The secondary of T1 drives the bridge and it will be seen that this part of the circuit is isolated

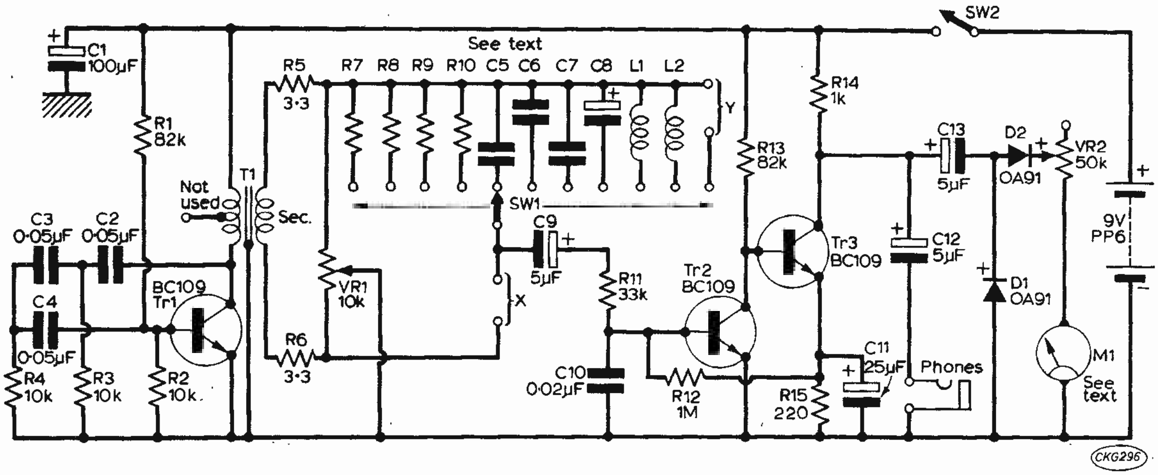


Fig. 2: Complete circuit of the Universal Bridge; the accuracy of the finished unit will depend on the tolerance of the standards and the care taken in calibration.

TEST VOLTAGES

	Emitter	Base	Collector
Tr1	0V	0·5V	7·5V
Tr2	0V	0·25V	1·2V
Tr3	1V	1·2V	3·4V

Note: Measured on Avo 8 (20,000 ohms per volt) on 10V range, battery voltage on load reading 8·5V. The above voltages should only be regarded as a guide.

from the audio oscillator. Two low value resistors are shown wired in series with the secondary; these do not really affect the circuit but prevent a complete short-circuit of the secondary if very low value resistance components need to be compared. If the secondary is short-circuited, the oscillator may cease to function.

The bridge potentiometer is represented by VR1 which has its slider taken to the negative line. This pot should be a high quality component and should of course have a linear track. A wire-wound component is to be preferred although not essential (the prototype shown uses a standard carbon track pot).

The standard components in the bridge circuit are represented by R7-R10, C5-C8 and L1, L2; these are selected by SW1. SW1 is also able to select an external pair of terminals (marked Y) for matching purposes.

The component to be measured on the bridge is connected across the terminals marked X.

The audio signal, indicating an imbalance in the bridge, will appear between chassis and the junction of the standard and unknown component and a d.c. blocking capacitor C9 takes this output to the amplifier. R11 is included to minimise the loading that the amplifier presents to the bridge. C10 bypasses any high frequencies to chassis and is necessary to prevent r.f. pickup since the amplifier has a very high gain.

The amplifier stage is made up from Tr2 and Tr3 with their associated components and is a fairly conventional arrangement. The use of BC109 transistors ensures considerable amplification of the input. The bias for Tr2 base is provided from the emitter of Tr3; this helps to stabilise the circuit and also takes up any variation in the parameters of the transistors.

The amplified audio signal appears at the collector of Tr3 and is connected via C12 to the headphone socket. Any type of phones can be connected to this

★ components list

Resistors

R1	82kΩ	R9	100kΩ
R2	10kΩ	R10	10MΩ
R3	10kΩ	R11	33kΩ
R4	10kΩ	R12	1MΩ
R5	3·3Ω	R13	82kΩ
R6	3·3Ω	R14	1kΩ
R7	10Ω	R15	220Ω
R8	1kΩ		

Resistors ¼W, 5 per cent except R7-R10, see text
VR1 10kΩ lin. pot, see text
VR2 50kΩ lin. pot. carbon track

Capacitors

C1	100µF 12V min.	C8	10µF 12V—see text
C2	0·05µF ceramic	C9	5µF 12V min.
C3	0·05µF ceramic	C10	0·02µF ceramic
C4	0·05µF ceramic	C11	25µF 12V min.
C5	10pF see text	C12	5µF 12V min.
C6	1000pF see text	C13	5µF 12V min.
C7	0·01µF see text		

Semiconductors

Tr1	BC109	D1	OA91
Tr2	BC109	D2	OA91
Tr3	BC109		

Miscellaneous

T1 Transistor output transformer, Eagle type LT700
SW1 1-pole, 12-way rotary switch
SW2 On-off, miniature toggle switch
M1 Recording level meter—see text
Jack socket; 4 off R.S. Components (Radiospares); Slim insulated Terminals, 4mm or similar; Veroboard, 0·15in. matrix, 12 x 16 holes; PP6 battery; Battery clip; Case: 'Elf' type, available from West Hyde Developments Ltd., Ryefield Crescent, Northwood, Middx., HA6 1NN. Price: £1·25 plus 10p postage. L1, CH4/A 10mH choke, L2 100µH choke, wire ends, available from Repanco Ltd., 203-265 Foleshill Road, Coventry, the price of each is 50p including postage.

point—even the low 8Ω types that are now common; the effect on the meter part of the circuit is marginal. The output is also connected to the meter circuit through C13 which rectifies the a.f. and applies it to the meter. D1 provides the d.c bias necessary for correct operation of D2. Since the variation of signal strength applied to this circuit is far more than any meter could sensibly handle, a sensitivity control is fitted. This is simply a variable resistor in series with the meter M1.

When the audio signal is at minimum, the meter will be showing the minimum reading and since we are not interested in calibration, only in noting the minimum deflection, a very simple and inexpensive meter may be used here. The most suitable type is a recording level meter; these come in a variety of shapes and sizes but most have a sensitivity of about 200μA and cost between 50p and £1. Suitable types are listed in the catalogues of the large mail order component suppliers.

The current drain of the prototype was measured at about 10mA and a PP3 or PP6 type battery may be used; the low consumption should ensure a long battery life.

SW2 is a separate on-off switch and C1 decouples the positive line. The table shows the transistor voltages measured on the prototype; these may be of help if difficulty is experienced in getting the circuit to operate.

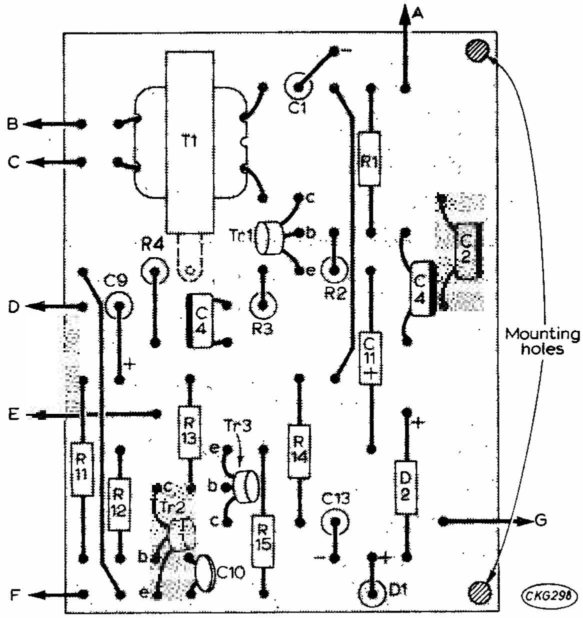


Fig. 4: The majority of the components are mounted on a small piece of Veroboard as shown. Certain of the conductor strips should be broken.

CONSTRUCTION

The circuit can, of course, be built into any type of case but the one chosen for the prototype is a very convenient size and looks very attractive. The main body of the case is made from thick plastic and the front panel from aluminium with mounting screws provided. An internal chassis is also provided but this is not required for our purposes. Bearing in mind the attractive appearance of the case the price, £1·25, is not expensive; details of the supplier are given in the components list. All the components are fitted to the front panel and the drilling and cutting of this is shown in Fig. 3. The front panel is supplied with a protective plastic sheet and this is best left on while the marking is done to prevent scratching but it should be removed before the actual drilling starts. The meter cut out is shown for the type used in the prototype but other types may vary and so this dimension may have to be worked out separately. The holes are of two diameters, $\frac{3}{8}$in and $\frac{1}{4}$in. Two holes are not shown on this diagram: these are for the component board mounting bracket. These are best sited to suit the type of bracket used; they will lie to the right of the VR1 hole.

The majority of the components are fitted to a piece of Veroboard with a 0·15in. matrix. The layout for this is shown in Fig. 4. Three chassis and two positive lines are used, these are connected by link

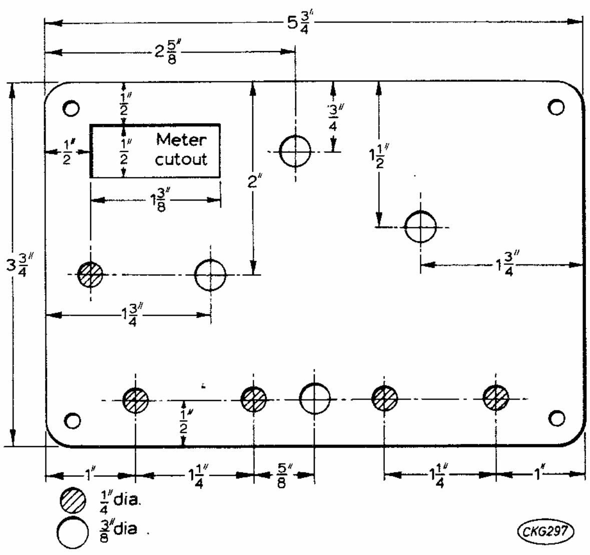
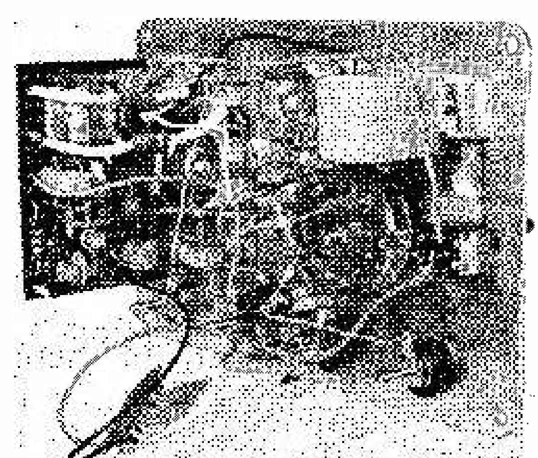


Fig. 3: The front panel, which is supplied with the case, should be drilled and cut as shown.



All the components are mounted on the front panel. The wiring, especially around VR1, should be short and straight.

wires as shown. The transformer T1 is fitted with two tabs which are rather larger than the holes in the board, but by slightly enlarging these with a drill the tabs may be pushed through the board and on one side bent over and soldered to the adjacent strip. The upper tag should be soldered to the upper strip. It is important that both sides are soldered to the correct strip as the upper strip must be at chassis potential for the connection for C1. Take-off pins are connected at various points, these are marked A-G and correspond with similar letters in Fig. 5.

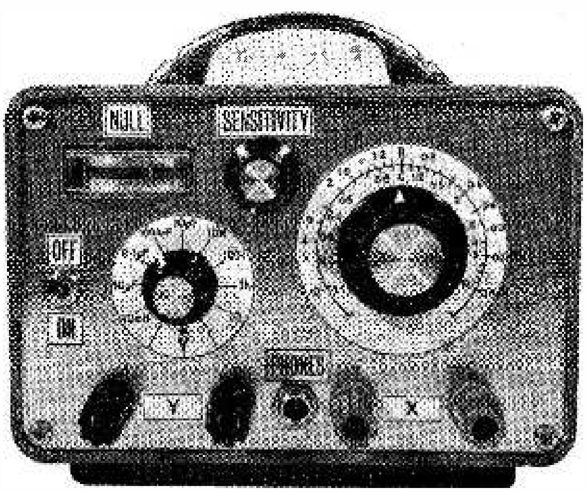
Several breaks are necessary in the copper conductor strip but these are clearly shown in the diagram.

Figure 5 shows the remaining wiring. The component board should be fitted to an aluminium angle bracket which in turn should be fitted to the front panel. A solder tag can be fitted under one of these mounting screws to act as the main chassis connection.

The standard components are wired directly to the switch SW1 and a common wire connects one side of these together; the photograph should make this clear.

To minimise the capacity of the wiring, all connections from and to SW1 and VR1 should be as short as possible and good stout wire should be used; it may look less attractive but will improve the performance of the unit.

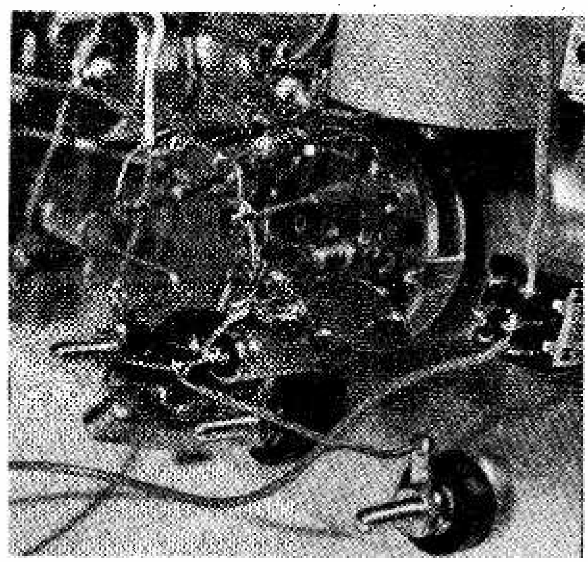
The only component not on the front panel is the battery. This fits into the main body of the case and should be held in some form of clip to prevent it moving around.



Using the recommended case, and taking care over the labelling of the controls, the finished unit can look quite professional.

CHOICE OF STANDARDS

The accuracy of the unit depends on two factors: the quality of the standards and the care taken in calibration. One per cent resistors are available although they are hard to find. Two per cent types are not all that expensive and should be quite adequate; Home Radio list these in their catalogue at 5p each. One per cent capacitors are available from a number of suppliers including Electrovalue Ltd., though C9, 10μF, costs a small fortune in this tolerance. However, it is highly unlikely that high accuracy is needed on this range.


Close-up of the reference components showing how these are wired directly to the switch.

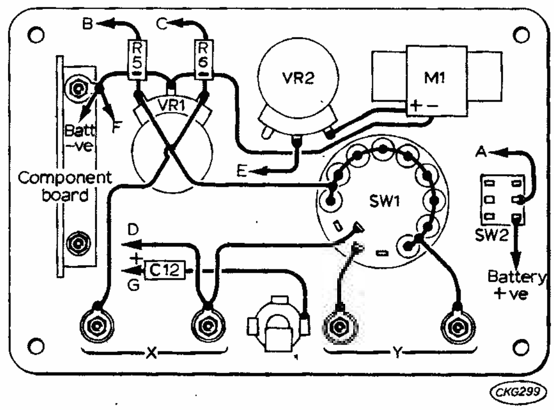


Fig. 5: Wiring of the controls. The letters match up with those on the main component board.

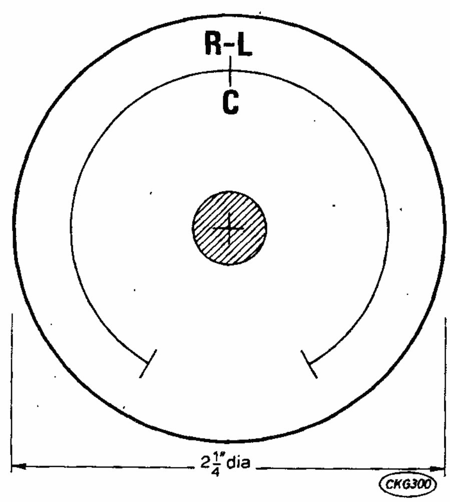


Fig. 6: This scale may be cut out and calibrated as described in the text.

The inductors chosen for the circuit are a matter of choice. The author only included two in the prototype, a 10mH and a 100μH. Arrangements have been made with Repanco Ltd., for the supply of these 5 per cent tolerance inductors, details are given in the components list. This will allow measurement within reasonable accuracy of inductors lying within the range 1mH to 10μH. Lower inductances can be measured but the accuracy below this must be suspect because of strays in the circuit.

The matter of standards must be left up to the reader. Many people may be content using 5 per cent components throughout and certainly little usefulness will be lost.

CALIBRATION

A blank calibration scale is shown in Fig. 6. This can be cut out and stuck onto the front panel, the null position is already marked. For calibration a source of close tolerance components is required and the remarks made above apply. However, as we are only interested in one set of markings, this can be done using the cheapest components—resistors. The best range on which to calibrate is probably the 1kΩ one and a set of resistors with their values ranging between 100Ω and 10kΩ will be needed. Points can be obtained by interpolation if only a few components are used. Alternatively, if a highly accurate test meter is available (one with an individually calibrated scale) a variable resistor can be adjusted on this and then used for the calibration. There are several ways of approaching this problem and the above points are only a guide. However, once calibrated, the scale will hold good for all values of resistance, capacitance and inductance as long as the standards are accurate.

For matching two components the internal standards are not used. The two components are fitted to X and Y and their similarity compared, if they are the same the null will appear at the 1:1 setting right at the top. ■

MAXWELL

by G8DSH

"I think it needs a plug change and its valves ground in!"

Electronotes..

S. GINSBERG

SOMETIME back, comment was made in this column about miniature lasers. Some will have wondered about the applications of these devices while others, perhaps, even doubted the existence of such midget marvels.

It will be of interest, therefore, that small lasers are available in this country from a company in Edgware. These are colourfully described as "Hip Pocket He-Ne Lasers". Ratings of one, three and 10mW are available and the power supply allows operation from 230V a.c. or 12V d.c. Dare our imagination picture a man from Mars reaching for the "sky" on the commands of a Space Sheriff on whose hip hangs a 45MW laser? Jesse James would turn in his grave!

Before anyone ridicules the laser as just a novelty, they should consider the latest application by the Dutch electronics giant Philips. The Eindhoven laboratories use one in their latest system of video recording.

