

# PRACTICAL WIRELESS

OCTOBER  
1972

20

**FREE INSIDE  
PRACTICAL  
AERIAL  
DATA  
WALL CHART**

**THE**

PW

**PRE-TUNED**

**CAR/PORTABLE**

**RADIO**

**also:**

**AUDIO REFERENCE SOURCE  
'LOGIPROBE' FOR DIGITAL IC's**





# RSC HIGH-FIDELITY STEREO PACKAGE OFFERS

Four fully wired units ready to 'plug in'.  
 ★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing  
 ★ GARRARD SP25 MK III Turntable on Plinth with cover  
 ★ GOLDRING G850 Magnetic cartridge with diamond stylus  
 ★ PAIR OF STANWAY II Speaker Units  
 Special Total Price **£87.95**  
 Carr. £1.50

Terms: Deposit £12.77 and 9 monthly payments £9.39 (Total £97.28).

★ Super 30 Amplifier (15 + 15 watt) in veneered housing  
 ★ Goldring GL69 II Transcription Turntable on Plinth as illustrated  
 ★ Goldring Magnetic P.U. Cartridge.  
 ★ Pair of Stanway II speaker units.  
 Special Total Price **£98.63** Carr. £1.50

Terms: Deposit £13.63 and 9 monthly payments £10.62 (Total £109.21).



ATTRACTIVE TEAK OR AFROMOSIA VENEERED CABINETS AND PLINTHS

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

★ TA12 AMPLIFIER 6.5 + 6.5 watt in veneered housing  
 ★ GARRARD SP25 MK III Player unit on Plinth  
 ★ SONOTONE 9TA1HC Ceramic P.U. Cartridge with diamond stylus  
 ★ PAIR OF DORCHESTER Loudspeaker Units  
 Special Total Price **£59.00**  
 Or Deposit £8.40 & 9 monthly payments £6.32 (Total £65.28). Carr. £1.25  
 Trans. Plastic Cover £3.15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25  
 Carr. £1.25  
 Or Deposit £7.50 and 9 monthly payments £5.64 (Total £58.26)  
 Trans. Plastic cover £3.15 extra.

## 'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

★ Moderate size only 25 x 14 x 10in. approx.  
 ★ Response 30-20,000 c.p.s. Impedance 15 ohms  
 ★ Performance comparable with units costing considerably more.  
 Consists of (1) 2in. 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 x 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).

COMPLETE KIT **£23** Carr. 65p

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

## 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 x 11 x 9in. approx. Range 45-15,000 c.p.s. Rating 6-10 watts. Fitted high flux 13 x 8in. **£9.45** Carr. 40p.  
 Dual Cone speaker. Imp. 3 or 15 ohms.  
 STANWAY II Size 20 x 10 1/2 x 9 1/2 in. approx. Rating 10 watts. Inc. 13 x 8in. speaker with highly flexible cone surround, long throw voice coil and 10,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. See 'package offers' for **£19.35** illustration Carr 50p

## 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 face plate and matching control knobs.



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagrams 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).

## 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.  
 OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6.95** Carr. 35p



## AUDIOTRINE HIGH FIDELITY SPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Plasticised Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. PLEASE STATE CHOICE.  
 Exceptional performance at low cost.  
 HF808T 8" 10W £2.88 HF120D 12" 15W £4.99  
 HF102D 10" 10W £3.40 HF128 12" 15W £5.75  
 HF120 12" 15W £4.50 HF126D 12" 15W £8.25

## FANE 807T HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high tone response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω. **£3.85**  
 PLEASE STATE IMPEDANCE WHEN ORDERING



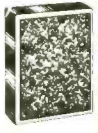
## R.S.C. TA12 MKIII 6.5 + 6.5 WATT STEREO AMPLIFIER

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 **£15.50** Carr. Factory built with WIRING DIAGRAMS & INSTRUCTIONS **£19.50** Dep. £3 and 9 monthly payments **£2.15** (Total £22.95). Or in Teak veneer housing **£23** Dep. £3 & 9 monthly payments **£2.55** (Total £25.95). Send S.A.E. for leaflet.



## HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. Sizes approx. Carr. 35p. per enc.  
 JE8 Size 16 x 11 x 9in. SE8 For optimum performance with any 8in. Hi-Fi spkr. Size 22 x 15 x 9in. **£6.47**  
 8in. Hi-Fi speaker. **£5.35**  
 SE10 For outstanding results with 10in. Hi-Fi spkr. Size 24 x 15 x 10in. P.t.d. **£6.74**  
 SE12 For excellent performance with 12in. Hi-Fi speaker and tweeter Size 25 x 16 x 10 1/2 in. **£7.87**



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

TYPE BML. An all-dry battery eliminator. Size 5 1/4 x 4 1/2 in. approx. Completely replaces batteries supplying 1.5v and 90v. to battery radio where A.C. mains 200/250v. 50c/s is available.  
 COMPLETE KIT **£3.25** ASSEMBLED READY **£3.75** WITH DIAGRAM FOR USE

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

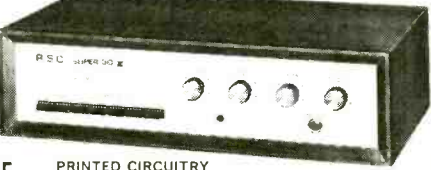
200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. - 2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case. 9 1/2 x 2 1/2 x 3 1/2 in. Attractive brushed silver finish facia plate 10 1/2 x 3 1/2 in. 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. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

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

Only high grade components by leading manufacturers.  
 COMPLETE KIT OF PARTS OR FACTORY BUILT with 12 months guarantee. Dep. **£5.75** and 9 monthly payments **£3.50** (Total **£37.25**).  
 OR FACTORY BUILT in cabinet as illustrated. Dep. **£7** and 9 monthly payments **£3.99** (Total **£42.91**)  
 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.



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  
 FREQUENCY RESPONSE - 30B 7Hz to 70kHz 0-1% at 1000 Hz 10 Watts  
 TREBLE CONTROL: +16dB to -12dB at 14kHz  
 BASS CONTROL: +17dB to -16dB at 40Hz  
 CROSS TALK - 58dB  
 SENSITIVITIES: Disc Mag. 2.5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.  
 REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

RSC STEREO HI-FI TUNER NOW AVAILABLE. Visually matches Super 30 MkIII **£44.95**

## RSC GROUP/DISCO UNITS

Units listed below



50 WATT SPEAKER



100 WATT AMPLIFIER



TWIN TURNTABLE WITH PREAMP FGI/2A

(a) 100w POWER AMPLIFIER  
 (b) PAIR OF HI-FI HEAD-  
 PHONES  
 (c) MATCHING DYNAMIC 'MIKE'  
 (Attached to headphones)  
 (d) PAIR 50 WATT SPEAKERS  
 Black Rexine covered  
 Cabinets  
 Size approx. £72-85  
 18" x 18" x 8"  
 (a) (b) (c) & (d)

Terms on Amps. Speakers and Head-  
 phone/Mike. Deposit £15 and 18  
 monthly payments of £3-95 (Total  
 £86-10).

**R.S.C.TDI DISCOCO NSOLE**  
 Incorporating twin Garrard SP25  
 Mk.III turntables and Ceramic  
 Cartridges with diamond stylus.  
 Separate Vol. controls for each  
 turntable. Also **MOUNTING**  
**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  
 Or Dep. £13-25 and  
 9 mthly pymts £6-75  
 (Total £74) or Dep. £15 and 18 mthly  
 pymnts £3-66 (Total £79-03)  
**£67-10**

### R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

All types 15 Ohms covered in Rexine and Vynair  
**TYPE C410 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN**

**TYPE C48S 25-30 WATTS**  
 Fitted four 8" high flux 8 watt speakers  
 Overall size approx. 48 x 18 x 10"  
 Terms: Dep. £3 and 9 monthly  
 payments £2 (Total £22) Carr. 50p.

**TYPE C412S 50 WATTS**  
 Fitted four 12" 11,000 line 15 watt  
 speakers: Overall size approx. 56 x 14 x 9 1/2"  
 Terms: Dep. £4 and 9 monthly pay-  
 ments £3-37 (Total £34-33) Carr. 75p

**£65**

**TYPE C4100 200 WATTS** Inc. four 12" 50 watt speakers for conserva-  
 tive raking. Extra heavy construction. Size approx. 68 x 16 x 10" Acoustically  
 filled and pressurised. Terms: Dep. £11 and 9 mthly. pmts. £6-75 (Total £21-75). 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	'POP' 60	'POP' 50
18" 100Watt 14,000 gauss 8/150	15" 60 Watt 14,000 gauss 8/150	12" 50 Watt 13,000 gauss 150
<b>£22-95</b>	<b>£12-90</b>	<b>£10-90</b>
Dep. £6 and 9 mthly payments £2-20 (Total £25-80)	Dep. £3-30 and 9 monthly payments. £1-30 (Total £15).	Dep. £2 and 9 monthly pay- ments £1-20 (Total £12-80)

FOR BASS GUITAR, ELECT. ORGAN, ETC.

### R.S.C. A10 30 WATT ULTRA LINEAR

HI-FI AMPLIFIER

Highly sensitive. Push-Pull high  
 output, Hum level -70dB. Response  
 ±3dB 30-20,000 c/s. All high grade components. Valves EF86,  
 EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls.  
 Sensitivity 36 millivolts. For High Impedance microphones.  
 For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions,  
 etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio  
 or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used  
 for mixing purposes. 200-250V. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Com-  
 plete kit of parts with wiring diagram and instructions. Twin-handled perforated cover  
 £15-75  
 £1-80. Or factory built with EL34 output valves and 12 months' guarantee for £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. or Dep. £1 and 9 mthly  
 free payments 75p (Total  
 £7-75).

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

FULLY GUARANTEED. Impregnated and Interleaved where necessary.

<p><b>Primarys 200-250V. 50c/s. Screened</b>  <b>MIDGET CLAMPED TYPE 2" x 2 1/2" x 2 1/2"</b></p> <p>260v., 60mA, 6-3v. 2a ..... £1-00          250v., 60mA, 6-3v. 2a ..... 99p</p> <p><b>FULLY SHROUDED UPBUILT MOUNTING</b></p> <p>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 ..... £2-65          For Mullard 510 Amplifier ..... £2-65</p> <p>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., 6v. 3a ..... £4-95          425-0-425V. 200mA, 6-3v. 4a, c.t., 6v. 3a, 5v. 3a ..... £5-10          450-0-450V. 250mA, 6-3v. 4a, c.t., 6v. 3a ..... £5-50</p> <p><b>TOP SHROUDED DROP-THRO' TYPE</b></p> <p>250-0-250V. 70mA, 6-3v. 2p, 0-5-6-3v. 2a ..... £1-35          250-0-250V. 100mA, 6-3v. 3a ..... £1-55          250-0-250V. 100mA, 6-3v. 2a, 6-3v. 1a ..... £1-60          300-0-300V. 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 ..... £2-60</p> <p>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</p>	<p><b>FLYBACK OR TRANSISTOR POWER PACK</b></p> <p>Types 6-3v. 1-5a. 49p; 6-3v. 2a. 54p; 6-3v. 3a. 76p;          6-3v. 6a. £1 30; 12v. 1a. 55p; 12v. 3a. 24c. or 24c.          1-5a £1-35, 0-9-18V 1 1/2 £1-10; 0-12-26-42v 2a £1-76.  <b>CHARGER TRANSFORMERS</b> 0-5-15V. 1 1/2a. 99p          2 1/2a. £1-10; 3a. £1-25; 5a. £1-45; 6a. £1-65; 8a. £2-00  <b>AUTO (Step UP/step DOWN) TRANSFORMERS</b>          0-110/120V. 200-230-250V. 60-70 watt £1-10,          150 watt, £1-90 250 watt £2-75; 500 watt £5-75  <b>OUTPUT TRANSFORMERS</b>          Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p          Push-Pull 8 watt EL34 to 3 Ω or 15 Ω ..... 83p          Push-Pull 10 watt 6V8, ECL86 to 3, 5, 8 or          15 Ω ..... £1-37          Push-Pull EL84 to 3 or 15 Ω 10-12 watts ..... £1-85          Push-Pull Ultra Linear for Mullard 510, etc. £2-20          Push-Pull 15-18 watt, 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  <b>SMOOTHING CHOKES</b> 150mA, 7-10H. 250 Ω          70p; 100mA, 10H, 200 Ω 60p; 80mA, 10H,          350 Ω 50p; 60mA, 10H, 400 Ω 25p.</p> <p><b>SELENIUM RECTIFIERS F. W. (Bridged)</b>          All 6/12v. D.C. output. Max. A.C. input 18v.          1a. 25p. 2a. 35p. 3a. 60p. 4a. 65p. 6a. 80p.</p>
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### GROUP/DISCO EQUIPMENT PACKAGE OFFERS

<p><b>F.A.L. PHASE 50 MK.III AMPLIFIER</b> £34-95  <b>PR. FANE POP 25/2 25W L/SPEAKERS</b> £13-50          Terms: Deposit £6-50 and 9 monthly          payments of £4-75 (Total £45-38)</p> <p><b>F.A.L. PHASE 50 MK.III AMPLIFIER</b> £34-95  <b>PR. FANE POP 50 L/SPEAKERS</b> £21-80          Terms: Deposit £10 and 9 monthly          payments of £5-25 (Total £57-25)</p> <p><b>F.A.L. PHASE 50 MK.III AMPLIFIER</b> £34-95  <b>PAIR L12/25 25W L/S in cabinets</b> £23-90          Terms: Deposit £12 and 9 monthly          payments of £5-75 (Total £61-75)</p> <p><b>F.A.L. PHASE 100 AMPLIFIER</b> £81-95  <b>4 FANE POP 50 L/SPEAKERS</b> £43-80          Terms: Deposit £15-95 and 9 monthly          payments of £10-50 (Total £110-45)</p>	<p><b>PACKAGE PRICE</b>  <b>£45</b> Carr. £1</p> <p><b>PACKAGE PRICE</b>  <b>£52</b> Carr. £1</p> <p><b>PACKAGE PRICE</b>  <b>£56</b> Carr. £1-25</p> <p><b>PACKAGE PRICE</b>  <b>£99-95</b> Carr. £2</p>
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### 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  
 Or deposit £4-50 and 9 monthly pmts. of £3-62. Total £37-08

<p><b>L12/25 12" 25 WATT</b>              10,000 lines              15 ohms.              Carr. 50p.  <b>£11-95</b></p>	<p><b>L13 13" x 8" 10 WATT</b>              10,000 lines 3 or 15              ohms. State imped-              ance required. Carr 40p  <b>£5-25</b></p>
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### FAL PHASE 50 MK.III AMPLIFIER 50W

Solid state. 4 Separately controlled inputs  
 Plus master vol. control. Ind. Bass and Treble  
 Controls. Protective circuit to guard against  
 damage from accidental short. Output for  
 Speakers 3 to 30 ohms. Size 17" x 7" x 7".  
 200-250V. A.C. mains. Output 50 watts music rating.  
 Or deposit £7-25 & 9 monthly payments £3-50. Total £38-75.  
**£34-95** Carr. 75p.

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

### R.S.C. Branches listed below open all day Saturdays

**BRADFORD** 10 North Parade (Half-day Wed.). Tel. 25349  
**BLACKPOOL** (Agent) O & C Electronics

227 Church Street

**BIRMINGHAM** 30/31 Great Western Arcade,  
 Tel. 021-236 1279 (Half-day Wed.)

**DERBY** 26 Osmaston Rd., The Spot (Half-day Wed.).  
 Tel. 41361

**DARLINGTON** 18 Priestgate (Half-day Wed) Tel 68043

**EDINBURGH**  
 101 Lothian Rd. (Half-day Wed.). Tel. 229 9501  
**GLASGOW** 326 Argyle St. (Half-day Tues.).

Tel. 248 4158  
 Tel. 20505.

**HULL** 91 Paragon Street (Half-day Thurs.). Tel. 20505.  
**LEICESTER** 32 High Street (Half-day Thurs.). Tel. 56420  
**LEEDS** 5-7 County (Mecca) Arcade, Biggate  
 (Half-day Wed.). Tel. 28252

**LIVERPOOL** 73 Dale Street (Half-day Wed.).  
 Tel. 236 3573

**LONDON** 238 Edgware Road, W.2. (Half-day Thurs.).  
 Tel. 723 1629

**MANCHESTER** 60A Oldham Street, (Half-day Wed.).  
 Tel. 236 2778

**MIDDLESBROUGH** 106 Newport Rd. (Half-day Wed.).  
 Tel. 47096

**NEWCASTLE UPON TYNE**  
 24 Newgate Shopping Centre (Half-day Wed.). Tel. 21469  
**NOTTINGHAM** 19/19A Market Street (Half-day Thurs.).  
 Tel: 48068

**SHEFFIELD** 13 Exchange Street (Castle Market Bldgs.)  
 (Half-day Thurs.). Tel. 20716

**SUNDERLAND** 5 Market Square  
 Tel. 70573

### NOW THREE NEW BRANCHES

19/19A MARKET STREET

## NOTTINGHAM

ALSO 5 MARKET SQUARE

## SUNDERLAND

8 LITTLE UNDERBANK

## STOCKPORT

AND NEW MUCH LARGER PREMISES

24 NEWGATE CENTRE, 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.**  
**S.A.E. PLEASE WITH ENQUIRIES.**  
**SUPPLIERS TO GOVERNMENT DEPARTMENTS.**  
**EDUCATION AUTHORITIES, SCHOOLS,**  
**HOSPITALS, H.M. FORCES ETC.**  
**MAIL ORDERS MUST NOT BE SENT TO SHOPS**

### 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.

\* 2 extra heavy duty 12in. 60W L'spkrs.  
 \* Four Jack inputs and two Volume  
 Controls for instant use up to four pick-ups  
 or "mikes". Bass and Treble controls.  
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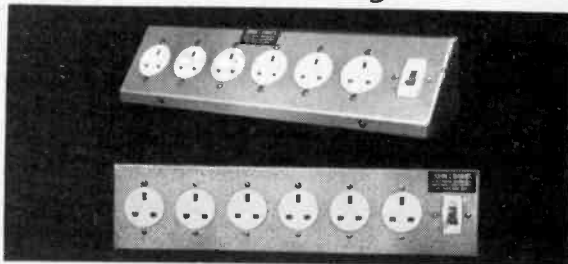
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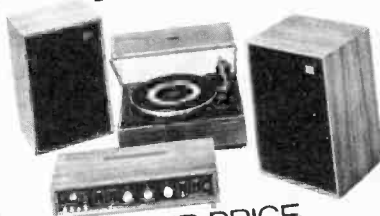


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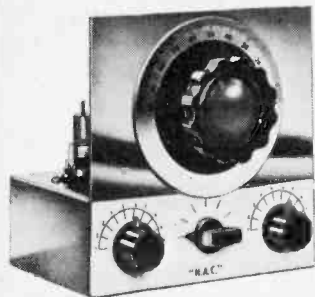
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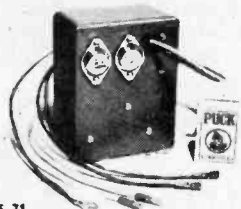
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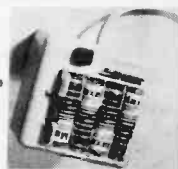
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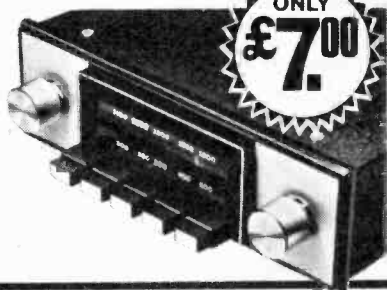
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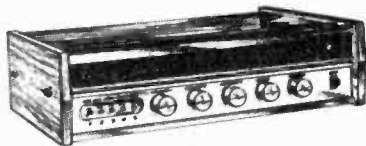
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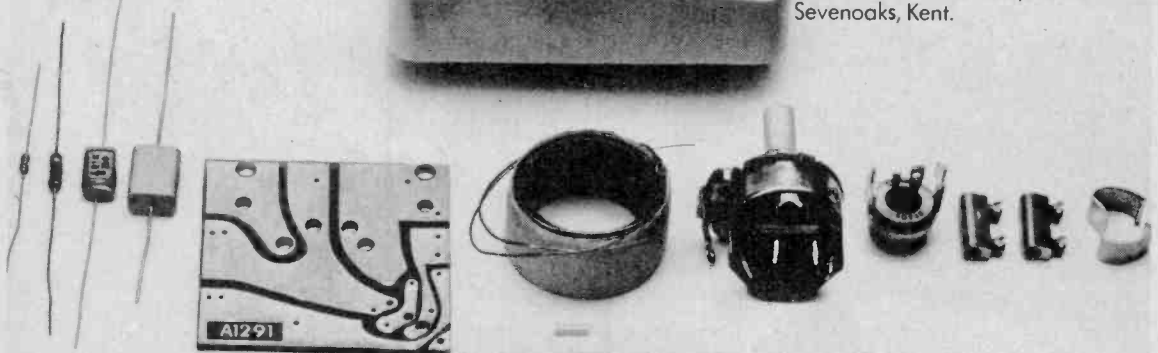
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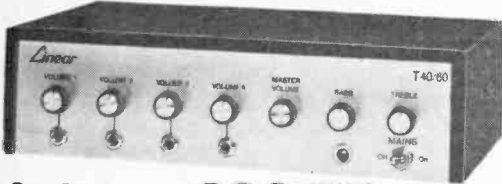
# LINEAR

## AMPLIFIERS FOR GUITAR PICK-UPS GRAM PICK-UPS RADIO or TAPE

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Suitable for application of Loudspeakers impedances between 3 and 30 ohms. Combinations not to measure less than 6 ohms across both speaker output jacks simultaneously.

The Amplifier cover is made of rigid plastic, bonded metal on the top and two sides. Finished in Black to suitably contrast with anodised metal control panel. Size approx. 14" x 4 1/8" x 9 1/2".



Rec. Retail  
Price

**£39-75**

## GENERAL PURPOSE AMPLIFIER

Model 40/60 40 - 50 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

## GENERAL PURPOSE GROUP/DISCO AMPLIFIER Model T40/60D

40 - 50 Watts Output Power

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

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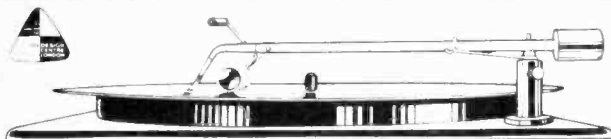
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ECC81	10p	PL81	17p	30D1	10p
ECC82	12p	PY81	8p	30P4	10p
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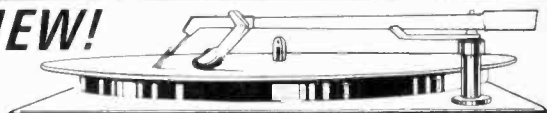
### GROOV-KLEEN Modern automatic record cleaner.

- Removes and collects dust without using liquid
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- Armrest incorporated
- Beautifully finished in Chrome, bright anodised Aluminium & shiny black

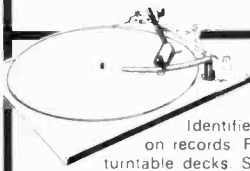
Model 42 £1.95

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

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Model 50 £1.26



### 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 when rectified improves reproduction.

Patent No 2460/72

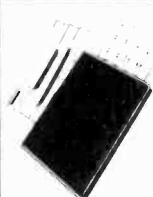
Ref 47 £1.45

### HI-FI Stereo Hints and Tips



2nd Edition completely revised. 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



### Indexa Record

Gramophone record filing and index system. Finds 1-100 instantly. Luxury padded index book, 100 pairs of numbered sleeve labels. Pad of coded printed pages.

Ref A £1.58½

### Stylus Balance



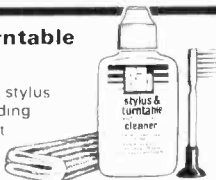
Precision built. Calibrated. Measures stylus pressure within ¼ gramme. In plastic container.

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### Stylus & Turntable Cleaning Kit

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Ref B 34p



### Tape Editing Kits— in Wallets

Tape splicer, cutter, marker, splicing tape. Reel or cassette labels. Instructions. For ½" tape.

Ref 23 £1.36

For cassettes

Ref 24 £1.50



### 12in Record Sleeve Protectors

Keep record sleeves like new in longlasting clear plastic.

Ref 44 44p per 5 pack



### Recording Tape Splicer

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

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### Cassette Head Cleaning Tape

For all cassette machines. Removes oxide and dirt from heads. Packed in plastic "library" case.

Ref 31 56p



Packed in attractive bubble pack, without "library" case.

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### Cassette Case

High quality black padded PVC, case with carrying handle for home and car. Holds 12.

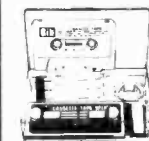
Ref 34 £1.34



### 8 Track Cartridge Case

Identical in style to cassette case. Holds eight.

Ref 35 £1.59



### Cassette Tape Recorder Care Kit

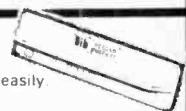
To clean tape heads safely and easily, and for joining and editing tapes precisely. Packed in plastic box.

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### Record Dust Off

Ideal for removing dust from records quickly and easily.

Ref 48 20p



### Spirit Level

Essential to assure correct tracking and to minimise stylus & record wear.

Ref 46 56p

### Spirit Level

Essential to assure correct tracking and to minimise stylus & record wear.

Ref 46 56p



### Compact Tape Head Cleaning Kit

Non-Flam cleaner, 4-Head Tools, 10 sticks and cloth in wallet. Recommended by Ferrograph, Revox and Tandberg.

Ref J 49p

### 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 96p



### Hi-Fi Cable & Flex Tidy

Shortens without cutting inter-unit cables, speaker leads, mains flex. Made of unbreakable plastic. Pack of five.

Ref D/2 16p

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- Hi-Fi Solder Pack Ref 37 15p
- Anti-Static Hi-Fi Cleaner Ref P 24p
- Tape Reel Labels Ref T1 12p
- Cassette Title Labels Ref T4 18p
- Cassette Wallet Ref 39 58p
- Wire Strippers and Cutters Model 3A 32p, Model 6 50p, Model 8 58p
- Cassette Re-record Kit Ref 54 44p

Available from good audio shops, if unobtainable send direct plus 20p P & P for amounts up to £3. Over £3 postage free UK only.

Bib Sales, Dept PW PO Box No. 78, Hemel Hempstead, Herts. Tel: Hemel Hempstead 3636



### LOW VOLTAGE D.C. POWER UNITS

I/P 115v 50c/s these provide a smoothed DC O/P of 0 to 26v at 3 amps., this can be adjusted from front panel by means of a small Variac; uses Silicon Rect and Choke I/P filter, fitted overload swt; compact size 7 x 7 x 13". Supplied in good condition with plug connections. Ex USAF surplus. Price £6-00 plus £1-00 carr.

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Combined W.M. & Osc unit, covers range 150 to 230 Mc/s with cal charts; supplied with spares, instructions etc., for use on 115v 50c/s. New condition. See September Practical Wireless or write for further details.

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Plug in frame unit with a number of printed circs fixed to it; these contain a number of 2N560 transistors; these are a Silicon N.P.N. type Vc 60v Ic 100 Ma, Col disp 500 Mil/W cut off freq. 50 Mc/s; also contain close tol resistors, metal fittings, etc. Size of panel 13 x 12". Good condition. All parts can be removed. Ex USAF surplus. We supply two panels with not less than 40 2N560s.

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### MISCELLANEOUS ITEMS

JOY STICK CONTROL UNITS give control in N.S. & E.W. directions with 4 swts. £1-20. CROSS POINTER IND meter unit with two separate units in same case, approx. 115 Ua each, possible use in Stereo balance circs. £1-40. HEADPHONE MATCHING TRANS with 5ft cord and standard jack plug 4000 to 250 ohm enables low imp phones to be used on high imp circs. New. 50p. TRIMMER CONDS 20pf air spaced ceramic base screwdriver adjustment. New. 10 for 50p or £4-00 per 100. TAG STRIPS solder type 24 way. New. 10 for 25p. CONTROL UNIT with valves 6BA6, 12AU7, 6AS6, pot core 1½ x ¾, 1uf 1% cond., 24v relay, V/H & scrs. New. Boxed. 95p. DYNAMOTOR UNITS two types, both 12v DC I/P fully enclosed American surplus type A 220v DC O/P at 100 Ma £1-25, Type B 440v DC O/P at 200 Ma £1-75. Both spares for TCS. DIODES 800 P.I.V. at 1 amp, new 12 for £1-00. TRANSISTORS type OC42 long lead on boards with parts, 12 for 50p. RELAYS 12v 180 ohm coil contacts 4 pole c/o MBB 50p. RADIAC SURVEY METERS portable unit as 3, ranges 3, 30 & 300 Rongt per Hr with carrying case, battery operated gen on batteries supplied. New cond. £3-00. MORSE KEYS fully enclosed key on base with send receive swt, adjustable with circ or morse osc £1-10. BATTERIES lead acid type 6v 40 A/Hr in metal case with filling inst. New £2-75. SPEAKER UNITS P.A. type by Truvox in a sloping front case, size 9" x 9" x 8", 8 ohm spk with 600 ohm line trans. Good cond. £2-75. INVERTORS 28v DC I/P, 115v 400 c/s 180 watts O/P all transistor single phase. New by Cossor £12-50. SILICON DIODES type ZR22 rated 200 P.I.V. at 8 amps. 4 for 60p. R1155B Rx 5 bands S.W.3 to 18.5 Mc/s, supplied tested and alignment checked with circ. £18-00.

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

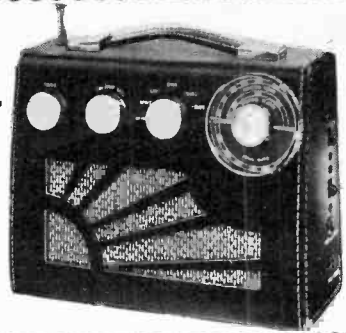
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated Telescopic Aerial, for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. Fine tone moving coil speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 80p (FREE with parts).

Total building cost

**£8-50**

P. P. & Ins. 50p

(Overseas P. & P. £1)



## ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL



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

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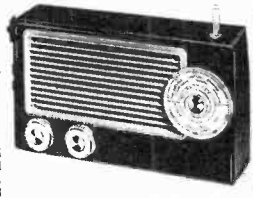
## ROAMER SEVEN MK IV



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

Total building costs **£5-98** P. P. & Ins. 41p. (Overseas P. & P. £1)

## ROAMER SIX



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

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

## POCKET FIVE



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

Total building costs **£2-29** P. P. & Ins. 21p. (Overseas P. & P. 63p)

## TRANSONA FIVE

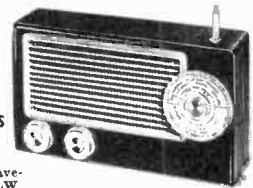


5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ x 4½ x 1½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-50** P. P. & Ins. 22p. (Overseas P. & P. 63p)

## TRANS EIGHT



8 TRANSISTORS and 3 DIODES

6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5½ x 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

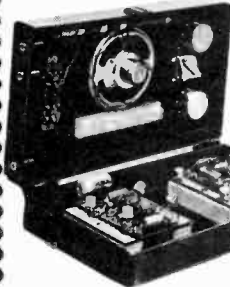
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AMSTRAD I.C. 2000	42-95	27-95
ARMSTRONG 521	59-00	44-95
DULCI 207M	29-00	20-50
FERROGRAPH F307 Mk. II (cased)	64-00	44-95
GOODMANS Maxopt	54-00	34-95
H.L. Audio Phoenix 707	29-00	15-95
JVC Nivico MCA 104Z	85-00	70-95
MCA 105E	130-50	110-95
MCA V5E Quadraphonic	89-00	74-95
MCA V9 Quadraphonic	148-00	124-95
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PHILIPS RH580	52-00	36-50
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PIONEER SA500A	45-50	32-95
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PIONEER SA800	119-85	75-95
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QA 800 Quadraphonic	179-05	113-68
QC 800 Quadraphonic pre-amp.	123-50	71-95
QM 800 Quadraphonic pow. amp.	152-88	92-95
Reverberation 202W	51-05	33-95
RANK Rotel 210	34-90	23-95
RANK Rotel 310	47-50	31-95
RANK Rotel 610	74-50	48-95
ROGERS Ravensbrook	64-50	45-50
ROGERS Ravensbourne (cased)	69-50	48-50
ROGERS Ravensbrook Mk. II	50-50	35-95
ROGERS Ravensbrook (cased) Mk. II	55-50	39-95
SINCLAIR 2000	35-00	22-95
Project 60/2 x Z30/PZ5.	23-90	15-95
Project 60/2 x Z50/PZ3/trans.	34-86	21-95
Project 605	29-95	18-90
AFU	5-98	4-50
Neoteric.	61-95	42-93
3000	45-00	29-50
TELETON SAQ 206B.	33-00	20-50
307	33-00	20-50
GA202 15 watt RMS Par. Chn.	42-75	28-95
WHARFEDALE Linton Amplifier	65-00	39-95

All take both ceramic and magnetic cartridges.

### TUNERS

AMSTRAD Multiplex 3000 FM	36-50	27-95
*ARMSTRONG 523 AM/FM	52-88	39-95
*ARMSTRONG 524 FM	40-87	31-95
*ARMSTRONG M8 Decoder	9-50	8-00
*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 Quadraphonic	86-89	69-95
MCT V7E AM/FM Quadraphonic	122-42	98-95
LEAK Delta FM	79-50	53-95
LEAK Delta AM/FM	89-50	65-95
PHILIPS RH 690	44-15	31-95
PIONEER TX500 AM/FM	70-93	49-95
PIONEER TX600 AM/FM	100-37	68-95
RANK Rotel 320	53-38	38-95
RANK ROTEL 620	86-33	63-95
ROGERS Ravensbourne chassis	57-95	43-95
ROGERS Ravensbourne Intek case	62-63	47-95
ROGERS Ravensbrook chassis	42-14	31-95
ROGERS Ravensbrook (cased)	48-00	35-95
SINCLAIR 2000	45-00	31-95
SINCLAIR 3000	45-00	31-95
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.

### TUNER/AMPLIFIERS

AKAI CR80T FM/AM Tuner Amplifier with built in Eight Track Tape Recorder	149-84	89-95
AKAI A.A. 8500	228-34	175-00
AKAI 6500	145-26	109-00
AKAI 6300	129-75	97-95
AKAI 6200	97-09	74-95
ARENA 2600	111-30	65-95
ARMSTRONG M8 Decoder	9-50	6-95
ARMSTRONG 525	90-14	69-95
ARMSTRONG 526	102-72	77-95
CARLTON M4000 AM/FM with 8 track player and speakers.	69-95	39-95
GOODMANS Module 80, 35w RMS	89-02	67-95
GOODMANS Module 80 Compact	160-38	122-95
GOODMANS Module 110 FM/MW/LW/SW 100w RMS	131-22	100-95
JVC Nivico VR 901 M/FM	96-96	81-95
VR 5521 AM/FM and SEA	165-00	139-95
4VR 5414 Quadraphonic	212-00	179-95
LEAK Delta 75	175-00	124-95
MIDLAND 19/542	49-56	36-75
PHILIPS RH 790	134-00	74-95
PIONEER SX525	135-80	94-95
SX626	181-59	126-95

### TUNER/AMPLIFIERS—continued

	Rec. Retail Price	Comet Price
SX727	224-61	157-95
SX828	281-52	197-95
ROGERS Ravensbrook Chassis	96-57	73-95
ROGERS Ravensbrook (cased)	105-35	79-95
ROTEL RX200	89-02	64-95
ROTEL RX150	67-93	49-95
TANDBERG 1171 MPX	103-03	84-95
TANDBERG TR200 MPX	86-23	79-95
TANDBERG TR1000 FM MPX(teak)	149-56	124-95
TELETON F2000	51-50	27-25
TELETON CR55	125-26	68-50
TELETON R8000 AM/FM	42-16	21-95

All the above teak magnetic cartridges except  
 Telephone F2000 and R8000 which take ceramic only.  
 All include MPX Stereo Decoder with the exception of  
 Armstrong where M8 decoder is extra.

### TURNTABLES

GARRARD SP25 Mk III	16-17	10-25
GARRARD SL65B	20-93	13-95
GARRARD SL95B	44-21	32-95
GARRARD 401	39-04	27-95
GARRARD SL72B	32-60	21-95
GARRARD Zero 100A	57-42	40-95
GARRARD Zero 100S	52-83	38-50
GARRARD WB4 base Mk III 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 £18-50
MCDONALD MP60 with Goldring G800	Special Price £18-50
MCDONALD MP60 with SHURE M 44/7	Special Price £19-50
MCDONALD MP60 with SHURE M 44/E	Special Price £20-25
GARRARD AP76 with Goldring G800	Special Price £28-25
GARRARD AP76 with Shure M55E	Special Price £30-95
GARRARD AP76 with Shure M75EJ	Special Price £33-50
GARRARD 2025 with Sonotone 9T4HC	Special Price £12-95
GOLDRING 705/P with G850	£26-00 £10-95
GOLDRING GL75 with G800	Special Price £36-75
THORENS 150 AB with TX11 cover Shure M55E cartridge	£60-46 £47-95

Base and Cover to fit GARRARD	Spec. Price	3-80
SP25, SL5, SL65B	1-63	10-95
GARRARD 40B	28-44	17-95
GARRARD AP76	28-86	18-50
GOLDRING GL69 MKII	35-23	25-25
GL69P Mk. II	39-06	26-95
GL75	47-43	33-50
Covers for 69P and 72P	4-36	3-70
Cover for 75P Deluxe	4-88	3-95
C99—plinth and cover for G99.	10-75	8-95
GOLDRING G99	27-90	19-25
GOLDRING G101P/C	27-90	19-95
GOLDRING GL72 Chassis	27-90	19-95
GOLDRING GL72P	36-27	25-95
GOLDRING GL85	61-03	42-95
GOLDRING GL85P	70-80	49-95
LEAK Delta	69-50	49-95
JVC Nivico SRP 473 Quadraphonic, including plinth and cover	69-50	58-95
MCDONALD MP60	14-80	9-95
610	18-79	12-95
HT70	20-68	14-50
HT70 inc. plinth and cover.	29-89	20-95

Base and Cover for MP60 and 610	Spec. Price	3-95
PHILIPS 202 Electronic	64-65	49-50
PHILIPS 308 transcription unit complete with base and cover	36-55	28-50
PHILIPS GA 105 with base, cover and cartridge	20-00	13-95
PIONEER PL12A cover with base & cover	47-15	32-95
THORENS T295 cover	8-26	6-60
THORENS TD125	76-73	58-95
THORENS TD125 Mk. II	76-73	62-95
THORENS TD125AB	115-69	89-95
THORENS TD125AB Mk. II with TP 18 arm	115-69	93-95
THORENS TD150 Mk. II	33-64	26-95
THORENS TD150A Mk. II	43-09	32-95
THORENS TD150AB Mk. II	46-63	36-95
THORENS TX11 Cover	4-13	3-50
WHARFEDALE Linton with base and cover and Shure M44-7 cartridge	37-50	25-95

### SPEAKERS—continued

	Rec. Retail Price	Comet Price
B & W DM1 (pair)	75-20	57-25
CELESTION County	23-97	18-50
CELESTION Ditton 120 (pair)	56-40	39-95
CELESTION Ditton 15	37-40	27-95
CELESTION Ditton 25	32-07	24-75
CELESTION Ditton 44	54-00	38-95
CELESTION Ditton 66	99-00	70-95
FERROGRAPH S1 inc. stand	95-00	69-95
GOODMANS Havant (pair)	54-42	39-95
GOODMANS Magister (pair)	50-62	35-95
GOODMANS Double Maxim	65-63	44-95
GOODMANS Mezzo 3	35-70	23-95
GOODMANS Magnum K2	46-20	28-95
GOODMANS Dimension 8	72-44	48-95
GOODMANS DIN 20NT Kit	12-19	8-95
KELETRON KN400 2-speaker System (pair)	15-86	11-95
KN600 3-speaker System (pair)	26-46	17-50
KN800 3-speaker System	15-90	9-95
KN1100 4-speaker System	20-40	12-95
KN1600 3-speaker System	25-20	15-95
KN2100 3-speaker System	30-60	19-95
LEAK 150 (pair)	50-00	34-95
LEAK 250 (pair)	63-00	45-95
LEAK 600	49-50	32-45
LINEAR 10 watt teak (pair)	Sp. Price	13-85
METROSOUND HFS 103 (pair)	29-21	21-50
METROSOUND 202	25-50	14-75
METROSOUND Duplex 15	56-00	37-95
METROSOUND Duplex 25	56-00	37-95
PHILIPS RH 402 (pair)	44-70	33-95
PHILIPS 406	34-00	25-95
PIONEER CS53	44-25	28-95
SINCLAIR Q16	8-88	6-75
STE-MA 450	25-00	16-95
TANDBERG TAN 7	27-22	22-95
TANDBERG Tan 11 (pair)	36-94	31-20
TANDBERG Tan 12 teak (pair)	48-82	41-40
TANDBERG Tan 25 teak (pair)	66-08	55-95
TANDBERG Tan 50 teak	65-00	49-95
TELETON 8000 (pair)	21-18	17-95
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

### WHARFEDALE

Linton Mark II (pair)	42-00	27-85
Melton Mark II	52-88	33-95
Melton Mark II	35-00	23-95
Dovedale 3 Mark II	47-50	30-50
Rosedale	65-00	44-25
Trilton III (pair)	65-00	44-95
Unit 3 Speaker Kit	12-50	8-75
Unit 4 Speaker Kit	19-00	12-25
Unit 5 Speaker Kit	27-50	17-60

### CHASSIS SPEAKERS

GOODMANS Twin-Axiom 8	8-65	6-95
Twin Axiom 10	9-58	7-50
Axiom 401	17-68	11-95
Axiom 8P	5-20	4-15
Axiom 10P	4-50	4-50
Axiom 12P	13-00	9-25
Axiom 15P	21-00	14-95
Axiom 18P	35-70	24-95
Axiom 200 400 watts DIN	12-00	8-95
Axent 100	4-50	3-20
Midex 1650	13-59	9-50
Attenuator	3-73	2-70
Crossover Network XO/950	7-77	5-45
WHARFEDALE 8in. Bronze/RS/DD	4-75	3-40
Super 8/RS/DD	8-50	6-25
Super 10/RS/DD	14-00	9-95
WMT1 Matching Transformer	0-84	0-70

### CARTRIDGES

AMSTRAD 900C	4-95	3-50
AMSTRAD 900D	7-50	5-50
AMSTRAD 900 EX	11-00	8-75
AUDIO TECHNICA AT66	6-47	3-60
GOLDRING G850	6-10	2-95
GOLDRING G800	12-21	4-50
GOLDRING G800E	17-67	7-50
GOLDRING G800 Super E	24-41	15-95
*GOLDRING CS90 Stereo	4-38	3-95
*GOLDRING CS91/E	7-33	5-50
EMPIRE 1000ZE/X	59-12	44-95
EMPIRE 999VE/X	42-14	32-50
EMPIRE 998TE/X	24-58	19-25
EMPIRE 990SE/X	19-90	15-25
EMPIRE 998E/X	15-57	11-50
EMPIRE 909E/X	12-12	8-25
EMPIRE 908E/X	9-37	7-15
ORBIT Magnetic NM 22	Sp Price	2-75
ORTOFON M15E	27-60	22-75
SHURE M31E	6-10	3-75
SHURE M32E	11-63	6-95
SHURE M32-3	10-73	6-50
SHURE M44-G	9-84	7-65
SHURE M44-7	6-50	4-95
SHURE M44-C	7-90	4-90
SHURE M44E	7-90	4-90
SHURE M45E	6-60	4-95
SHURE M75G	9-70	5-95
SHURE M75G	14-70	8-45



# OVER 1000 ITEMS ALWAYS IN STOCK

All items brand new and fully Guaranteed and backed by after-sales service

— latest models in manufacturers' sealed cartons



## COMET for after-Sales Service THROUGHOUT THE U.K.

Pictured, Service Dept. at Clough Rd., Mill, also at Birmingham, Bridlington, Concaster, Edinburgh, Gosle, Leeds, Leicester, Rochdale, Sheffield, Stockton, Wakefield and York.

	Rec. Retail Price	Comet Price
<b>CARTRIDGES—continued</b>		
SHURE M75-5	13.60	7.90
SHURE M75EJ	15.40	9.25
SHURE M75E	19.00	11.50
SHURE M75 ED	19.00	11.50
SHURE M75/95G	20.80	12.95
SHURE V15-11	39.40	26.95
*SONOTONE BT/AHC Diam/Seaph	3.75	1.45

Starred cartridges above are ceramic. All others are magnetic.

	Rec. Retail Price	Comet Price
<b>BASES AND COVERS</b>		
GARRARD WBI Base	3.78	3.20
WB4 Base	5.60	4.70
SPC1 Cover	3.68	2.90
SPC4 Cover	4.38	3.50

Special offer of Base and Cover to fit SP25, SL55, SL65B and 3500 Special Price 3.90

WB4 base Mk IIZ to fit Zero 100 and Zero 100S

C60	6.55	4.95
GOLDRING Plinth 75	8.37	7.00
GOLDRING Plinth 69	8.37	7.00
GOLDRING Covers for 69P and 72P	4.36	3.70
Cover for 75P De Luxe	4.88	3.95
THORENS TX25 (for TD125AB)	8.26	6.90
THORENS TX11 Cover	4.13	3.50
Base and Cover for TD125	12.39	10.50

SME Plinth System 2000 with motor-board

46.20	34.50	
MOTORBOARDS only	5.85	4.45
SME P1 Spacer	0.98	0.75

	Rec. Retail Price	Comet Price
<b>BLANK TAPES</b>		
<b>SCOTCH DYNARANGE CASSETTES</b>		
C60	0.71	0.45
C90	0.99	0.55
C120	1.48	0.80

	Rec. Retail Price	Comet Price
<b>SCOTCH HIGH ENERGY COBALT CASSETTES</b>		
C60	1.45	0.95
C90	1.90	1.25

	Rec. Retail Price	Comet Price
<b>SCOTCH Low Noise 8—TRACK BLANK CARTRIDGES</b>		
40 mins	1.50	0.95
80 mins	1.80	1.10

	Rec. Retail Price	Comet Price
<b>SCOTCH LONG LIFE SPOOLED TAPES</b>		
8" L.P. 900	1.41	0.95
5 1/2" L.P. 1200	1.76	1.20
7" L.P. 1800	2.52	1.70

	Rec. Retail Price	Comet Price
<b>SCOTCH DYNARANGE SPOOLED TAPES</b>		
5 1/2" L.P. 1200	2.11	1.40
7" L.P. 1800	2.99	1.95

Package—Tapes, cassettes and 8T cartridges 1-9

Items 5p per order. Packs of ten post free.

	Rec. Retail Price	Comet Price
<b>HI-FI STEREO SYSTEMS COMPLETE</b>		
ALBA UA552	47.75	29.95
BUSH A1005	69.89	53.25
DANSETTE Consort Stereo	34.43	24.95
DANSETTE 4005	71.45	53.25
DECCA Sound 613	Special Price	49.95
DECCA Sound 614	Special Price	52.95
DECCA Sound 1204	Special Price	76.95
DECCA Compact 2	Special Price	99.95
DECCA Compact 3	Special Price	99.95
DECCA 403	Special Price	44.95
ELIZABETHAN LZ101	58.33	41.85
FERGUSON 3425	136.35	102.75
FERGUSON 3450 with Radio	101.70	79.95
FERGUSON 3451 with Radio	101.70	79.95
FIDELITY UA2 Music Master	43.50	30.95
UA1 Music Master with Radio.. Stereo Nine	100.00	69.95
	38.50	23.00

	Rec. Retail Price	Comet Price
<b>GOODMANS Module 80 compact system FM/35 watts. RMS (Less L/S)</b>		
HMV 2451	165.00	125.75
HMV 2452	122.00	95.95
HMV 2450 with Stereo Radio	66.00	48.95
KB1025 with 657 speakers	138.00	108.95
KB 2250 with 658 speakers	48.25	37.95
KB 2010 with 658 speakers	124.00	95.95
MARCONI 4452	101.50	77.95
MARCONI 4452	77.00	56.95

	Rec. Retail Price	Comet Price
<b>MCDONALD MP60 complete with base, cover and Goldring G800 cartridge, Amstrad IC 2000 amplifier. 2 Wharfedale Denton speakers</b>		
114.96	74.40	

	Rec. Retail Price	Comet Price
<b>MURPHY 902 Studio 1, AM/VHF Radio</b>		
84.50	65.95	
MURPHY 903	84.42	65.95
PHILCO FORD M1500	97.96	66.75
PHILIPS 808	93.50	71.95
PHILIPS GF824	65.30	49.85

	Rec. Retail Price	Comet Price
<b>HI-FI STEREO SYSTEMS—continued</b>		
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 Parly Time	27.50	19.95
STEEPLETONE stereo system	41.75	25.95
TELETON STP 8-track stereo system	57.50	38.95
TELETON R 8000 Tuner/Amplifier with stereo decoder, Garrard 2025 TC turntable and one pair of Teleton 8000 speakers	87.95	47.80
ULTRA 8028	59.95	44.95
ULTRA 6450	74.20	54.95
ULTRA 6454	38.85	29.95
ULTRA 6455	41.35	31.95

Full range of headphones, Pick Up Arms & Heads available at discounted prices.

	Rec. Retail Price	Comet Price
<b>TAPE RECORDERS AND TAPE DECKS</b>		
AKAI 1720L 4-track Stereo	87.36	59.95
AKAI 4000D 4-track stereo deck	93.65	64.95
AKAI CR80D 8-track stereo tape deck	85.02	58.45
AKAI CR80 B 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	100.45
AKAI GX220D	223.00	164.95
AKAI 1800SD	162.79	102.30
AKAI 2000SD	289.07	223.30
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 702/4 Dolby	264.38	224.50
FERROGRAPH 702H Dolby	274.95	233.50
FERROGRAPH 722/4 Dolby	301.98	255.95
FERROGRAPH 722H Dolby	312.85	264.95
FERROGRAPH 702 2-track tape deck	224.43	170.65
FERROGRAPH 704/W 4-track deck	224.43	170.65
FERROGRAPH 722	262.03	190.13
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
PHILIPS 4303 Twin-track	39.46	24.95
4307 4-track	48.65	34.95
4308 De Luxe 4-track	56.85	41.45
4404 4-track stereo recorder	89.25	65.95

	Rec. Retail Price	Comet Price
<b>TAPE RECORDERS—continued</b>		
4407 4-track stereo recorder	106.50	73.95
4418 4-track stereo	104.00	80.95
4450 4-track stereo	189.75	139.95
4500 4-track stereo tape deck	272.50	199.95
TANBERG 2000 (Stereo)	124.30	91.85
TANBERG 1841 4-track stereo tape deck	125.61	103.95
TANBERG 1841 4-track stereo tape deck	66.09	48.75
TANBERG 3021X twin track stereo	104.00	80.85
TANBERG 3041X 4-track stereo	169.12	135.50
TANBERG 4014X 4-track stereo	169.12	135.50
TANBERG 6041X 4-track stereo	182.73	145.25
TANBERG 6021X twin track stereo	182.73	145.25

	Rec. Retail Price	Comet Price
<b>TAPE RECORDERS (CASSETTES)</b>		
AKAI CS 350 recorder	125.83	92.95
AKAI CS 50D Deck	104.46	77.95
AKAI GXC 40D Tape Deck	92.26	68.25
AKAI GXC 40D Recorder	111.75	83.95
APCO Batt./Mains with AM/FM Radio	35.00	22.95
BUSH Discassette DC70	20.62	15.95
BUSH TP60	27.62	15.95
BUSH TP 66 Batt./Mains	28.18	21.50
BUSH TP 70 battery/mains	28.13	19.95
CARLINE LCR500	Sp. Price	11.95
DANSETTE DCT105	20.62	14.95
DECCA 2000 (batt./mains)	Sp. Price	22.95
DECCA CR1000 Cassette Recorder with VHF Radio	Sp. Price	32.85
EKCO 350 Bt./Mns. VHF/MW Radio	37.52	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	37.95	26.95
GRUNDIG C210 batt./mains	48.75	36.95
GRUNDIG C410	41.55	29.95
HARVARD Elite with AM/FM radio batt./mains	42.00	23.95
JVC NIVICO 9420 L/S with AM/FM radio batt./mains	61.45	42.95
PHILIPS R.R. 392 with MW/VHF Radio Cassette	49.95	36.55
2202	22.85	17.95
2204 battery/mains	29.10	23.95
3302	20.35	15.95
2400 stereo less L/S	66.10	51.95
PYE 9109	20.37	14.95
PYE 9118 Stereo	66.10	49.95
PYE 9119	29.11	22.95
TELETON TRC 130 with VHF/AM radio battery/mains	42.50	28.00
TC110 battery/mains	27.50	18.50