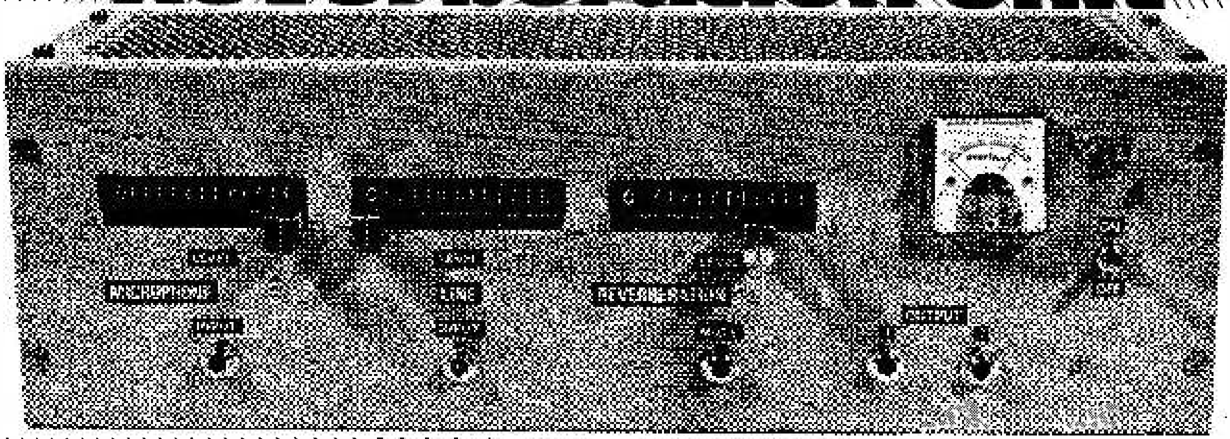
The reflection from a minute spot of light generated by a miniature laser is used to obtain a signal from a video LP. A 45 minute colour television programme can be recorded on a normal LP sized disc. This amounts to something like recording 50,000 separate frames or individual pictures.

Since there is no direct physical contact with the pick-up head, wear is almost non existent. However, one sees scratches as a problem and, more importantly, dust and/or dirt in the groove will throw up as noise in the system.

New electronic products flood the market every week. From amongst the current list is an interesting new IC. It is believed to be the first IC timer commercially available. Designated the 555 its applications include a timer which will cover intervals from fractions of a second to one hour, frequency divider, frequency modulator and missing pulse detector.

Another interesting newcomer is the range of epoxy-coated inductors. This IR-4 Series extends from 0·015μH to 240μH which is a very useful coverage. The devices are small, wire-ended and colour coded. The smaller ones in the range might be mistaken for resistors by the unwary. Self-resonant frequencies go from 5·9MHz to 525MHz. Weight is only 0·65 grammes maximum and size of the largest is 0·45in. by 0·2in. with an overall length of almost 3in. (including the length of the wire end leads). Looks as though it won't be long before nobody bothers to wind coils. Old timers in radio wil be saddened and doubtless harbour fond nostalgic memories of winding 100 turns of 24s.w.g. on a cardboard toilet roll former in order to receive 2LO.

Reverberation Unit



F.C.JUDD

PART TWO

CONNECTIONS to each of the panel mounted components are given in Fig. 11. Note that the slider control connections are numbered as follows—1 is the earth connection, 2 is the slider and 3 is the signal input. They must be wired this way to obtain the logarithmic performance of the potentiometer.

The layout and wiring of the circuit board is shown in Fig. 12. Note also that the leads coupling the spring line unit to the circuit board have to be screened and connected to the unit itself by means of phono plugs.

Construction of the power supply is shown in Fig. 13 in which details are also given regarding the size of the chassis etc. The capacitor C13 and the bridge rectifier BR1 are mounted on a small piece of circuit board elevated from the chassis on stand-off pillars.

Checking out and Performance

The overall performance of the finished reverb unit is given in the specification table given last month.

The supply rail current at the negative 18V point (see circuit) should be approximately 15mA with no signal and with the reverb control off. The no-signal current of the reverb driver amplifier only should, if possible, be checked by connecting a meter in series with the negative supply rail at the starred point shown in Fig. 2. The pre-set PR1 should be adjusted until the standing current is about 10mA. Otherwise set PR1 to mid position.

With signals, and with the reverb control VR3 at max, the current to the driver amplifier should rise to not more than 100mA on speech peaks. A higher current indicates overload.

The Overload Meter

The overload meter will read only with reverb on and on strong signals may show full scale deflection. This is well beyond the point of overload at which distortion from the reverb amplifier circuit will be high. The meter used in the prototype is an Eagle type MR2P with a 50μA movement and calibrated 0-10. For the prototype reverb unit the figures on the meter scale were erased leaving only the scale itself. The overload point is marked (in red ink) at what was division 8 as shown in Fig. 14. In normal use the input signal should always be adjusted so that with full reverb the overload meter never quite reads to the overload mark.

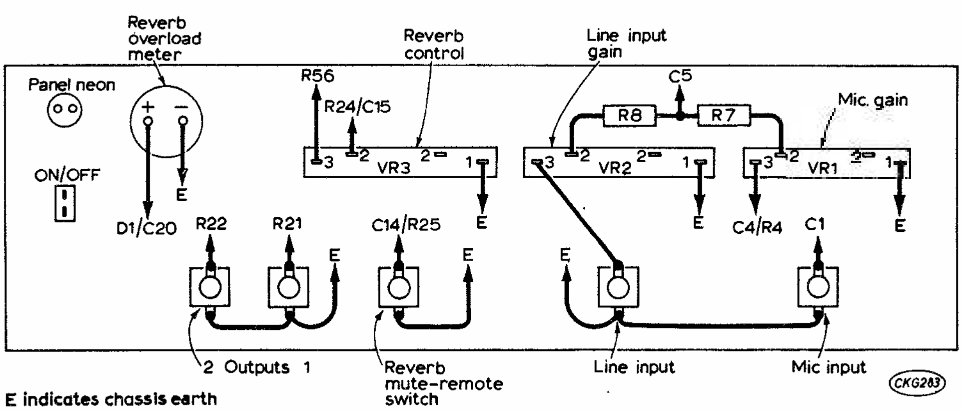
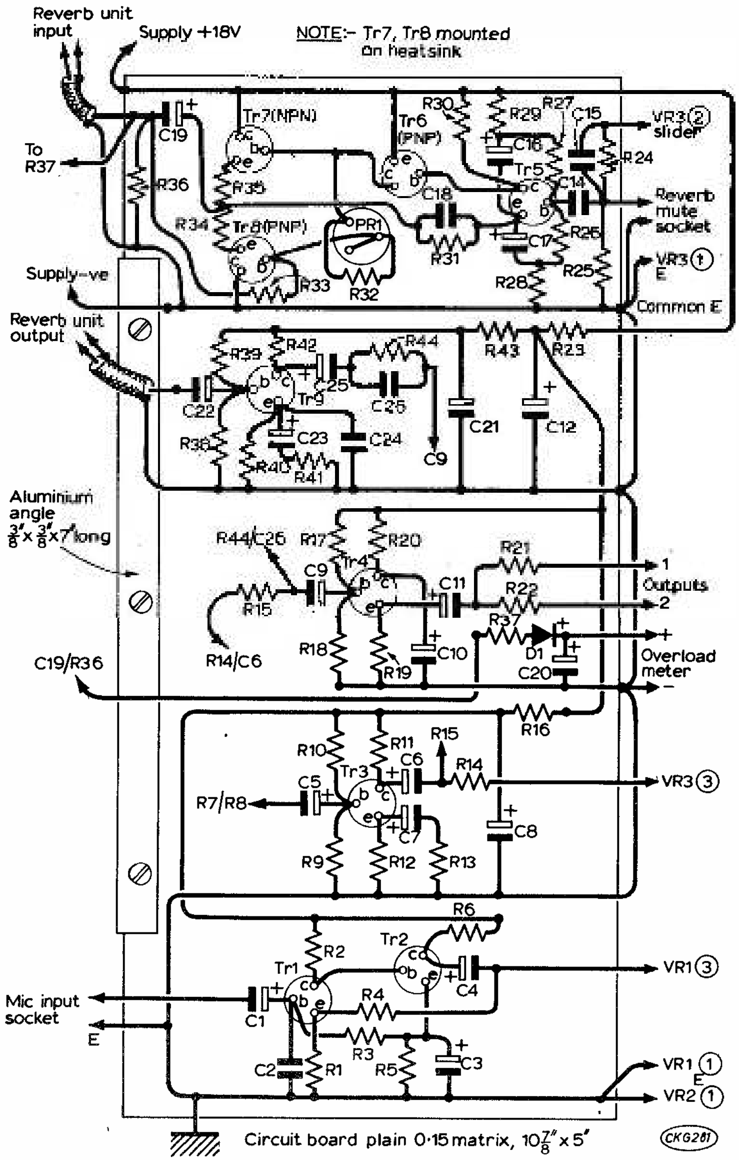


Fig. 11: The wiring of the front panel components.



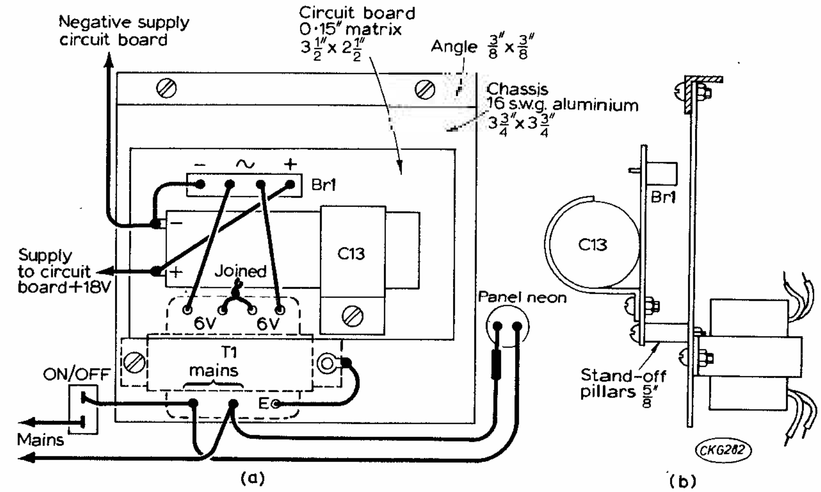
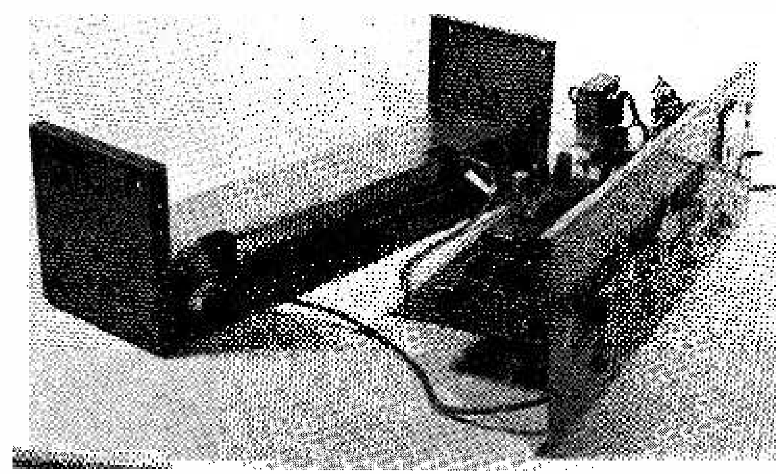


Fig. 12 (left): The wiring of the main component board. The siting of this can be seen from the photograph below.

Fig. 13 (above): The wiring and construction of the power supply on its own small sub-chassis.



A view of the prototype. The main component board and power supply sub-chassis can be seen behind the front panel and fixed to it.

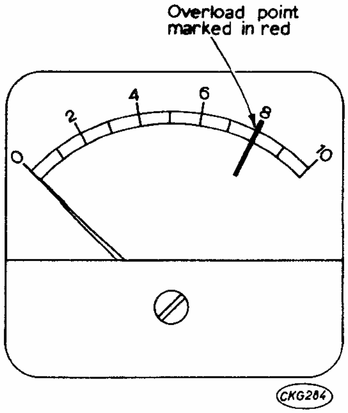


Fig. 14: The overload meter can be marked as shown. The plastic cover can easily be removed to do this.

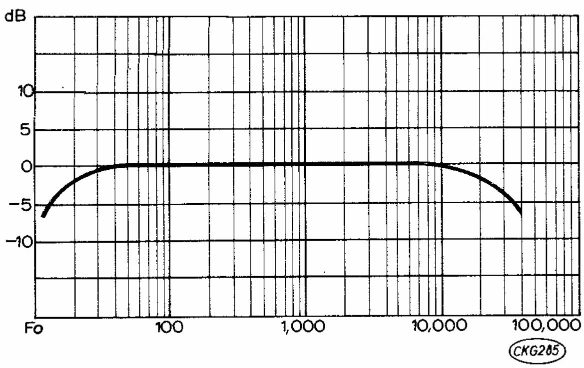


Fig. 15: The overall frequency response of the reverb unit from either input but with no reverb included.

Frequency Response

The overall frequency response for through signals (i.e., with reverb 'Off'), is shown in Fig. 15. The frequency responses of the spring line driver amplifier and its output amplifier can be checked against the responses shown in Figs. 3 and 4 respectively. For checking the response of the line driver amplifier, connect an audio signal generator at the junction of R14 and VR3 and set VR3 at maximum. Input signal should be not greater than about 20mV. Check the response at the output with an audio voltmeter between C19/R36 and chassis and with the line unit disconnected. Check the response of the spring line output amplifier Tr9 with an audio signal generator connected to C22 and with line unit output plug connected. Input signal should not be greater than about 5mV. Check the response with an audio voltmeter connected between C9/R15 and chassis.

Reverb Mute

The socket marked "Reverb Mute" (external remote switch) as in Fig. 2, is optional but can be used for remote control by means of a switch on the end of a screened lead. When the switch is closed signals feeding the reverb driver amplifier are short circuited to chassis. ■

The Medium Wave Column

CHARLES MOLLOY

GEOFFREY DRIVER who lives in Woodham, Surrey has been active on the medium waves and he reports reception of Tenerife, Canary Islands on 620kHz after 2300hrs; Radio Andorra 701kHz in both French and Spanish from 2030hrs until midnight; Radio Portugal 755kHz in English at 2300hrs with "DX Magazine" on the last Monday of the month; Algiers 890kHz in English at 0300hrs; Bissau, Portuguese Guinea with a good signal on 1070kHz after midnight.

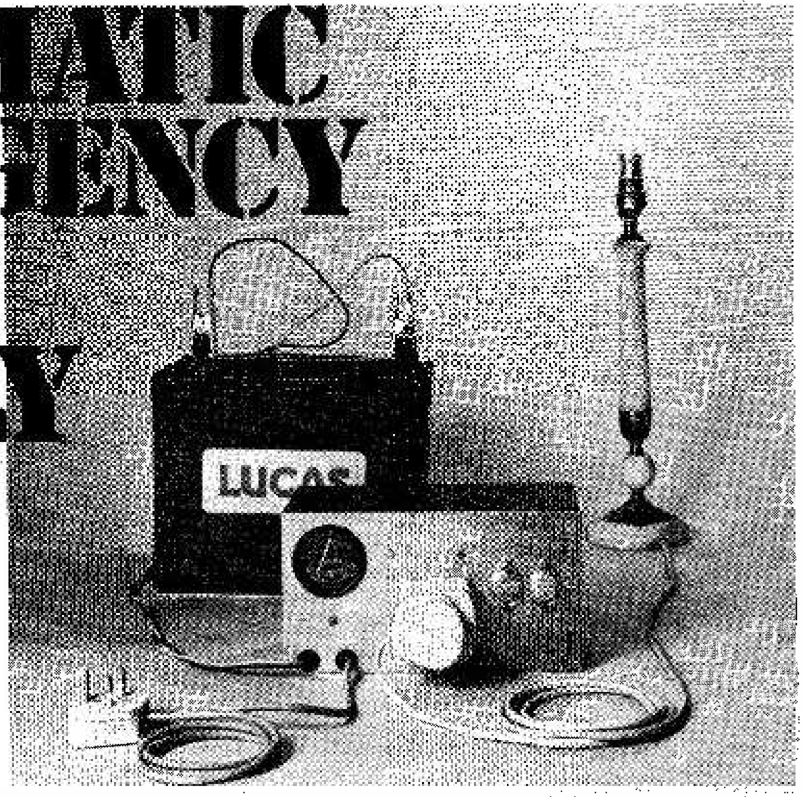
During the winter months North American medium wave stations are often heard in the U.K. before midnight and sometimes they are audible as early as 2300hrs. This is the hour when a number of Europeans close down for the night leaving a few spaces for the DX to be heard. North Americans operate on channels spaced 10kHz apart and all of them are allocated identifying call letters which they use frequently. Listen on 710kHz at 2305hrs after Cairo 2 signs-off, for CJOX which is located in Grand Bank, Newfoundland. This is a commercially owned station and it carries the "CJON Radio Service" programme. On 1070kHz, Paris closes down at 2300hrs leaving the frequency clear for CBA, a 50kW outlet of the Canadian Broadcasting Corporation situated in Moncton, New Brunswick. CBA relays the CBC Radio Network and it identifies locally on the hour and the half hour. Propagation is variable on the North American path but when conditions are favourable CJOX and CBA should be heard by 2330hrs. Others to listen for between 2330hrs and midnight, are WHDH Boston on 850kHz; CJON St John's, Newfoundland on 930kHz; CBM Montreal on 940kHz; CHER Sydney, Nova Scotia 950kHz; WINS New York City on 1010kHz; WNEW 1130kHz also in NYC; CKEC 1320kHz in New Glasgow, Nova Scotia.

A list of North American loggings made in the UK since 1962 and covering nearly 400 different stations, is currently being distributed by the Medium Wave Circle to its members. This club, which is now in its 19th year, deals exclusively with DXing on the medium waves. Its bulletin "Medium Wave News" appears 8 times a year and contains up-to-date information about the medium waves, loggings of DX, a verification section and articles on MW DXing. Further information about the MWC is obtainable from Ken Brownless, 7 The Avenue, Clifton, York YO3 6AS.

S. N. Gaythorpe of Cranbrook, Kent asks if it is possible to hear Bermuda on the medium waves. Bermuda has 3 medium wave stations; ZFBI on 960kHz; ZBM1 on 1230kHz and ZBM2 on 1340kHz and all have been heard in the UK. There is no short wave broadcasting in Bermuda and consequently this is a "medium waves only" DX country. Try on 1230kHz after midnight for ZBM1, and log this rare DX country.

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

AUTOMATIC EMERGENCY 250V SUPPLY



Within the last two years there have been two electricity supply emergencies and, at the time of going to press, there is a possibility of another. This unit will save you the indignity of spending yet another spell 'blacked-out'.

S. SOAR

THE unit described here was developed during the power crisis of February 1972 and was primarily intended as a standby emergency lighting unit, although since the restoration of normal power the device has had considerable use, both as a battery charger and as a portable power supply in garage and caravan. The power output is sufficient to operate a small electric drill or an inspection lamp.

Specification

	As a Charger	As an Inverter
Input	240V mains	12V battery
Output	12V, 12A d.c. to battery	240V, 50Hz square wave, up to 150W

Circuit Description

The unit has two modes of operation, with a 12V accumulator and 240V mains connected, the unit is a charger capable of delivering up to 12A, this charge rate falls to approximately 1·5A with the battery fully charged. An auxiliary socket on the unit provides a 240V mains output.

In the event of the mains supply being interrupted, the unit automatically switches over and power is taken from the battery and by inverter action is delivered to the auxiliary socket at 240V thus maintaining the supply. When the mains supply is restored, the unit again switches automatically to its charging condi-

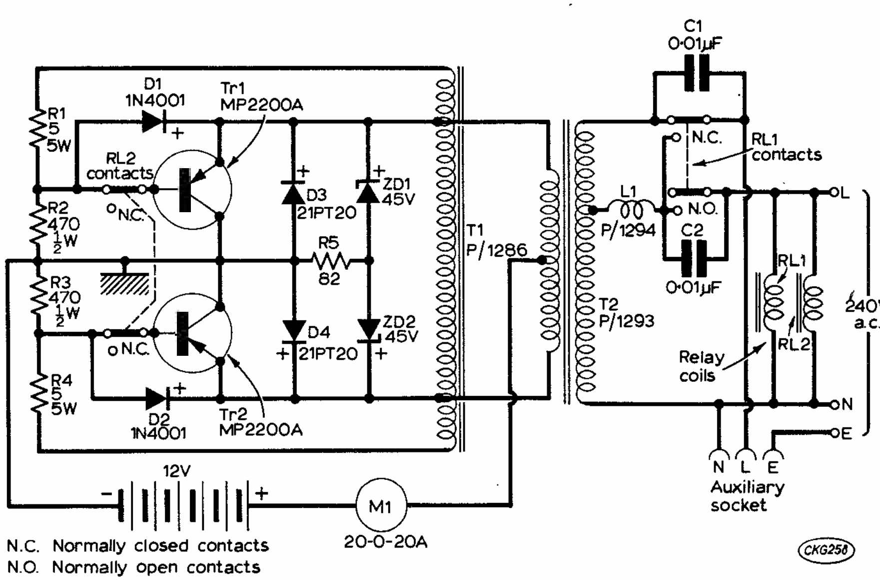


Fig. 1: The complete circuit on the combined charger/inverter. This will give up to 150W at 240V, 50Hz. See text for a description of the operation.

tion and the battery is restored to its fully charged state.

Since the inverter output is a square wave, it is not ideally suitable as a supply for equipment such as a television receiver, however, satisfactory performance has been achieved with slightly reduced picture size and tolerable interference on sound.

As a Charger

With the mains supply connected, relays RL1 and RL2 are energised, transistor bases are isolated and mains supply is connected directly to the auxiliary socket and to the output transformer secondary via choke L1. Rectifiers D3 and D4 supply full wave rectified current to charge the battery. Ballast choke L1 limits the charging current to a safe maximum of around 12A with a flat battery, this charge rate decreasing as the battery potential rises.

As an Inverter

With the mains supply interrupted, the relays de-energise, the transistor bases are connected and the output socket is connected directly to the secondary of the output transformer. The unit now operates as an inverter.

Referring to Fig. 1, assume Tr1 to be conducting, then transformer action (T1) holds Tr2 off (+ve on base) and Tr1 on (−ve on base) magnetic flux in the transformer core (T1) increases uniformly and current is substantially constant. However, as the flux density in the core approaches saturation, current increases rapidly in an attempt to maintain the rate of flux increase constant. Base drive on Tr1 is limited by R1 and the gain of the transistor falls with increased collector current, these two factors result in Tr1 coming out of its saturated state and collector current can increase no further, flux cannot increase and base drive falls causing a further reduction in collector current. Falling flux causes Tr2 to become biased on and the collector current increases rapidly and Tr2 is switched hard on, this completes one cycle.

Frequency of operation is determined by the time taken for the transformer core to saturate, suitable choice of core and windings results in an operating frequency of approximately 50Hz.

The transistors are protected against reverse bias by diodes D1 and D2, and ZD1 and ZD2 clip voltage switching transients to a safe level.

Construction

Since the power transistors are connected in common collector, these devices should be fixed directly to the chassis, 16 s.w.g. aluminium was used on the prototype. Transformers, relay and choke are also bolted directly to the chassis, and if rectifiers with anode studs are used, these can also be fixed directly to chassis. Other components should be mounted on insulated tag strips. It is advisable to have all low voltage components on one side of the output transformer (i.e. primary winding side) and all mains voltage components on the other side (i.e. secondary side). ■

★ components list

Resistors

R1	5Ω	5W	R4	5Ω	5W
R2	470Ω	½W	R5	82Ω	1W
R3	470Ω	½W			

Semiconductors

Tr1 MP2200A		D3	20A 100V p.i.v. rectifier (e.g. 21PT20)
Tr2 MP2200A		D4	20A 100V p.i.v. rectifier (e.g. 21PT20)
D1 1N4001		ZD1	45V 1W zener, e.g. 1S3045
D2 1N4001		ZD2	45V 1W zener, e.g. 1S3045

Tr1 and Tr2 are available from Jermyn Industries, Vestry Estate, Sevenoaks, Kent. D3 and D4, 21PT20, are International Rectifier types. ZD1 and ZD2 are available from Quarndon Electronics, Slack Lane, Derby.

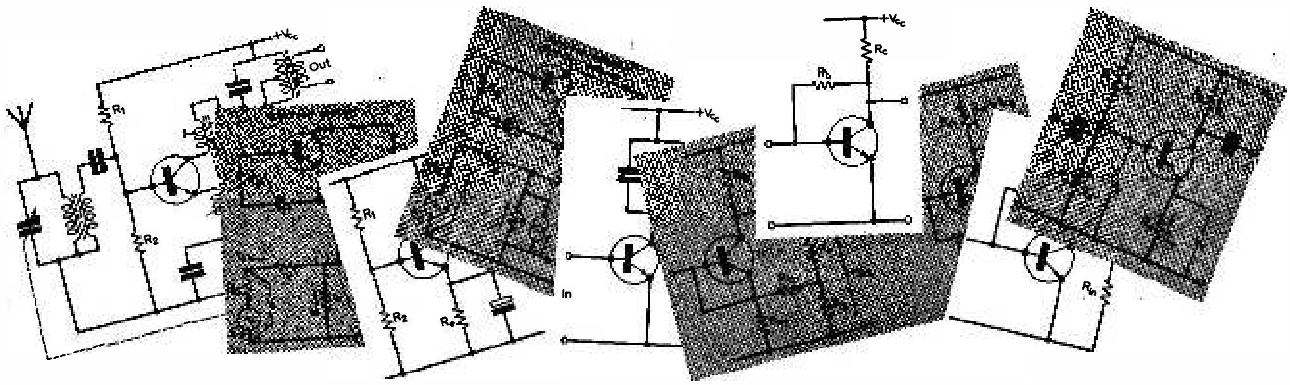
Transformers, Coils and Relays

RL1 2-pole changeover with 240V a.c. coil
RL2 2-pole changeover with 240V a.c. coil
T1 Driver transformer type P/1286
T2 Output transformer type P/1293
L1 Ballast Choke type P/1294

T1, T2 and L1 are available from Magtor Limited, 68 Dale Street, Manchester; a complete kit of these costs £6·65 plus 50p postage.

Miscellaneous

C1, C2, 0·01μF 600V; M1, Ammeter with centre zero, 20–0–20A or similar (Car types are suitable).



TRANSISTOR CIRCUITRY for beginners

PART 13

H. W. HELLYER & MICHAEL HOLLIER

Minimum noise

We have already stated that our principal aim is as good a signal swing as we can afford provided that we do not thereby increase the noise in the circuit. With any transistor type, some noise is generated, but this can be aggravated tremendously by collector currents and also by the source resistance seen by the transistor—and, as might be expected, the optimum conditions alter with frequency.

A digression here, for colleague Mike feels strongly on this subject, having been too often caught with unsuitable replacements. Transistors with the same code number but made by different firms can have widely odd noise performances, as we have found when using them for laboratory equipment.

To find the optimum operating conditions under which our chosen transistor is to be used, we must turn to the graphs of noise figures quoted by the maker. These indicate a typical noise level expected at a selected collector current, with a selected source resistance 'seen' by the transistor base. But the quotes are at one single frequency. In practice we find conditions vary widely—a whole family of curves is really needed for optimum choice—and is seldom available, even from our old friends Mullard, who kindly acknowledged our quotes while pointing out an omission, in a letter from L. W. Owers in the October issue of *PW*. Very few firms, including Mullard, give figures that allow us to optimise for the whole audio band—in fact, they seem to think the world ceases revolving below 100Hz, giving data at 1kHz and 10kHz, generally. More noise is generated at low frequencies than high, and the higher the operating current, the higher the noise level.

We have decided upon a collector current of 80 microamps for Tr1 and the graphs, such as are available, would indicate that a source resistance of between 5 and 20kΩ would be best for low noise. We shall aim at the lower figure.

The base of Tr1 will 'see' the resistance formed by the virtual earth (see Fig. 62) shunted by the series input resistor plus whatever the impedance may be of the device that is feeding the circuit. The inset of Fig. 64 should give us some idea.

The virtual earth resistance can be calculated from $R_v = \dfrac{R_b}{G_o}$ so R_b becomes 500kΩ, or, in practice, a 470kΩ, 5% component. The voltage across this resistor is the Tr2 emitter voltage less the base voltage of Tr1, or 9·303V and the current through this resistor will be around 19·8 microamps (remember we are ignoring the very small Ib1).

The current through R2 will, of course, be the same. So we come to a preferred value of 39kΩ. I shall not insult you with the details of the workings after 11 plodding articles of preparation . . .

We now have a working circuit with a low input resistance of around 5kΩ. And we insert R3 into the base 'feed' circuit of Tr1. This does two things: first, it raises the input resistance—that is, the resistance the source will 'see'; second, it gives us some control of the gain of this circuit. Remember, closed loop gain is equal to R_b dividend by R, which is, in this particular configuration, R1+R3. To get a theoretical gain of 20, for example, R3 would have to be 23·5kΩ (preferred value, 22kΩ).

$$G_c = \frac{R1}{R3} = \frac{470k\Omega}{22k\Omega} = 21{\cdot}3613$$

Coupling

As for that input and output coupling. We found, in practice, great care had to be taken. In fact, we built the circuit and had some very strange figures before remembering that the feedback was both a.c. and d.c. conscious. So the input capacitor serves a double function; that of blocking the d.c. from previous stages (and *to* previous stages) and coupling the signal to the stage which we are designing.

Now the problem is that it must be of a sufficiently large value to present a short-circuit, or as near this as may be, to the frequencies over which our amplifier has to work. In the practical case, something like 200μF is in order. One reason that

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TRANSISTORS

2G301	0·15	2N2924	0·12
2G302	0·15	2N2925	0·12
2G303	0·25	2N2926	
2G306	0·30	Green	0·10
2G309	0·30	Yellow	0·10
2G344A	0·25	Orange	0·10
2G345B	0·25	2N3053	0·15
2G371	0·15	2N3054	0·47
2G374	0·15	2N3054	0·46
2G381	0·22	2N3055	0·50
2G417	0·20	2N3390	0·20
2N109	0·49	2N3391	0·20
2N174	1·40	2N3391A	0·22
2N176	0·75	2N3392	0·13
2N274	0·75	2N3393	0·12
2N335	0·75	2N3394	0·12
2N351	0·95	2N3402	0·17
2N376	1·00	2N3403	0·19
2N384	0·93	2N3404	0·24
2N388A	0·40	2N3405	0·27
2N404	0·23	2N3414	0·10
2N404	0·20	2N3415	0·10
2N456	0·75	2N3416	0·15
2N456A	0·75	2N3417	0·21
2N457A	0·80	2N3570	1·25
2N491	3·25	2N3571	1·12
2N584	0·26	2N3572	0·97
2N591	0·34	2N3702	0·10
2N696	0·15	2N3703	0·10
2N697	0·15	2N3704	0·10
2N698	0·25	2N3705	0·10
2N699	0·29	2N3706	0·90
2N706	0·10	2N3707	0·10
2N706A	0·12	2N3708	0·70
2N708	0·13	2N3709	0·90
2N709	0·38	2N3710	0·90
2N711	0·30	2N3711	0·90
2N718	0·21	2N3712	0·95
2N718A	0·30	2N3713	1·08
2N720	0·50	2N3714	1·15
2N721	0·55	2N3715	1·23
2N914	0·15	2N3716	1·30
2N916	0·17	2N3773	2·35
2N918	0·80	2N3774	3·33
2N919	0·20	2N3775	4·19
2N929	0·14	2N3776	5·95
2N930	0·14	2N3777	4·84
2N1090	0·23	2N3778	2·25
2N1091	0·24	2N3779	3·15
2N1131	0·20	2N3780	4·50
2N1132	0·20	2N3781	3·67
2N1184	1·27	2N3782	3·37
2N1302	0·16	2N3789	1·76
2N1303	0·16	2N3790	1·90
2N1304	0·20	2N3791	2·06
2N1305	0·20	2N3792	2·20
2N1306	0·22	2N3794	0·10
2N1307	0·22	2N3819	0·26
2N1308	0·25	2N3820	0·47
2N1309	0·25	2N3823	0·50
2N1483	0·90	2N3824	0·75
2N1507	0·24	2N3826	0·23
2N1613	0·20	2N3854	0·16
2N1631	0·35	2N3854A	0·16
2N1637	0·30	2N3855	0·16
2N1638	0·27	2N3855A	0·16
2N1671	1·00	2N3856	0·16
2N1701	1·10	2N3856A	0·16
2N1702	2·15	2N3858	0·16
2N1711	0·17	2N3858A	0·16
2N1893	0·34	2N3859	0·16
2N2102	0·30	2N3859A	0·16
2N2147	0·70	2N3860	0·16
2N2148	0·60	2N3866	0·70
2N2192	0·40	2N3877	0·25
2N2192A	0·40	2N3877A	0·26
2N2193	0·40	2N3878	1·22
2N2193A	0·42	2N3879	1·91
2N2194	0·27	2N3900	0·20
2N2194A	0·30	2N3900A	0·21
2N2195	0·37	2N3901	0·32
2N2195A	0·18	2N3903	0·20
2N2218A	0·18	2N3904	0·17
2N2219	0·20	2N3905	0·21
2N2219A	0·20	2N3906	0·20
2N2220	0·20	2N4036	0·40
2N2221	0·20	2N4037	0·35
2N2221A	0·22	2N4058	0·12
2N2222	0·20	2N3059	0·90
2N2222A	0·25	2N4060	0·11
2N2368	0·11	2N4061	0·11
2N2369	0·12	2N4062	0·11
2N2369A	0·15	2N4302	0·25
2N2646	0·41	2N4303	0·32
2N2647	1·20	2N4913	0·80
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	0·26	2N4920	0·60
2N2905A	0·23	2N4921	0·50
2N2906	0·18	2N4922	0·55
2N2906A	0·23	2N4923	0·60
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
2N5172	0·08	AF117	0·20
2N5174	0·22	AF118	0·50
2N5175	0·26	AF121	0·22
2N5176	0·32	AF124	0·24
2N5245	0·43	AF125	0·20
2N5190	0·92	AF126	0·19
2N5191	0·96	AF127	0·20
2N5192	1·24	AF139	0·38
2N5193	1·01	AF170	0·25
2N5194	1·10	AF172	0·25
2N5195	1·46	AF178	0·55
2N5245	0·43	AF179	0·65
2N5457	0·30	AF180	0·50
2N5458	0·33	AF186	0·40
2N5459	0·33	AF200	0·35
3N128	0·63	AF239	0·41
3N138	1·37	AF240	0·72
3N199	1·36	AF279	0·54
3N140	0·76	AF280	0·54
3N141	0·69	AFY42	0·74
3N142	0·54	AF211	0·55
3N143	0·64	AL102	0·75
3N152	0·79	AL103	0·70
3N153	0·74	ASY26	0·30
3N154	0·74	ASY27	0·36
3N159	1·00	ASY28	0·28
3N187	1·30	ASY29	0·30
3N200	2·07	ASY50	0·20
3N201	1·05	ASY55	0·35
		ASZ21	0·55
		AU103	1·25
40050	0·78	BC107	0·10
40251	0·81	BC108	0·10
40309	0·33	BC109	0·12
40310	0·50	BC113	0·10
40313	0·92	BC114	0·12
40316	0·50	BC115	0·15
40318	0·92	BC116	0·15
40322	0·92	BC116A	0·18
40360	0·46	BC117	0·20
40361	0·48	BC118	0·11
40362	0·44	BC119	0·27
43063	0·88	BC121	0·20
40389	0·46	BC123	0·25
40394	0·56	BC125	0·15
40395	0·50	BC126	0·20
40406	0·44	BC132	0·30
40407	0·33	BC134	0·11
40408	0·50	BC135	0·11
40409	0·52	BC136	0·15
40410	0·58	BC137	0·15
40411	2·00	BC138	0·20
40414	3·55	BC140	0·30
40438	1·44	BC141	0·34
40467A	0·69	BC142	0·18
40468A	0·44	BC143	0·21
40600	0·69	BC144	0·24
40601	0·67	BC145	0·21
40602	0·46	BC147	0·10
40603	0·58	BC148	0·09
40604	0·56	BC149	0·10
40636	1·10	BC153	0·10
40673	0·56	BC154	0·11
AC107	0·35	BC157	0·09
AC113	0·16	BC158	0·10
AC115	0·16	BC159	0·10
AC117	0·20	BC160	0·37
AC121	0·13	BC167B	0·11
AC126	0·20	BC168B	0·10
AC127	0·20	BC168C	0·10
AC128	0·20	BC169B	0·11
AC141K	0·30	BC169C	0·11
AC142K	0·25	BC170	0·11
AC151V	0·14	BC171	0·13
AC152V	0·17	BC172	0·11
AC153	0·22	BC182	0·10
AC153K	0·25	BC182L	0·10
AC154	0·20	BC183	0·09
AC176	0·18	BC183L	0·09
AC176K	0·20	BC184	0·11
AC187K	0·20	BC184L	0·11
AC188K	0·26	BC186	0·25
ACY17	0·25	BC187	0·25
ACY18	0·15	BC204	0·11
ACY19	0·20	BC205	0·10
ACY20	0·20	BC206	0·11
ACY21	0·18	BC207	0·10
ACY22	0·13	BC268	0·09
ACY28	0·18	BC209	0·10
ACY30	0·42	BC211	0·30
ACY39	0·55	BC212K	0·10
ACY40	0·17	BC212L	0·12
ACY41	0·15	BC214L	0·14
ACY44	0·23	BC236	0·16
AD136V	0·94	BC237	0·08
AD140	0·50	BC238	0·08
AD140	0·55	BC239	0·08
AD142	0·50	BC251	0·20
AD143	0·45	BC252	0·18
AD149V	0·66	BC253	0·23
AD149V	1·26	BC257	0·08
AD150	0·63	BC258	0·08
AD161	0·37	BC259	0·11
AD162	0·37	BC261	0·20
AD161 } AD162 }	PR 0·69	BC262	0·18
ADZ11	1·50	BC263	0·23
ADZ12	1·75	BC300	0·42
AF106	0·27	BC301	0·34
AF109R	0·40	BC302	0·27
AF114	0·25	BC303	0·50
AF115	0·24	BC304	0·43