## COMPLETE HI-FI SYSTEMS

Completely wired mounted and ready for use

H.L. Audio Phoenix 707 amp. McDonald MP60 turntable, complete with base, cover and Shure M44/7 cartridge. Fully wired plus 2 Thorpe Grenville 100 loudspeakers	213.37	134.15
ROTEL RA 210 amplifier with McDonald MP60, base cover and Goldring G800 magnetic cartridge. Plus two Linear 10 watts speakers (Teak)	88.91	56.40
AMSTRAD IC2000 integrated circuit amp. 20 watts per channel, with McDonald MP60 turntable, plinth, cover and Goldring G800 cartridge. Plus two Wharfedale Denton Mk. II speakers	114.96	74.40
PIONEER SA500A amp. with McDonald MP60 turntable, plinth, cover and Shure M44-E cartridge. Plus two Wharfedale Denton speakers	113.90	81.15
PHILIPS RH802 Stereo Tuner/Amplifier/Player. 2 x 15 watts. LW/MW1/MW2/SW/FM. MPX. with GP400 magnetic cartridge. Speakers extra	155.00	118.95
ARMSTRONG 525 FM Tuner/Amplifier. 25 watts RMS per channel, teak case, with M8 MPX Decoder. Goldring GL75 turntable, plinth, cover and G800 cartridge, plus two Wharfedale Dovedale III speakers	247.91	174.65
ARENA 2600 Tuner/Amplifier. FM/MW/LW 49m. Band. Marine Band. 15 watts. RMS per channel. Five pre set F.M. Stations and manual tuning with Garrard AP76 plinth, cover and G800 cartridge. Plus two Goodmans Havant speakers	213.37	134.15
ROTEL RX150 Tuner/Amplifier, AM/FM. MPX with McDonald MP60 plinth, cover and G800 cartridge, plus two Wharfedale Denton Mk. II speakers	139.94	96.40
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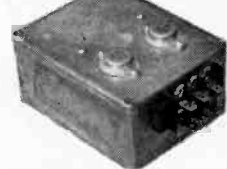
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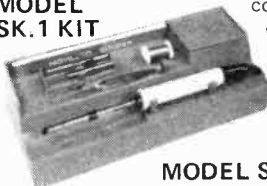
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AC115	0-23	AD162 (MP)	0-55	BC150	0-18	BD139	0-55	BF195	0-12	OC22	0-38	2G373	0-17	2N2221	0-20	2N3091	0-14	2N4061	0-12		
AC117K	0-20		0-55	BC151	0-20	BD140	0-80	BF196	0-14	OC23	0-42	2G374	0-17	2N2222	0-20	2N3091A	0-16	2N4062	0-12		
AC122	0-12	AD1740	0-50	BC152	0-17	BD165	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	BD176	0-80	BF200	0-45	OC25	0-38	2G378	0-18	2N2369	0-14	2N3393	0-14	2N4285	0-17		
AC126	0-17	AF115	0-24	BC154	0-30	BD176	0-80	BF222	0-35	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	0-85	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	0-85	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	AF128	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	0-12	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	0-80	OC72	0-14	2N598	0-42	2N2906	0-15	2N3646	0-08	2N5459	0-40		
AC155	0-20	AF181	0-45	BC173	0-14	BD196	0-85	BFX29	0-27	OC74	0-14	2N599	0-45	2N2906A	0-18	2N3702	0-10	2N5460	0-42		
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	2N5461	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	2N5462	0-42		
AC165	0-20	AL102	0-65	BC177	0-19	BD199	0-95	BFX86	0-22	OC77	0-25	2N698	0-24	2N2925	0-14	2N3705	0-10	2N5463	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	2N5464	0-70		
AC167	0-20	ASV26	0-25	BC179	0-19	BD205	0-80	BFX88	0-22	OC81D	0-15	2N706	0-08	2N2925	0-14	2N3707	0-11	2N5465	0-84		
AC168	0-24	ASV27	0-30	BC180	0-24	BD206	0-80	BFY50	0-20	OC82	0-15	2N706A	0-08	2N2926 (G)	0-12	2N3708	0-07	2N5466	0-84		
AC169	0-14	ASV28	0-25	BC181	0-24	BD207	0-85	BFY51	0-20	OC82D	0-15	2N706	0-12	2N2926 (H)	0-12	2N3709	0-09	2N5467	0-84		
AC176	0-20	ASV29	0-25	BC182	0-10	BD208	0-95	BFY52	0-20	OC83	0-20	2N711	0-30	2N2926 (Y)	0-11	2N3710	0-09	2N5468	0-84		
AC177	0-24	ASV50	0-25	BC183L	0-10	BDY20	1-00	BFY53	0-17	OC84	0-20	2N717	0-35	0-20	2N717	0-35	0-21	2N3711	0-09	2N5469	0-84
AC178	0-28	ASV51	0-25	BC183	0-10	BF115	0-24	BPX25	0-85	OC139	0-20	2N718	0-24	2N2926 (O)	0-10	2N3819	0-28	2N5470	0-84		
AC179	0-28	ASV52	0-25	BC183L	0-10	BF117	0-45	BX19	0-15	OC140	0-20	2N718A	0-50	0-20	2N718A	0-50	0-20	2N3820	0-28	2N5471	0-84
AC180	0-17	ASV54	0-25	BC184	0-12	BF118	0-70	BX20	0-15	OC169	0-25	2N726	0-28	2N2926 (B)	0-10	2N3821	0-35	2N5472	0-84		
AC180K	0-20	ASV56	0-25	BC184L	0-12	BF119	0-70	BY25	0-15	OC170	0-25	2N727	0-28	2N2926 (R)	0-10	2N3823	0-28	2N5473	0-84		
AC181	0-17	ASV56	0-25	BC185	0-28	BF121	0-45	BSV25	0-15	OC171	0-25	2N743	0-20	0-20	2N743	0-20	0-20	2N3824	0-28	2N5474	0-84
AC181K	0-20	ASV57	0-25	BC186	0-28	BF123	0-50	BSV27	0-15	OC200	0-25	2N744	0-20	0-20	2N744	0-20	0-20	2N3825	0-28	2N5475	0-84
AC187	0-22	ASV58	0-25	BC207	0-11	BF125	0-45	BSV28	0-15	OC201	0-28	2N914	0-14	2N3010	0-70	2N3905	0-28	2N5476	0-84		
AC187K	0-20	ASZ21	0-40	BC208	0-11	BF127	0-50	BSV29	0-15	OC202	0-28	2N918	0-10	2N3011	0-14	2N3906	0-27	40361	0-40		
AC188	0-22	BC107	0-09	BC209	0-12	BF152	0-55	BSV38	0-18	OC203	0-25	2N929	0-21	2N3053	0-17	2N4068	0-12	40362	0-40		
AC188K	0-20	BC108	0-09	BC212L	0-11	BF163	0-45	BSV39	0-18	OC204	0-25	2N930	0-21	0-21	2N930	0-21	0-21	2N4069	0-40	40363	0-40
ACV17	0-25	BC109	0-10	BC213L	0-11	BF164	0-45	BSV40	0-18	OC205	0-25	2N131	0-20	0-20	2N131	0-20	0-20	2N4070	0-40	40364	0-40
ACV18	0-20	BC113	0-10	BC214L	0-14	BF165	0-70	BSV41	0-28	OC509	0-40	2N1132	0-22	0-22	2N1132	0-22	0-22	2N4071	0-40	40365	0-40
ACV19	0-20	BC114	0-15	BC225	0-25	BF166	0-48	BSV46	0-12	P346A	0-20	2N1302	0-14	0-14	2N1302	0-14	0-14	2N4072	0-40	40366	0-40
ACV20	0-20	BC115	0-15	BC226	0-35	BF167	0-55	BSV58A	0-12	P397	0-42	2N1303	0-14	AA119	0-08	BY133	0-21	OA10	0-35	40367	0-40
ACV21	0-20	BC116	0-15	BCY30	0-24	BF168	0-56	Bu105	2-00	OCPT1	0-43	2N1304	0-17	AA120	0-08	BY164	0-50	OA47	0-07	40368	0-40
ACV22	0-18	BC117	0-15	BCY31	0-26	BF169	0-60	C11E	0-50	OPF12	0-43	2N1305	0-17	AA125	0-08	BYX38/30	0-40	OA79	0-07	40369	0-40
ACV27	0-18	BC118	0-10	BCY32	0-30	BF169	0-40	C400	0-30	OPF60	0-43	2N1306	0-21	AA130	0-08	BYZ11	0-35	OA81	0-07	40370	0-40
ACV28	0-19	BC119	0-30	BCY33	0-22	BF162	0-40	C407	0-25	ORP61	0-40	2N1307	0-21	AAZ13	0-10	BYZ10	0-35	OA82	0-07	40371	0-40
ACV29	0-35	BC120	0-80	BCY34	0-25	BF163	0-40	C424	0-20	ST140	0-12	2N1308	0-23	BA100	0-10	BYZ11	0-30	OA85	0-09	40372	0-40
ACV30	0-28	BC125	0-12	BCY70	0-14	BF164	0-40	C425	0-50	ST141	0-17	2N1309	0-23	BA116	0-21	BYZ12	0-30	OA90	0-08	40373	0-40
ACV31	0-28	BC126	0-18	BCY71	0-18	BF165	0-40	C426	0-35	T1843	0-30	2N1613	0-20	BA126	0-22	BYZ13	0-25	OA91	0-08	40374	0-40
ACV34	0-21	BC132	0-12	BCY72	0-14	BF167	0-22	C428	0-20	UT46	0-27	2N1711	0-20	BA148	0-14	BYZ16	0-40	OA95	0-07	40375	0-40
ACV35	0-21	BC134	0-18	BCZ10	0-20	BF173	0-22	C441	0-30	VC201	0-20	2N1880	0-32	BA153	0-12	BYZ17	0-35	OA290	0-06	40376	0-40
ACV36	0-22	BC135	0-12	BCZ11	0-25	BF176	0-35	C452	0-30	VC302	0-19	2N1890	0-45	BA155	0-14	BYZ18	0-35	OA292	0-07	40377	0-40
ACV40	0-17	BC136	0-15	BCZ12	0-25	BF177	0-35	C444	0-35	VG303	0-19	2N1893	0-37	BA156	0-13	BYZ19	0-28	SD10	0-05	40378	0-40
ACV41	0-18	BC137	0-15	BD121	0-60	BF178	0-30	C455	0-22	VG304	0-24	2N2147	0-72	BY100	0-15	CG62	0-05	SD19	0-05	40379	0-40
ACV44	0-35	BC139	0-40	BD123	0-65	BF179	0-30	MAT100	0-19	VG306	0-40	2N2148	0-57	BY101	0-12	(Eq) OA91	0-05	SD20	0-05	40380	0-40
AD130	0-38	BC140	0-30	BD124	0-60	BF180	0-30	MAT101	0-20	VG308	0-35	2N2160	0-60	BY105	0-17	CG651	0-05	SD34	0-07	40381	0-40
AD140	0-48	BC141	0-30	BD131	0-50	BF181	0-30	MAT120	0-19	VG309	0-35	2N2192	0-35	BY114	0-12	CG651	0-05	SD35	0-07	40382	0-40
AD142	0-48	BC142	0-30	BD132	0-60	BF182	0-40	MAT121	0-20	VG339	0-20	2N2193	0-35	BY126	0-14	(Eq) OA70	0-05	SD36	0-07	40383	0-40
AD143	0-38	BC143	0-30	BD133	0-65	BF183	0-40	MPI102	0-42	VG339A	0-16	2N2194	0-35	BY127	0-15	OA79	0-06	SD37	0-07	40384	0-40
AD149	0-50	BC145	0-45	BD135	0-40	BF184	0-25	MPI104	0-37	VG344	0-18	2N2217	0-22	BY128	0-15	OA5	0-35	SD38	0-07	40385	0-40
AD181	0-33	BC147	0-10	BD136	0-40	BF185	0-30	MPI105	0-37	VG345	0-16	2N2218	0-20	BY130	0-16	OA5L	0-21				

# The largest selection

## NEW LOW PRICE TESTED S.C.R.'s

PIV1A	3A	5A	5A	7A	10A	16A	30A
T05	T06	T06	T06	T04	T04	T04	T04
50	23	0.25	0.35	0.35	0.47	0.50	0.53
100	0.25	0.35	0.47	0.47	0.50	0.53	1.40
200	0.35	0.37	0.49	0.49	0.57	0.61	1.60
400	0.43	0.47	0.56	0.56	0.67	0.75	0.93
800	0.53	0.57	0.68	0.68	0.77	0.97	1.25
1000	0.63	0.70	0.80	0.80	0.90	1.20	1.50

## SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1.5A	3A	10A	30A
50	0.04	0.05	0.05	0.07	0.14	0.21	0.60
100	0.04	0.06	0.05	0.13	0.16	0.23	0.75
200	0.05	0.09	0.06	0.14	0.20	0.24	1.00
400	0.06	0.13	0.07	0.20	0.27	0.37	1.25
800	0.07	0.16	0.10	0.25	0.34	0.45	1.86
1000	0.10	0.17	0.11	0.25	0.37	0.50	2.00
1200	—	0.33	—	0.38	0.57	0.76	—

## TRIACS

VBO	2A	6A	10A
TO-1	TO-66	TO-88	
\$p	2p	\$p	
100	80	50	76
200	50	60	90
400	70	75	1-10

## DIACS

FOR USE WITH TRIACS
BR100 (D32) 37p each

## FREE

One 50p Pak of your own choice. First 1000 orders valued \$4 or over.

## BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed	
Pak No.	EQVT
T1	8 2G3713 OC71
T2	8 D1374 OC75
T3	8 D1216 OC81D
T4	8 2G381T OC81
T5	8 2G382T OC82
T6	8 2G344B OC44
T7	8 2G345B OC45
T8	8 2G378 OC78
T9	8 2G399A 2N1302
T10	8 2G417 AF117
All 50p each pak	

## EN2960 NPN SIL. DUAL TRANS. CODE D1699 TEXAS. Our price 25p each.

## 120 VCB MIXIE DRIVER TRANSISTOR. 8sin. BSX21 & C407 2N1893 FULLY TESTED AND CODED ND. 120-1.24 17p each. TO.5 NPN. 25 up 15p each.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

## POWER TRANS BONANZA!

**GENERAL PURPOSE GERM. PNP TO-3 case. G.P. BRAND NEW TO-3 CASE. POSS. REPLACEMENT. — OC25-29-30-35-36. NKT 401-403-404-405-406-450-451-452-453. TI027-3028, 2N250A, 2N456A-457A-458A. 2N611 A & B. 2G220-222. ETC. VCB0 80V VCE0 50V IC 10A PT. 30 WATTS Hfe 36-170. PRICE 1-24 43p each 25-99 40p each 100 up 36p each**

**SILICON High Voltage 250V NPN TO-3 case. G.P. Switching & Amplifier Applications. Brand new Coded R 2400 VCB0 250V/VCE0 100V/IC 6A/50 Watts. HFE type 20T/5MHZ. OUR PRICE EACH: 1-24 100 up 45p 25-99 40p**

**AD161/162 PNP M/P COMP GERM TRANS. OUR LOWEST PRICE OF 55p PER PAIR**

**FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-23V. 400mV (DO-7 Case) 13p ea. 11W (Top-Hat) 25p ea. All fully tested 5% tol. and marked. State voltage required.**

**10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 90p each**

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**UNIUNION UT46. Eqvt. 2N2846, 30vt. T1843. BEN3090 27p each, 20-99 25p 100UP 20p.**

**CADMIUM CELLS ORP12 43p ORP60, ORP61 40p each**

**GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8. BSF-17/28/85A. All usable devices no open or short circuits. ALSO AVAILABLE IN PNP Sim. to 2N2906. BCY70. When ordering, please state preference NPN or PNP.**

20	For	0-50
50	For	1-100
100	For	1-75
500	For	7-50
1000	For	13-00

**SIL. G.P. DIODES 2p 300mW 30. 0-50 40PIV(Min.) 100. 1-50 Sub-Min. 500. 1-50 Full Tested 1,000. 9-00 Ideal for Organ Builders.**

**2N3055 115 WATT SIL POWER NPN 50p EACH**

**SILICON 50 WATTS MATCHED NPN/PNP BIP 1NPN TO-3 Plastic. BIF 20 PNP. Brand new. VCB0 100V/VCE0 50V/IC 10A. HFE type 100T/3mHZ. OUR PRICE PER PAIR: 1-24 prs 60p 25-99 prs 55p 100 prs 50p**

## KING OF THE PAKS Unequaled Value and Quality

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Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.	Description	Price
U 1	120 Glass Sub-Min. General Purpose Germanium Diodes	0-50
U 2	60 Mixed Germanium Transistors AF/RF	0-50
U 3	75 Germanium Gold Bonded Sub-Min. like OA5, OA47	0-50
U 4	40 Germanium Transistors like OC81, AC128	0-50
U 5	60 200mA Sub-Min. Silicon Diodes	0-50
U 6	30 Sil. Planar Trans. NPN like B8Y96A, 2N706	0-50
U 7	16 Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000 50	0-50
U 8	50 Sil. Planar Diodes DO-7 like 250mA like OA200/202	0-50
U 9	20 Mixed Voltages, 1 Watt Zener Diodes	0-50
U 10	20 BAY50 charge storage Diodes DO-7 Glass	0-50
U11	25 PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0-50
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U13	30 PNP-NPN Sil. Transistors OC200 & 2S 104	0-50
U14	150 Mixed Silicon and Germanium Diodes	0-50
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U16	10 3 Amp Silicon Rectifiers Stud Type up to 1000V PIV	0-50
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U26	30 Fast Switching Silicon Diodes like IN914 Micro-Min.	0-50
U27	12 NPN Germanium AF Transistors TO-1 like AC127	0-50
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U31	20 Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0-50
U32	25 Zener Diodes 400mW DO-7 case 3-18 volts mixed	0-50
U33	15 Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0-50
U34	30 Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	0-50
U35	25 Silicon Planar Transistors PNP TO-18 2N2906	0-50
U36	25 Silicon Planar NPN Transistors TO-5 BFY50/51/52	0-50
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U45	7 3A SCR. TO66 up to 600PIV	1-00

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

**SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BP X25 and P21. BRAND NEW. Full data available. Fully guaranteed. Qty. 1-24 25-99 100 up Price each 45p 40p 35p**

**F.E.T.'S**

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2N3820	50p	2N6459	40p
2N3821	35p	BFW10	40p
2N3823	30p	MFP105	40p

## NEW EDITION 1971

**TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK 90p each.**

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Pak No.	Contents	Price
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UIC02	— 12 x 7402	0-50
UIC03	— 12 x 7403	0-50
UIC04	— 12 x 7404	0-50
UIC05	— 12 x 7405	0-50
UIC06	— 8 x 7406	0-50
UIC07	— 8 x 7407	0-50
UIC10	— 12 x 7410	0-50
UIC13	— 8 x 7413	0-50
UIC20	— 12 x 7420	0-50
UIC30	— 12 x 7430	0-50
UIC40	— 12 x 7440	0-50
UIC41	— 5 x 7441	0-50
UIC42	— 5 x 7442	0-50
UIC43	— 5 x 7443	0-50
UIC44	— 5 x 7444	0-50
UIC45	— 5 x 7445	0-50

## QUALITY TESTED SEMICONDUCTORS

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Q4	6 Matched transistors OC44/45/81/81D	0-50
Q5	4 OC 73 transistors	0-50
Q6	5 OC 72 transistors	0-50
Q7	4 AC 128 transistors PNP high gain	0-50
Q8	4 AC 126 transistors PNP	0-50
Q9	7 OC 81 type transistors	0-50
Q10	7 AC 71 type transistors	0-50
Q11	2 AC 127/128 Complementary pairs PNP/NPN	0-50
Q12	3 AF 116 type transistors	0-50
Q13	3 AF 117 type transistors	0-50
Q14	3 OC 171 H.F. type transistors	0-50
Q15	7 2N2926 Sil. Epoxy transistors mixed colours	0-50
Q16	2 GBT880 low noise Germanium transistors	0-50
Q17	5 NPN 2 x ST.141 & 3 x ST.140	0-50
Q18	4 MADT'S 2 x MAT 100 & 2 x MAT 120	0-50
Q19	3 MADT'S 2 x MAT 101 & 1 x MAT 121	0-50
Q20	4 OC 44 Germanium transistors A.F.	0-50
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Q22	20 NKT transistors A.F. R.F. coded	0-50
Q23	10 OA 209 Silicon diodes sub-min.	0-50
Q24	8 OA 81 diodes	0-50
Q25	15 IN914 Silicon diodes TS PIV 75mA	0-50
Q26	8 OA95 Germanium diodes sub-min IN69	0-50
Q27	2 10A PIV Silicon rectifiers IS425R	0-50
Q28	2 Silicon power rectifiers BYZ 13	0-50
Q29	4 Silicon transistors 2 x 2N696, 1 x 2N697, 1 x 2N698	0-50
Q30	7 Silicon switch transistors 2N706 NPN	0-50
Q31	6 Silicon switch transistors 2N708 NPN	0-50
Q32	3 PNP Silicon transistors 2 x 2N1131, 1 x 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 x 2N2904 & 1 x 2N2905	0-50
Q36	7 2N3646 TO-18 plastic 300 MHz NPN	0-50
Q37	3 2N3053 NPN Silicon transistors	0-50
Q38	7 NPN transistors 4 x 2N3703, 3 x 2N3702	0-50

## ELECTRONIC SLIDE-RULE

The MK Slide Rule, designed to simplify Electronic calculations features the following scales:— Conversion of Frequency and Wavelength. Resistance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and e Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 2 cm x 4cm. Complete with case and instructions. Price each: \$3-35

Pak No.	Contents	Price
UIC68	— 5 x 7468	0-50
UIC90	— 5 x 7490	0-50
UIC91	— 5 x 7491	0-50
UIC92	— 5 x 7492	0-50
UIC93	— 5 x 7493	0-50
UIC94	— 5 x 7494	0-50
UIC95	— 5 x 7495	0-50
UIC96	— 5 x 7496	0-50
UIC100	— 5 x 74100	0-50
UIC121	— 5 x 74121	0-50
UIC141	— 5 x 74141	0-50
UIC151	— 5 x 74151	0-50
UIC154	— 5 x 74154	0-50
UIC193	— 5 x 74193	0-50
UIC195	— 5 x 74195	0-50
UICX1	— 25 Assorted 74's	1-50

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

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	1	25	100+		1	25	100+
SN7400	0-15	0-14	0-12	SN7472	0-29	0-28	0-24
SN7401	0-15	0-14	0-12	SN7473	0-37	0-35	0-32
SN7402	0-15	0-14	0-12	SN7474	0-37	0-35	0-32
SN7403	0-15	0-14	0-12	SN7475	0-45	0-43	0-42
SN7404	0-15	0-14	0-12	SN7476	0-40	0-39	0-38
SN7405	0-15	0-14	0-12	SN7480	0-87	0-84	0-88
SN7406	0-35	0-31	0-28	SN7481	£1-20	£1-15	£1-10
SN7407	0-35	0-31	0-28	SN7482	0-87	0-86	0-85
SN7408	0-18	0-17	0-16	SN7483	£1-10	£1-05	£0-95
SN7409	0-18	0-17	0-16	SN7484	£1-00	£0-95	£0-90
SN7410	0-15	0-14	0-12	SN7485	£3-60	£3-50	£3-40
SN7411	0-25	0-24	0-23	SN7486	0-32	0-31	0-30
SN7412	0-35	0-31	0-28	SN7489	£5-50	£5-25	£5-00
SN7413	0-29	0-28	0-24	SN7490	0-87	0-84	0-88
SN7416	0-43	0-40	0-38	SN7491	£1-00	£0-96	£0-90
SN7417	0-43	0-40	0-38	SN7492	0-67	0-64	0-68
SN7420	0-15	0-14	0-12	SN7493	0-67	0-64	0-68
SN7422	0-50	0-48	0-45	SN7494	0-77	0-74	0-68
SN7423	0-50	0-48	0-45	SN7495	0-77	0-74	0-68
SN7425	0-50	0-48	0-45	SN7496	0-87	0-84	0-78
SN7427	0-45	0-42	0-40	SN74100	£1-65	£1-60	£1-55
SN7428	0-70	0-65	0-60	SN74104	0-97	0-94	0-88
SN7430	0-15	0-14	0-12	SN74105	0-97	0-94	0-88
SN7432	0-45	0-42	0-40	SN74107	0-40	0-38	0-36
SN7433	0-80	0-75	0-70	SN74110	0-55	0-53	0-60
SN7437	0-64	0-62	0-60	SN74111	£1-25	£1-15	£1-10
SN7438	0-64	0-62	0-60	SN74118	£1-00	0-95	£0-90
SN7440	0-15	0-14	0-12	SN74119	£1-35	£1-25	£1-10
SN7441	0-87	0-84	0-58	SN74121	0-40	0-37	0-34
SN7442	0-87	0-84	0-58	SN74122	£1-40	£1-30	£1-10
SN7443	£1-30	£1-25	£1-20	SN74123	£2-80	£2-70	£2-60
SN7444	£1-80	£1-77	£1-75	SN74141	0-67	0-64	0-58
SN7445	0-97	0-94	0-88	SN74145	£1-50	£1-40	£1-30
SN7447	£1-00	0-97	0-95	SN74150	£2-00	£2-70	£2-50
SN7448	£1-00	0-97	0-95	SN74151	£1-00	0-95	0-90
SN7450	0-15	0-14	0-12	SN74153	£1-20	£1-10	0-95
SN7451	0-15	0-14	0-12	SN74154	£1-80	£1-70	£1-60
SN7453	0-15	0-14	0-12	SN74155	£1-40	£1-30	£1-20
SN7454	0-15	0-14	0-12	SN74156	£1-40	£1-30	£1-20
SN7460	0-15	0-14	0-12	SN74157	£1-90	£1-80	£1-70
SN7470	0-29	0-28	0-24				

## LINEAR I.C.'s—FULL SPEC.

Type No.	1-24	25-99	100 up
BP 201C—8L201C	83p	55p	45p
BP 701C—8L701C	63p	50p	45p
BP 702C—8L702C	63p	50p	45p
BP 702—72702	53p	45p	40p
BP 709—72709	36p	34p	30p
BP 709P—7A709C	36p	34p	30p
BP 711—72710	44p	42p	40p
BP 711—7A711	45p	43p	40p
BP 741—72741	75p	60p	50p
7A708C—7A703C	28p	26p	24p
TAA 263—	70p	60p	55p
TAA 293—	90p	75p	70p
TAA 350—	170p	158p	150p

S.G.S. BA1000 2-63

## ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C.'s

Type No.	1-24	25-99	100 up
BP930	12p	11p	10p
BP932	13p	12p	11p
BP933	13p	12p	11p
BP935	13p	12p	11p
BP936	13p	12p	11p
BP944	13p	12p	11p
BP945	25p	24p	22p
RP446	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
BP962	12p	11p	10p
BP963	40p	38p	35p
BP904	40p	38p	35p
BP907	40p	38p	35p
BP909	40p	38p	35p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

## NUMERICAL INDICATOR TUBES



MODEL	CD66	GR118	3015P Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2-3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1-70	£1-55	£1-90

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

## RTL MICROLOGIC CIRCUITS

	1-24	25-99	100 up
Epoxy TO-5 case	35p	33p	27p
uL800 Buffer	35p	33p	27p
uL814 Dual 21/p gate	35p	33p	27p
uL923 J-K flip-flop	50p	47p	45p

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

## DUAL IN LINE SOCKETS

14 & 16 Lead Sockets for use with

	15p	13p	11p
DUAL-IN-LINE I.C.'s. TWO Ranges PROFESSIONAL & NEW LOW COST. PROF. TYPE No. 1-24 25-99 100up.			
TSO 14 pin type	30p	27p	25p
TSO 16 " " "	35p	32p	30p

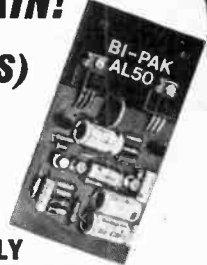
LOW COST No.

	15p	13p	11p
BP8 14	15p	13p	11p
BP8 16	15p	13p	11p

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## THE AL50

- ★ Frequency Response 15Hz to 100,000—1dB. **ONLY £3.25p each**
- ★ 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 x 105mm x 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.F. amplification needs. FULLY BUILT - TESTED - GUARANTEED.

## STABILISED POWER MODULE SPM80



AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Main Transformer MT80, the unit will provide outputs of up to 1-5 amps at 35 volts. Size: 63mm x 105mm x 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:- Discos Systems, Public Address, Intercom Units, etc. Handbook available, 10p **PRICE £2-95**

TRANSFORMER BMT80 £1-95 p. & p. 25p.

## STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.

Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

### SPECIFICATION

Frequency Response	20Hz - 20KHz ± 1dB
Harmonic Distortion	better than 0-1%
Inputs : 1. Tape Head	1-25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1-5 mV into 50K Ω
All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.	
Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters : Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than - 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm x 82mm x 35mm

**ONLY £11-95**

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

All prices quoted in new pence Giro No. 388-7006  
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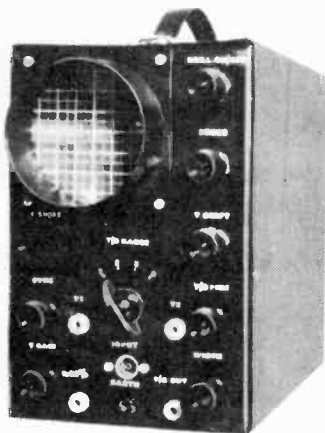
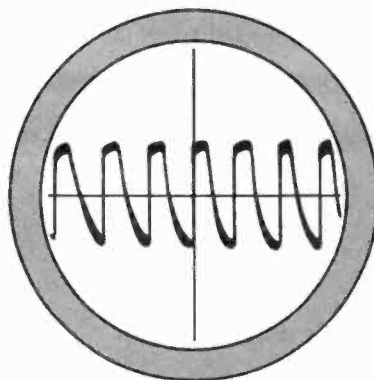
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no "maths"



RAPY

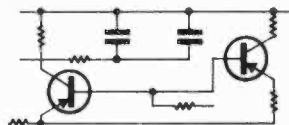
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# PRACTICAL WIRELESS

VOL 48 NO 6

Issue 788

OCTOBER 1972

## Wires and Waves

ASKED what type of aerial he uses, an enthusiast of the new generation might well reply "What's an aerial?". Apart from those multi-rod devices on the roof associated with television, the aerial is usually just another component fitted snugly inside the case of a transistor radio.

DX enthusiasts and amateur transmitters are, of course, alive to the importance of the external aerial, but there must be thousands of would-be DX-ers battling against the odds by trying to find exotic stations on ordinary transistor radios and relying only on the pickup capabilities of the internal ferrite rod assembly or at best a diminutive pull-out rod. While some success is possible under these conditions, experienced listeners will testify as to the vastly improved results obtained by using a well-designed external system, perhaps terminated in an aerial tuning unit.

It is not, however, just a matter of throwing out a random piece of wire and hoping for the best. Some thought must be given to the wavebands on which peak performance is wanted and the directions from which optimum reception is needed. In fact, devising an aerial can be quite as absorbing as the building of active equipment.

The erection of an aerial system is more an art than a science, because the siting and lengths of wire are somewhat empirical. Formulae for dimensions and directions are based on the ideal conditions obtained in "free space" but the average amateur is rarely fortunate enough to have unrestricted space and a clear open site. The immediate terrain and features (hills, large buildings, etc.) may modify the ideal calculations and so there is a fruitful field here for experimentation.

Once embarked on the subject of aerials, it is a short step to begin thinking about what happens between the transmitter and the receiver. Here again is a complete field for exploration. One of the first things that an embryo DX-er has to learn is how the various phenomena associated with radio wave propagation are going to affect his listening activities. A good aerial system coupled with a knowledge of propagation are the foundations for successful long distance listening.

That there is a need for information on aerials is borne out by the many letters we have received asking for help in this direction. The wall chart enclosed with this issue should provide all the basic material for those wishing to install a good aerial system, or improve their existing set-up, and it is complementary to the DX Data Chart supplied with the March issue.

We have also included in this issue, an introductory article on radio wave propagation, which it is hoped will provide a further stimulus to investigation into this somewhat neglected, yet vital, sphere of interest.

W. N. STEVENS—*Editor*

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## FREE—AERIAL DATA WALLCHART

Some Readers may be aware of a slight loss of quality in printing. This is due to a shortage of our usual paper which has been brought about by the Dock Strike.

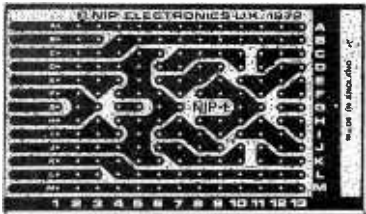
**THE NOVEMBER ISSUE WILL BE  
PUBLISHED ON OCTOBER 6th**

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## Nip-E-Board

Remember some time ago we mentioned Nippiboard — the etched P.C. Board? Well now NIP Electronics, the manufacturers have announced additions to their range.

The Nip-E-System provides for a number of basic etched printed circuit board arrangements that can be used in many circuit applications immediately. The user then goes ahead with the component layout assembly and wiring, knowing that he does not need to worry about special designs or messy etching procedures. The basic layout design

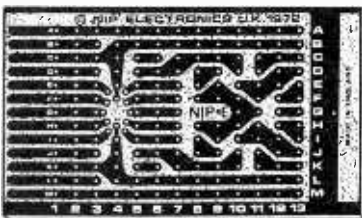


STANDARDISED PCB FOR TRANSISTORS

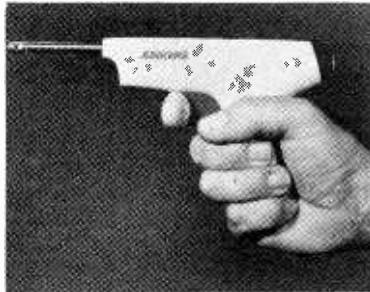
procedures and photographic image transference have been done for the constructor. All the user needs to do is apply the standardised pattern to his circuit and assemble the components. Connectors are available as part of the Nip-E-System for single row and double row pattern arrangements of discrete or integrated circuits or both.

With the boards you get a choice of ready-made paper base laminate or epoxy glass fibre board  $\frac{1}{16}$ in. (1.58mm.), a hole matrix 0.1in. (2.54mm.) $\times$ 0.15in. (3.81mm.) and a choice of drilled or undrilled boards. A choice of board for discrete components only or a mixture of integrated circuits and discrete components is available and there is a choice of board size to take up to about

PCB FOR I.C.

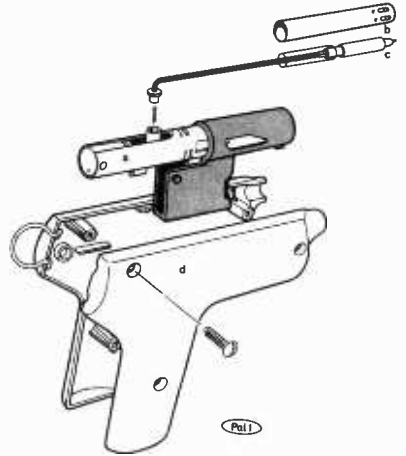


## Gas igniter



No, it's not a device for "doing-in" Editors—it's a piezo electric gas igniter! It's guaranteed for ten years, does not need any batteries or flints, you don't have to plug it in the mains or hold it under a hot tap! While you pause for breath, we'll explain:

The device, made in Germany by Junkers, operates on the principle that if a sudden force is applied to the interfaces of various crystals, an electric charge results. In practice, when the trigger on this igniter is pressed, it releases a "firing" pin which deforms the piezo crystal and causes a discharge voltage in the region of 20kV to appear at the end of the pistol "barrel". The end of the barrel is designed like a car



sparkling plug so that the spark (of 50 $\mu$ S duration) jumps from the centre electrode to the barrel wall thus igniting the gas it is held near.

In the sketch (a) is the crystal mounting and housing unit. (b) and (c) are the points the spark jumps from and (d) is the plastic housing of the complete unit.

The Junkers Piezo Electric Gas Igniter is priced at £2.25 plus 15p postage and packing and may be obtained from *Servitronix Limited*, 572 Kingston Road, Raynes Park, London, S.W.20.

26 transistors (possibly more) in the 11E to 18E series or up to eight integrated circuits plus 16 transistors in the 21E to 28E series.

Constructors can have plug-in contacts for 14-way or 30-way gold-plated edge connectors (as supplied) for single row or double row boards, contact pitch 0.1in. (2.54mm.).

The customer chooses the size most suitable to his application and the Company supplies a ready-made Nip-E-Board.

The boards are reasonably priced and they certainly help to make construction much easier and far neater.

If you would like further details of prices, accessories and layouts, drop a line to *NIP Electronics*, P.O. Box 11, St. Albans, Herts. They will be pleased to send readers their comprehensive free booklet on the Nip-E-System.

## Anyone help?

Our squadron has recently started a radio section, and all projects are of a self help basis, thus you may understand that supplies and money are very limited. The boys' ages vary from 13 years to 16 years.

I would be most obliged if through your column, I might request any radio hams etc who have surplus to requirements any books, components or radio equipment, to contact us.

All expenses for postage and packing would be refunded, and all communications acknowledged.

Please address all letters, parcels, etc. to:—Mr. G. H. Barker, "Training Officer", 2380, A.T.C. Dartmouth Sqdrn., "The Lodge", Longcross Cemetery, Townstal Road, Dartmouth, South Devon.



**BI-PRE-PAK LTD.**

Due to a printer's error in our August issue an incorrect price was quoted for the Complete Telephone as offered for sale by the above Company. The correct price should have read 95p. We offer our apologies to BI-PRE-PAK LTD. and to any readers who may have been inconvenienced by this error.

**Decoder**

Motorola Semiconductors have announced the type MC1310 monolithic f.m. broadcast receiver stereo decoder which requires no external tuning inductors. Stereo channel separation is stated to be 40dB at 1kHz, with 0.3% total harmonic distortion.

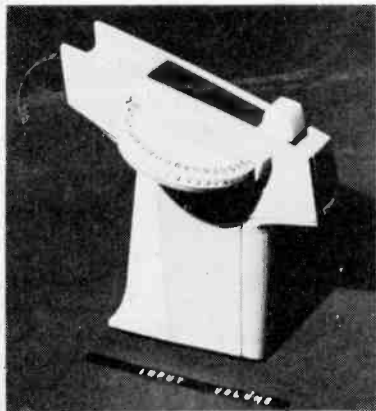
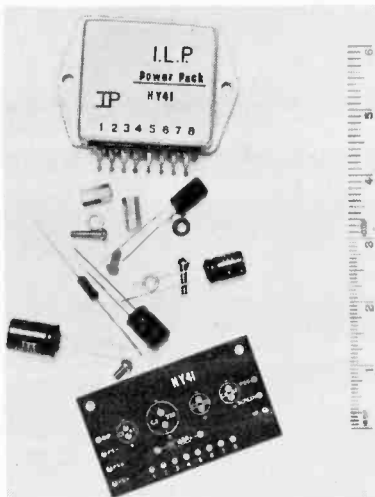
**Dymo Star 1710**

We recently had the opportunity to try out the Dymo Star 1710 labelling machine. This machine is ideal for stamping out the wording for the front panels of equipment.

Letter selection is made by turning the dial wheel until the required character appears in the letter slot.

Technical symbol and character wheels may be fitted to this machine quite simply and different colour tapes are available.

Full instructions are provided with each Dymo Star.

**IC power amp**

The HY41 is a linear integrated circuit, power amplifier with an output of 20 Watts r.m.s. into 4-16Ω having a total harmonic distortion of less than 0.15% (typical 0.05%) at 1kHz into 8 ohms.

P.C. board, resistor, capacitors, hardware mountings and comprehensive manual are all included in the basic kit, no further components being required in constructing a complete power amplifier of high performance.

Internally the HY41 is based on proven circuit techniques developed over recent years and is sufficiently versatile to provide power not only for Hi-Fi but for public address systems and industry.

Supplied by the Canterbury Company I.L.P. (Electronics) Ltd., the HY41 requires no adjustment whatsoever and can be assembled without recourse to sophisticated measuring equipment or electronics know how. I.L.P. (Electronics) Ltd., Crossland House, Nackington, Canterbury, Kent.

**Rover-point**

Nettle Accessories Limited, a member of the Aerialite Group of Companies, announce the introduction of a portable extension lead to their range of electrical accessories, known as the "Rover-point".

It consists of a 15 metre length of white 0.65 sq. mm. 3 core, P.V.C. cable, contained in a moulded plastic reel. A flush 13A socket is incorporated into the reel, and the cable is supplied complete with 13A plug.

The reel has a handle that can be utilised for carrying or hanging, and its rotating section is provided with two projections to facilitate easy rewinding.

Suitable for feeding loads of up to 1kW, with the cable fully extended and 500W with the cable coiled on the reel, "Roverpoint" sells at a recommended retail price of £3.99. Nettle Accessories Limited, Warren Street, Stockport, Cheshire.

**Sonex 73**

Sonex 73, the high fidelity equipment exhibition organised by British Audio Promotions, will be held at the Excelsior Hotel, London, from March 30 to April 1.

**Erie catalogue**

Erie Electronics have published a new comprehensive catalogue of their electronic components. It covers all product ranges, and catalogue contains specifications on all Erie distributor sales, Erie Electronics and Erie Controls products, as well as information on Erie thick film devices and Toshiba semiconductors. Copies are available from Erie Electronics Ltd., South Denes, Great Yarmouth, Norfolk.

**Chadacre Electronics**

Please note their new address: 63 Stratford Broadway, London, E-15. Telephone 01-534 1207.

**D**ESPITE the use of high-power transmitters, used in conjunction with aerial systems of considerable gain and directivity, as well as extremely sensitive receiver techniques to accomplish a high standard of world-wide h.f. communication, the final merit of reception is controlled by many natural causes and variations.

## The Pioneers

The medium through which a radio wave must propagate, termed the *Ionosphere*, determines this final pattern of reception including field strength, fading and even "black outs." The early pioneers were well aware of the electro-magnetic wave with its effects though proof of its vast potential only came when Guglielmo Marconi established contact between Bournemouth and the Isle of Wight in 1898. This was followed by an even greater breakthrough in 1901 when he transmitted the first telegraph signal from Poldhu, Cornwall to be intercepted at St. Johns, Newfoundland.

Research in this field by many workers revealed great discoveries. The name of mathematician Oliver Heaviside in England, who propounded the existence of a *Conducting Layer* in the upper atmosphere in 1892, as well as the work carried out by Kennelly in the U.S.A. as early as 1902 can never escape mention. Sir E. V. Appleton and M. A. F. Barnett, who determined the position of the *Heaviside Layer* in

on the atmosphere will show considerable variations when we consider the changes from day to night, the four seasons of the year and the eleven year cycle of the sun's regular variation. This solar cycle appears to follow an average change of 11.4 years; from one of minimum activity to maximum in 4 years and falling from maximum to the next minimum in 7 years. (The last maximum occurred in 1968 and present predictions are estimating the next minimum will occur in 1975). Differences of this kind affect the conditions of the atmosphere and as a result have considerable influence on the propagation of radio waves. The solar radiations affect the atmosphere and cause it to assume a "mirror-like" reflecting surface which return radio waves to earth.

## Ionization

The radiation from the sun unsettles and excites the normal arrangements of the atoms and molecules of gas. This brings about a condition known as *ionization*; the atoms of gas become incomplete, having lost some of their electrons.

The region of ionization will, therefore, consist partly of free electrons and this process will continue so long as the earth's rotation permits that region of the atmosphere to be exposed to the sun.

After sunset this process ceases and the free electrons rejoin their "mother" atoms, a process known as *recombination*, and this region will fall in ionized

# PRINCIPLES OF propagation HENRY HATCH

1925, are also great names that we associate with early radio experiments.

The many effects acting in different ways on radio signals during their passage from transmitter to receiver is indeed a great scientific subject—yet perhaps to the majority of readers the fascination lies in the fact that, even by using only simple equipment, signals may be intercepted from the other side of the world.

## Sun and Atmosphere

Let us consider how transmission of this kind is possible. A mode of propagation of this kind requires two essential and indispensable components, the atmosphere and the sun. The atmosphere, forming a gaseous envelope surrounding our planet, consists mainly of two gases, nitrogen and oxygen. This atmosphere is subjected to the full exposure and effect of the sun's rays, not only those of heat and visible light but of other radiations, including ultra-violet, gamma and X-rays, all bombarding our atmosphere after a journey of some 93 million miles. The effect of these rays falling on our atmosphere permits long distance radio communication.

## The Solar Cycle

The difference in the amount of sunlight falling

density. The ionized region is called a *Layer* and is able to reflect the wave back to earth though it must be remembered that radio (like light waves) travel only in straight lines. To make use of this reflecting property the transmitted signal must be beamed in a skyward direction, as well as towards that part of the earth where it is to be heard. For long distance communication the radiated signal must leave the earth at a low angle so that the first encounter with the ionosphere will be as far away as possible. In the same way a signal with a high angle of elevation will reach the layer at a much closer distance and may be regarded as being more suitable for reception in a nearby area.

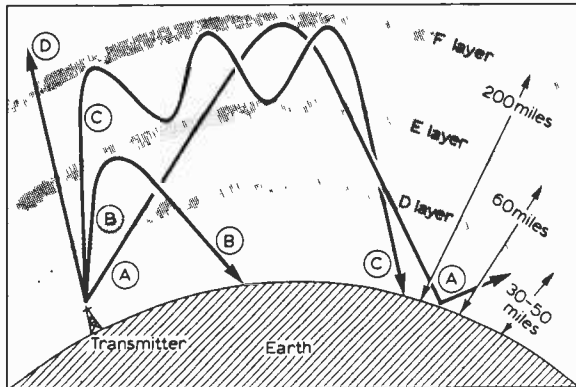
## Bending

It should be mentioned at this stage that the rays of the sun will be first absorbed by the upper part of the atmosphere so that the overall density of the layer will show some variation. The radio signal coming up from the earth's surface will first enter an area of comparatively low density but as it enters deeper into the ionized region it will encounter an area of greater free electron density. The wave will meet an adverse force, presenting some opposition to its progress. It is convenient to think of the radio wave behaving in a similar way to light when considering how it is turned in the ionosphere to be

returned to earth (both travelling at a speed of 186,000 miles per second).

## Hop and Skip

The word *Refraction* or *Deflection* explains this particular point in that a ray is changed in its course after entering a medium differing in density from one through which it has already passed. In this way the wave will be turned away from its original path and, providing the density of the medium and the frequency of the vibration are suitable, a point will be reached where the wave will be turned from its original route so as to follow a parallel course with the layer. Eventually it will be completely turned and leave the ionosphere at a similar angle as that of entry. The wave will return to earth having accomplished its first *Hop*—leaving a *Skip* distance between the sending and receiving points suggesting an area of silence existing between them. This is not so because the width of the transmitting beam will usually cover a considerable angle and the random scatter of the downcoming wave due to irregularities of the ionosphere tends to fill in this void. The second hop is made possible by an



Representation of the various methods by which radio waves are propagated. The main layers (D, E and F) are shown with their approximate heights above the earth's surface; the F layer is shown simplified—see text. The wave A is the normal long hop transmission; further reflection may take place when it meets the earth's surface. For reception in nearby areas the signal is beamed at a higher angle and is reflected by the E Layer.

C shows a form of propagation that is thought to occur at times. A number of reflections take place between the upper layers before the signal is returned to earth. If the angle of radiation is too high (and the frequency unsuitable) the waves will be lost in space as shown by D.

upward reflection from the earth's surface but the effectiveness of this is somewhat variable. It will depend upon the texture of the particular area of the earth's surface. Sea water is excellent, next comes pastoral land, while at the lower end of the scale desert areas may be regarded as poor; all have different conduction values. There is no rigid limit as to how many hops may take place since these are governed by the height of the layer at the time of transmission, the radiation pattern given by the aerial and the distance to be covered as well as the original transmitted power.

Some idea of a professional mode of transmission may help to make this point clear; the path from the United Kingdom to India needs three such hops and that to Australia six or seven. It will now be clear that although the wave will follow only a straight

line, the curvature of the earth has been overcome by each individual hop although so far the ionosphere has been considered as one reflecting region. This is not so and it does in fact consist of several parts, each playing a different role and each one having a profound effect upon the wave.

## D Layer

The basic structure of the ionosphere starts with that area known as the *D layer*, situated between 30 and 50 miles above the earth; this becomes very dense by day but falls to a very low level—almost non-existent—at night. During the hours of daylight it will cause considerable attenuation of the signal due to absorption, particularly to the lower frequencies. This effect is well known to the medium wave DXer as long distance reception on this band is virtually confined to the 'locals' until after sunset when the D Layer will begin to fail.

## E Layer

The *E Layer* (sometimes known as the *Kennelly-Heaviside Layer*) lies about 60 miles above the earth and although not the most important part of the ionosphere, it is responsible for the reflection of both medium and short waves.

A particular development of the E region, which at times can produce really sensational forms of propagation, is that known as *Sporadic E*. As the term implies this condition is irregular and cannot be forecast with any accuracy. An increase in ionization takes place usually around noon in our latitude. These abnormal conditions permit the reflection of very high frequencies and even enable TV signals to be observed from distant stations.

## F Layer

The topmost layer is that known as the *Appleton* or *F Layer*. The height varies from about 200 miles upwards and ionization is mainly confined to nitrogen as at this height oxygen becomes rare. The F Layer is frequently considered as the most important. It becomes divided into two parts during daylight, the upper part designated as *F<sub>2</sub>* and the lower portion *F<sub>1</sub>*. After sunset, and prior to dawn, it assumes the form of only one layer.

## Frequency Choice

Having examined the structural and reflecting arrangements which affect the wave, let us now consider how these various parts are put to practical use. Most of us are aware of the general rule that high frequencies are most useful by day and the lower ones give the best performance by night, although the exact choice of frequency used is critical if reception is to be of a standard worthy of being termed a service. Indeed, numerous observations are needed to formulate the vast number of short wave schedules published in advance which have to take into account the many factors already mentioned.

## Ionosphere Sounding

Such information is compiled by "sounding" the ionosphere. A radio wave with an adjustable frequency is sent vertically upwards to a layer so that it is able to engage it at right-angles and then the

# Radio Propagation Characteristics

Frequency	Day	Night
A. 100kHz-400kHz	Reception very dependent on power of station. Reliable reception possible at distances of 1000 miles or more.	
B. 400 kHz-1.5MHz	Ground wave reception only, usually no more than 200 miles but certain winter conditions can increase this to 1000 miles.	'Skip' takes place and reception of stations up to 1000 miles is common with not infrequent reception of stations at much greater distances.
C. 1.5MHz-3MHz	Similar to B but distant reception more common.	Varies with conditions but similar to, and usually better than, B.
D. 3MHz-8MHz	Similar to C but distant stations much easier and more reliable. Distances of several thousand miles especially at night.	
E. 8MHz-15MHz	Generally the best frequencies for DX but ground wave absorption limits local reception.	Often good for long distance reception but depends on conditions and time of year.
F. 15MHz-25MHz	As for E but DX, although often better, is more dependent on conditions.	Usually poor for long distance reception but dependent on time of year and conditions.
G. 25MHz-45MHz	Highly dependent on conditions—sometimes excellent DX is possible but more often unsuitable.	Local reception only.
H. 45MHz-120MHz	Local reception except for occasional 'freak' conditions, usually associated with high pressure areas—when stations several hundreds of miles away can be received.	
I. 120MHz-250MHz	As for H but freak conditions much less common.	
J. 250MHz-1GHz	Local reception only—rarely more than 30 miles. Signals absorbed very easily. Very occasional freak conditions give reception of stations at a few hundred miles.	

frequency is adjusted so that it can be observed to either penetrate the ionosphere or be reflected back to earth. When this frequency is found—the highest limit to which the frequency can be raised and retain its reflection—it is known as the *Critical Frequency*.

Having obtained this frequency it may be increased up to three or even five times, provided the wave is radiated in such a manner and angle that it will meet the layer at a slanting or oblique angle. Such arrangements may appear straightforward but in the case of a multi-hop circuit—perhaps one crossing the equator or a dusk and night period—the requirements become complex, requiring many calculations and even some compromises to meet the variations over the path. The wave for reflection from the F Layer will, even during its first hop, need to be strong enough not only for reflection but to overcome losses through absorption when it passes through the D and E regions. It will, in fact, have to pass through these lower layers on two occasions even during its first hop.

## S.I.D.

We often hear on the amateur bands comments such as "Conditions aren't too good today". Such remarks refer to changes in propagation which can broadly be placed in two categories, one type of disturbance is referred to as a *Dellinger* or *SID* (*Sudden Ionospheric Disturbance*). This is often of a sensational effect happening in a very short time—so suddenly that the receiving equipment is often suspected. The effect is brought about by solar action

which causes an overwhelming ionization of the D Layer leading to almost complete absorption.

The lower frequency end of the shortwave band is most affected and signals in this part may even become inaudible. The higher frequencies are less affected and will be the last to suffer losses and the first to return to normal. The duration of such disturbance is usually short lived.

When the face of the sun looking towards the earth is subjected to an eruption, solar flare (often called a sun spot) this brings about the emission of numerous kinds of radiation. These vary in their intensity but when of a great magnitude, may persist for a long period. For these reasons this kind of unsettled condition may reoccur with a complete rotation of the sun in approximately 28 days. The *Dellinger* or *SID* will normally only effect that side of the earth facing the sun.

## Ionospheric Disturbance

A more prolonged type of disturbance known as an *Ionospheric Disturbance*—or *Storm*—may also be associated with solar conditions and often occurs some 30 hours after observation of changes on the surface of the sun. The general merit of reception falls considerably with deep and sometimes rapid flutter fading due to a lower and variable density of the F Layer.

Having described such adverse conditions, the reader may begin to wonder how a wave survives for so many thousands of miles, and especially as variations in the signal strength may be as much



as 1000 to 1, yet so much in modern receiver design is included to bring these variations to a stable and acceptable listening quality. The information given in the chart headed "Radio Propagation Characteristics" should be of value in helping to choose the correct wave bands.

## Reception Reports

Considering the complexities and variations in propagation it is not surprising that all broadcasting organisations giving a service in the international broadcasting bands welcome accurate reception reports from listeners.

Considerable sums of money are spent each year to inform the listener of recommended frequencies and times of operation. Even after a schedule is published, the broadcaster is still in need of accurate information regarding the level of interference, as the shortwave bands are so congested—a situation which will become worse as we move to solar minimum conditions and the higher frequency bands become less useful.