BC307	0·09	BF271	0·21
BC307A	0·09	BF272	0·53
BC307VI	0·09	BF273	0·25
BC308	0·08	BF274	0·28
BC308A	0·08	BF457	0·46
BC308B	0·08	BF458	0·57
BC309	0·09	BF459	0·57
BC309A	0·09	BFS21	2·10
BC309B	0·09	BFS21A	2·30
BC313	0·30	BFS28	0·92
BC327	0·21	BFS61	0·27
BC328	0·19	BFS98	0·28
BC337	0·17	BFW10	0·61
BC338	0·17	BFW11	0·61
BCY30	0·27	BFW15	0·35
BCY31	0·30	BFX13	0·23
BCY32	0·50	BFX29	0·25
BCY32	0·50	BFX30	0·25
BCY33	0·25	BFX37	0·30
BCY34	0·30	BFX44	0·33
BCY38	0·40	BFX63	2·48
BCY39	0·60	BFX68	0·30
BCY40	0·50	BFX84	0·24
BCY42	0·15	BFX85	0·29
BCY43	0·15	BFX86	0·24
BCY58	0·18	BFX87	0·25
BCY59	0·19	BFX88	0·20
BCY66	0·58	BFX89	0·45
BCY67	0·82	BFY10	0·35
BCY70	0·15	BFY11	0·45
BCY71	0·20	BFY17	0·90
BCY72	0·13	BFY18	0·25
BCY87	3·47	BFY19	0·25
BCY88	2·40	BFY20	0·50
BCY89	0·80	BFY29	0·40
BCZ10	0·27	BFY37	0·20
BCZ11	0·40	BFY41	0·43
BD115	0·75	BFY43	0·62
BD116	0·75	BFY50	0·16
BD121	0·65	BFY51	0·16
BD123	0·80	VFY52	0·16
BD124	0·60	BFY53	0·15
BD130	0·50	BFY56	0·34
BD131	0·75	BFY64	0·41
BD132	0·75	BFY75	0·40
BD135	0·38	BFY76	0·22
BD136	0·44	BFY77	0·24
BD137	0·47	BFY78	0·36
BD138	0·55	BFY90	0·55
BD139	0·62	BRY39	0·30
BD140	0·75	BSX19	0·13
BDY10	1·25	BSX20	0·14
BDY11	1·50	BSX21	0·20
BDY17	1·50	BSX26	0·34
BDY18	1·75	BSX27	0·34
BDY19	1·97	BSX28	0·25
BDY20	0·92	BSX29	0·47
BDY38	0·65	BSX30	0·68
BDY60	0·90	BSX59	0·78
BDY61	0·85	BSX60	0·54
BDY62	0·75	BSX61	0·42
BF115	0·23	BSX76	0·15
BF117	0·43	BSX77	0·20
BF119	0·58	ASX78	0·25
BF121	0·25	BSW70	0·28
BF123	0·27	BSY24	0·20
BF125	0·25	BSY25	0·15
BF127	0·27	BSY26	0·20
BF152	0·20	BSY27	0·15
BF153	0·29	BSY28	0·15
BF154	0·16	BSY38	0·15
BF158	0·15	BSY39	0·15
BF159	0·27	BSY51	0·25
BF160	0·23	BSY52	0·25
BF161	0·35	BSY53	0·25
BF163	0·20	BSY54	0·30
BF166	0·35	BSY56	0·79
BF167	0·18	BSY65	0·15
BF173	0·19	BSY78	0·40
BF177	0·25	BSY79	0·40
BF178	0·25	BSY790	0·45
BF179	0·30	BSY95A	0·09
BF180	0·35	BU104	1·42
BF181	0·32	BU105	2·25
BF182	0·30	C111	0·53
BF183	0·40	C407	0·18
BF184	0·17	C424	0·15
BF185	0·17	C425	0·36
BF194	0·14	C426	0·25
BF195	0·15	C428	0·25
BF196	0·15	C444	0·26
BF197	0·15	D40N3	0·62
BF198	0·15	GET111	0·45
BF199	0·18	GET113	0·20
BF200	0·35	GET114	0·20
BF224J	0·14	GET115	0·50
BF225J	0·19	GET119	0·35
BF257	0·22	GET120	0·25
BF238	0·22	GET535	0·20
BF244	0·16	GET536	0·20
BF245	0·33	GET538	0·20
BF246	0·43	GET873	0·12
BF247	0·49	GET880	0·30
BF254	0·14	GET883	0·20
BF255	0·15	GET887	0·20
BF257	0·41	GET890	0·22
BF258	0·46	GET895	0·25
BF259	0·48	MA8001	0·16
BF261	0·23	MA8002	0·47
BF264	1·45	MA8003	0·47
BF270	0·25		

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SN7402	0·20	0·18	SN7432	0·48	0·42	SN7472	0·30	0·25
SN7403	0·20	0·18	SN7433	0·71	0·62	SN7473	0·40	0·34
SN7404	0·20	0·18	SN7437	0·52	0·45	SN7474	0·40	0·34
SN7405	0·20	0·18	SN7438	0·52	0·45	SN7475	0·45	0·35
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SN7422	0·48	0·42	SN7450	0·20	0·18	SN7492	0·75	0·70
SN7423	0·52	0·45	SN7451	0·20	0·18	SN7493	0·75	0·70
SN7425	0·48	0·42	SN7452	0·20	0·18	SN7494	0·84	0·80
SN7426	0·32	0·28	SN7453	0·20	0·18	SN7495	0·80	0·74
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6A	—	—	25p	30p	32½p	35p	—	—
10A	30p	35p	40p	47p	56p	66p	75p	—
15A	36p	45p	48p	55p	65p	75p	87p	—
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IN916	7p	AAZ13	12p	BAY31	7p	OA10	20p
IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
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care is needed here is again to reduce that bother—noise. If we make short-circuit and open-circuit input tests while measuring the residual noise at the output, we find there are some amazingly variant readings. A practical tip, for those who get fun from building their own hook-ups, is to load the circuit, at the actual input point, with the input impedance you want the circuit to 'see'. You may be surprised at the difference from abstract theory which your eventual readings reveal!

Measurement

We have talked glibly about open-loop gain, G_0, but given no clues as to its measurement. This is no easy task—you see, if you disconnect the feedback to measure open-loop gain the first transistor bias goes adrift, and the measurements mean nothing.

We must take into account the a.c. feedback as well as the d.c., and here there is a gag which is worth recounting. A network can be made up temporarily, and inserted in place of the feedback resistor, which maintains the essential d.c. conditions, but effectively ties the a.c. feedback down to chassis. Fig. 65(a) shows a simple, three resistor

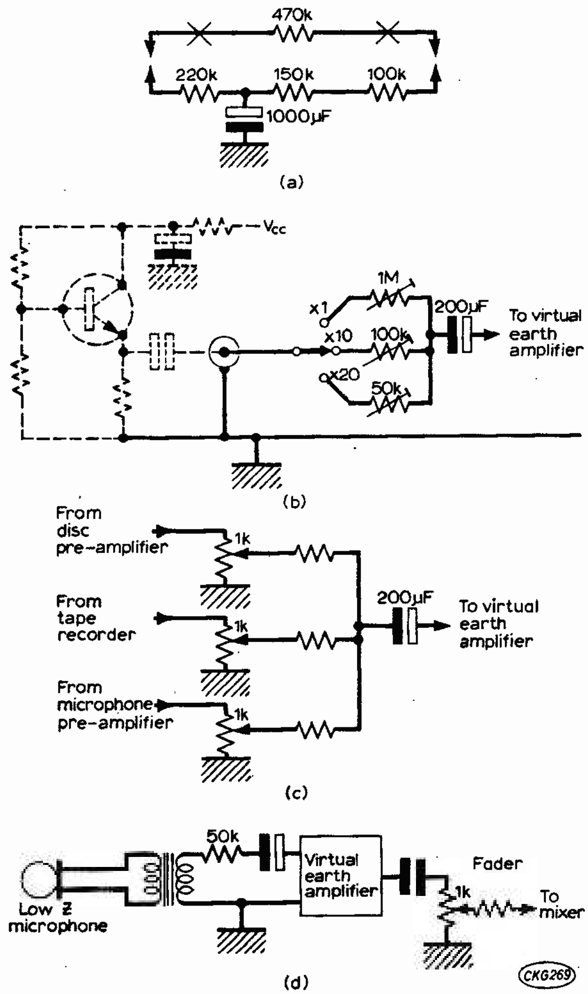

Fig. 65. (a) Substituting the feedback resistor with a decoupled network enables the gain to be measured more accurately. (b) Input for a variable gain pre-amplifier. An emitter follower, shown dotted, may be needed to effect matching. (c) Mixing facilities. (d) Microphone pre-amplifier.

and one-capacitor network, chosen so that the resistive values are approximately as R1 in Fig 64, but the large electrolytic capacitor acts as a complete shunt to any a.c. in which we might be interested. As Mike says, this may be of academic interest, but is worth a mention.

Of greater than academic interest is the capacitor shown dotted across the feedback resistor in Fig. 64. It has been said too often—which does not stop me from saying it again—that the wider one opens the window, the more the dirt blows in. Being interpreted, the wider our bandwidth, the more likelihood is there of our little amplifier getting upset by extraneous influences, like Aunty switching on the vacuum cleaner.

Without joining the argument that can set the hi-fi world by its ears; one group of contenders arguing for an almost infinite bandwidth and the inclusion of filters, the other for a 'tailored bandwidth', we can say here that the ease of making our frequency response roll off in a controlled manner at the top end appeals to us. Without that capacitor, our frequency response of the built amplifier (made up in a Norman Rose AB9 box with co-axial terminations, for complete screening) was within +0−3dB at 78kHz and at 150kHz, we were still only 8·2dB down.

At the bottom end, incidentally, we were −0·1dB at 40Hz and −0·8dB at 15Hz, which is negligible.

Shunting the feedback resistor with 22pF gave us −3dB points at 20kHz and −6dB points (complying with DIN 45 500, in case anyone wanted to argue!) at 31kHz. Under these conditions, the broadband residual noise was 0·13mV with an open-circuited input, 990 microvolts with a short-circuited input. As clipping took us to slightly over 6 volts (for a 410mV input), our signal-to-noise ratio, unweighted, could be said to be 20 log 10^{-6}:0·0001, taking a figure of 0·1mV as a typical residual noise measurement. A rather impressive (who said impossible?) 95·5dB.

Effective input noise is the output noise with input short-circuited divided by the gain. Our measured gain at a typical 10mV input was only 14·7, not as much as we had expected, but accounted for most likely by component spreads and the second transistor, which happened to be an odd type we had handy. You can always select with great care for precision, as we said earlier, but it is great fun to 'suck it and see'. So in the practical instance, we can say our effective input noise is 68 microvolts. This now becomes the limiting factor for any use to which we are going to put such a device. I think you will agree that in the present case the limitation is hardly exclusive.

Application

A few of the possible applications were hinted at previously. Without wasting any more space on design data, take a look at the three sub-circuits of Fig. 65 (b), (c) and (d). First we see a way of altering the input resistor, precisely, by presets, so that we get a variable gain pre-amplifier, as might be useful for an oscilloscope. The problem here may be an alteration of input impedance, and it is a good idea to precede the virtual earth pre-amplifier with an emitter follower stage, which gives, you will remember, a reasonably high input impedance and a low output impedance (providing the necessary low source our device wants to 'see'.)

Let's suppose we want to use the virtual earth pre-amplifier as an input stage for a mixer, where there are several odd sources that may be used separately or simultaneously, and where the action of one must not interfere with that of another. As any amateur disc-jockey will tell you, a very practical problem. In Fig. 65(c) we get the inputs from the sources taken to low value potentiometers and from there we can feed up to three R3 resistors to the virtual earth point, this time using our coupling capacitor to follow the resistors, for effective isolation. By juggling resistor values, with a little experiment, we can again get our levels somewhere the same, and use a master gain control later in the circuit, where its operation at a higher signal level will not introduce unwanted noise, etc.

Of course, there is always the microphone pre-amplifier, as in (d), where we want a bit more gain prior to a mixer stage. The transformer is a low/high or medium/high type and is best mounted in the overall screened box that houses the virtual earth amplifier.

Power supply

Finally, this month, having again not kept my promise to lead us on to tone controls, although a careful perusal of the foregoing will have seen the trend our thoughts are taking, we have a brief look at the proposed power supply for this and other projects. This was knocked up easily in an hour and needs no particular layout finesse, nor screening. It uses any convenient transformer that can give between 24 and 33 volts—not really safe to exceed 33·6V—and the rectifiers are easily obtained types with minimum requirements of peak-inverse voltage

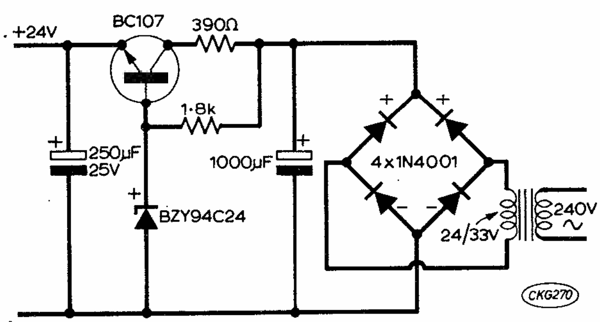

Fig. 66. A practical power supply, suitable for use with the circuits described.

50V and handling capacity 200mA. We used a REC 60 because it happened to be there, but four 1N4001's would have done. The particular requirement is the zener diode, which must be a 24 volt type, such as shown, and components can be half-watt types, with the biggest problem the mounting of the two large capacitors. Note that this zener operates in the reverse to the breakdown mode, i.e., it is set to regulate, with cathode to positive. This 24 volt output, with the 2kΩ resistor (or 2·2kΩ, if you have no 2kΩ version available) drops to the needed 20 volts for our amplifier.

TO BE CONTINUED

AMATEUR BANDS RECEIVER

—continued from page 698

crystal pass-band. Adjustment of any of the i.f.t. cores should then bring about a great increase in signal strength as they are shifted into the crystal pass-band. The i.f.t.'s are all finally peaked in this way, signal strength being reduced by VR1 as necessary.

When the i.f. amplifier is aligned in this way, a very steep sided response should be obtained. If X6 and X7 are removed and a 100pF capacitor plugged into one holder, general selectivity will still be very good, but there should be a very noticeable reduction in sharpness of tuning and noise will increase due to the broader pass-band.

MODIFICATIONS

As the idea of construction in stages is to obtain fully working circuits as quickly and easily as possible, the i.f. section can be simplified initially then modified to the full circuit.

The S-Meter circuit can be omitted completely at first and fitted later.

IFT1 and V1, Fig. 2C may be omitted and mixer pin 6 taken to pin 3 on i.f.t.2 or V1 and i.f.t.2 may be omitted and the crystals or secondary of i.f.t.1 may be temporarily connected to pin 1 of V2.

When the tunable first i.f. section is constructed, the receiver can be employed for the 3·5-4MHz band only. The receiver cannot be used on other bands until the crystal controlled first conversion section is completed.

With some valves i.f. instability occurred with VR1 at maximum gain. This was cured by placing a 2·2kΩ resistor between pin 2 of i.f.t.1 and h.t., with a 0·25μF capacitor from pin 2 to chassis.

TUNABLE FIRST IF AMPLIFIER

This has two stages, Fig. 2B, and is constructed in a screened box to minimise pick-up of unwanted signals. Coverage is 3·5MHz to 4MHz, with a little to spare at the extreme positions of the 3-gang capacitor VC1, VC2 and VC3.

V1 operates as an r.f. amplifier on the 3·5-3·8MHz band and as first i.f. on the other ranges. The gain of this stage is also controlled by VR1. AGC bias is applied to both stages via R1 and R4 (*it is not good practice to apply a.g.c. to a frequency changer of this type—Ed*).

The oscillator section of the mixer-oscillator V2 is run from the 150V stabilised h.t. supply. Input to L1 is via a screened lead and a similar screened lead runs from V2 to the 455kHz i.f. amplifier.

The box is 5×4×2in. deep, with the valves on top and all other parts, including VC1/2/3, inside. This box is made from a 5×4in. flat plate, to which are bolted two 4×2in. and two 5×2in. "universal chassis" flanged members. It is easier to leave the sides and back off the box until wiring is completed.

TO BE CONTINUED

Next month we shall cover the construction and alignment of the tunable IF amplifier and give full information on the BFO/Product Detector and RF/1st Mixer stages to enable the receiver to be completed.

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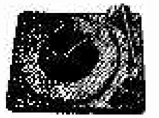

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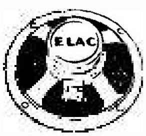

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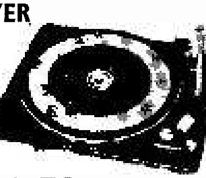

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2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £3·25
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AUTO TRANSFORMERS 115v. to 230v. or 230v. to 115v. 150w. £2·25; 500w. £6·25; 750w. £10; 1000w. £14.
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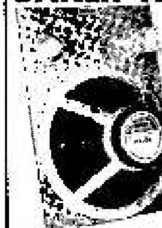
Hi Fi Enclosure Manual containing 20 plans, designs, crossover data and cubic tables. 42p. Post Free

BAKER 12in. MAJOR £9



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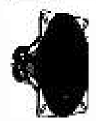

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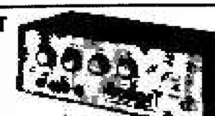

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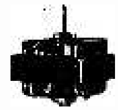

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ON THE SHORT WAVES
MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS
Malcolm Connah

Frequencies in kHz • Times in GMT

ALTHOUGH a great deal of pleasure can be obtained from simply listening to Broadcast stations many listeners take the hobby a step further and collect QSL cards from all over the world.