## Medium Waves

Most of these remarks have concerned the short waves or high frequencies as these are the ones most used for long distance reception. However, reception of distant stations is also possible in the medium wave band (525-1605kHz). MW Dxing is made especially difficult due to the large number of high powered stations operating in Europe. This wave band is basically designed for local reception and there are far fewer opportunities for long distance listening, even after midnight. Owing to so many broadcasters extending their hours of broadcasting such services frequently include an aerial system designed to avoid the sky wave and emphasise the ground wave. This reduces after dark interference and at the same time permits an economy by the sharing of frequencies. Listening to stations operating in the MW band is in any case confined to the hours of darkness if reception from a great distance is the aim. After dark these frequencies are reflected by the E Layer; the D Layer at night being almost non-existent. There are cases, however, when frequencies approaching 2MHz find reflection from the F Layer, having penetrated the E region.

## Other Bands

Other bands are subjected to other influences; remarkable reception due to tropospheric propagation in the VHF and UHF bands occurs occasionally. An outstanding example of the abnormal mode of propagation is that in earlier sunspot maximum periods, BBC Television pictures have been resolved as far away as the West Indies and South Africa.

Many listeners appear to associate bad weather, such as rain and fog, with either good or bad reception but there is no real evidence to substantiate this, at least not as far as the medium and shortwave bands are concerned. As the frequency is increased towards the microwave portion of the spectrum, that above 1000MHz, these and other factors have to be taken into account.

At a recent press conference given by the GPO Telecommunications Department, many interesting facts were disclosed concerning the adverse effects of rainfall over even short path transmissions on these channels. ■

# your PRACTICAL AERIAL DATA WALL CHART

**W**E expect rather a lot of our receivers don't we? In the early days of radio most homes sported a beautiful long wire aerial but with the tremendous improvement in receiver design and the vastly improved sensitivity we seem to have forgotten just how important a decent aerial is. Some receivers now being marketed claim that the silly little telescopic aerial which is an integral part of the set is all that is needed—rubbish!

For good DX results three things are needed, all of about equal importance: the receiver, the skill of the listener and the aerial. The receiver will cost quite a bit of money and the skill can only be learned with time; on the other hand an aerial will cost very little—wire isn't all that expensive after all—and the erection will take only a few hours.

The type of wire is far from critical. Hard drawn copper is possibly the best, it doesn't stretch, but it is expensive. One of the best, and cheapest forms is aluminium garden binding wire. 250ft. reels cost only about 30p.

Ex-Government aerial wire is still available on the surplus market and this is excellent; it is usually made up from one strand of copper surrounded by steel wires for strength.

On the Wall Chart we have tried to deal with practical types; it is all very well to read about wonderful professional arrays but few of us have the room or the money to pay for the tall masts required. Instead we have dealt with the types that readers are likely to have space for. Even if you live in a small flat you will usually be able to find room for a pretty good Whip Type, or even an Inverted L.

The chart deals with aeriels but of course any signals induced into them will only be with respect to earth and a good earth should be used. One always used to see comments such as ". . . the earth wire can be taken to a cold water pipe . . ." but in these days of plastic plumbing this will not always work. A good earth can be made by soldering a wire to a piece of copper clad board—such as is used for making printed circuits; this should be buried as deep in the ground as can be managed and a bucket of water should then be poured over it to make the earth resettle around it. The size of the board is not critical but the larger the better. The wire from this earth to the receiver should be of very low resistance and as short as possible. ■

# reference source



E. BUCKLAND

NO one would deny that a full-range, full-facility audio signal generator is not useful. The author has a good one (built from a design published in *Practical Wireless* some years ago) and it is continually in use for designing, testing and trouble shooting but only a few of the facilities account for 95 per cent of the usefulness. Most of the time the frequency is left on 1kHz and only the calibrated output is used. When the frequency is varied it is nearly always at the spot frequencies of 100Hz, 1kHz and 10kHz. Nearly all signal generators have a switch to give either a sine-wave or square-wave output. This is frequently used but it is rare that the type of wave-form matters very much. Where it does matter, it is nearly always the square-wave that is required.

The main signal generator was found to be so useful that the author decided on building another, this time to be battery operated for portability. Bearing in mind the points made above it was also decided to make a far simpler and less expensive version, incorporating only the most useful facilities.

This unit gives a constant square-wave output—irrespective of battery voltage and other factors—at three spot frequencies: 100Hz, 1kHz and 10kHz. The output is continuously variable over a wide range. To simplify the switching, the on-off switch is incorporated with the frequency selector and the decade outputs are provided from separate output sockets.

The complete unit is very small, fitting nicely into a small aluminium box, 4in. x 2½in. x 2in. and the total cost is only a fraction of that for a full facility audio signal generator.

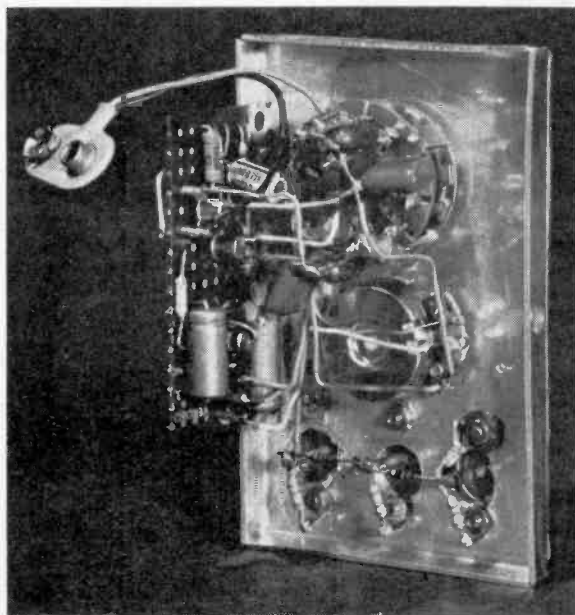
This makes an excellent “back-up” unit but even by itself it should be useful for those without an a.f. signal generator.

## THE CIRCUIT

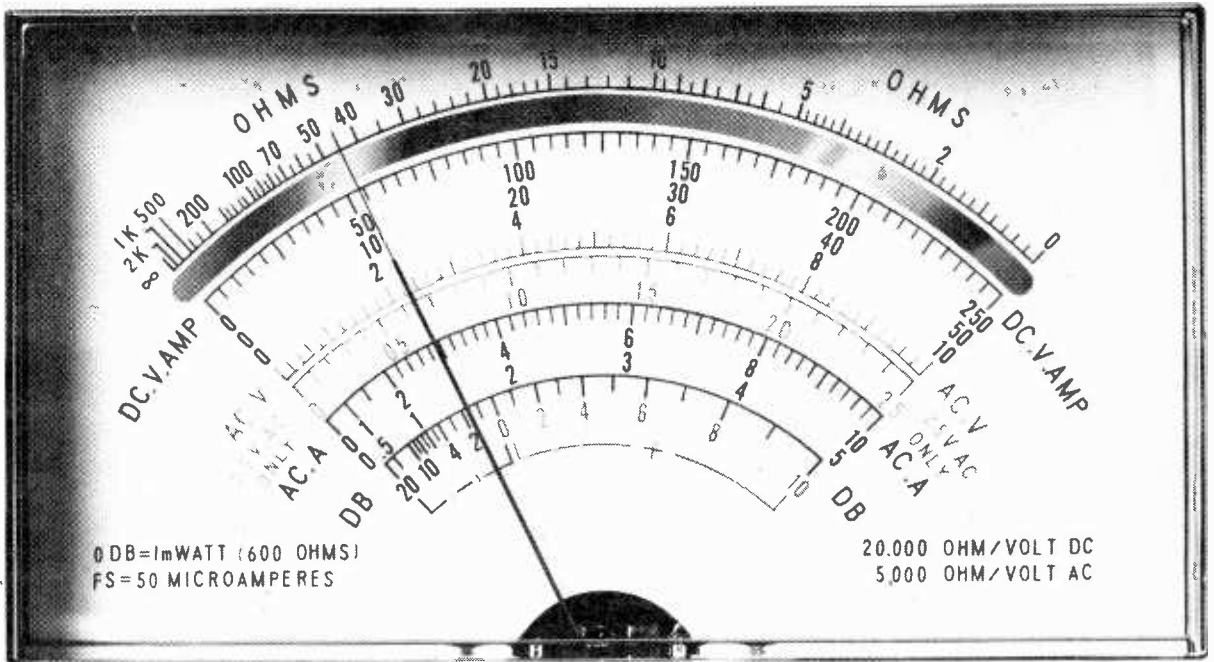
The signal oscillator is a basic multivibrator, made up from Tr1 and Tr2. Both halves of this are identical, with similar base bias resistors and the same collector load, although for Tr2 this is a variable potentiometer and not a fixed resistor as that for Tr1.

The values of the coupling capacitors are altered by the main switch, SW1, and one of three capacitors can be selected. This balance in the two sections ensures a square wave output with a 1:1 mark space ratio, not vital but easy to incorporate and occasionally useful. The values of the bias resistors etc., ensure that the transistors are driven on hard when they are turned on, this ensures that the output will be constant.

The output is taken from the collector load of Tr2, the slider of VR1 is connected via C2 to the base of the emitter-follower Tr3. The high value of C2 is deliberate, this will ensure no degradation of the tops and bottoms of the square wave at 100Hz. Tr3 was found necessary to isolate the output from the



Internal view of the prototype.



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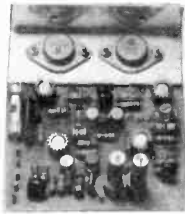
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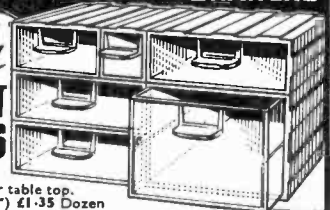
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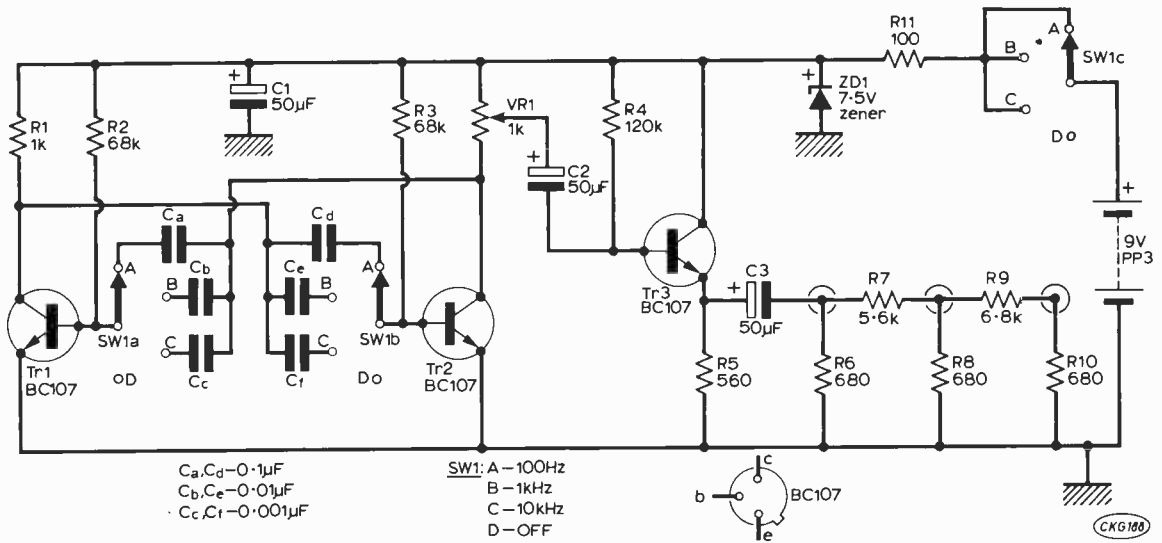


Fig. 1: Complete circuit of the Audio Reference Source.

multivibrator. As this stage contributes no gain it may be thought that the output network could be connected directly to the slider of VR1 but this would vary the load at the collector of Tr2 and affect the frequency and level. The inclusion of Tr3 makes certain that this interaction is minimal.

The output from the emitter of Tr3 is taken via the d.c. blocking capacitor C3 to a decade attenuator. At each of these output sockets the output is one tenth that of the previous one.

Because of the operation of a multivibrator, we can always be sure that the output will be constant, irrespective of frequency as long as the supply voltage is constant. This is done by including a zener diode with a rating of 7.5V in the positive supply line, the voltage drop taking place across the resistor R11. SW1 is a three-pole, four-way switch; three of the sections are used to alter the frequency of operation of the multivibrator, the fourth section acts as the on-off switch.

The whole circuit is very simple as can be seen from Fig. 1. BC107 transistors are specified but BC108, BC109 or their plastic versions (BC168 and BC169) can also be used, as can a 2N2926. None of

## ★ components list

### Resistors

R1	1kΩ	R7	5.6kΩ
R2	68kΩ	R8	680Ω
R3	68kΩ	R9	6.8kΩ
R4	120kΩ	R10	680Ω
R5	560Ω	R11	100Ω
R6	680Ω		

All resistors  $\frac{1}{4}$ W, 5 per cent types.  
VR1 1kΩ linear pot., carbon track

### Capacitors

C1 50μF 10V min.	Ca, Cd 0.1μF Mylar or ceramic
C2 50μF "	Cb, Ce 0.01μF " "
C3 50μF "	Cc, Cf 0.001μF " "

### Semiconductors

Tr1 BC107 see text	Tr3 BC107 see text
Tr2 BC107 " "	ZD1 7.5V, 50mW zener diode

### Miscellaneous

SW1, three-pole, four-way rotary switch; 3 off coax sockets—see text; battery clip; Veroboard, 16 x 9 holes, 0.15in. matrix; small aluminium case with lid.

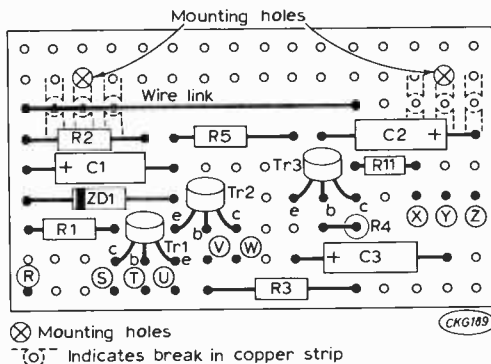


Fig. 2: The component layout on Veroboard. The only breaks in the copper strip are those near the mounting holes.

these changes will affect the constant output which is controlled by the supply voltage and nothing else.

VR1 should of course be a linear control and the associated knob can be calibrated if required.

The capacitors in the multivibrator may not give the exact frequency specified, this will depend on their tolerance, but it should be close enough for all practical purposes.

The unit takes only a small current and this is adequately provided for by a PP3 battery.

## CONSTRUCTION

The component layout of such a unit is far from critical but that used in the prototype is both simple and neat. The majority of the components are mounted on a small piece of 0.15in. matrix Vero-

# THE Medium Wave Column

board, 16 holes by 9 holes; this can be cut from a standard 2½in. width. The component layout is shown in Fig. 2. Various take-off points are letter coded R to Z to tie up with the main wiring diagram in Fig. 3.

No breaks are necessary in the copper conducting strip of the Veroboard other than those near the mounting screws. The battery negative is taken to the board by a wire running from a small solder tag which fits under one of these mounting screws.

The frequency determining capacitors are mounted directly onto the switch SW1, this can be seen from the photograph of the prototype.

The output sockets are mounted next to each other and the attenuating resistors are wired directly to these, the chassis connections being taken to solder tags under the mounting screws. Coax output sockets were used on the prototype mainly to continue standardisation in the author's test equipment but other types—such as phono sockets—can be used.

The component board is held onto the chassis by means of a short length of aluminium angle bracket.

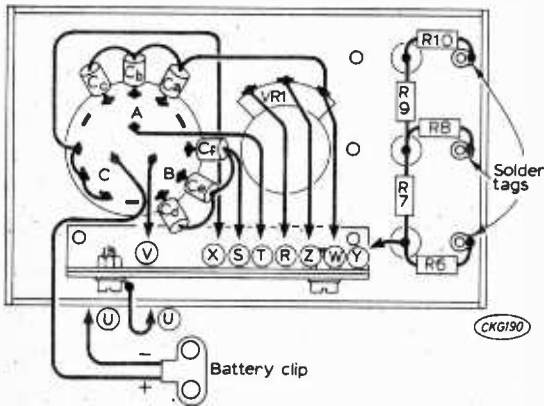


Fig. 3: The wiring diagram. The letters R-Z match up with those in Fig. 2.

## CALIBRATION

It is not possible to say what the exact output will be for any particular version, this depends on the saturation of the individual transistors, but what can be said is that it will not vary with frequency or battery voltage. If a highly accurate output is required this is best measured on a 'scope. The output can also be reduced to a reference figure by wiring in an extra resistor between the collector of Tr2 and VR1. If the output is say 2V and the maximum output wanted is 1V then a 1kΩ resistor will be required. The output from the prototype is 1.8V and this level has been found sufficient. The output from the other decade outputs is 180mV and 18mV at maximum output. ■

## BACK NUMBERS

We regret that the back numbers department of P.W. has now closed and consequently we are unable to supply these. Requests for specific back issues can usually be included in our 'CQ' section; there is no charge for this but it is a service between readers and P.W. is unable to meet any of these requests.

NEWCOMERS to the medium waves are often surprised at the number of West African countries that can be heard on this band. La Voix de la Revolution located at Conakry in the Republic of Guinea, is a conspicuous signal on 1403kHz after 2300hrs GMT. Programming is African in style with announcements in French. The new high power broadcaster at Bissau, Portuguese Guinea can be logged on 1070kHz between 2300hrs and 0100hrs GMT with pop music, announcements and news being in Portuguese. From the Canary Islands, the high power Radio Nacional Espana outlet in Tenerife is a strong signal on 620kHz after 2300hrs. Programmes are in Spanish and there is interference at times from Batra in Egypt. Dakar, Senegal on 764kHz can be heard on weekdays with African music and French announcements after Sottos, Switzerland closes down. From the Republic of Zaire (Congo) the station at Kinshasa on 692kHz is on the air all night and is audible, with African programming after the East German station on this frequency signs-off, usually at 0100hrs GMT on weekdays. Radio Nigeria at Enugu is on 1320kHz until sign-off at 2300hrs GMT. Programmes are in English and can be found during the last half hour of transmission, as a weakish signal between the European channels 1313kHz and 1322kHz. Another English speaking broadcaster is occasionally heard on 629kHz. This is ELBC at Monrovia, Liberia which closes down at 0045hrs GMT and is usually logged towards the end of its transmission.

A new broadcaster in North Africa has appeared on the Long Waves. It is located in Algeria and is audible in the UK during the evening on 254kHz (1181m); a channel it shares with Lahti, Finland. Programmes are in French and reception reports, which are requested over the air, should be sent to Radio Television Algerienne, 21 Boulevard des Martyrs, Algiers, Algeria. This is the second North African to appear on the LWs in recent years. Azilal, Morocco is on 209kHz with programmes in Arabic and can be logged after dark with some interference from Kiev on the same channel. The range of long wave stations increases considerably at night—Europeans fade-in regularly along the eastern seaboard of North America after local sunset. Stations heard in the UK by the writer include Reykjavik, Iceland on 209kHz at 0100hrs GMT; Ashkhabad, Turkmenia on 200kHz after Droitwich signs-off; Ankara, Turkey 182kHz with sign-off at 1930hrs GMT; Baku, Azerbaijan on 218kHz at 0100hrs GMT; Novosibirsk 272kHz at 0130hrs and Omsk 394kHz at 1900hrs. In Europe, the long waves covers 151kHz to 282kHz but in Asiatic Russia the band extends to 400kHz. Regulars to be heard in the "hf" section are Orenburg 300kHz; Kharkov 384kHz and Minsk 400kHz.

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

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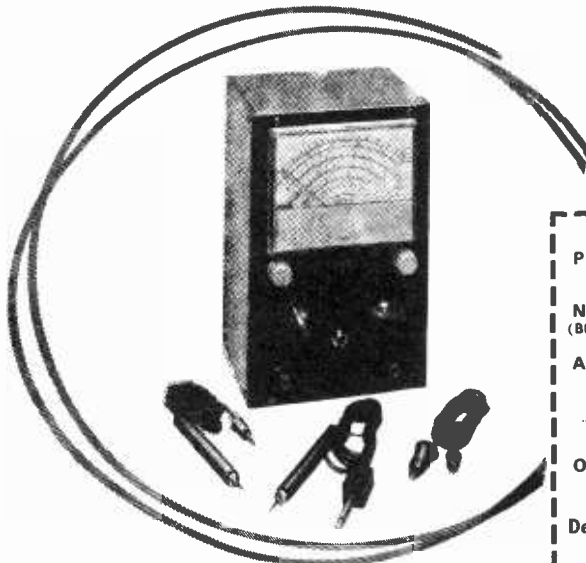
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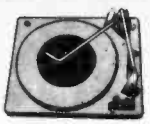
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# 'THE Logiprobe'



## LAURENCE COOK

THE circuit to be described was designed to fulfil the need to see what was going on in TTL logic systems without having to use a voltmeter to determine whether a "1" or "0" existed at any point. To give a positive indication of the presence of a logic level it was decided at the outset to have two lamps, corresponding to a "0" or "1". Neither lamp would light with the probe either floating or at an inadmissible voltage (e.g. 1.2V).

Since the probe has been completed, it has proved extremely useful to me (and to those who have borrowed it!) and will doubtless soon repay its cost in time saved tracking down faults. It may even encourage people to "have a go" at logic circuitry, since it quashes the familiar cry, "I can't see what's going on inside those bugs".

## CIRCUIT

Only four transistors, four resistors, two diodes and two bulbs are used (see Fig. 1). A few moments spent studying the circuit should enable one to spot

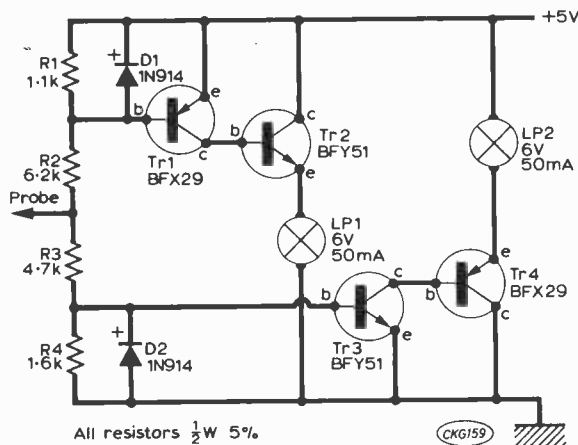


Fig. 1. Circuit of the Logiprobe.

the fact that it is really two circuits, one the inverse of the other; that is, Tr3 and Tr4 are arranged in a similar fashion to Tr1 and Tr2 but "upside down". The reason for this is simple.

With the probe on a logic "0" the voltage at Tr1 base, determined by the divider chain and probe voltage ( $>0.8V$ ) causes Tr1 to turn on. Tr1 collector goes towards +5V and Tr2 emitter does the same, since Tr2 operates in common collector mode. LP1 therefore lights, indicating a logic "0". Similarly a logic "1" at the probe causes the voltage at Tr3 base to turn Tr3 on, and so Tr4 drives LP2, which lights up.

The resistors in the divider chain are of such values as to keep both lamps off when the probe is either floating or between 0.8V and 2.4V with respect to earth. Should the probe be accidentally touched on a voltage below earth or above +5V, then D2 or D1 respectively conduct to prevent the reverse base-emitter voltages of Tr3 or Tr1 being exceeded. Resistors R2 and R3 limit this current, but it is inadvisable to deliberately look for trouble by touching the probe onto higher voltage rails for long periods.

## CONSTRUCTION

The logiprobe is assembled on a piece of 0.15 in. matrix veroboard (see Fig. 2.), with flying leads for supply and lamps. This enables it to be housed in any convenient small plastic box. The probe may be made from an old ball-point pen. It is largely a matter of choice how one terminates the supply leads, but since the supply must be the same as that of the TTL circuitry to be tested, then small insulated crocodile clips would be handy.

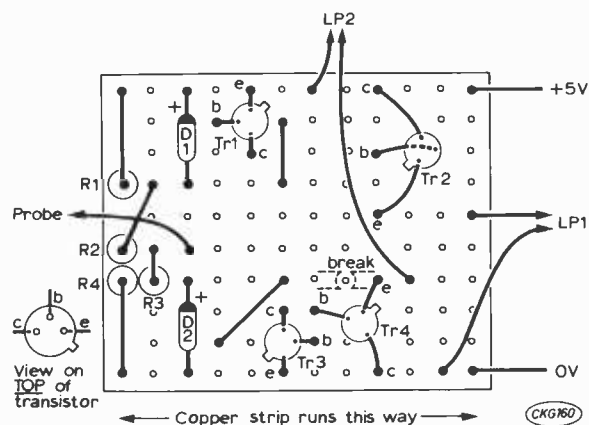
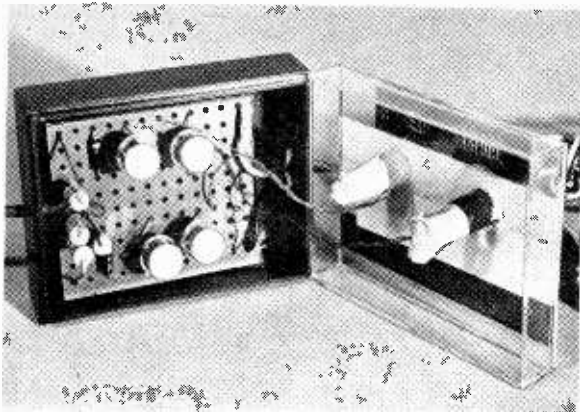


Fig. 2. Layout of the Logiprobe on a small piece of veroboard. Note that transistor leadout connections are shown as seen from on top. Compare this layout with photograph of completed unit.

Start by cutting a piece of veroboard to the right size for the box, then solder flying leads as shown. Next solder in the resistors, diodes and transistors. Use a heatsink and a small well-tinned iron just in case the resistor values are altered by overheating them, since these determine the levels at which LP1 and LP2 light. For this reason R1 to R4 should be 5% or better, and not nasty old things out of that TV set recently butchered! Finally solder LP1 and LP2 onto their respective leads.



The lid of the box carries the two lamps which should be of differing colours, representing "0" or "1". The lamp terminals are insulated to prevent short circuits when the lid is fitted to the box.

## TESTING

Connect the logiprobe to a 5V supply. If all is in order both lamps will be off. If not, either the supply is wrong, or a mess has been made of the board. Look for blobs of solder bridging the copper strips and get rid of them! If both or either of the two lamps are still on, make sure that everything is connected the right way round; we all make mistakes!

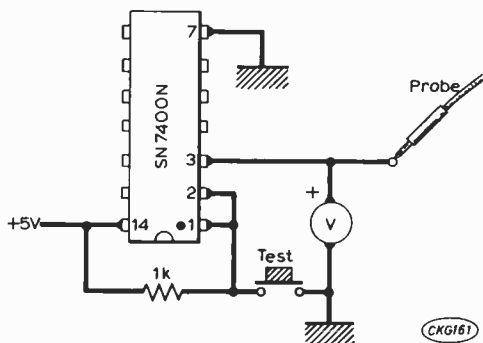


Fig. 3. Test set-up using an integrated circuit.

Touching the probe to earth or +5V should light LP1 or LP2; just to make sure all is well try the probe on an i.c. output with a voltmeter as a temporary check. (See Fig. 3).