A QSL card is a verification from the station that the listener did, in fact, hear their broadcast. QSL cards are issued as a reply to reception reports from the listener after the details have been checked against the station log.

The majority of stations are very glad to receive reports from listeners as a well prepared report tells the station how well its transmissions are getting through. The subject for this month is the preparation of reception reports which are helpful to the station.

The first essential of a good reception report is the name and address of the reporter, without this the station does not know where the reception occurred and is unable to send a reply. The technical information should be given in the following manner:—

RECEPTION REPORT

I received your broadcast on .... (date), on a frequency of ....kHz, and listened to it from .... to .... hours G.M.T.

The receiver used was a .... (TRF/Superhet etc.) with .... (Number) Valves/Transistors, made by .... model number ....

The aerial was an interior/exterior one, ... metres high and .... metres long of the .... type.

Reception was .... in the SINPO code, i.e.: "S" Signal Strength ......, "I" Interference ......, "N" Noise ......, "P" Propagation ......, "O" Overall Merit .... The broadcast was in the .... language and the programme details were as follows ....

I hope that this report is of use to your Engineers and trust that you will be able to verify that my report is correct. If so, will you please send me your QSL card, or verification letter, in reply to this report. I enclose an International Reply Coupon to cover your postage costs.

I hope that I shall have the pleasure of hearing your station in the future and look forward to sending you further reports on your transmission.

Yours sincerely,

....

The SINPO code mentioned in the above specimen report may be new to some readers so I will give details of this method of assessing reception.

The "P" in the SINPO code stands for Propagation but is probably easier to understand if we refer to it as Fading.

Rating	1	2	3	4	5
S	Barely Audible	Poor	Fair	Good	Excellent
I	Extreme	Severe	Moderate	Slight	Nil
N	,,	,,	,,	,,	,,
P	,,	,,	,,	,,	,,
O	Unusable	Poor	Fair	Good	Excellent

Reception of BBC Radio One on 247 metres in the medium wave band can usually be rated as 55555 but the transmissions are sometimes affected by slight interference which reduces the rating to 54554. Radio Luxembourg on 208 metres is usually subject to severe fading and slight interference giving a rating of 54522.

The overall Merit figure is a very subjective rating and takes into account the other four figures, it would however be unusual to have an overall merit figure which is greater than the lowest of the other four. To use the above example some listeners would rate Radio Luxembourg as 54523, others would take the average of the first four figures as the "O" rating. In this case Luxembourg would rate 54524, which is incorrect since reception with severe fading cannot be classed as good.

The first log this month comes from **Michael Berry** of Dewsbury in Yorkshire who used his Eddystone EB35 receiver and 20 foot horizontal wire in the loft to hear:

3227 *ELWA, Liberia,* vernacular at 2010.
4890 *R. Diff. Venezuela,* Spanish at 0100.
11795 *ETLF, Ethiopia* in Malagache at 0330.
15105 *R. Rural, Brazil,* Portuguese at 2125.
15155 *R. Diff. de Sao Paulo,* Portuguese, 2235.
15170 *ELWA, Liberia* in French at 2000.
15445 *R. Nacional be Brazilia,* English at 2130.

Nigel Knowlman of Cullompton in Devon has sent in another log using his Lafayette HA-600A with an inverted 'L' antenna to hear:

11720 *Radio Tashkent,* USSR, at 1405.
11815 *TWR, Bonaire* noted at 0040.
11850 *Radio Vilnius,* USSR at 2245.,
15185 *WINB, USA* in English at 2215.
15195 *R. Ankara, Turkey* in English at 2200.
17855 *NHK, Japan,* news in English at 0705.
17920 *Radio Cairo* in English at 1415.

A. P. Turner of Eastbourne, Sussex has a Peto-Scott H-25, 5-valve domestic superhet receiver and a 65 foot long wire which enabled him to hear:

6040 *VOA* with news at 1917.
7100 *R. Tirana, Albania* in English at 2223.
7245 *R. Austria,* news in English at 0907.
11805 *R. Pakistan* in English at 1830.
15245 *RSA, South Africa* in English at 1608.
17810 *R. Kuwait,* news in English at 1738.

Reports should arrive by the 15th. of the month and be addressed to me at 59 Windrush, Highworth, Swindon, Wiltshire. *Please note the new address.*

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz ● Times in GMT

DOUBTLESS many will not be pursuing the noble art of Amateur Radio on November 5 but will usefully employ the time to honour (?) Guy Fawkes for his near miss. However, that does leave another twenty nine days in which to make up for lost time.

One thought is the topband transatlantics. Quite a few signals have been received, not merely from across the pond but from other countries/continents also. A session around 0600 hours might be worth a try although most 160 metre stalwarts are just as liable to be putting out a slow CQ in c.w. in the evenings too. Many d.x. stations are trying their hands at topband using s.s.b. and this band should make an interesting playground for the more seriously minded s.w.l. during the long winter evenings ahead.

Intruders in the Amateur bands are pests who have no moral or legal right to be there. The R.S.G.B. keep an intruder watch and this relies heavily upon reports received. Any s.w.l. with reasonable equipment is welcome to assist, but reports must be accurate. If you have a single conversion superhet, for example, you must ensure that it is not an image signal you are hearing which is, in fact, outside the band.

It's funny callsign time again. Queries flood in about those using a letter followed by two numbers. Not a postal code for Hong Kong, just a new prefix time—again! Bangladesh is apparently active and the call sign here begins S21 (sounds like the wash-room in a Government building). Just in case you think I've picked out an odd one, how about C21 for Nauru. Don't be fooled though, the latter have also been known to use a C29 prefix too.

Paul Genner (Liverpool) writes in with news of activity from Vietnam which must surely be a rare one for anyone to bag. Callsign is XV5AC and no band given but 20 and/or 15 would be a safe bet. Paul also mentions that anyone wanting to add Willis Island to their list should look out for VK9ZB who will set sail in December from Willis. Quick, while there is yet time.

John Tirrall (Bognor) tells the amazing tale of a W7 reported to be putting up a 40 (forty) element beam for 28MHz and will feed the brute on generous helpings of r.f.—a kilowatt no less. Those who hear nothing on ten metres could make it a red letter day. (Perhaps a red aerial day with all that power coming in).

Talking of ten metres, with the decline of the sun-spot activity count this band is perhaps one of the most interesting. Readers might consider erecting a simple ground plane antenna especially for this band. The elements are only just over 8 feet in length and even a vertical dipole might be dangled down the side of the house. Feed in the centre with 75Ω coax as for a horizontal dipole and your in business. Watch that your receiver isn't one which is to be nurtured on 300Ω feed though or you'll have a mis-match.

Times to listen are always a dangerous thing to predict with any degree of dogma since some bright soul always hears half the world at the very opposite times to those you have predicted. However, according to the JDG crystal ball, afternoons and evenings appear favourite for 21 and 14MHz which are still the most popular listening bands if logs received are any indication. Hopefully, adventurous s.w.ls will venture forth into regions such as 3·5MHz and 7MHz during the coming months as conditions improve.

Alan Smith (Nelson), JR310, a.t.u. and 60ft. end fed is one who braved 3·5MHz to get s.s.b. scalps from; HK1NR, KZ5JF, K3JH, PY1HA, SP9FMA, VE1ARH, VE1IE, VE1XI, VO1BT, VO1CV, W1PSK, W3MFW, XE1IIJ, YN1FI, ZL2BT, ZM4PG, 6Y5AR.

Up on 21MHz Alan bagged; CR6QA, CR7LE, CR8BF, DU1BOB, DU2EL, EP2JW, ET3USA, FP8DH, HS4AGN, HS4AGZ, JA1HIV, JA2DX, JA3BLC, JA4FDZ, JA6FBQ, JA7MFA, JA8QX, JA9EFQ, JA0GRR, KA6MH, KH6KHD, KP4DDO, LU1ACO, SV0WW, SV1GP, TJ1DF, VE1AM, VE3AUM, VS6AD, W8EX, W9ADW, XV5AC, ZS1J, ZS2MI, ZS3AK, ZS4LW, ZS5OE, ZS6OF, 4S7AB, 4S7PB, 4Z4EF, 4Z4LK, 5B4KP, 5N2ESH, 6W8YL, 6Y5GB.

Paul Russell (High Wycombe), went to West Norfolk for a holiday. With him went a Sentinal converter, UR-1A receiver as a tuneable i.f. (4-6MHz) and a 5-element yagi which posed transport problems on the way there, especially on the London Underground. Rewards for these sterling efforts included 144MHz signals from; F5VA, F6AGV, F6NM, G2AKQ, G3BN, G3CZA, G3DAH, G3OXV, G3PMH/P, G3POI, G3SRT/A, G3TTV, G3UJK, G3WW, G3XIX, G3ZYC, G4ARD/P, G8DYK, GW4ABR/P, P0HVA, PA0VJ, PA0VZL.

William Fereday (Aston-on-Trent) uses an R107 and bent 50ft long wire (Oh—bold). Twenty metre tweets from; JA1QZY, JA2PJC, VK3AHI, VK3RZ, VK5FH, W6BMP, W6BT, YN3NPF, 9V1QT.

Roger Dixon (Skipton), PR30, CX203 receiver and 100ft. long wire end fed sent in a log for ten metres (bless you). Stations bagged incluude; CE3AGU, LU4DCO, TU2DO and 9J2KY. Who says there's nothing up there?

Glyn Fisher (Oakham) landed a number of EU stations on 7MHz. Among these were signals of the s.s.b. type from VK2AVA, VK5PB and VK7GK. Gear is a Westminster radiogram and a 50ft. endfed.

Well worth a listen is the 1·8MHz contest on November 11-12. There is also a Czechoslovakian contest on the 12th. The Czech stations are often in evidence on topband but if you want to log stations from further afield, try the CQ WW d.x. c.w. contest on November 25-26.

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

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

In the post

As a purchaser, in a small way of components advertised in *P.W.* I have sometimes been amazed at the varying rates of postage charged for parcels to N.Z. I therefore wrote to the Post Office, London to find out the reason.

I enclose copies of my letter and the reply.

I am sure that the advertisers are trying to act in our best interests. It is no advantage to them to pay out extra postage, but it's our money they're using!—**C. J. Christie** *(Whangarei, New Zealand)*.

LETTER TO GPO:

I should be grateful for your advice in the following problem.

I am a hobbyist meddler in things electronic and from time to time I make purchases of equipment from England.

Postage on parcels varies so much—for example: (1) Six hearing-aid inserts (1 oz.) Liversedge, 5p. (2) One integrated circuit (1 oz.) Sevenoaks, $61\frac{1}{2}$p. (3) Resistance wire (7 ozs.) Croydon, $7\frac{1}{2}$p. (4) Loudspeakers (3 lb.) Liversedge, £1·23. (5) Five tape cassettes from London, 75p.

All these goods have been marked "surface mail"—not registered.

I don't object to waiting a couple of months for goods sent sea-mail but I must confess to being mystified by the postages quoted.

Can you advise the most economical rate in general terms for the sort of equipment I am buying please?

REPLY FROM POST OFFICE:

We were interested to see the rates that were charged on the packets you have been receiving. Items 1 and 2, the hearing aids and integrated circuit, weighing one ounce each, should have been sent by the Letter Post at the Commonwealth Rate of 2 new pence (3p from 1 July 1971). There was no service operating in March 1971, surface or air, by which the charges you mention of 5p and $61\frac{1}{2}$p could have been correctly made for these items. Although they were sent a long time ago, if you still have their wrappings we will gladly investigate how the charges were raised. Item 3 was sent by the Small Packet service, and although you have not given us a date for the packet, the charge of 1s 6d was almost certainly correct. Item 4, the radio speakers weighing 3 lb would have been sent by the Surface Parcel Post Service for £1·15p.

The most economical service available for the sort of goods you have been receiving, including the tape cassettes, is undoubtedly the Small Packet service. This provides a cheap rate for lightweight goods (up to 2 lbs in the case of New Zealand). Small packets must be packed so that they can be easily examined without breaking any seal, and should not contain any letters or personal correspondence, although an invoice is permissible. The words 'Small Packet' should be marked on the top left hand corner. In this service a packet of cassettes weighing, say, 14 oz can be sent for 15p.

I enclose various leaflets showing our current charges and a photocopy of the Small Packet regulations taken from the current edition of the Post Office Guide. I am sure you will find the Small Packet service meets your needs.

Radio fags

I enclose the photo of a packet which once held ESS-O-ESS cigarettes as I thought you might like to reproduce it in your magazine.

Whereas countless cigarette brand designs are based on ideas to do with the sea there must be few that have anything to do with radio. The only item apart from this that I know of is Wireless Mixture tobacco.

I do not know when the packet was introduced but this brand was on sale in 1939 at 3d for 6, also 12 for 6d and 3 for $1\frac{1}{2}$d. It was to disappear during the next ten years as it is not included in the 1949 retail price lists. Gallaher Ltd. are now the proprietors of Cope's brands.

One of my achievements is getting something into the Guinness Book of Records concerning wireless. I sent them an obituary from a newspaper called "the forgotten inventor." This resulted in the inclusion of details of the world's first advertised broadcast by Sir Aubrey Fessenden.—**W. Humphries** *(Suffolk)*.

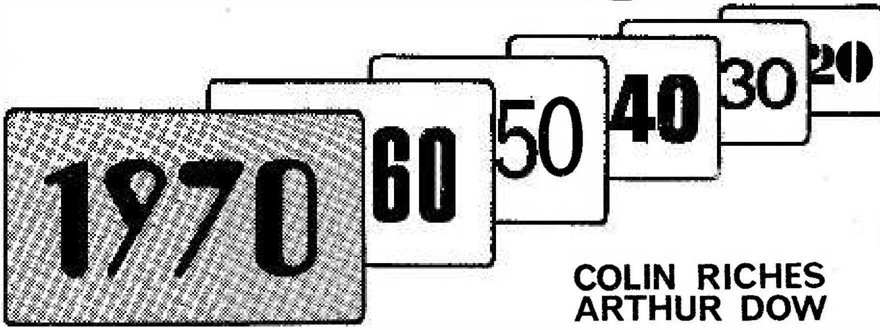
She saw the light

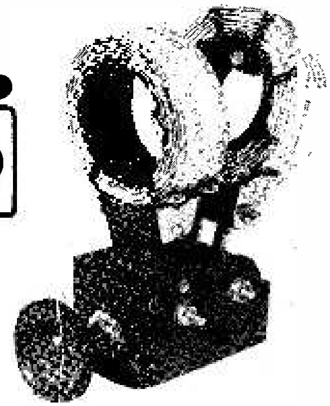
One day a dear old lady came into our shop and asked if we could sell her a light bulb for her "loo". Upon asking what wattage she wanted she replied that she had not any idea. I then asked her to bring her old bulb into the shop so that I might try to read the wattage. At this suggestion she stepped back in surprise and flatly refused to do this. When asked the reason for her attitude she replied, "Young man, if I take the old bulb out without putting a new one in straight away, all the electricity will fall out of the socket and I'll have a big bill to pay next quarter".

It took me several minutes to explain to her that this was not the case and she went away with a new 25W bulb in her bag which we gave her as a prize for being our 'customer of the month'.—**C. Scott,** *(Edinburgh)*.

We are glad to hear that the lady went away a happy customer. If any readers have amusing stories like this, we'll be glad to consider them for our "Letters" pages—Editor.

GOING BACK...

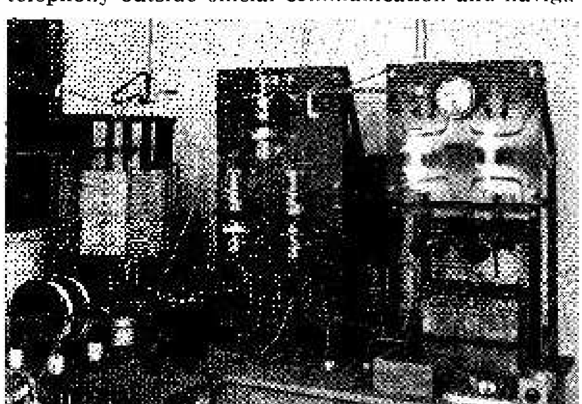




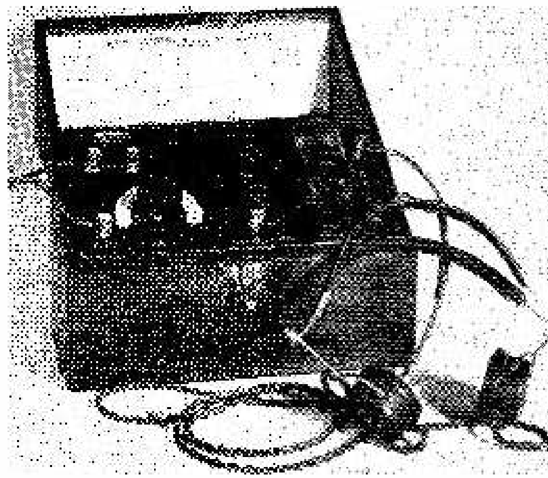
COLIN RICHES
ARTHUR DOW

FIFTY years ago British broadcasting was born in an ex-army hut near Chelmsford in Essex, when on 14th February 1922 a group of Marconi engineers began a series of regular experimental transmissions. Every Tuesday evening from a rigged-up transmitter, call sign 2MT Writtle, or more affectionately to its listeners, Two Emma Tock, they transmitted programmes whose original purpose was entirely technical. Shortly afterwards, in May, another transmitter, later to be even better known, was opened up by the company at Marconi House in the Strand in London. This was the famous 2LO station that provided the foundation from which the British Broadcasting Company grew after its formation on 14th November of the same year.

Two Emma Tock provided the first regular broadcast service in this country, and incidentally broadcasting's first audience, an audience which in its enthusiasm for the pioneering programmes, generated the original demand for public service broadcasting. The 2MT transmitter was set up for use in a series of experiments designed to establish the effective range of a wireless telephony transmitter. At the same time a number of radio amateurs were appearing, largely young ex-service men who had learnt about radio during the 1914-18 war, who had put together their own receiving sets, and who wanted transmissions to receive. Earlier experiments with entertainment, as when Dame Nellie Melba and later Lauritz Melchior, the Danish tenor, had broadcast from a makeshift studio in Chelmsford in 1920, had shown that there was a potential for wireless telephony outside official communication and navigation usage, but the official attitude had been discouraging, and the duty of granting licences for transmitters was the preserve of the Postmaster General. Government was unwilling to consider licences for more than a token number of even technical transmissions.



The 2MT transmitter at Writtle from which the first regular broadcast transmissions in this country began on Feb. 14th, 1922.