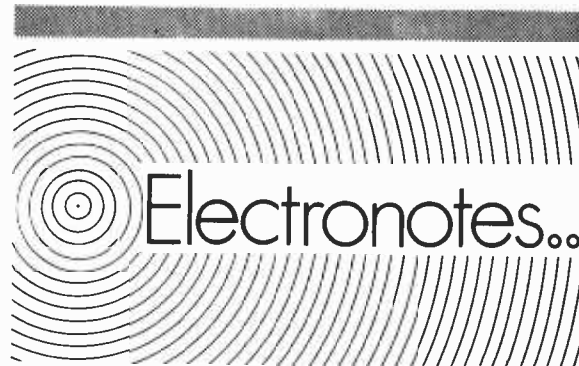
Finally, a word of warning. Unless one is prepared to fiddle for hours with stacks of resistors, use the components specified. If you can't resist trying different transistors, at least use silicon of a similar type.

When your logiprobe is finished you'll wonder how you managed without it. But keep it hidden or people will borrow it from you! ■

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S. GINSBERG

ONE so often reads about the amazing advances and research programmes which take place in other parts of the globe. It is, therefore, refreshing to hear of some work which is being done in this country. This is particularly so since the establishment in question is the Post Office Research Department at Dollis Hill.

Workers at Dollis Hill are experimenting with those intriguing things called magnetic bubbles. A new generation of words is now fast coming into being. For example, a "bubble eater" and a "keyhole generator" are commonplace.

Basically, one method of employing magnetic bubbles is to lay down a series of minute conductive elements in the form of "T" shapes. These are typically formed of nickel-iron and are of the order of  $1\mu\text{m}$  thick. The idea is that a tiny magnetic bubble can be transferred from one "T" to the next and even annihilated. Thus the bubbles can be used as a means of storing data. The bubbles themselves are only some  $10\text{-}18\mu\text{m}$  in diameter.

The workers at Dollis Hill have developed, and I kid you not, a bubble detector bridge (see what I mean about the terminology?). The idea is an extremely clever one. Four minute resistive arms of a bridge circuit are formed by a deposition of a very thin nickel-iron alloy which is less than  $1000\text{\AA}$  thick. The resistivity of this alloy changes whenever it is subjected to a magnetic field. Thus, when a magnetic bubble arrives at the bridge, its magnetic field will affect, say, two of the "resistors" effectively altering their resistances and thus unbalancing the bridge.

This work is impressive and follows closely on the heels of a previous announcement of work done here on transistors rated at around 1.5 Watts in the 4GHz region. These transistors were reported to have base widths of only 0.14 microns. Truly it is a small world.

Occasionally one hears news which is disturbing. Not only because of the actual content and what it implies, but also because of the reliable source from which it comes. This piece of news concerns lasers. One can use a laser beam and modulate it, thus using it to convey communications. If you "shine" a laser beam down a light fibre you can carry it from one place to the next. Again, it is possible to get quite a few "channels" on a laser beam, far more than you can on a single, comparable coaxial cable, for example. The thought now goes that for all communications work, land lines etc., lasers plus light fibres will be used. If this is true, then it could mean our old friend the coaxial cable is on the way out!

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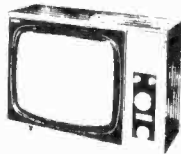
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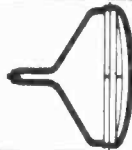
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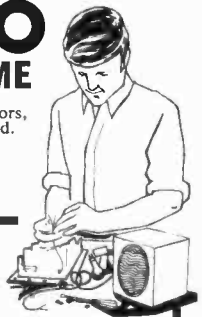
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## CQ complaint

I wish to make a complaint regarding an advertisement in your CQ column of June 72.

I supplied a S.A.E. and requested lists of issues especially Nov. 71 from a reader.

This was over a month ago and as yet have received no word from him. I think he must be collecting 3p stamps!

Would you please put an advert in your CQ column for me? I require Nov. 71 *Practical Wireless* or a copy of the article on the organ.—**M. F. Longmore**, (31 Kent Ave., Larne, Co. Antrim, N. Ireland).

## Construction award

The 2nd G3XBF Constructors Award, sponsored by the Barking Radio and Electronics Society G3XBF—Affiliated to the Radio Society of Great Britain will be held on Thursday, November 9th, 1972 at the new BRES HQ: Westbury Recreation Centre, Westbury School, Ripple Road, Barking, Essex, at 7.45 pm.

Talk-in facilities are: 160m-G3XBF, on 2m—G8EAY/A, (TX 145.0). Judges: G. M. C. Stone, CEng, MIEE, MIERE, G3FZD, Council Member and v.h.f. Manager RSGB. D. A. Findlay, DFC, FCA, G3BZG, General Manager and Secretary RSGB. R. S. Hewes, G3TDR, Region 7 Representative RSGB.

There will be an award for each section and an overall winner. Each award will consist of a hand produced certificate and a worthwhile cash prize.

A film will be shown during the judging and refreshments will be available. Closing date for entries Wednesday, October 25th, 1972. Entry forms and further information may be obtained from **Alan P. Foss**, G8EAY, 73, Coolgardie Avenue, Chigwell, Essex. (01-500 6034).

## VHF hope

So interesting is your August editorial on "Hope for VHF" that I could write sufficient about it to fill another!

VHF has not "caught on" for several reasons, and I will list a

few technical ones first. A v.h.f. radio costs  $1\frac{1}{2}$  to 3 times as much as a comparable type for m.w. Invariably it uses at least two more transistors, which, so far as batteries are concerned, raise the quiescent current by about 10 per cent, and this is aggravated by the fact that v.h.f. oscillators are not only less stable in the face of falling voltage, but in fact actually cut out completely when the battery has still an appreciable amount of "life" in it usable on m.w. With battery manufacturers seemingly not knowing where to stop with their price-rises, and many of the receivers being of the "pocket" type, the matter speaks for itself.

But away from technical aspects, the BBC HAS something to answer for. As an example, take Sundays on Radio 4.

At 8.20 a.m., v.h.f. and m.w. part company, and unless one wants a Pakistani programme, he scraps his m.w. and goes v.h.f. But some 45 minutes later he is assailed by "Open University", so, out has to come his trusty m.w. I have always said that v.h.f. and m.w. should never part course, and neither should have Radios 1 and 2, because in the latter case the 247m. transmission was to fill up locally the areas not well served by Droitwich on 1500m. Since the service areas of the v.h.f. stations more nearly coincide with the centres of Pakistani population this would be the more logical frequency for that service, but better still these should be on the "Local" stations, since for a large part of their time they just repeat BBC programmes available at better quality on the regional stations a little along the dial. In North-Northumberland, listeners have to rely upon m.w. because v.h.f. is not reliable there, and there is no Pakistani population either!

I run a v.h.f. tuner to Mr. Cameron's excellent design a year or two ago in "P.W." and it does enable me to hear the broadcast distortion more clearly, for the programmes are either full of badly received telephoned matter, or of the "popular" type to which a bit of distortion makes little difference anyway.—**James W. Robson**, (Newcastle Upon Tyne).

## Thanks

In the issue August 1972 your contributors H. Hellyer and M. Hollier continue with Part 9 of their excellent series "Transistor Circuitry for Beginners".

Their style is lucid and most readable, and in this issue we were particularly gratified to note their suggestion, page 341, "if Mullard Ltd. didn't exist, they would have had to be invented".

We especially appreciate their acknowledgement of (sic), "a direct crib from Chapter 3 of the Mullard Transistor Handbook". It is perhaps carping to indicate that reference should be made to the end of Chapter 2, and that the title used is ambiguous, in connection with other Mullard publications. For the benefit of readers wishing to supplement the information provided by your contributors the correct title should be "Transistor Audio and Radio Circuits".

**L. W. Owers**, Manager—Educational Service, Mullard Ltd.

## VHF services

With regard to your editorial column in the August *Practical Wireless*, I would, as a newcomer to the arts of practical electronic work, like to make one comment.

Although your column makes a fair general statement, I feel that one reason for the lack of use of v.h.f. services is the fact that reception in many areas (for example the Pennine valley in which I live) is very difficult. This problem may, I suppose, be overcome by the erection of a dipole aerial but the average radio listener is still faced with the fact that very few of the popular battery operated portables are equipped to take a coaxial or twin feeder from an external aerial (idea for a future article?). The so-called "v.h.f. telescopic aerials" fitted to these sets are virtually useless in these sheltered areas.

Of course, when one writes to the BBC commenting on the problems of receiving Radio 3 on **Medium Wave**, they in turn refer one to the v.h.f. services! Do they realise that v.h.f. is not easily available to all?—**T. D. Jackson** (Lancashire).



# practically wireless

commentary by **HENRY**

No. 92  
what you  
mean is...

**P**ICTURE, if you can, the tele-pundits squaring-off across the studio table, dissembling when flummoxed, leaping eagerly into the subject when a question slots into their pigeon-hole of knowledge. The scene is familiar.

But have you ever been exasperated by the overbearing type who listens with evident impatience to his opposite number's bumbblings, then thrusts in with the verbal pike off: "What you mean is . . ." and proceeds to expound his own meaning?

I think we could do with a few of those pikers in the hushed rooms and holy corners where Users' Manuals, Operating Handbooks and Service Instructions are compiled. In one classic example of the dismantling instructions for a Japanese radio-cum-portable tape recorder, a sequence of nearly a dozen operations had to be made to get the chassis from the cabinet. Following the quaint orders was bad enough, but after action 3 one reached an impasse. The next step in the sequence could only be taken if you tugged, pulled, shoved, wrenched and twisted the loudspeaker mounting. Some plastics break with a gut-rending "Crack", don't they?

The solution comes, after one failure, at about Stage 12, when



Leaping eagerly into the subject.

we are told: "Before unloosing the regulator board, take off the two clips marked A and B in diagram."

But even when meanings are explicit there can be an embarrassing contretemp. Five times in a fortnight, soon after Garrard brought out their SP25 Mark III autochanger, we had to explain patiently to new users that rejecting during Manual Play required one to flick the lever to Auto and then bring it back to Manual. If you left it in the Auto position, the pickup arm would reject—sure—but cycling commenced and the record would be replayed in the selected size position. The instructions are there, plainly enough on Page Nine of the handbook issued with the gramophone deck, but who reads handbooks?

Not so good are those handbooks, usually printed in several expensive colours and all sorts of languages from Serbo-Croat to Sanskrit, which have such convoluted language that the English version is as ambiguous as the hieroglyphics.

Henry has whiled away many hours cross-referencing the English with adjacent columns of French and German, which deluded tutors were under the impression he had learned in his younger days.

Instructions in some strange Scandinavian tongue translate curiously if one attempts to be literal. Take the phrase: "Nun das Stromkabel in eine Steckdose anschliessen." That comes near the beginning of the Bedienungsanleitung (which everybody knows is the manual de Instrucciones) for the Sanyo STD-100 stereo cassette recorder.

Well, if we have to cope with the Common Market, let's have a go. Looks like a tale about this nun who climbs some mountain to get more living room. And lower down we see . . ." *reglers so einstellen, dass optimale Aufnahmequalität erzielt wird.*" That one



Who reads handbooks?

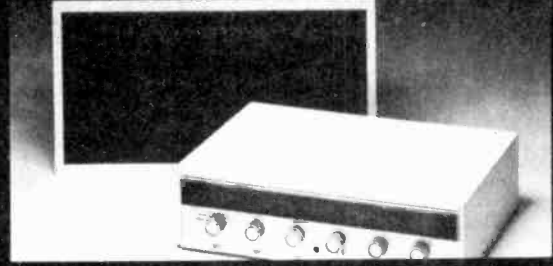
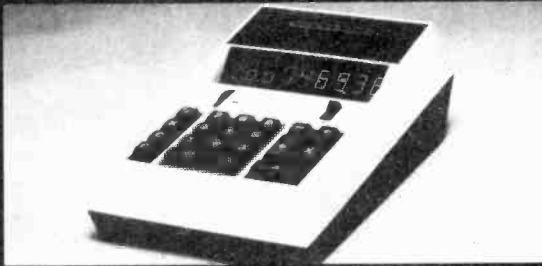
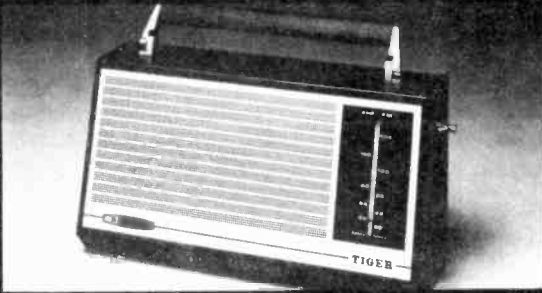
is obvious: "if you've go to instal it regularly, cheer up and do not use that naughty word."

It becomes quite deflating to learn that the first phrase tells you to plug the power cord into an a.c. outlet, while the second is about adjusting the input level for optimum recording quality.

The section in Japanese was most intriguing, especially as English words like ON, OFF and EJECT larded the text like plums in a pudding.

Henry has campaigned for years to make suppliers add at least a circuit diagram to their equipment, and to put the specifications where they can be seen. In the June issue of *Hi-Fi News*, the B & O publicity boys mention that they always include a circuit diagram in a cute little pocket inside each piece of their equipment. In the same issue, a reader tells us he could not get a service manual with his tape recorder. He received, instead, a courteous letter pointing out that it was not Company policy to supply service manuals to the consumer public.

He answers that he, too, has a policy, which stated quite simply says: "No Manual—No Machine." Henry feels that more people should wield that pike.



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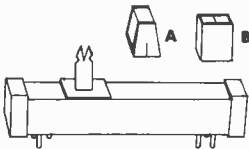
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# TAKE 20

JULIAN ANDERSON

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

At this time of year the nights are closing in and unless something miraculous occurs, winter will follow shortly. As a nation we are supposed to ignore that season until it actually happens; iced points on the railways and the resulting chaos is just one example. However *Take 20* is going to set an example to the nation with this month's circuit—a Frost Alarm. You may think that such a project has few uses, but think about it. Freezing pipes in the loft can be prevented, the greenhouse heating can be turned on and the fruit growers can take the necessary precautions if you are given some warning that the air temperature is approaching 0°C. The circuit falls within our £1 limit but if it is to become a permanent fixture, rather than built up for interest, a mains operated power supply must be used, batteries are quite unsuitable unless you are prepared to keep switching the unit on and off.

We are calling the circuit a Frost Alarm but it can be made to operate over a wide range of temperatures, it is simply a matter of adjustment. The alarm device is a bulb which will light as soon as the temperature falls below the preset level. The warning device can be situated in any convenient position where it will be seen easily with the temperature sensor up to 100 yards away. This is the main advantage; you don't have to go out in the cold to look at a barely readable mercury thermometer.

## The Circuit

The circuit of the frost alarm is shown in Fig. 1. The temperature sensing device is a thermistor. This is a device whose ohmic resistance varies with the temperature. At 25°C the resistance of the one specified is about 4.7kΩ. Above this the resistance falls to a low level but below it the resistance increases. On the one used for the prototype this was measured as 8kΩ at 0°C.

The thermistor is wired in series with a variable resistor, VR1, and the junction of these is taken to the Schmitt Trigger circuit which comprises Tr1 and Tr2. The voltage at the junction of TH1 and VR1 will depend on two factors; the temperature and the setting of VR1. We can easily arrange for this voltage to be just sufficient to bias Tr1 into conduction and set VR1 so that when the temperature falls, and TH1 increases in value, that Tr1 will have insufficient voltage at the base to maintain conduction.

While Tr1 is switched on, Tr2 will be held switched off since the saturation voltage (which is that voltage between the emitter and the collector when the transistor is fully conducting) is below that necessary to bring Tr2 into conduction. The connection of these two transistors is such that when one is conducting, the other is off and vice versa. The switching action is very rapid and very positive. We have explained

## No. 41 FROST ALARM

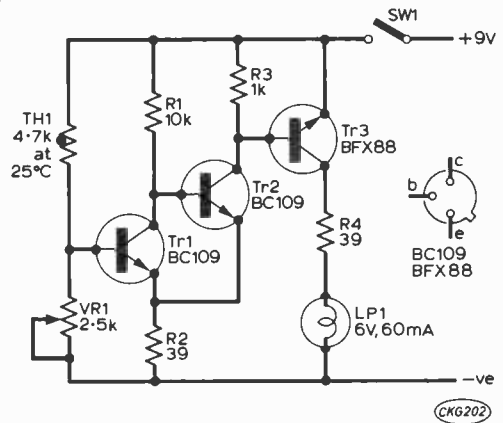


Fig. 1: The circuit of the Frost Alarm.

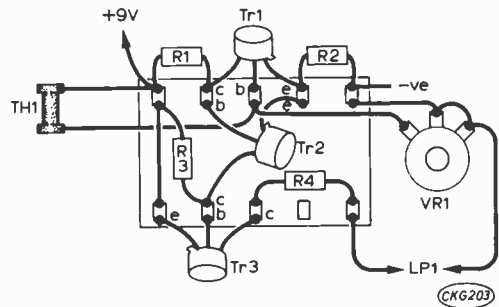


Fig. 2: Suggested component layout on tag-board.

## ★ components list

R1	10kΩ 5% ½W	1p
R2	39Ω 5% ½W	1p
R3	1kΩ 5% ½W	1p
R4	39Ω 5% ½W	1p
VR1	2.5kΩ lin. pot	12p
TH1	VA1066S, 4.7kΩ thermistor (Henry's Radio)	20p
Tr1	BC109	10p
Tr2	BC109	10p
Tr3	BFX88	20p
LP1	6V, 60mA bulb	5p
Bulbholder		11p
SW1	On-off switch	7p
		<hr/> 99p

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

the operation of this circuit before in this series in more detail. When Tr2 is off there will be no voltage drop across R3 and so Tr3 will be off. When Tr2 is on, this will turn on Tr3 and current will pass through the bulb. The reason for R4 is only because 9V bulbs

do not seem widely available, unlike 6V versions, and this resistor prevents the bulb being overloaded. A switch is shown only for convenience. If a mains operated power supply is used, as it should be, the switch should be on the input to this. As we mentioned before the thermistor can be connected to the circuit by a long length of wire, as the resistance of this will be negligible compared to that of the device itself.

## Calibration

It is not too difficult to calibrate VR1. Put the thermistor with its leads into a small plastic bag and put this into a bowl of water and melting ice. The temperature among the melting ice will be 0°C but this may mean that the warning will come too late. If a decent sized bowl is used, it is better to calibrate using the water temperature at the bottom of the bowl, here the temperature will be 4°C. Once calibrated the unit can be tested by putting it into a fridge, checking the switch-on temperature against a mercury thermometer. The inside of a fridge should be just above freezing, say 3°C or so.

A suggested layout on a small tagboard is shown in Fig. 2. ■



## Practical Wireless Designer's Trophy

1972

To encourage new authors, entries for the 1972 Trophy will be restricted to readers who have not previously had an article published in PW. This leaves the field wide open for those wanting to try their hand at writing technical constructional articles. Contestants will not be in competition with well-known authors, only with other newcomers, so the cup can only be won by a new writer. **It Could Be You.**

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2. The winner of the competition will receive and retain outright the PW Designer's Trophy 1972. Other prizes will be awarded to the best runners-up. Articles will be paid for shortly after publication.
3. The competition is open only to authors who have not previously had any work published in PW.
4. Articles submitted for the competition should conform to the general style of material published in PW and must describe the operation and construction of a piece of radio, audio or test equipment that has been designed and built by the author.
5. Articles should, preferably, be typed using double spacing, leaving wide margins, on one side only of each sheet. Circuit diagrams and any other drawings must be separate and numbered to agree with the text. Author's roughs must be clear enough to permit re-drawing. Components list must also be separate and laid out to the standard PW format.
6. Photographs of the equipment are desirable and should be in black and white, sharp and clear. Photographs may be identified by sticking a label on the reverse instead of writing on the back of the photograph itself.
7. Components used in the design must be readily available from retail sources.
8. Articles should be sent to the Editor, Practical Wireless, Old Fleetway House, Farringdon Street, London, E.C.4. Authors will be advised as soon as possible of the acceptance or rejection of their articles. Equipment, the subject of an article, must not be sent to the Editor until advised to do so.
9. Employees and staff of PW are not eligible for entry to this competition.

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 ...P.W. Vol. 45 No. 7 for data on Pedal steel Guitar.—A. Nicholson, 7 Blawarthill Street, Glasgow, G14 0EB.  
 ...P.W. November 1970.—J. F. Glavin, 3 North Lodge, Northlands, Salthill, Chichester, Sussex.  
 ...P.W. Feb. 1971 issue or the circuit diagram for P.W. Stereo tape recorder.—C. Daniels, 22 Hadfield Street, Stabrook Georgetown, Cooperative Republic of Guyana South America.  
 ...P.W. Feb. 1972 (first part of the transistorised Oscilloscope).—D. R. Gardiner, 12 Lambley Lane, Burton Joyce, Nottingham, NG14 5BG.  
 ...Jan./Feb./March and August 1970 issues P.W.—A. W. Please state price.—C. J. Toplis, 14 Beech Avenue, Darwen, Lancs.  
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 ...blueprint published in Practical Wireless issue November 1964. The Autocrat Car Radio.—N. W. Davidson, "Church View", Upper Ballinderry, Co. Antrim, N. Ireland.  
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 ...September 1971 to January 1972 issues of P.W.—A. Conble, 1 Courtral Avenue, Helensburgh, Dumbartonshire.  
 ...Television Nov. 1970 (Murphy Conversion Plinth).—R. Malcolm, 66 Low Garth, Kendal.  
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### 8 WATT SILICON AUDIO AMPLIFIER

The falling cost of silicon output transistors now makes them an attractive alternative to germanium types. This article describes a high specification, all-silicon, 8W power amplifier with a suitable power supply. In addition a circuit is given for a matching high quality preamplifier.

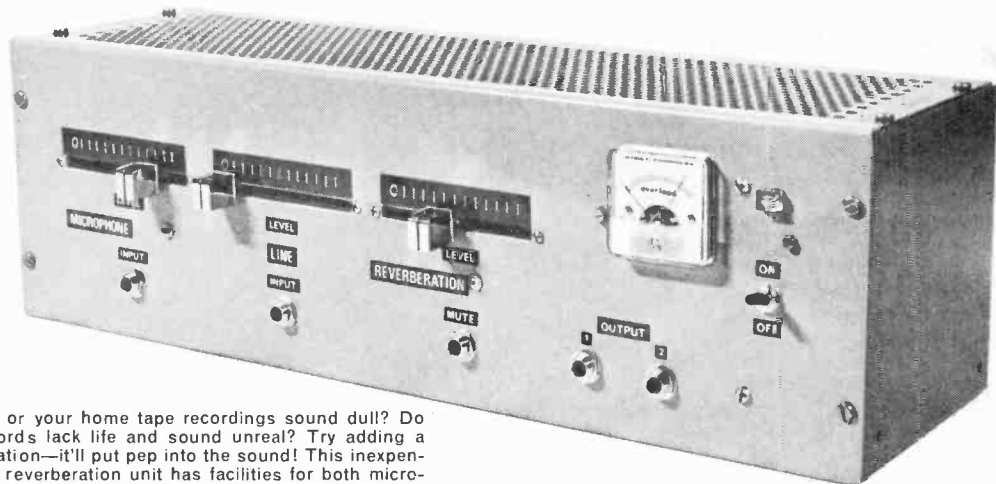
### SIMPLE RF SIGNAL GENERATOR

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## R. H. LONGDEN

# THE PRE-TUNED CAR/PORTABLE RADIO

FOR general use it is an advantage to have a receiver with a number of pre-selected stations available so this receiver is pre-tuned to four frequencies with provision for adding two more stations, or variable tuning, if wanted later. Three m.w. stations are available, with one l.w. station for reception of the BBC on 1500m. This is very convenient for day to day use and reception of a variety of programmes.

Reception normally is on the loudspeaker but there is provision for plugging in a personal earphone or headset, when this is more convenient for listening. A car aerial connector socket is provided, so that the receiver can be placed in a car where the use of pre-set station selection is a decided advantage. The receiver shape allows it to rest on a parcel shelf with its speaker upwards, or suspended under a shelf with the speaker downwards.

A diode output socket is fitted which is of advantage when a tuner is required for a tape recorder or other audio equipment. The receiver audio stages may then provide a signal for monitoring purposes.

The circuit is shown in Fig. 1 and is a straightforward and reliable one using easily obtained components. L1 is the ferrite aerial rod, and section S1a of the 6-way switch selects TC1, TC2, TC3 or TC4 pre-set trimmers, to give automatic tuning of the wanted stations. L1, TC4 and the parallel capacitor C1 provide l.w. reception, no additional winding being required.

Switch S1b similarly selects one of four oscillator trimmers, TC5 to TC8, and these tune the oscillator coil L3 to the required frequency. In practice, it is sometimes found that changes in battery voltage, temperature or slight changes in oscillator capacitor values, throw some pre-set stations slightly off tune. This is avoided by using a small panel control VC1, which can if necessary be adjusted to compensate. In use, the trimmers are set with VC1 half closed, then it is only necessary to adjust VC1 if signals are heard to be off-tune.

It will be noted that alignment between L1 and L3, throughout one or more fully variable tuning ranges, is not necessary, as when ordinary tuning is used. There are thus no ganging difficulties here, as it is only necessary to adjust pairs of capacitors TC1/TC5, TC2/TC6 etc., for the wanted stations.

As the ferrite rod aerial is unsatisfactory in a vehicle, coil L2 allows a car aerial to be coupled to the receiver.

The 2-stage i.f. amplifier has three single-tuned i.f.t.'s, and a.g.c. via R9 from the detector diode D1. Audio signals may be taken directly from the diode circuit by the outlet provided. VR1 is then turned to zero, unless audio signals for monitoring are wanted from the receiver.

The remaining outlet is for a personal earphone or headset, when required, inserting the plug silencing the receiver speaker. A large external speaker can also be plugged into this socket.

### SWITCHED CAPACITOR ASSEMBLY

This consists of the switch, with eight pre-sets and C1, wired on a paxolin panel 4 x 2in., as in Fig 2. TC1 and TC5 are both 60pF max as are TC2 and TC6. These were set for 1214kHz, Radio 1 and

1088kHz, Radio 4. TC3 is 50-450pF, and TC7 is 20-250pF, for 647kHz, Radio 3. For 200kHz, Radio 2 TC8 is 450pF and TC4 is 1250pF with C1 1000pF in parallel.

It is unlikely that other values will be wanted for TC1 and TC5. TC2 and TC6 can be 100pF if a lower frequency than about 1088kHz is needed here, or may have small fixed capacitors in parallel. In some parts of the country Radio 2 on 200kHz may not be required when TC4 and TC8 can then be 100-400pF, for an additional m.w. station in which case C1 is omitted. Ranges with the pairs of pre-sets overlap considerably. The oscillator circuit requires less capacitance than the aerial circuit.

Washers on the switch keep leads and tags clear of the metal panel of the receiver and when the assembly is wired, it is fixed with the selector switch nut.