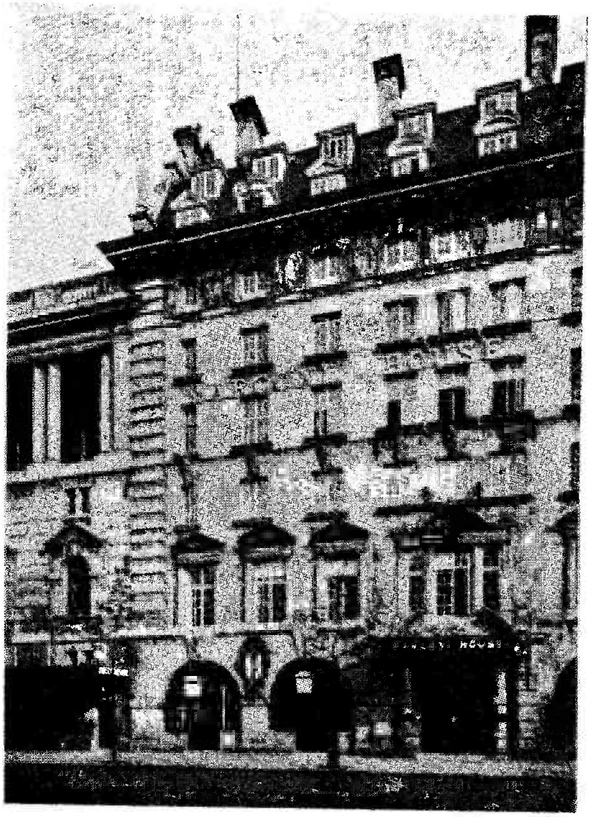


A B.T.H. crystal receiver of 1923 vintage.

2MT was finally granted an experimental licence to transmit early in 1922, though the permission was hedged about with many restrictions. But for half an hour on Tuesday evenings, experiments were to be allowed, though even then with three-minute breaks in every ten, to ensure that no interference with "legitimate services" was being perpetrated.

2MT opened regular broadcasts officially on behalf of the amateurs who needed a source against which they could calibrate their receivers, and to begin with its programmes were not very much more interesting than early 1920 transmissions made before the government clamp-down, when W. T. Ditcham read from Bradshaw's railway timetable, but the enthusiasm and gaiety of the young Marconi engineers who ran it very soon turned it into a half-hour's entertainment in its own right. The names of those men read like a roll-call of some of the great names in broadcasting. In charge of the project was Captain P. P. Eckersley, who later went to the new British Broadcasting Company as its first chief engineer. It was his infectious and spontaneous humour which gave 2MT its unique flavour; he was

PICTURES TO BRING BACK MEMORIES . . .



"Marconi House" main entrance from the Strand (taken 1912).

The "Television Toppers" view a 23in screen. The largest at the 1953 Radio Show.

The "Roving Eye", taken in 1954.

Jean Metcalf, compère of "Family Favourites" (1954).

BBC camera used for televising the "Victory Parade". Seen here with Windmill Girls (1946).

not only the first engineer in charge, he was also the first of the true radio entertainers, with a gift for ad-libbing that constantly alarmed those of a less adventurous disposition who worked with and around him. Others in the team were Noel Ashbridge, later Sir Noel, who was the BBC's first technical director, till his retirement in 1952, R. T. B. Wynn, a later chief engineer of the BBC and B. N. MacLarty, who became head of the BBC's Design and Installation team before he returned to Marconi's in 1947 as Engineer in Chief.

By contrast, Marconi's 2LO station, granted its licence in May, began a rather staid existence, a happy coincidence for the pioneers of 2MT, as it gave them an opportunity to provide skits and lampoons which were much appreciated by their listeners. 2LO operated on conditions of restricted timing, at first even no music, and low power, beginning with 100 watts, later raised to 1½kW. Its programmes had each to be individually licensed by the PMG, and were limited to private occasions often for charity, at which Marconi engineers installed the receiving apparatus and operated it. Each programme was notified to listeners by postcard by means of a special mailing list kept by The Marconi Company, and most of them consisted of polite light music.

The 2LO station transmitter was designed by Captain H. J. Round, installed by C. S. Franklin and run by A. R. Burrows who eventually became the much-loved Uncle Arthur of the BBC. Among the many papers in the Marconi archives which tell the story of the birth of British Broadcasting, not the least interesting is Arthur Burrows' letter requesting permission to recruit a young man of particular quality to compere the station's programmes, a young man with "technical tendencies . . . . . grace of manner . . . . . and an excellent telephone voice." Many of Burrows' requirements were couched in terser terms and it was his organisational skill and foresight that shaped the studio techniques which are still the basis of modern broadcasting.

By this time many wireless societies had been formed and more and more the demand for radio receivers was being felt. In the United States since 1919 "wireless" had become fashionable, but with no constitutional control of the use of wavelengths, chaos reigned in a commercially sponsored free-for-all. The British Government, seeking a way from the dilemma posed by popular demand on the one hand and a justifiable reluctance to allow free access to the air on the other, set up the Wireless Sub-Committee of the Imperial Communications Committee in April of 1922. After consideration, their recommendation to set up a single broadcasting company was accepted and in November 1922 the British Broadcasting Company was formed from six commercially interested companies with £100,000 share capital.

The six companies were The Marconi Company, the Metropolitan Vickers Co., the Western Electric Co., the British Thomson-Houston Co., the Radio Communication Co., and the General Electric Co., and on its formation on 14th November a Broadcasting Committee of the founder members took over the responsibility of running 2LO.

2MT Writtle continued to transmit until the following January, when it finally closed down.

Our favourite "dumb blonde"—Sabrina shown during rehearsals for Arthur Askey's "Before Your Very Eyes" show (1955).

We would like to thank the Marconi Company, the BBC, the Science Museum and readers whose help in compiling this article has really been appreciated.

TUT! TUT!!

CAR/PORTABLE RADIO. October 1972
Readers experiencing difficulty in obtaining the oscillator coil L3 (Osmor PW/01) can use the Denco coil Type TOC1 using the following connections:—Pin 1 to C3 and R3, Pin 2 to the positive line, Pin 3 to S1b, Pin 4 to IFT1, Pin 5 to Tr1 collector and Pin 6 to Tr1 emitter. (Denco Ltd., 357 Old Road, Clacton-on-Sea, Essex).

INTERCOMM CALLING SYSTEM. October 1972
There is an error regarding the wiring around the secondary of T2. The loudspeaker is connected in series with the wire from pin 5 of SW1 to the positive line; the speaker is not connected directly to the top of the secondary of T2.

DX'ers A.F. PROCESSING UNIT. July 1972
In Fig. 4 a break in the conductor strip should be shown at 30-g.

I.C. AUTO PARKING LIGHT. September 1972
It has been brought to our attention that a single parking light is no longer sufficient; all four parking lights are necessary. This does not of course invalidate the circuit.

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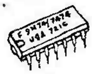

Type	1/11 p	12/24 p	25/99 p	Type	1/11 p	12/24 p	25/99 p	Type	1/11 p	12/24 p	25/99 p
SN7400	0·20	0·18	0·16	SN7450	0·20	0·18	0·16	SN74145	1·50	1·40	1·30
SN7401	0·20	0·18	0·16	SN7451	0·20	0·18	0·16	SN74150	3·35	2·95	2·15
SN7402	0·20	0·18	0·16	SN7453	0·20	0·18	0·16	SN74151	1·10	0·95	0·90
SN7403	0·20	0·18	0·16	SN7454	0·20	0·18	0·16	SN74153	1·35	1·27	1·20
SN7404	0·20	0·18	0·16	SN7460	0·20	0·18	0·16	SN74154	2·00	1·75	1·55
SN7405	0·20	0·18	0·16	SN7470	0·30	0·27	0·25	SN74155	1·55	1·47	1·35
SN7406	0·30	0·27	0·25	SN7472	0·30	0·27	0·25	SN74156	1·55	1·47	1·35
SN7407	0·30	0·27	0·25	SN7473	0·40	0·37	0·35	SN74157	1·80	1·70	1·50
SN7408	0·20	0·19	0·18	SN7474	0·40	0·37	0·35	SN74160	2·60	2·40	2·25
SN7409	0·45	0·42	0·35	SN7475	0·55	0·52	0·50	SN74161	2·60	2·40	2·25
SN7410	0·20	0·18	0·16	SN7476	0·45	0·42	0·39	SN74162	3·40	3·25	2·70
SN7411	0·23	0·22	0·20	SN7480	0·80	0·75	0·67	SN74163	3·40	3·25	2·70
SN7412	0·42	0·40	0·35	SN7481	1·25	1·15	1·10	SN74164	2·75	2·30	2·10
SN7413	0·30	0·27	0·25	SN7482	0·87	0·80	0·70	SN74165	4·00	3·50	3·00
SN7416	0·30	0·27	0·25	SN7483	1·00	0·90	0·85	SN74166	4·00	3·50	3·00
SN7417	0·30	0·27	0·25	SN7484	0·90	0·85	0·80	SN74167	6·25	5·60	5·10
SN7420	0·20	0·18	0·16	SN7486	0·45	0·41	0·38	SN74170	4·10	3·55	3·05
SN7422	0·48	0·44	0·40	SN7490	0·75	0·70	0·65	SN74174	2·00	1·75	1·30
SN7423	0·48	0·44	0·40	SN7491AN	1·00	0·95	0·90	SN74175	1·35	1·27	1·15
SN7425	0·48	0·40	0·35	SN7492	0·75	0·70	0·65	SN74176	1·60	1·35	1·20
SN7427	0·42	0·39	0·35	SN7493	0·75	0·70	0·65	SN74177	1·60	1·35	1·20
SN7428	0·50	0·45	0·42	SN7494	0·80	0·75	0·70	SN74180	1·55	1·30	1·20
SN7430	0·20	0·18	0·16	SN7495	0·80	0·75	0·70	SN74181	7·00	6·00	5·50
SN7432	0·42	0·39	0·35	SN7496	1·00	0·97	0·95	SN74182	2·00	1·80	1·60
SN7433	0·70	0·61	0·44	SN7497	6·25	5·50	5·00	SN74184	2·40	2·00	1·80
SN7437	0·65	0·60	0·50	SN74100	2·50	2·30	2·00	SN74185A	2·40	2·00	1·80
SN7438	0·65	0·60	0·50	SN74104	1·45	1·35	1·20	SN74190	1·95	1·85	1·75
SN7440	0·20	0·18	0·16	SN74105	1·45	1·35	1·20	SN74191	1·95	1·85	1·75
SN7441AN	0·75	0·72	0·70	SN74107	0·50	0·45	0·40	SN74192	2·00	1·90	1·80
SN7442	0·75	0·72	0·70	SN74110	0·80	0·70	0·60	SN74193	2·00	1·90	1·80
SN7443	1·00	0·95	0·90	SN74118	1·00	0·95	0·90	SN74194	2·50	2·25	1·90
SN7445	2·00	1·75	1·60	SN74119	1·90	1·78	1·65	SN74195	1·85	1·70	1·60
SN7446	2·00	1·75	1·60	SN74121	0·60	0·55	0·50	SN74196	1·50	1·40	1·30
SN7447	1·75	1·60	1·45	SN74122	1·35	1·25	1·10	SN74197	1·50	1·40	1·30
SN7448	1·75	1·60	1·45	SN74123	2·70	2·55	2·47	SN74198	4·60	3·70	3·35
				SN74141	1·00	0·95	0·90	SN74199	4·60	3·70	3·35

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BC108	10p	BFY51	20p	OC28	65p	TIP42A	85p	2N2906	20p	40360	40p
BC109	10p	BFY52	20p	OC35	50p			2N2926 (all cols)	10p	40361	40p
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IN4004	400	8
IN4005	600	10
IN4006	800	12
IN4007	1000	15
1·5 amp miniature		
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PL4003	200	10
PL4004	400	10
PL4005	600	12
PL4006	800	15
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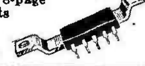

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B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
ONE AMP (G.I.) TUBULAR		
W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
TWO AMPS ½ H × ½ L × 3/16		
B2/05	50	35p
B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
B2/1000	1000	60p
FOUR AMPS ½H × ½L × 3/16		
B4/100	100	60p
B4/200	200	65p
B4/400	400	70p
B4/600	600	75p
B4/800	800	£1·00
SIX AMPS ½H × ½L × 3/16		
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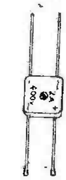
B6/200	200	75p
B6/400	400	90p
B6/600	600	£1·00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CRS 1/40	400	35p
CRS 1/60	600	45p
THREE AMP (TO48)		
CRS 3/05	50	30p
CRS 3/10	100	30p
CRS 3/20	200	35p
CRS 3/40	400	45p
CRS 3/60	600	55p
FIVE AMP (TO66)		
CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
SIXTEEN AMP		
SCR 16/100	100	65p
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1 Amp T05


3 Amp T048

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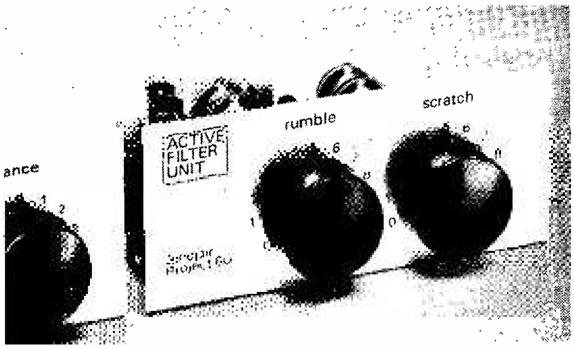

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SPECIFICATIONS

The A.F.U. employs two Sallen and Key type active filter stages, one **rumble** (high pass) and one **scratch** (low pass). The two stages use complementary transistors to minimise distortion.

Supply voltage: 15 to 35 volts. Current 3mA maximum.

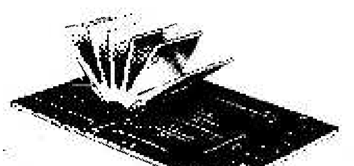
Gain at 1kHz: Filters flat 0.98 (—0.2 dB)

HF cut off: (—3dB) variable from 28 kHz to 5 kHz at 12 dB/octave.

LF cut off: (—3dB) variable from 25Hz to 100Hz at 12dB/octave.

Distortion: at 1kHz (35 volt supply) 0.02% at rated output.

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:** 22×45×28mm including pins and heat sink.

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual, **£2.98** Post free

Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing: one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

Everything you need to assemble a superb 30 watt high fidelity stereo amplifier without having to solder.

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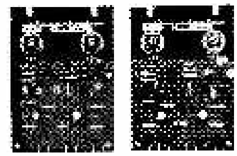
Sinclair Radionics Ltd, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel: St. Ives 64311

the world's most advanced high fidelity modules

Z.30 & Z.50 power amplifiers

Built, tested and guaranteed with circuits and instructions manual. **Z.30 £4.48 Z.50 £5.48**

The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to provide unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and are intended for use principally with other units in the Project 60 range. Their performance and design are such, however, that Z.50s and Z.30 may be used in a far wider range of applications.

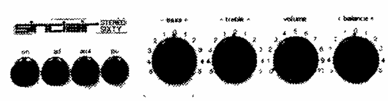


SPECIFICATIONS ***(Z.50 units are interchangeable with Z.30s in all applications).*** **— Power Outputs:**
Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts. 30 watts R.M.S. into 8 ohms using 50 volts.
Frequency response: 30 to 300,000Hz ±1dB. **Distortion:** 0.02% into 8 ohms. **Signal to noise ratio:** better than 70dB unweighted. **Input sensitivity:** 250mV into 100 Kohms (for 15w into 8Ω). For speakers from 3 to 15 ohms impedance. **Size:** 14 x 80 x 57mm.

Stereo 60 Pre-amp/control unit

Built, tested and guaranteed. **£9.98**

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.

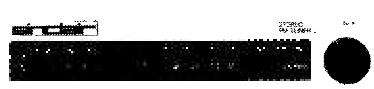


SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A. curve ±1dB: 20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE +12 to —12dB at 10KHz: BASS +12 to —12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stero decoder and switchable squelch circuit for silent tuning between stations. In terms of high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with most other high fidelity systems.

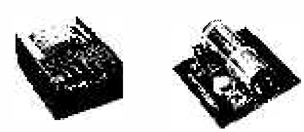


SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz **Sensitivity:** 7μV for lock-in over full deviation. **Squelch level:** Typically 20μV **Signal to noise ratio:** >65dB. **Audio frequency response:** 10Hz – 15KHz (±1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2μV. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. maximum **Operating voltage:** 25–30VDC. **Indicators:** Stereo on, tuning **Size:** 93 x 40 x 207mm.

Power Supply Units

Designed specifically for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 or PZ.8 where a stabilised supply is essential.

PZ.5 *30 volts unstabilised* **£4.98**
PZ.6 *35 volts stabilised* **£7.98**
PZ.8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ.8 *mains transformer* **£5.98**



Typical Project 60 applications

System	The Units to use	together with	Units cost
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control, etc.	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control, etc.	**£9.45**
12W. RMS continuous sine wave stereo amp. for average needs	**2 x Z.30s, Stereo 60; PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
25W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	**2 x Z.30s, Stereo 60; PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
80W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60W. RMS into 8 ohms)	**2 x Z.50s, Stereo 60; PZ.8, mains transformer**	As above	**£34.88**
Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

F.M. Stereo Tuner **(£25)** & A.F.U. **(£5.98)** may be added as required.

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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Strong leather cloth finish ¾" board, fully lagged. Fitted high efficiency 8 or 16 ohm speakers.

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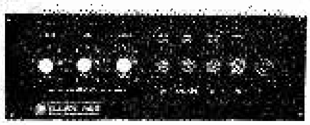
SOVEREIGN. 100 watt rms. 18" Bass. 12" Full range. Size 50" × 26" × 14".

FULL RANGE OF MICROPHONES, STANDS, ETC. ALWAYS IN STOCK



SOUND CONTROLLED AND SOUND TO LIGHT UNITS

Mid, Treble and Bass Channels, up to 1kw of lamps per channel plus override switching.

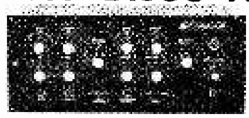
DJ30L. Sound to light. Takes output from most amplifiers. Adjustable levels.

DJ40L. Sound controlled version. Built in microphone, no connections required.

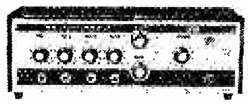
ASSEMBLED DISCOTHEQUES

DISCO-PLINTH. Consists of 2 turntables fitted with high quality ceramic cartridges. The unit has a built in cross-fade rotary control for transferring the sound from left to right decks. The unit has no amplification built in and must be used with amplifiers such as the D.J. 105S or D.J. 70S. Size 32" × 14½" × 7" (incl. lid). **£55·00**
DISCO-IMP. The latest addition to the Disco-sound Range of discotheques. Even smaller and more compact than the Disco-Mini, it contains all the necessary features for the smooth running of a mobile unit. Size 29" × 18½" × 7". **£79·00**
DISCO-MINI. Complete portable Disco with built-in full function preamplifier/mixer. For use with any power amplifier such as "Discmaster". Size 30" × 20" × 8". **£98·50**
DISCO-STANDARD. Has all the facilities of the Disco-Mini with the addition of a built-in 100 watt power amplifier making it a completely self contained disco unit. A V.U. meter gives visual indication of output levels. Size 32" × 27" × 7½". **£180·00**
DISCO-SUPER. A slightly larger version of the Disco-Standard. Fitted individual controls for both mic. and deck inputs plus a cross-fade for deck to deck transfer. A built in P.F.L. cueing system, mic. over-ride, also a V.U. meter gives visual indication of output levels. DJ. 30L (3000w) 3-channel psychedelic light unit is a standard fitting. Deck cut out switches are also featured for ease of cueing. Size 38" × 27" × 10". **£224·00**
DISCO-SUPREME. All facilities of the Disco-Super plus a third turntable which can be used for Jingles or other effects without using the main deck system. Flexi lights are also fitted. Size 50" × 27" × 10". **£261·00.**

PA—DISCO AMPLIFIERS



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

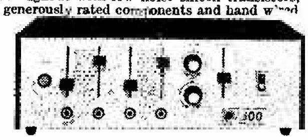


DJ.70S MIXER/AMPLIFIER. 70 watt rms. output for 8-16 ohms. 2-mic, 2-aux/decks. Master volume/Bass/Treble. Size 15½" × 5" × 6".

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

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

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



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

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

SPECIFICATION

Frequency Response	50-20,000 Hz ± 3db (10dB Bass Boost at 10 Hz)
Signal/Noise Ratio	better than =50db.
Harmonic Distortion	less than 1%
Speaker Impedance	8–16 ohms.
Inputs: Mic 1 & 2	5mV at 50K ohms (50 or 600 ohm to order)
Aux 3 & 4	100mV at 1 meg ohm.
Size (all models)	15¼" × 5" × 6".

Power Output: (at 8 ohms)	Model D.J.500	—	50 watts R.M.S.	£56·25
	Model D.J.700	—	70 watts R.M.S.	£67·50
	Model D.J.1000	—	100 watts R.M.S.	£79·00

DISCO MINI

Hardly larger than a suitcase yet contains all the necessary features for a high quality mobile unit. The pre-amp has separate tone controls for both mic. and decks, and each input has its own individual volume controls and inputs, plus the addition of a cross fade for deck to deck sound transfer. A built in P.F.L. system for cueing, together with mic-over-ride facility are standard on all units. Response 20-20,000 Hz. Mic. input 5mV. 50K. Output 1 volt.
McDonald M.P.60 Turntables are used with high quality ceramic cartridges, and each deck has its own individual cut out switch fitted. This unit is suitable for Discos or Clubs having a power amplifier, or for use with the 'Discmaster' 100 watt power amplifier as above. Size 32" × 20" × 8". **£98·50.**

EFFECTS PROJECTORS

A small selection from our vast stock.

DISCO COLT. 150 watt.
LIQUIMATIC MINI, 50 watt Q1 with 6" wheel.
DISCOWHEEL, 50 watt Q1 with quick change Cassette.
GNOME 150, 150 watt Q1 with Cassette.
LIQUIMATIC, 150 watt Q1 with 6" wheel.
PLUTO TUTOR-2, 250 watt Q1 with Cassette and 6" wheel.
TUTOR-2, with Liquisplode Tank.
KALEIDOSCOPE LENS (for Tutor-2) 6" Liquid Wheel and Crystal Wheel Liquid Cassette and Moire (24 different types to choose from). Portable Hi-Power Strobes.

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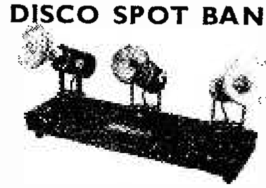
SDL POWER SPEAKERS

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

DISCO SPOT BANK



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

Size 18" × 6" × 7" (excluding bulbs)

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

MIXER UNITS

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

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

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

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Discosound
122, Balls Pond Road, London, N.1.
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Discosound
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494, Bristol Road, Selly Oak, B'ham 29.
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TOTAL COST OF COMPLETE COMPONENTS ONLY £27·85—POST FREE !

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

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

P. E. 'GEMINI' STEREO AMPLIFIER

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

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

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

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

All parts available separately.

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QUALITY ● SERVICE ● VALUE

GUNTON ELECTRONIC IGNITION KIT £7·95 + 35p P. & P.

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Kit includes absolutely everything for assembly: Case, Cables, Coil Connectors, Silicon Grease, etc. 8 page illustrated instructions cover fitting of all Types of Tachometers. Call in for a Workshop Demonstration. S.A.E. all enquiries please or Phone 33652 (many letters from satisfied customers).
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50µA	£3·50		
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500µA	£3·05	5 amp. D.C.	£2·85
1mA	£2·85	300V. A.C.	£2·85
20V. D.C.	£2·85	VU Meter	£3·70

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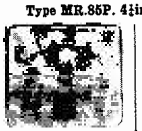
Type MR.85P. 4¼in. × 4¼in. fronts.



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

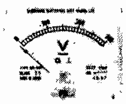
Type MR.52P. 2½in. square fronts.

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

Type MR.65P. 3½in. × 3¼in. fronts.

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

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



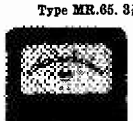
		200mA	£1·75
		300mA	£1·75
		500mA	£1·75
		750mA	£1·75
		1 amp.	£1·75
		2 amp.	£1·75
		5 amp.	£1·75
		10 amp.	£1·75
		3V. D.C.	£1·75
50µA	£2·30	10V. D.C.	£1·75
50-0-50µA	£2·10	15V. D.C.	£1·75
100µA	£2·10	20V. D.C.	£1·75
100-0-100µA	£1·95	50V. D.C.	£1·75
200µA	£1 95	100V. D.C.	£1·75
500µA	£1·80	150V. D.C.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

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

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

"SEW" BAKELITE PANEL METER

Type MR.65. 3½in. square fronts.



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

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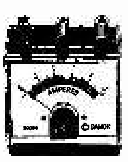
SEW EDUCATIONAL METERS



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

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

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100µA	£3·30	300V. A.C.	£2·70
100-0-100µA	£3·20	VU Meter	£3·75
200µA	£3·20		

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

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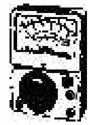

HIOKI MODEL 720X
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Overload protection
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10/50/250/1000 VAC.
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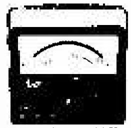
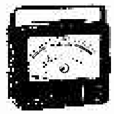
£4·97. P. & P. 15p.

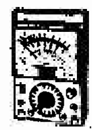


MODEL PL436
20kΩ/Volt D.C. 8kΩ/Volt AC. Mirror scale. ·6/3/12/30/120/600V D.C. 3/30/120/600V A.C. 50/600uA/60/600 mA. 10/100K/1 Meg/10 MegΩ −20 to +46db. **£6·97½** P & P 12½p



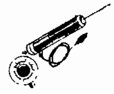
MODEL 5025 57 Ranges, Giant 5¼in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250,.500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50IA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. **£12·50.** P. & P. 17½p.

HIOKI MODEL 700X



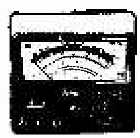
100,000 O.P.V. Overload protection. Mirror scale. ·3/·6/1·2/1·5/3/6/12/30/60/120/300/600/1200VDC 1·5/3/6/12/30/60/150/300/600/1200 V.A.C. 15/30µA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm −20 to +62 db **£13·50.** P. & P. 20p.

ROUND SCALE TYPE PENCIL TESTER MODEL TS.68



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

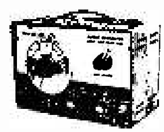
TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



Battery operated, 11 meg input, 26 ranges. Large 4⅜" mirror scale. Size 5⅞" × 4⅝" × 2⅜". DC VOLTS 0.3 – 1200V. AC VOLTS 3 – 300V RMS. 8·0 – 800V P-P. DC CURRENT ·12 – 12MA. Resistance up to 2000M ohm. Decibels − 20 to + 51 db. Complete with leads/instructions. **£17·50,** P. & P. 20p.

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

TE22 SINE SQUARE WAVE AUDIO GENERATORS



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

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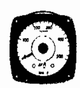
Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V A.C. Brand new with instruction. **£15** P. & P. 37½p.



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0/10/50/250/1000 V. A.C.
0/1/100 M.A. 0/150 K ohms.
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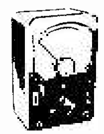
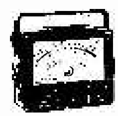
TMK MODEL MD.120
Mirror scale. 20k/Volt D.C. 10kΩ Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current 0-60µA/0 — 12/0 300mA. 0-60K/0-6 MegΩ. −20 to + 63 dB. **£4·62½** P & P 15p



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



TMK LAB TESTER. 100,000 O.P.V. 6½in-Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K/Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100µA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size: 7½in. × 6¾in. × 3¾in. **£18·90.** P. & P. 25p

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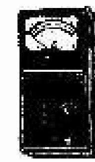
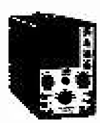


TO-3 PORTABLE OSCILLOSCOPE



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–300kHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb. 220/240V. A.C. Supplied brand new with handbook. **£40·00.** Carr. 50p.

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2G301	20p	2N3417	37p	2S102	25p	BC116	15p	BFX12	22p	NKT224	22p
2G302	20p	2N3439	130p	2S103	25p	BC118	15p	BFX13	22p	NKT225	22p
2G303	20p	2N3440	97p	2S104	25p	BC119	30p	BFX29	25p	NKT229	30p
2G306	42p	2N3564	17p	2S301	50p	BC121	20p	BFX30	25p	NKT237	35p
2G308	30p	2N3565	15p	2S302	50p	BC122	20p	BFX37	30p	NKT238	25p
2G309	30p	2N3566	22p	2S303	60p	BC125	15p	BFX44	37p	NKT240	27p
2G371	15p	2N3568	25p	2S304	75p	BC126	20p	BFX68	67p	NKT241	27p
2G374	20p	2N3569	25p	2S501	32p	BC134	12p	BFX84	25p	NKT242	20p
2G381	22p	2N3570	125p	2S502	35p	BC135	12p	BFX85	30p	NKT243	62p
2N388A	49p	2N3572	97p	2S503	27p	BC136	15p	BFX86	25p	NKT244	17p
2N404	20p	2N3605	27p	3N83	40p	BC137	15p	BFX87	25p	NKT245	20p
2N696	15p	2N3606	27p	3N128	70p	BC138	20p	BFX88	20p	NKT261	20p
2N697	15p	2N3607	22p	3N140	77p	BC140	35p	BFX89	62p	NKT262	20p
2N698	25p	2N3638	18p	3N141	72p	BC141	35p	BFX93A	70p	NKT264	20p
2N699	30p	2N3638A	20p	3N142	55p	BC147	10p	BFY11	42p	NKT271	20p
2N706	10p	2N3641	18p	3N143	67p	BC148	10p	BFY18	25p	NKT262	20p
2N706A	12p	2N3642	18p	3N152	87p	BC149	12p	BFY19	25p	NKT274	20p
2N708	15p	2N3643	20p	40050	55p	BC152	17p	BFY21	42p	NKT275	20p
2N709	62p	2N3644	25p	40250	50p	BC153	20p	BFY24	45p	NKT278	25p
2N718	25p	2N3645	25p	40251	32p	BC154	20p	BFY29	40p	NKT281	27p
2N718A	30p	2N3691	15p	40309	32p	BC157	15p	BFY30	40p	NKT401	87p
2N726	30p	2N3692	18p	40310	45p	BC158	11p	BFY41	50p	NKT402	90p
2N727	30p	2N3693	15p	40311	35p	BC159	12p	BFY43	62p	MKT403	75p
2N914	17p	2N3694	18p	40312	47p	BC160	35p	BFY50	20p	NKT404	55p
2N916	17p	2N3702	10p	40314	37p	BC167	11p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	40315	37p	BC168B	10p	BFY52	20p	NKT406	62p
2N929	22p	2N3704	11p	40316	47p	BC168C	11p	BFY53	15p	NKT451	62p
2N930	20p	2N3705	10p	40317	37p	BC169B	11p	BFY56A	57p	NKT452	62p
2N987	40p	2N3706	9p	40319	55p	BC169C	12p	BFY76	42p	NKT453	47p
2N1090	22p	2N3707	11p	40320	47p	BC170	12p	BFY77	57p	NKT713	20p
2N1091	22p	2N3708	7p	40323	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1131	25p	2N3709	9p	40324	47p	BC172	15p	BSX19	17p	NKT734	27p
2N1132	25p	2N3710	9p	40326	37p	BC175	22p	BSX20	15p	NKT736	35p
2N1302	17p	2N3711	12p	40329	30p	BC177	20p	BSX21	20p	NKT773	25p
2N1303	17p	2N3713	187p	40344	27p	BC178	20p	BSX26	45p	NKT781	30p
2N1304	22p	2N3714	200p	40347	57p	BC179	20p	BSX27	47p	OC16	50p
2N1305	22p	2N3715	123p	40348	52p	BC182	10p	BSX28	32p	OC19	37p
2N1306	25p	2N3716	130p	40360	40p	BC182L	10p	BSX60	82p	OC20	75p
2N1307	25p	2N3773	240p	40361	40p	BC183	9p	BSX61	62p	OC22	50p
2N1308	25p	2N3791	206p	40362	50p	BC183L	9p	BSX76	15p	OC23	60p
2N1309	25p	2N3819	34p	40370	32p	BC184	11p	BSX77	20p	OC24	60p
2N1507	17p	2N3820	55p	40406	57p	BC184L	11p	BSX78	25p	OC25	40p
2N1613	20p	2N3823	50p	40407	40p	BC186	25p	BSY24	15p	OC26	25p
2N1631	35p	2N3854	27p	40408	52p	BC187	27p	BSY25	15p	OC28	60p
2N1632	30p	2N3854A	27p	40409	55p	BC212L	12p	BSY26	17p	OC29	60p
2N1637	30p	2N3855	27p	40410	62p	BC213L	12p	BSY27	15p	OC35	50p
2N1638	27p	2N3855A	30p	40412	50p	BC214L	15p	BSY28	17p	OC36	60p
2N1639	27p	2N3856	30p	40467A	57p	BCY10	27p	BSY29	17p	OC41	22p
2N1701	162p	2N3856A	35p	40468A	35p	BCY30	27p	BSY32	25p	OC42	25p
2N1711	24p	2N3858	25p	40528	72p	BCY31	30p	BSY36	25p	OC44	15p
2N1889	32p	2N3858A	30p	40600	57p	BCY32	50p	BSY37	25p	OC45	12p
2N1893	37p	2N3859	27p	40603	50p	BCY33	25p	BSY38	20p	OC46	15p
2N2147	72p	2N3859A	32p	AC107	30p	BCY34	30p	BSY39	22p	OC70	15p
2N2160	57p	2N3860	30p	AC126	20p	BCY38	40p	BSY43	50p	OC71	12p
2N2193	40p	2N3866	150p	AC127	24p	BCY39	60p	BSY51	32p	OC72	12p
2N2193A	42p	2N3877	40p	AC128	20p	BCY40	50p	BSY52	32p	OC73	30p
2N2194	27p	2N3877A	40p	AC151	18p	BCY41	15p	BSY53	37p	OC74	30p
2N2194A	30p	2N3900	37p	AC152	22p	BCY42	15p	BSY54	40p	OC75	20p
2N2217	25p	2N3900A	40p	AC154	22p	BCY43	15p	BSY56	90p	OC76	22p
2N2218	20p	2N3901	97p	AC176	20p	BCY54	20p	BSY79	45p	OC77	30p
2N2219	20p	2N3903	20p	AC187	25p	BCY58	25p	BSY90	57p	OC78	20p
2N2220	25p	2N3904	25p	AC188	25p	BCY59	25p	BSY95A	12p	OC81	20p
2N2221	25p	2N3905	30p	ACY17	27p	BCY60	97p	C424	15p	OC81D	20p
2N2222	20p	2N3906	25p	ACY18	24p	BCY70	15p	C450	15p	OC82	25p
2N2222A	25p	2N4058	12p	ACY19	24p	BCY71	20p	GET102	30p	OC82D	15p
2N2297	30p	2N4059	10p	ACY20	20p	BCY72	15p	GET113	20p	OC83	25p
2N2368	15p	2N4060	12p	ACY21	20p	BCY78	30p	GET114	20p	OC84	25p
2N2369	15p	2N4061	12p	ACY22	10p	BCY79	30p	GET118	20p	OC139	25p
2N2369A	15p	2N4062	12p	ACY28	17p	BCZ10	27p	GET120	25p	OC140	32p
2N2410	42p	2N4244	47p	ACY39	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2483	27p	2N4248	15p	ACY40	20p	BD112	50p	GET880	30p	OC171	30p
2N2484	32p	2N4249	15p	ACY41	15p	BD116	112p	GET887	20p	OC200	40p
2N2539	22p	2N4250	18p	ACY44	25p	BD121	65p	GET889	22p	OC201	60p
2N2540	22p	2N4254	42p	AD140	47p	BD123	80p	GET890	22p	OC202	75p
2N2613	35p	2N4255	42p	AD149	47p	BD124	60p	GET896	22p	OC203	40p
2N2614	30p	2M4284	17p	AD150	62p	BD131	75p	GET897	22p	OC204	40p
2N2646	40p	2N4285	17p	AD161	35p	BD132	80p	GET898	22p	OC205	75p
2N2711	25p	2N4286	17p	AD162	35p	BDY10	125p	MAT100	25p	OC206	95p
2N2712	25p	2N4287	17p	AF109	45p	BDY20	105p	MAT101	25p	OC207	75p
2N2713	27p	2N4288	15p	AF114	25p	BDY61	125p	MAT120	25p	OC271	42p
2N2714	30p	2N4289	17p	AF115	25p	BDY62	100p	MAT121	25p	ORP12	50p
2N2904	20p	2N4290	12p	AF116	25p	BF115	25p	MJ400	107p	ORP60	40p
2N2904A	25p	2N4291	15p	AF117	20p	BF117	47p	MJ420	80p	ORP61	42p
2N2905	25p	2N4292	15p	AF118	60p	BF152	28p	MJ421	80p	P346A	22p
2N2905A	27p	2N4294	17p	AF121	30p	BF154	20p	MJ430	102p	ST140	15p
2N2906	20p	2N4303	47p	AF124	22p	BF158	15p	MJ440	95p	ST141	20p
2N2906A	25p	2N4964	15p	AF125	19p	BF159	35p	MJ480	97p	TIS34	62p
2N2907	23p	2N4965	18p	AF126	19p	BF163	35p	MJ481	125p	TIS43	40p
2N2923	15p	2N5027	52p	AF127	16p	BF167	18p	MJ490	100p	TIS44	10p
2N2924	15p	2N5028	57p	AF139	28p	BF170	33p	MJ491	137p	TIS45	27p
2N2925	15p	2N5029	47p	AF178	47p	BF173	19p	MJE340	50p	TIS46	11p
2N2926G	10p	2N5030	42p	AF179	45p	BF177	30p	MJE370	80p	TIS47	11p
2N2926O	10p	2N5172	12p	AF180	50p	BF178	25p	MJE371	80p	TIS48	12p
2N2926Y	10p	2N5174	52p	AF181	40p	BF179	30p	MJE520	60p	TIS49	12p
2N3011	20p	2N5175	52p	AF186	39p	BF180	35p	MJE521	70p	TIS50	12p
2N3014	32p	2N5176	45p	AF239	30p	BF181	30p	MPF102	42p	TIS51	10p
2N3053	18p	2N5232A	30p	AF279	47p	BF182	30p	MPF103	35p	TIS52	11p
2N3054	46p	2N5245	42p	AF280	47p	BF184	20p	MPF104	37p	TIS53	22p
2N3055	60p	2N5246	42p	AFZ11	32p	BF185	20p	MPF105	37p	XB112	20p
2N3133	30p	2N5249	67p	ASY26	25p	BF194	15p	MPS3638	32p	XC141	35p
2N3134	15p	2N5265	325p	ASY27	30p	BF195	15p	NKT124	42p	ZTX107	15p
2N3135	25p	2N5305	37p	ASY28	24p	BF196	15p	NKT125	27p	ZTX108	12p
2N3136	25p	2N5306	40p	ASY29	27p	BF197	15p	NKT126	27p	ZTX109	15p
2N3390	25p	2N5307	37p	ASY50	25p	BF198	15p	NKT128	27p	ZTX300	12p
2N3391	20p	2N5308	37p	ASY51	32p	BF200	35p	NKT135	27p	ZTX301	15p
2N3391A	30p	2N5309	62p	ASY54	25p	BF224	14p	NKT137	32p	ZTX302	20p
2N3392	17p	2N5310	42p	ASY67	45p	BF225	19p	NKT210	30p	ZTX303	20p
2N3393	15p	2N5354	27p	ASY86	32p	BF237	22p	NKT211	30p	ZTX304	25p
2N3394	15p	2N5355	27p	ASZ21	51p	BF238	22p	NKT212	30p	ZTX500	15p
2N3402	22p	2N5356	32p	AUY10	150p	BF244	23p	NKT213	30p	ZTX501	15p
2N3403	22p	2N5365	47p	BC107	10p	BFW61	47p	NKT214	20p	ZTX502	20p
2N3404	32p	2N5366	32p	BC108	10p	BFW87	25p	NKT215	22p	ZTX503	17p
2N3405	45p	2N5367	57p	BC109	10p	BFW88	23p	NKT216	35p	ZTX504	40p
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4004 400PIV	8p	10p	25p
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50 + less 15% 100 + less 20%