## CIRCUIT BOARD

This is 5 x 3in., a piece 1<sup>3</sup>/<sub>4</sub> x 1<sup>3</sup>/<sub>4</sub>in. being cut out to accommodate the speaker, as in Fig. 3. Wiring will be simplified if the perforated board is cut so that there are 19 rows of holes one way, and 32 rows the other. Components can then be placed with their

wire-ends exactly as shown, and wiring will closely follow the diagram of the underside of the board.

Holes have to be drilled for L3 and the i.f.t.'s. A very small round file will be found useful to obtain a fit if any holes prove to be out of position. The identification spot on L3 falls between pins 1 and 6, and these pins should come as in Fig. 4.

Check resistor values as they are inserted, and note also the polarity of the electrolytic capacitors and diode D1. When some components are in position, turn the board over and connect as in Fig. 4, snipping off excess wire.

If each item and its leads are marked in coloured ink or pencil on the drawing as inserted and connected, it is unlikely that anything will be overlooked, or wrongly connected. It may prove helpful to use red 1mm sleeving on positive circuits, black on negative and some other colour for remaining connections.

Pieces of coloured sleeving about 3/8in. long can be put on the transistor wires. This will identify them, and also hold these at a suitable height from the board.

Transformer T1 is held by its leads plus a little adhesive. Other driver transformers of similar type will give the same results, but connections must be

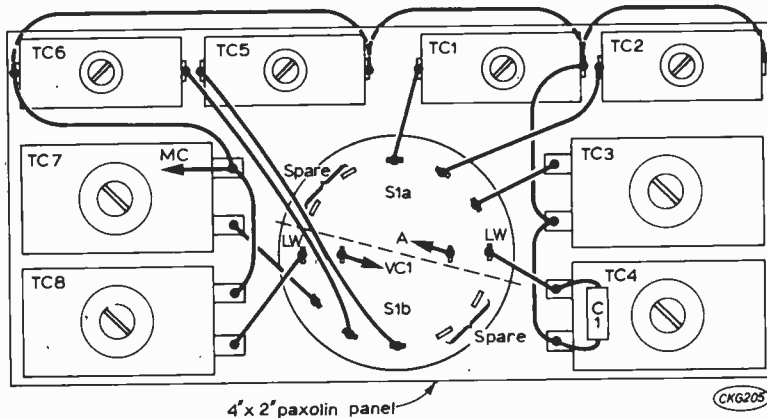
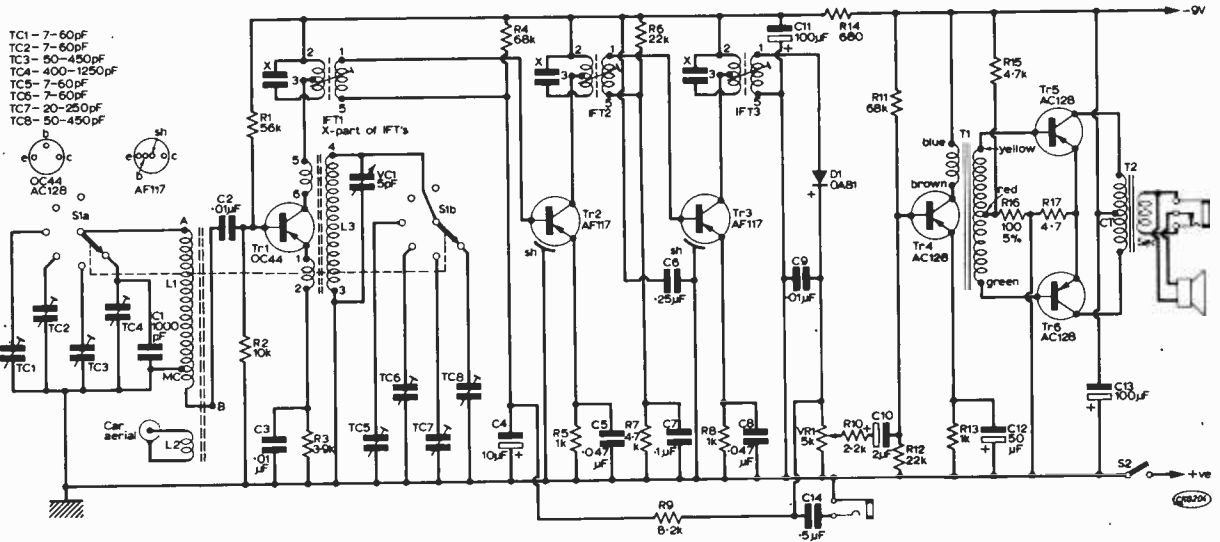


Fig. 1: above, shows the complete circuit diagram for the PW pre-tuned radio, together with the base data for the transistors. Values of pre-set trimmers TC1-8 are tabulated separately. Fig. 2: left, gives the layout of the trimmer capacitors and connections to station selector switch, all mounted on a separate paxolin panel.



## ★ components list

### Resistors

R1 56kΩ	R7 4.7kΩ	R13 1kΩ
R2 10kΩ	R8 1kΩ	R14 680Ω
R3 3.9kΩ	R9 8.2kΩ	R15 4.7kΩ
R4 68kΩ	R10 2.2kΩ	R16 100Ω 5%
R5 1kΩ	R11 68kΩ	R17 4.7Ω
R6 22kΩ	R12 22kΩ	All 10% ¼W
VR1 5kΩ log potentiometer with switch, S2		

### Capacitors

C1 1000pF SM	C8 0.047μF
C2 0.01μF	C9 0.01μF
C3 0.01μF	C10 2μF 6V
C4 10μF 6V	C11 100μF 12V
C5 0.047μF	C12 50μF 6V
C6 0.25μF	C13 100μF 12V
C7 0.1μF	C14 0.5μF 150V

TC1 7-60pF	TC5 7-60pF
TC2 7-60pF	TC6 7-60pF
TC3 50-450pF	TC7 20-250pF
TC4 400-1250pF	TC8 50-450pF

All compression trimmers

VC1 5pF variable (Jackson C804)

### Semiconductors

Tr1 OC44	Tr4 AC128
Tr2 AF117	Tr5 AC128
Tr3 AF117	Tr6 AC128
D1 OA81	

### Miscellaneous

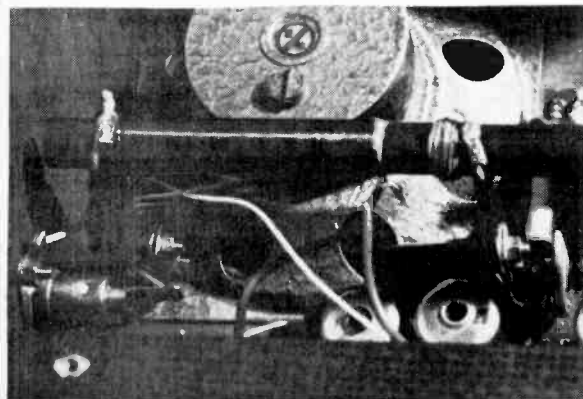
L1-2, see text. L3, oscillator coil (Osmor PW/01). IFT1 (Weyrad P51/1). IFT2 (Weyrad P51/2). IFT3 (Weyrad P50/3V). T1, driver transformer (Osmor QXD1). T2, output transformer 6.2:1 CT (Henry's MOP). Switch S1a-b, rotary water switch, 2 pole 6 way. Speaker 3½ in. 3Ω. Universal chassis flanged members, 7 x 3 in. (2) (Home Radio). Knobs (3). Handle. Veroboard, plain, 0.15 in. 5 x 3 in. Coaxial aerial socket. Output jacks (2, 1 shorting type). Battery PP9 and clips.

The a.f. output jack socket is below this, and has contacts which open when the plug is inserted. It is connected as in Fig. 3, so that inserting a plug breaks the internal speaker circuit.

## CABINET

The receiver can be tested out of its case, by wiring the circuit board to VR1, VC1, and S1a-b, as in Fig. 3.

*Close-up shot of the method of attaching the ferrite rod to paxolin brackets.*



The leads MC from VR1 and VC1 go to tags bolted to the panel flanges.

The parts of the cabinet are quite easily prepared, and holes should of course be drilled before fitting the speaker or any other items.

**Top and Bottom** These are 7 x 3 in. flanged universal chassis members. Punch the top for VR1, S1a-b and VC1, and drill holes for the handle fixing bolts. Drill the front flanges for 6BA bolts or self-tapping screws (to secure the front) and the back flanges for self-tapping screws. Cover the top with self-adhesive material of the required colour.

**Sides** Each side is 3-ply, 6½ x 3½ in., to allow overlapping the front and back, with a small projection at the top and front. The end flanges of the top and bottom are secured to the sides by two bolts in each position.

**Front and Back** These are 3-ply, each 7 x 6 in. Place the speaker to the bottom right, mark its fixing holes, and cut an aperture to match the speaker cone. Put the circuit board in place, and drill the two holes X-X in Fig. 3, through board and front, so that the board can later be fixed in this position.

**Speaker Fitting** Pass two countersunk headed 6BA bolts through from the front, to hold the speaker and also the brackets for the ferrite rod supports. Use other bolts or small wood-screws for the remaining speaker fixing holes.

**Circuit Board** Two countersunk bolts are put through the holes which match with X-X, and held with nuts. Extra nuts are then put on, so that when the circuit board is on these bolts, a clear space of ¾ in. or so remains between it and the case front, to clear the wiring. Nuts at X-X then hold the board in place.

**Finishing** A piece of fabric about 8 x 8 in. of the required colour has its top edge placed between the plywood front and the top flange. Temporarily fold this fabric over the knobs, so that the screws holding the front to the flange can be tightened. Also spread Bostik 1 or other adhesive along the top edge of the front. Screw the case bottom to the front. The fabric is then drawn taut over the whole front, and is folded over and fixed with adhesive at the case bottom, and front edges. The two sides are then fitted with bolts or screws.

## TUNING ADJUSTMENTS

The receiver is tested and tuned before fixing it in the case, as mentioned. If no signal generator is available, the i.f.t. cores are adjusted for best volume, any transmission being tuned in by means of a pair of trimmers. Once this has been done, the cores need no further adjustment.

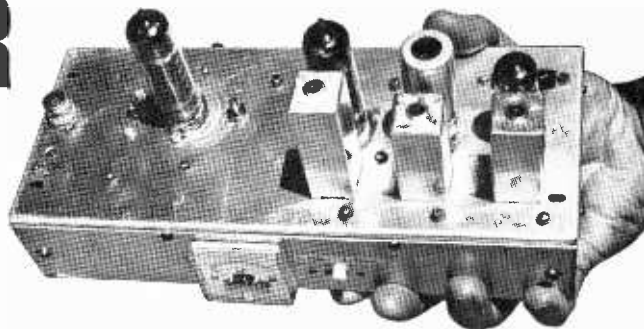
When setting the trimmers for the wanted stations, deal with each pair of trimmers in turn, according to the position selected by the rotary switch. The position of the core of L3 has considerable influence on frequency, so needs to be left alone once a suitable setting has been located. VC1 is half closed while adjusting the trimmers.

Pre-sets having a range of 7-60pF will cover about 1500-1000kHz in aerial and oscillator positions. For oscillator tuning, 20-250pF trimmers will cover the remainder of the m.w. band, with 50-450pF trimmers for aerial tuning. For 200kHz, extra capacitance is necessary, up to about 450pF for oscillator, and 2,000pF for aerial circuits.



# TRANSMITTER for 2 metres

PART 2 F. G. RAYER G30GR



## POWER SUPPLY/MODULATOR

This power-supply/modulator was made for use with the 2-metre Transmitter described last month, for which it will provide all power requirements, and adequate modulation. It is only necessary to insert an octal plug from the transmitter into the modulator. The modulator is designed to have other uses, to increase its utility, as follows:—

- (1) It will supply approximately 12 to 15W of audio for one or more speakers.
- (2) It will modulate a transmitter of up to about 25W d.c. input where the transmitter has its own power supply.
- (3) It will supply power and modulation for a transmitter in the 10W power range.
- (4) The modulator can be switched off, leaving 300V at 120mA available for, say c.w. working.
- (5) Optional choke input drops the supply to about 240V for receiving equipment and similar uses.

An h.t. current meter is included to check working of the modulator and associated equipment, and an h.t. "ON" switch allows the modulator and a transmitter used with it to be switched on and off.

## CIRCUIT

The circuit is shown in Fig. 1. The first section of the double triode 12AX7 is an amplifier for the usual type of crystal microphone, with contact potential

bias from R1. Potentiometer VR1 is the audio gain or modulation level control. The triode 6C4 is a phase-splitter, driving the two 6BW6's of the output stage, V3 and V4. This is a very straightforward and troublefree circuit.

The h.t. circuit is well smoothed, by C10, C11 and L1 while R16 is a safety bleeder resistor. Some modification to working conditions can easily be made, if better suited to other associated equipment.

**HT Voltage.** With the values given, the h.t. supply is 300V when loaded to 120mA. If R14 and R15 are each 270Ω, the supply obtained is 280V when loaded with 100mA. A terminal board with pairs of small terminals is fitted under the chassis, so that the positive connection to C11 can be interrupted. The power supply then works as a choke input circuit, giving a reduced supply of about 240V at 120mA.

**Output Stage.** Operating conditions with cathode bias provide about 9 watts of audio with 250V, and about 12 watts with 285V. For modulating a transmitter the audio output required is about half the d.c. input of the transmitter, say 7 to 8 watts, for a 15 watt d.c. input. If wished, it will be found that R12 can be considerably increased in value, to reduce the current taken by the 6BW6's, without loss of audio quality.

**Modulated HT.** This is derived from the h.t. line and secondary of T1, the fixed ratio transformer being intended for a p.a. load of about 3 to 8kΩ.

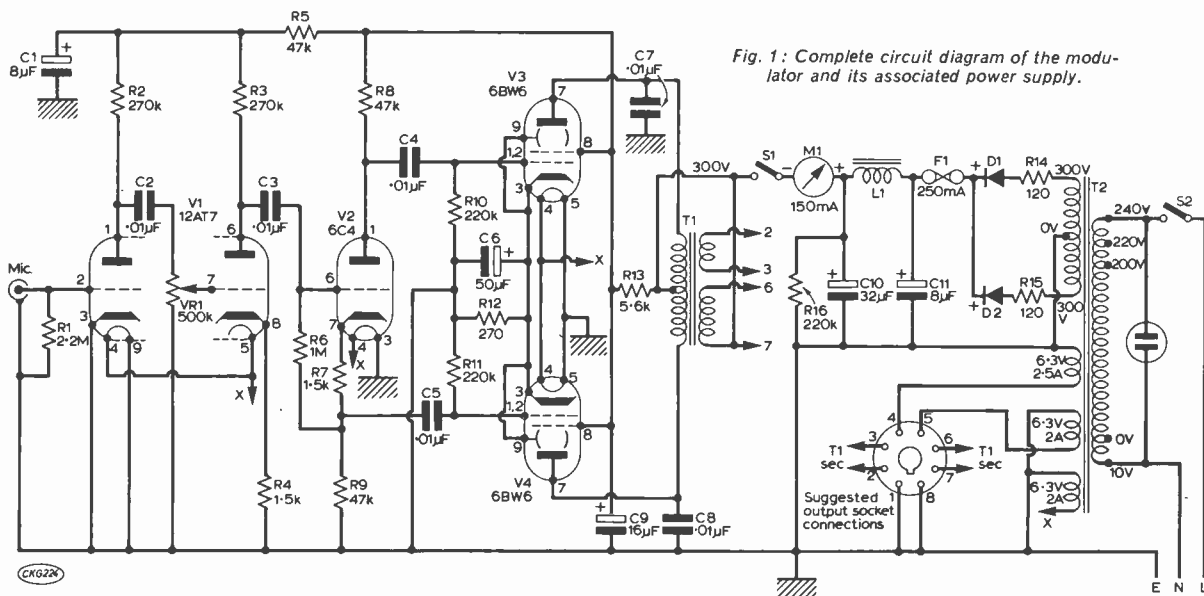


Fig. 1: Complete circuit diagram of the modulator and its associated power supply.

## ★ components list

### Resistors

R1	2·2M $\Omega$ $\frac{1}{2}$ W 10%	R9	47k $\Omega$ $\frac{1}{2}$ W 5%
R2	270k $\Omega$ $\frac{1}{2}$ W 10%	R10	220k $\Omega$ $\frac{1}{2}$ W 5%
R3	270k $\Omega$ $\frac{1}{2}$ W 10%	R11	220k $\Omega$ $\frac{1}{2}$ W 5%
R4	1·5k $\Omega$ $\frac{1}{2}$ W 10%	R12	270 $\Omega$ 2W 10%
R5	47k $\Omega$ $\frac{1}{2}$ W 10%	R13	5·6k $\Omega$ 1W 10%
R6	1M $\Omega$ $\frac{1}{2}$ W 10%	R14	120 $\Omega$ 2W 10%
R7	1·5k $\Omega$ $\frac{1}{2}$ W 10%	R15	120 $\Omega$ 2W 10%
R8	47k $\Omega$ $\frac{1}{2}$ W 5%	R16	220k $\Omega$ 1W 10%
VR1	500k $\Omega$ log. potentiometer		

### Capacitors

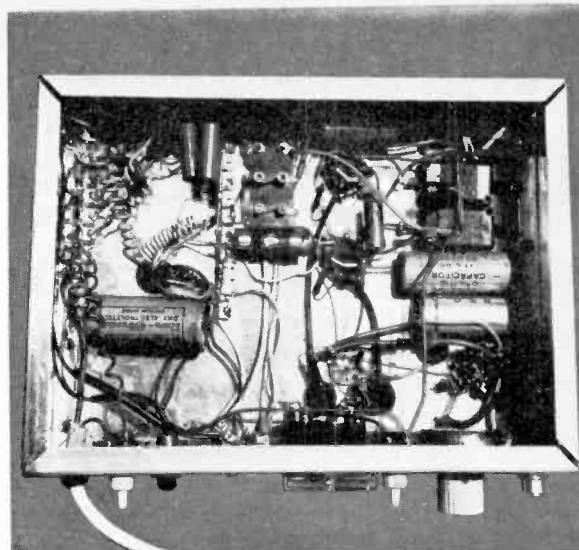
C1	8 $\mu$ F 450VW	C7	0·01 $\mu$ F 750VW
C2	0·01 $\mu$ F 350VW	C8	0·01 $\mu$ F 750VW
C3	0·01 $\mu$ F 350VW	C9	16 $\mu$ F 450VW
C4	0·01 $\mu$ F 350VW	C10	32 $\mu$ F 450VW
C5	0·01 $\mu$ F 350VW	C11	8 $\mu$ F 450VW
C6	50 $\mu$ F 50VW		

### Valves

V1	12AT7	V3	6BW6
V2	6C4	V4	6BW6

### MISCELLANEOUS

Valveholders, B9A with skirt and screening can (1), B9A plain (2) B7G with skirt and screening can (1). Meter M1, 150mA. Toggle switches (2). Microphone socket. Octal valveholder, for power outlet. Mains neon indicator. Fuse, 250mA and holder. D1/D2 silicon rectifiers, 1000 p.i.v. 1A or better. Chassis 10 x 7 x 2in. L1, about 10H at 120mA. T1, modulation transformer Type 223 (Garex, Chinnor, Oxon) T2, mains transformer to provide 300-0-300V at 120mA, 6·3V at 2·5A and 6·3V 2A twice (Douglas, Parmeko etc.).



Underneath the chassis. Suggested layout of the major components should be followed. Otherwise component positioning is not particularly critical.

earlier stages was reduced to about 260V by placing a 1k $\Omega$ /2W resistor in series with pin 7 of the octal socket, Fig.1.

## CONSTRUCTION

This is on a 10 x 7 x 2in. "universal chassis" so that the front runner can be prepared for the meter, etc., before it is fixed in position. Securing bolts for the mains transformer and modulation transformer also pass through the side and back flanges for additional strength and rigidity.

In the layout adopted, the microphone socket and VR1 are to the left, adjacent to the 12AX7 holder. Grid leads here are screened, and clear of heater wiring. The 6C4 is towards the centre, and the two 6BW6's in line towards the back, with the modulation transformer to the left, and the mains transformer to the right. This leaves the front right of the chassis for the smoothing choke. The only live circuits above the chassis are leads to the choke, and these were covered with tape.

The front runner carries the following, left to right:—microphone socket, VR1, h.t. switch, meter, octal socket, AC "ON" neon indicator, AC switch, and outlet for the mains lead. Transmitters, speakers or other associated equipment employ octal plugs wired to match.

The small terminal board mentioned has two terminals wired to the modulation transformer secondary, so that it can be shorted in a few moments with a wire link for c.w. when the same equipment is also used for a.m. If frequent changes are made from c.w. to a.m. in this way a switch can be placed across the secondary.

The modulator should never be used without a load connected to the modulation transformer.

## AERIALS

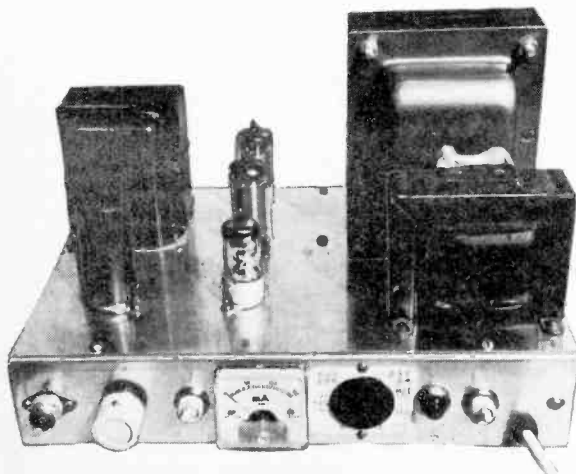
The output of the transmitter can be matched into any of the usual aerials requiring a low impedance feed.

A simple dipole will give good results over local

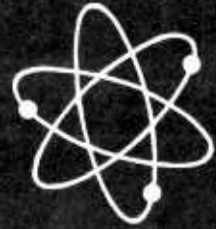
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A multi-ratio transformer may be used for other load impedances. The transmitter d.c. input is VxI, for example, 300V at 40mA or 12 watts. So the transmitter p.a. modulating impedance is approximately V/I or 300/0·04=7·5k $\Omega$ . (For the impedance calculation, remember to add the p.a. screen grid current to the p.a. anode current.)

**Unmodulated HT.** This is derived from the h.t. line, after the switch, to allow metering of the total h.t. drain, and control of h.t. to the transmitter. When using the 2-metre transmitter described, more grid current that required was available, so h.t. to the



General view of the prototype chassis.



## INTERCOMM CALLING SYSTEM R. A. BUTTERWORTH

**M**OST intercomms use three wires or a complicated relay/switch system. The system described here uses only two wires and can be adapted to any amplifier already available providing it has both input and output transformers. The two wire cables connecting the units can be any cheap twin type. A bonus in this system is that only one *Slave* unit is necessary because by paralleling several pairs at a convenient junction point, communication can be had from any two points.

In the author's arrangement the *Master* unit is usually in the shack at the bottom of the garden but the *Slave* can be in the lounge (telephone) hall (door bell) and bedroom or kitchen. By moving the units and plugging in, communication can be had between any two locations. Another bonus is that the units consume current only when communication/calling is made.

### OPERATION

Figure 1 is the full schematic of the author's unit to enable the reader to follow the way in which the unit operates. With SW3 "OFF", when SW1 or SW2, which are spring loaded, are pressed it causes a loud bleep in the following manner. If the master wishes to call the remote unit, SW1 is pressed, shorting contacts 5 and 6, thus completing the positive line through the primary of the input transformer/speech coil of the loudspeaker to the common line. The amplifier is in operation and at the same time the current through the primary winding induces a low frequency note in the secondary which is amplified. Contacts 2 and 3 have been connected at the same time so that the *Slave* speaker is connected to the output of the amplifier so the resultant amplified audio note (generated in the input transformer) is heard in the *Slave's* speaker. Switch 3 is now operated to await the reply, if no response, put SW3 "OFF" and press SW1 again. Once contact is established, the *Master* controls all Speak/Listen operations and switches "OFF" SW3 ready for the next call. A similar operation takes place when the *Slave* wishes to call the *Master*. The 50 $\mu$ F electrolytic blocks what would otherwise be a direct d.c. connection but not the audio signal. It will become obvious that the *Master*

can monitor the *Slave* by simply switching "ON" SW3 and so act as a baby alarm, telephone/door bell warning.

Any pair of miniature 3 $\Omega$  speakers can be used and the transformers are a pair of miniature transistor single ended output (3 $\Omega$ ) types. The potentiometer VR1 is a preset skelton type, the required volume, once set, does not require further adjustment. As will be seen from Fig. 1, SW1 is a DP/DT type, SW2 is a SP/ST, and SW3 a simple ON/OFF type. Switches 1 and 2 are, of course, biased types (spring loaded); there are many varieties on the

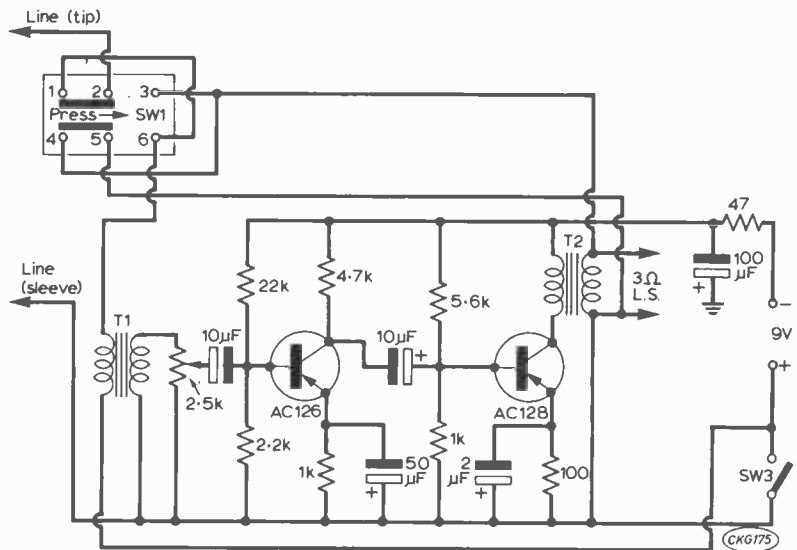


Fig. 1: The circuit of the Master unit—see text for an explanation of the unusual calling system.

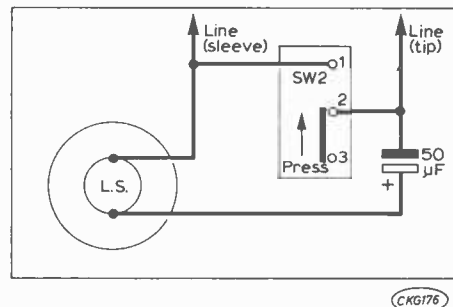


Fig. 2: The circuit of the Slave unit.

market, the most easily available is the toggle type, but the constructor has a choice.

As stated at the beginning, the main reason for offering yet another intercomm unit is the novel method of calling and the use of only two wires. This gives a versatile and flexible installation, well worth

the few hours needed to construct. It may interest the reader to know that this method of calling was developed as a result of a mistake made when making up a conventional system and to the best of the writer's knowledge has never been used before.