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3·3-33 V	2·4—100	3·9—100V
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25 + less 15% 100 + less 20%

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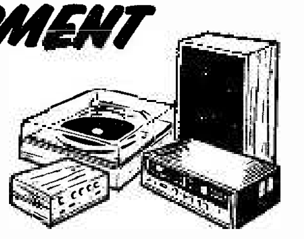

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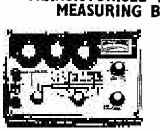

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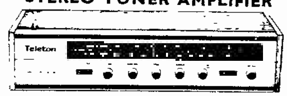

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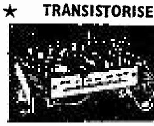

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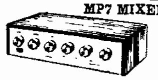

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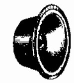

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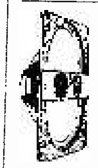

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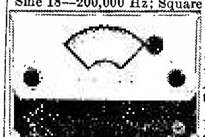

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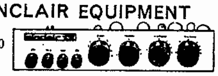

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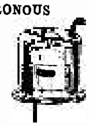

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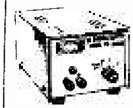

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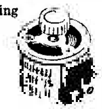

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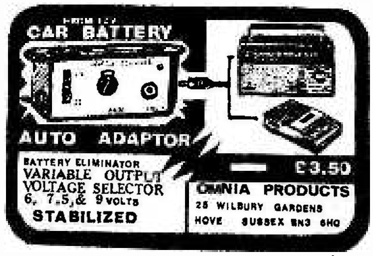

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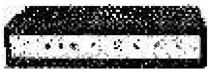

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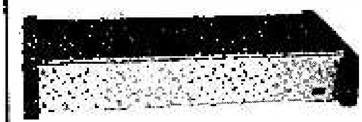

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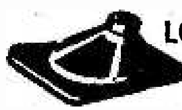

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6AQ5	0.42

6AQ6	0.70
6AR5	0.55
6AR6	0.65
6AR11	1.25
6AS5	0.50
6AS7G	0.85
6AT6	0.38
6AU6	0.30
6AV6	0.40
6AW8A	0.65
6BA6	0.28
6BE6	0.32
6BF6	0.55
6BH6	0.75
6BJ6	0.55
6BK7A	0.75
6BN5	0.43
6BN6	0.60
6BQ5	0.25
6BR8	0.75
6BS7	1.35
6BW6	0.90
6BW7	0.90
6BX6	0.25
6BZ6	0.45
6C4	0.35
6C5GT	0.55
6CB6	0.40
6CD6GA	1.30
6CG7	0.60
6CH6	0.60
6CL6	0.60
6CU6	0·80
6CW4	0.70
6CY5	0.50
6CY7	0.75
6D3	0.55
6DC6	0.80
6DK6	0.60
6DQ6B	0.75
6DS4	1.25
6EA8	0.65
6EH7	0.30
6EJ7	0.35

6EW6	0.70
6F1	0.75
6F5	0.75
6F6G	0.45
6F11	0.50
6F13	0.50
6F14	0.70
6F15	0.65
6F18	0.50
6F23	0.90
6F24	0.80
6F25	1.00
6F26	0.35
6F28	0.70
6GK6	0.60
6J4	0.60
6J5GT	0.40
6J6	0.30
6J7	0.45
6K6GT	0.75
6K7	0.43
6K8G	0.45
6K25	0.75
6L6GT	0.55
6L7	0.45
6L18	0.50
6LD20	0.50
6N7GT	0.55
6P25	1.50
6P28	0.65
6Q7	0.50
6SA7	0.45
6SG7	0.45
6SK7	0.50
6SL7GT	0.45
6SN7GT	0.45
6SQ7	0.50
6SR7	0.50
6T8	0.38
6U4GT	0.70
6U5G	0·75
6U8A	0.48
6V6GT	0.45
6X4	0.40
6X5GT	0.45

6X8	0.65
6Y6G	0.80
7Y4	0.75
9BW6	0.70
10C2	0.60
10D1	0.65
10D2	0.55
10F1	0.75
10F9	0.65
10F18	0.60
10L1	0.60
10LD11	0.70
10P13	0.75
12AB5	0.70
12AC6	0.60
12AD6	0.60
12AE6	0.60
12AL5	0.55
12AQ5	0.50
12AT6	0.40
12AT7	0.40
12AU6	0.45
12AU7	0.33
12AV6	0.45
12AV7	0.70
12AX7	0.33
12AY7	0.75
12B4A	0.65
12BA6	0.45
12BA7	0.50
12BE6	0.50
12BH7	0.50
12BY7	0.65
12K5	1·00
12K7GT	0.50
12Q7GT	0.45
12SR7	0.50
20D1	0.60
20L1	1.10
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30FL14	0.90
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30L17	0.95
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30P19	0.95
30PL1	0.95
30PL13	1.10
30PL14	1.25
35A3	0.60
35A5	0.75
35B5	0.65
35C5	0.60
35D5	0.75
35L6GT	0.75
35W4	0.40
35Z3	0.75
35Z4G	0.40
35Z5GT	0.70
50A5	0.80
50B5	0.70

50C5	0.60
50CD6G	1.20
50EH5	0.65
50L6GT	0.60
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EBC33	0.60
EBC41	0.65
EBC81	0.33
EBF80	0.40
EBF83	0.40
EBF89	0.32
EBL31	1·50
EC53	0.50
EC86	0.60
EC88	0.60
EC90	0.35
EC92	0.45
EC93	0.60
ECC35	1.00
ECC40	0.70
ECC81	0.40
ECC82	0.33
ECC83	0.33

ECC84	0.30
ECC85	0.40
ECC88	0.40
ECC89	0.50
ECC91	0.30
ECC189	0.65
ECC807	1.00
ECF80	0.35
ECF82	0.35
ECF804	1.65
ECH81	0.30
ECH83	0.45
ECH84	0.45
ECL80	0.50
ECL81	0.50
ECL82	0.35
ECL83	0.70
ECL84	0.55
ECL85	0.55
ECL86	0.40
ECLL800	2·20
EF40	0.50
EF41	0.65
EF42	0.70
EF80	0.30
EF85	0.35
EF86	0.30
EF89	0.28
EF91	0.37
EF92	0.35

EF95	0.40
EF97	0.65
EF98	0.75
EF183	0.30
EF184	0.35
EF804	1.25
EK90	0.32
EL33	1.50
EL34	0.50
EL36	0.50
EL37	1.70
EL41	0.75
EL81	0.55
EL83	0.50
EL84	0.25
EL85	0.43
EL86	0.40
EL90	0.42
EL95	0.35
EL821	0.60
EL822	1.40
ELL80	0.75
EM34	1.00
EM71	0.80
EM80	0.45
EM81	0.60
EM83	0.50
EM84	0.35
EM85	1.00
EM87	0.70
EN91	0.40
EY51	0.40
EY80	0.75
EY81	0.40
EY83	0.55
EY86	0.40
EY87	0.43
EY88	0.43
EZ40	0.50
EZ41	0.75
EZ80	0.28
EZ81	0.29
GT1C	3.00
GY501	0.70
GZ30	0.45

GZ31	0.40
GZ32	0.50
GZ33	0.75
GZ34	0.60
HABC80	0.55
HK90	0.50
KT66	2.35
KT88	2·25
N78	1·60
PABC80	0.41
PC86	0.60
PC88	0.60
PC92	0.05
PC97	0.50
PC900	0.48
PCC84	0.40
PCC85	0.40
PCC88	0.55
PCC89	0.55
PCC189	0.60
PCC805	0.95
PCC806	0.95
PCF80	0.30
PCF82	0.35
PCF84	0.60
PCF86	0.60
PCF87	1·10
PCF801	0.50
PCF802	0.50
PCF805	0.90
PCF806	0.75
PCF808	0.90
PCH200	0.70
PCL81	0.50
PCL82	0.35
PCL83	0.65
PCL84	0.45
PCL86	0.45
PCL88	1.25
PCL800	1.10
PCL801	0.95
PCL805	0.50
PD500	1.30
PF86	0.70
PF818	1.00

PFL200	0.65
PL33	0.40
PL36	0.55
PL81	0.50
PL82	0.45
PL83	0.45
PL84	0.40
PL302	0.95
PL504	0.75
PL508	0.90
PL509	1.10
PL801	1.00
PL802	0·95
PM84	0.60
PY31	0.35
PY33	0.63
PY80	0.40
PY81	0.30
PY82	0.35
PY83	0.38
PY88	0.40
PY500	1.00
PY800	0.47
PY801	0.50
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QQV02-6	2.25
QQV03-10	1.25
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TT22	3.50
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U25	0.85
U26	0.85
U31	0.70
U37	6.50
U52	0.40
U76	0.40
U78	0.40
U191	0.75
U201	0.50
U281	0.55
U282	0.55

U301	0.55
U403	0.70
U404	0.70
U801	0.80
UABC80	0.40
UAF41	0.70
UAF42	0.60
UB41	0·65
UBC41	0.55
UBC81	0.45
UBF80	0.40
UBF89	0.40
UBL1	0.70
UBL21	0.70
UC92	0.45
UCC85	0.45
UCF80	0.70
UCH21	0.60
UCH42	0.70
UCH81	0.40
UCL81	0.60
UCL82	0.35
UCL83	0.65
UF9	0.65
UF11	0.60
UF41	0.65
UF42	0.65
UF43	0.65
UF80	0.35
UF85	0.40
UF89	0.40
UL41	0·65
UL84	0.43
UM84	0.30
UY1N	0.50
UY11	1.00
UY41	0.48
UY82	0.50
UY85	0.40
W729	0.75
Y63	0·75
Z759	8·00
Z803U	1.85

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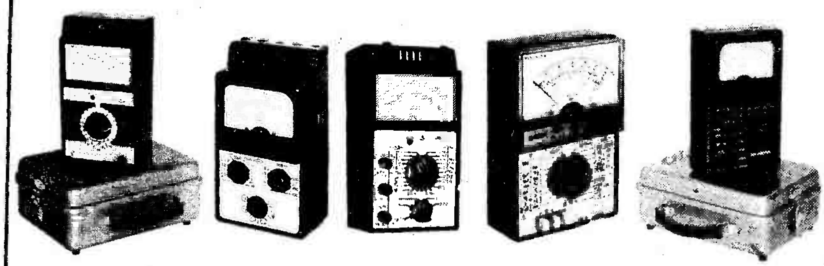
2N696	0.15	AC128	0.15	BD123	0.80
2N697	0.15	AC132	0.35	BD124	0.60
2N698	0.30	AC153	0.20	BD131	0.75
2N705	0.70	AC154	0.15	BD132	0.80
2N706	0.10	AC157	0.17	BF115	0.20
2N708	0.15	AC169	0.10	BF167	0.18
2N753	0.25	AC176	0.17	BF173	0.20
2N929	0.20	AC187	0.25	BF179	0.30
2N930	0.20	AC188	0.25	BF180	0.30
2N987	0.30	ACY17	0.25	BF181	0.30
2N1131	0.25	ACY18	0.20	BF184	0.20
2N1132	0.25	ACY19	0.25	BF185	0.20
2N1184	1.25	ACY20	0.20	BF194	0.14
2N1302	0.17	ACY21	0.20	BF195	0.14
2N1303	0.17	ACY22	0.10	BF196	0.12
2N1304	0.20	AD140	0.50	BF197	0.12
2N1305	0.20	AD149	0.45	BF200	0.35
2N1306	0.25	AD161	0.35	BFW87	0.25
2N1307	0.25	AD162	0.35	BFW88	0.20
2N1308	0.25	ADZ11	1.25	BFW89	0.20
2N1309	0.25	ADZ12	1.25	BFW91	0.20
2N1613	0.17	AF114	0.17	BFX88	0.20
2N1711	0.20	AF115	0.17	BFY17	0.40
2N1756	0.75	AF116	0.17	BFY19	0.25
2N2147	0.75	AF117	0.17	BFY50	0.20
2N2160	0.60	AF118	0.30	BFY51	0.20
2N2217	0.25	AF125	0.20	BFY52	0.20
2N2218	0.20	AF127	0.20	BSY26	0.17
2N2219	0.20	AF180	0.35	BSY27	0.15
2N2369A	0.15	AF181	0.35	BSY28	0.17
2N2477	0.65	AF186	0.40	BSY65	0.20
2N2646	0.40	AF239	0.36	BSY95A	0.12
2N2905	0.25	AFZ11	0.45	OC16	0.50
2N2923	0.12	AFZ12	1.00	OC22	0.50
2N2924	0.13	ASY26	0.25	OC23	0.60
2N2926	0.10	ASY27	0.30	OC24	0.60
2N3053	0.20	ASY28	0.25	OC25	0.35
2N3054	0.50	ASY29	0.30	OC26	0.25
2N3055	0.60	ASY54	0.25	OC28	0.50
2N3133	0.25	ASZ15	0.70	OC29	0.60
2N3134	0.25	ASZ16	0.70	OC35	0.50
2N3391	0.17	ASZ17	0.75	OC36	0.45
2N3392	0.17	ASZ18	0.75	OC42	0.20
2N3393	0.15	ASZ20	0.25	OC44	0.15
2N3394	0.15	ASZ21	0.40	OC45	0.12
2N3395	0.20	BC107	0.10	OC70	0.10
2N3402	0.15	BC108	0.10	OC71	0.12
2N3403	0.15	BC109	0.10	OC72	0.12
2N3404	0.32	BC113	0.10	OC73	0.30
2N3414	0.20	BC118	0.20	OC75	0.15
2N3415	0.15	BC134	0.20	OC76	0.15
2N3417	0.25	BC147	0.10	OC78	0.25
2N3702	0.10	BC148	0.10	OC78D	0.20
2N3703	0.10	BC149	0.12	OC81	0.20
2N3704	0.12	BC152	0.15	OC81D	0.20
2N3707	0.12	BC158	0.15	OC83	0.20
2N3709	0.10	BC175	0.20	OC139	0.30
2N3710	0.10	BC186	0.25	OC140	0.35
2N3819	0.35	BCY30	0.25	OC141	0.60
2N3906	0.25	BCY31	0.30	OC170	0.25
2S702	0.50	BCY33	0.25	OC171	0.25
2S746	0.25	BCY34	0.30	OC200	0.30
AC113	0.15	BCY72	0.15	OC201	0.60
AC125	0.30	BCZ10	0.30	OC202	0.65
AC126	0.20	BCZ11	0.40	OC203	0.40
AC127	0.17	BD121	0.65	OC204	0.40



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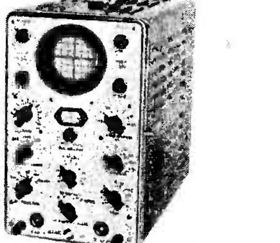

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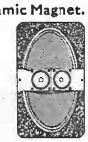

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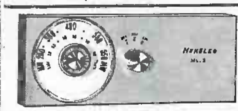

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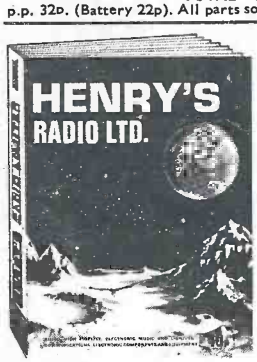

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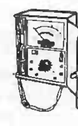

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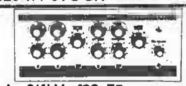

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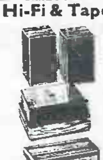

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