## 25W D.C. to A.C. INVERTER

S. SOAR

**T**HE inverter described here will operate 240V 50Hz appliances of up to 25W consumption. It was originally built to drive an electric shaver or a 25W soldering iron from a car battery.

The circuit is a simple resistance coupled inverter with a square wave output of 240V 50Hz.

Considering the circuit in Fig. 1, assume that Tr1 starts to conduct; voltage induced in N1 rapidly drives Tr1 into saturation and biases Tr2 off. Flux increases in the transformer core until saturation is reached which results in a sudden rapid increase in current in Tr1. This current exceeds the current which Tr1 can supply with the available drive, Tr1, therefore, comes out of its saturated state. Voltage induced in N1 falls to zero as the transformer core saturates and Tr1 is returned to the "off" state, this ends the first half cycle. Flux collapse in the transformer core results in an induced voltage in such a direction as to turn Tr2 on so initiating the start of the second half cycle.

### ★ components list

R1, R2	100Ω, 2W
Tr1, Tr2	OC35
Fuse	5 Amps
Transformer:	Type P2/2 available from Magtor Limited, 68 Dale Street, Manchester 1.

Construction is straightforward and operation is little affected by position of components. However, it is advisable to keep interconnections as short as possible to reduce inductance.

Since transistors Tr1 and Tr2 are not operating at maximum load, large heat-sinks are not necessary and the entire unit can be inserted in a metal case measuring only 3in x 3in x 4in. Care must be taken to ensure that the collectors of both transistors are isolated from each other, this can most easily be done by mounting these in the side of the case on insulating washers, alternatively a plastic case can be used.

If a d.c. output is required, this can be easily obtained by connecting a bridge rectifier to the secondary, since the output is square wave, smoothing represents no problem and a capacitor of 2μF will suffice for most requirements.

It is not recommended that half wave rectification be used as this will tend to saturate the transformer core in one polarity only and this may cause malfunction of the inverter.

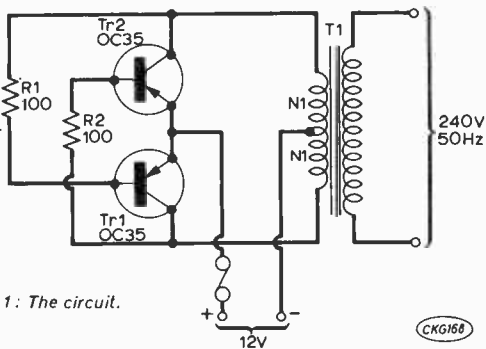


Fig. 1: The circuit.

### Performance

No Load	..... Input current 700mA (8.4W)
Load 15W	.... Input current 2.0A, efficiency 62.5%
Load 25W	... Input current 2.8A, efficiency 75%.

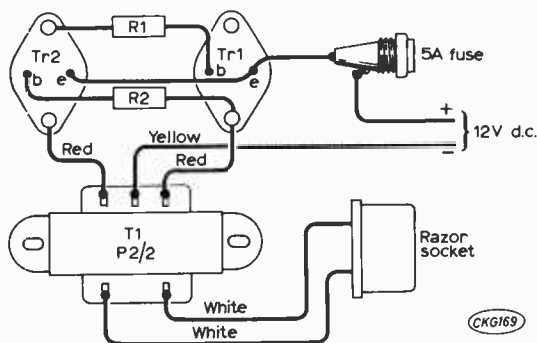


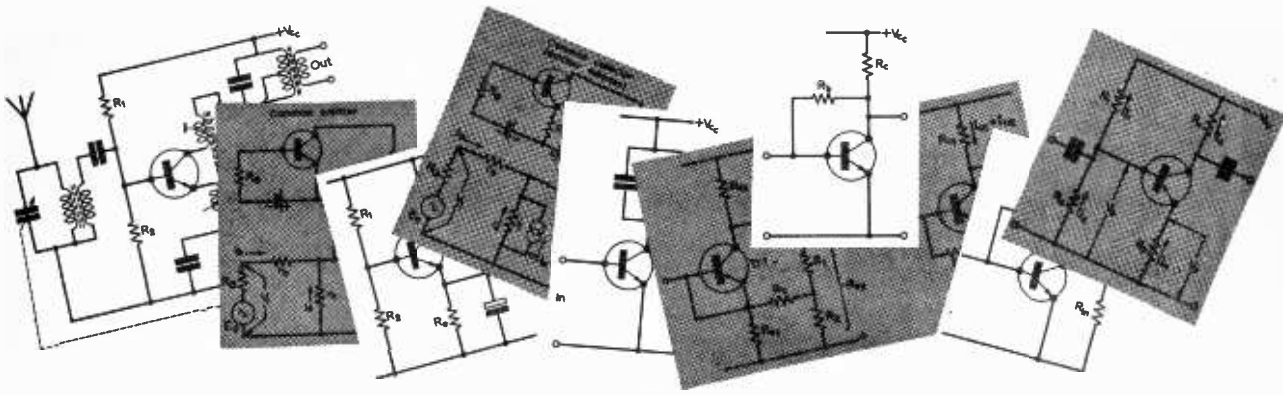
Fig. 2: Wiring of 25W inverter

# MAXWELL

by G8DSH



"—about eighty turns tapped ten turns up, please!"



# TRANSISTOR CIRCUITRY for beginners

H.W. HELLYER & MICHAEL HOLLIER

## PART 11

### A breather

Before we can progress with our look at transistor circuits, we must halt, survey the battlefield of some of our illusions, and reconnoitre the lines of our next advance.

In other words, having taken single stage circuitry and combinations of stages, we must now consider the effect of the sub-circuits on those before and those after. The more we delve into transistor circuitry, the less we can regard each "block" as an entity unto itself. Black boxes, so beloved of the academic, are seldom darker than a shade of mottled grey when we come to put them into practice.

One such circuit concept, that seems primarily to make hay of basic theory, is the so-called "virtual earth".

We have reached a stage in our talk about circuits where we can see, without the aid of equivalent transistor circuits or little arrows showing electron flow, that the d.c. conditions and the a.c. conditions in any given configuration will be different, though interdependent.

As an example, consider the plain problem of decoupling. In your humble transistor radio you have a perfect example. As you bothered your neighbours on the beach with Bach's Partita and Fugue while all they wanted was to be Woganised (how I've longed to do that!) the signal current in the power supply circuits were being bypassed from the battery by a relatively hefty electrolytic capacitor. Fig. 55 illustrates this, and shows that the h.t. line

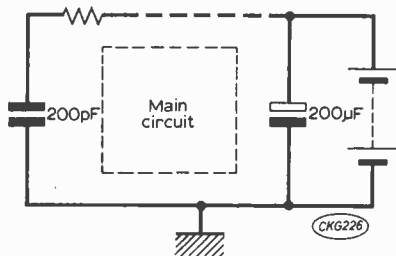


Fig. 55: Simple decoupling. The capacitors represent a virtual short-circuit to signal currents.

is, as far as the a.c. signals are concerned, at the same potential as the chassis.

From there, it is a small step to think in terms of impedance and frequency rather than resistance and direct current when considering a signal-handling circuit.

Why, for instance, do we need that hefty capacitor back there, across the supply, when the decoupling of the tuner section is efficiently performed by a fraction of a microfarad? The answer lies in the frequency. At the supply, signal currents at audio frequencies are having to be bypassed, and 2000µF to a 100Hz signal is an impedance (a.c. resistance) of 0.81ohm.

At the front end, taking the FM radio that you, of course, will be using, despite the BBC's recent retrograde step to duplicate local radio on medium waves, the frequency you want to bypass is somewhere near a million times as great and so the capacitance need only be a millionth of the former, that is 2 picofarad against 2,000 microfarad, to have the same effect. Of course, to safeguard over a wider bandwidth, the actual value will be a couple of hundred picofarad,

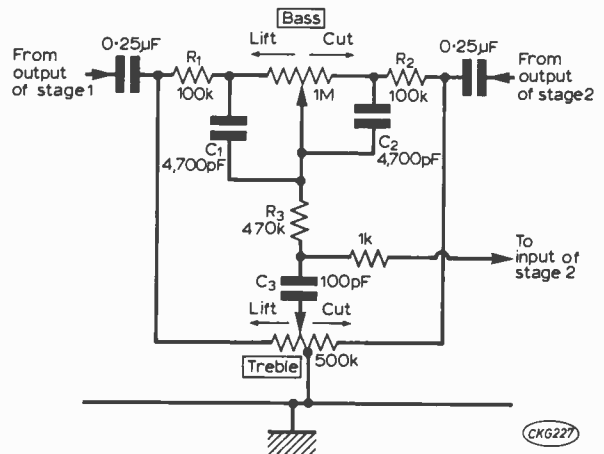


Fig. 56: The original Baxandall tone control circuit, to suit an input of less than 10kΩ, for use with an SP61 valve.



but the comparison—and the point—remains. When considering circuits, you must consider the effect of the a.c. signals they will be handling as well as the d.c. conditions that provide basic biasing, etc.

## Virtual earths

Which brings us back to the concept of the virtual earth. Fig. 56 shows a simple circuit, again a practical one, and very familiar, that of the Baxandall tone control circuit, widely used in all sorts of constructions, and not always completely understood. If it serves no other purpose, it should remind us that Peter Baxandall dreamed this one up in 1952, based on an SP61 valve (or, in war surplus terms, a VR65).

The underlying reason for choosing such an example is (a) to make the opportunity of talking a bit more about feedback, (b) to introduce tone control circuitry, which will feature in our next constructional project and (c) to get over as well as we can, to satisfy a number of enquirers, the concept of the “virtual earth”.

Feedback has featured already in our potted circuits, d.c. feedback to bring bias conditions to the operating state we require and a.c. feedback to regulate the signal flow through a stage, and, as we shall have to consider later, to make a stage non-linear in an especially controlled way (as, for example, in designing an RIAA corrected magnetic pickup pre-amplifier).

The whole point about the Baxandall tone control circuit, first considered in a *Wireless World* article of October 1952, is that its action depends on negative feedback and that it requires an understanding of the virtual earth concept to grasp its principles of operation. Having once got hold of this, we can step forward briskly into the world of “closed-loop gain” and “variable feedback control”, which scares so many students away from what is really quite elementary circuitry. Incidentally, the virtual earth concept preceded Baxandall by quite a few years and he was quick to give credit to Professor F. C. Williams for the coining of the term.

## Feedback

Enough waffling: Feedback is the principle of taking part of the output from a stage, or stages, and applying it to the input. If it is positive feedback, the signal you re-apply to the input is in phase, and thus aids the input, eventually driving the stage beyond its working limits. Control this positive feedback and you have a simple oscillator—the more output it delivers, the more it wants to deliver, until it blocks the stage off, things revert to normal, and away we go again.

But we are more concerned at this juncture with negative feedback. If you are audio-oriented (as you must have guessed by now that Mike and I are!) you will have read all manner of attributions for negative feedback. In the late Forties and early Fifties there were so many articles on negative feedback, interlaced with symbolic formulæ, that one would have imagined it could cure all amplifier ills from operator's twitch to the galloping parasitics!

In fact, the principle is simple: take off a portion of the output signal from a stage (or stages) and apply it to the signal in such a way as to oppose the input, i.e., in antiphase, and you have a method of

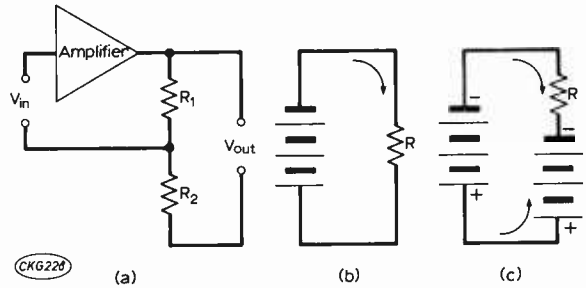


Fig. 57: (a) Negative feedback in series with the input signal. If  $R_1 = R_2$  the gain is unity. (b) a battery analogy, with no feedback. (c) with feedback equal to the drive, voltage across  $R$  is virtually zero.

exercising control that depends on the nature of the input—it is to some extent, and within certain limits, self-regulating.

When we take a brief recap. of some previous articles in this series, we shall also appreciate that negative feedback from the output to the input of an amplifier stage *effectively changes the impedance* as well as reducing the gain.

This is important, and I am not going to insult regular readers by going, chapter and verse, over our earlier chats about  $R_{IN}$  and  $R_{in}$ , etc. But to summarise a few points, take a look at Fig. 57(a). Here we have an amplifying stage with a signal voltage applied and negative feedback in series with that input signal. (Again, this is important).

Let's assume, for easy figuring that the amplifier has an open-loop gain of 100. That's to say, it would increase its applied signal 100 times if there was no extra circuitry to consider. Then, commonsense tells us that if the values of  $R_1$  and  $R_2$  are the same, the gain will be unity, not 100 times, because the feedback is in series with the input. To get the hang of this, we have to look at things in terms of the impedance that the signal “sees”. Fig. 57(b) shows a battery driving a current through a resistor. The battery “sees” the impedance of the resistor. But what if, Fig. 57(c), we put another battery of the same sort in series with  $R$ ? We haven't changed the value of  $R$  but little or no current flows—so the *effective* impedance seen by the source voltage, the prime battery, is now high.

## Back to the amplifier

Let's now get back to our amplifier with its feedback and instead of applying the feedback in series as before, we shall apply it in parallel, Fig. 58(a). Again,  $R_1 = R_2$ . But as the feedback is now in parallel with the input signal, we can see, applying the battery analogy, in Fig. 58(b) that it effectively shorts out the signal. In other words, adding  $V_1$  to  $V_2$  produces an *effective* zero.

Sorry about that repetitious word “effective”, but if I say “this is zero”, some pedant is going to hurl a wad of mathematical treatises at me to prove that Isaac Newton never went near the orchard, or something!

Go back to that mini-circuit of Fig. 58(a) and you can now see that the voltage at the junction  $X$  of  $R_1$  and  $R_2$  is very low indeed. Not zero, for we have to take into account the voltage across the amplifier, and the best we can say is that the voltage at this junction,  $R_1/R_2$ , is very low, virtually at

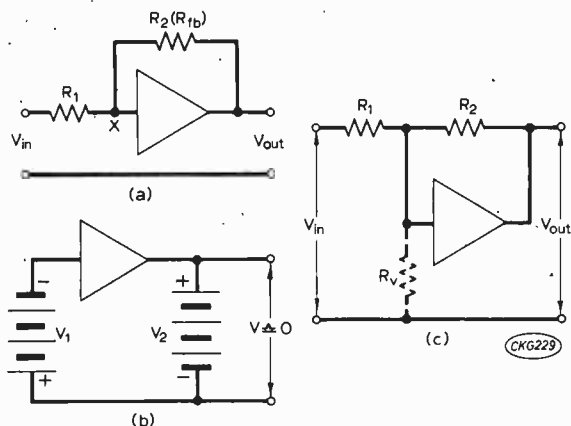


Fig. 58: (a) Parallel feedback, point  $X$  is virtual earth point. (b) battery analogy repeated. (c) choice of amplifier gain and resistors gives virtual impedance, dotted, between virtual earth point and true earth.

earth potential. Hence the term, virtual earth. From this, it follows that the input impedance of the circuit is low at this point.

Here, we have one of the bones of contention over which audio pundits have worried, and with which we shall not concern ourselves now—suffice to say, the source signal “sees” an impedance equal to  $R_1$  in parallel with whatever the virtual resistance  $R_v$  in Fig. 58(c) may be, while the amplifier sees an impedance of about  $R_v$ . And the beauty of this arrangement is that by juggling with amplifier gain and feedback component values, we can make the input match our source exactly, for best signal energy transfer conditions, while making our amplifier “see” a source resistance (impedance) that is just right for its job. In many audio applications, an impedance of around  $600\Omega$  would do us very nicely for lowest noise conditions, and this case can be met quite easily.

The important factor to remember is that the imaginary resistor we produce by the virtual earth application is approximately equal to the value of  $R_2$  divided by the amplifier gain. Its value is not affected by  $R_1$ . There is no need for  $R_1$  and  $R_2$  to be equal in all cases, although we have chosen this circumstance for ease of explanation—the performance depends on the ratio between resistor values.

## Back to Baxandall

So now back to Baxandall, and a circuit that originated from valved techniques.

This time we shall split the circuit into its “Lift” and “Cut” conditions first, showing the virtual earth points. Forget, at the moment, the tapped potentiometer of Fig. 56 and consider the treble lift circuit. This, shorn of all extraneous detail, could be redrawn as Fig. 59(a). If  $V_R$  is made low enough so that the voltage at the slider when in the middle of its travel is not affected by the current supplied by  $C$  (even at higher frequencies) then the total current flowing toward the virtual earth point,  $X$ , is  $I_1 + I_2$ .  $I_1$  is approximately equal to  $V_{in}/R_{in}$  and  $I_2$  depends on the value of capacitance. If we make  $R_{fb}$  equal to  $R_{in}$ , merely to simplify combination of lift and cut control, and call this simply  $R$ , then the output voltage has one component independent of frequency, for a constant value of  $V_{in}$  while the

other one, leading in phase by  $90^\circ$  is both proportional to frequency and to  $k$  which is the fraction of the potentiometer setting.

What this means, in practical terms, is that for any particular potentiometer setting the response of the cut circuit will be down by the same number of decibels as the lift circuit is up. As we know from Baxandall tone controls published many times before, the curves are a mirror image of each other. This is one of the virtues of the control.

The tapped control is just a convenience and it can be seen that there is actually a small voltage between the centre point of the practical circuit (Fig. 56) and virtual earth, across the capacitor. But its value makes this voltage practically negligible.

A look at the combined bass control in its simplified layout of Fig. 59(c) may help to understand better the working of the tone control. To give level

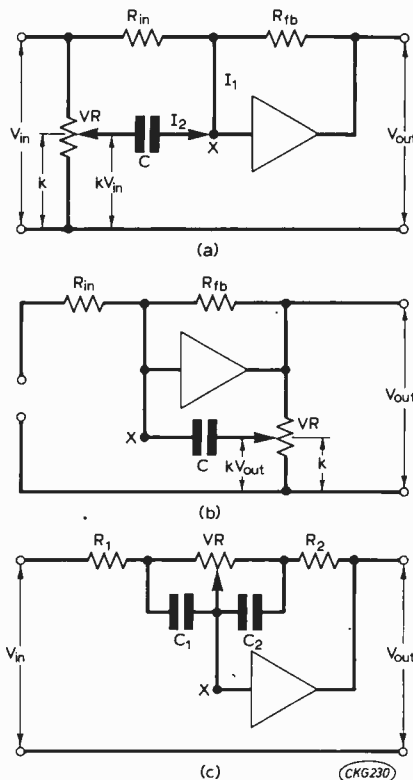


Fig. 59: Fundamental Baxandall treble lift circuit. (b) treble cut circuit. (c) bass lift and cut section of combined circuit.

response at mid-setting,  $R_1$  and  $C_1$  are the same as  $R_2$  and  $C_2$ . At middle and high frequencies the potentiometer,  $V_R$  is almost shorted out by the low reactances of  $C_1$  and  $C_2$ , so we are back to Fig. 58(a) with  $R_{in} = R_{fb}$  and unity gain. As the frequency of the signal falls, the gain rises (or, if the potentiometer setting is changed, falls to the level determined by the response curve), and, just as with the treble circuit, the curves are mirror images.

The symmetrical beauty of the finished control, with components calculated to suit Baxandall's original case, the  $VR65$  valve, a high-gain pentode, can be seen in Fig. 56. One of the interesting points about its chosen values is that the treble response will be up or down 3dB at full lift or cut settings of the control when the reactance of  $C_3$  is numerically

equal to  $R1 + 2R3$ . The values of  $C1$  and  $C2$  must be equal, as are  $R1$  and  $R2$ , for reasons already stated, and values are chosen to give the correct bass response.

### In practice

Coming to the present time, we can see an example of virtual earth circuitry used in the much-vaunted input stage of the Cambridge P40 amplifier, Fig. 60, where the aim was to get a high-gain, low-noise input amplifier, controlled so that the local feedback loop alters the gain, and thus provides a volume control right at the front of the circuit, in a low-signal level stage—just where we are told never to put it! The aim succeeded to some extent, because there was indeed a very low-noise result, and the overload capability, where most input amplifiers fall down badly, was a phenomenal 60dB.

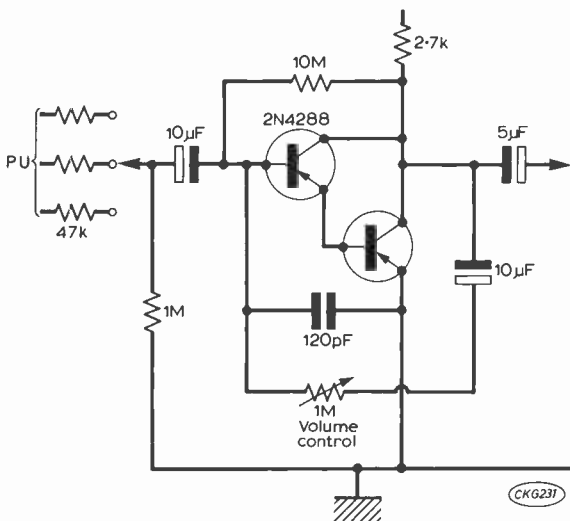


Fig. 60: Virtual earth input stage used in Cambridge P40 and P50 amplifiers.

But later versions of Cambridge amplifiers reverted to an uncontrolled input stage and put the virtual earth amplifier in the second stage, mainly because the original design gave a peculiar volume control "law". You see, the accepted use of a control is a 20dB attenuation when the knob is half-way from maximum (or the slider half retarded). By putting a twin-gang 1MΩ log law potentiometer in the virtual earth feedback circuit, Cambridge limited the attenuation to between 3 and 6dB for the same movement, with its action accelerating as it was turned farther down.

To get the range of input levels, the control had to be shunted with a 47kΩ resistor, except in the Pickup 1 mode, so except in this mode, only about three-quarters of the control action was effective. Later versions use a 50kΩ linear potentiometer to get the approximate log law (using the fixed resistor, 22kΩ, across part of it).

So we have now considered practical ways of using virtual earth circuitry, and can go on to the even more practical matter of building a circuit whose action may not seem quite so mysterious.

**TO BE CONTINUED**

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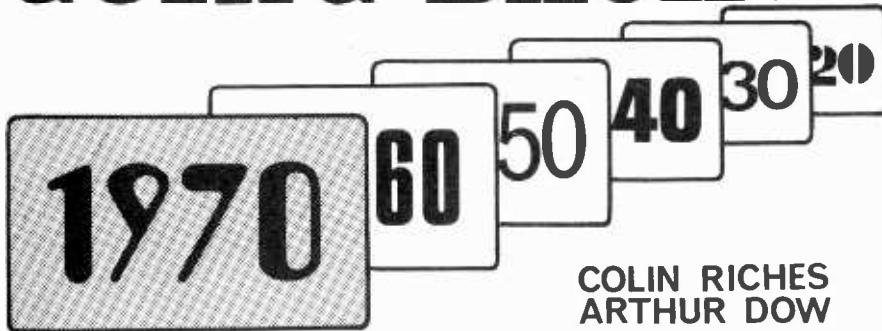
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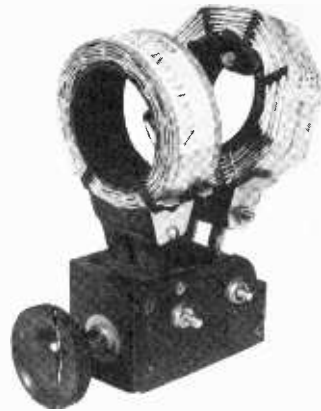
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**ICS**

# GOING BACK...



COLIN RICHES  
ARTHUR DOW



**D**EVOTEES of this column will be highly delighted at the publicity currently being given by the Post Office to the 50th. anniversary of broadcasting in this country by issuing a set of three postage stamps to commemorate the event. Since we mentioned the subject in the last issue details of the stamps have been released by the Post Office and they are reproduced here.

The 3p stamp depicts six of the many types of microphones used in broadcasting since 1922. Observant old-timers will recognise the Marconi-Sykes electromagnetic microphone of 1924 as well as the Marconi-Reisz carbon microphone of 1926 among the collection. On the 5p stamp a typical domestic wooden horn loudspeaker of the 1920's is illustrated. Some readers may recall the S.G. Brown conical horn speaker and the Amplion horn of the same period.

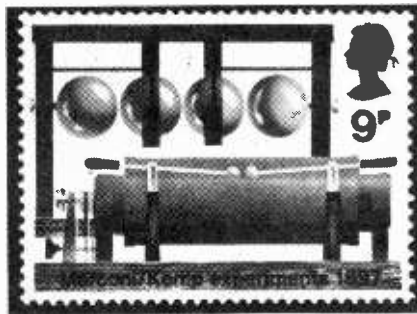
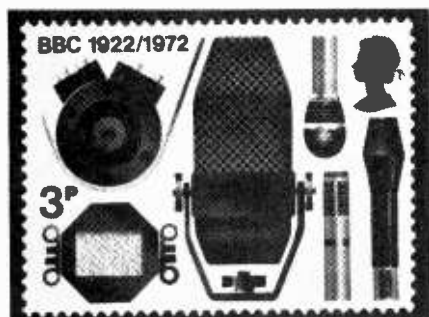
No doubt there are many of these speakers still hidden away in attics and cupboards so let us hope that this invaluable publicity will cause the public at large to appreciate the value and significance of

these treasures from the early days of wireless and thus prevent their needless destruction.

The third stamp, for 7½p, brings us right up to date with a fine illustration of one of the latest colour TV cameras as used by both the BBC and the independent TV companies.

The fourth stamp, to be issued at the same time as the other three, is for 9p and shows an early form of spark transmitter as used by Marconi in establishing wireless contact between Lavernock Point, Glamorgan, and Brean Down, Somerset, in May 1897. On the 75th. anniversary of this historic event the name of George Kemp is coupled with that of Marconi. Kemp was a Post Office engineer loaned to Marconi as a senior assistant. Their experiments resulted in the first successful tests over water and, incidentally, the first between two countries.

All four stamps are the work of David Gentleman who was also the designer of the Philympia series of stamps issued in 1970. The anniversary stamps described will be on sale on September 13th.

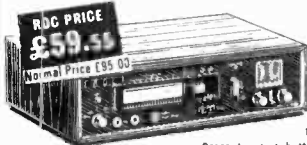


*The 3p stamp is printed in several shades of grey with black, brown and yellow while the 5p stamp is grey, beige, red, brown, black and umber. The 7½p stamp featuring the TV camera also has several shades of grey combined with black and red. The 9p Marconi-Kemp commemorative issue combines light and blue grey with black, yellow and brown. A special first-day cover and two pictorial hand-stamps are being provided by the Post Office.*



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As reviewed in "POPULAR HI-FI" February 1972

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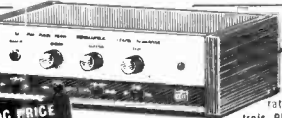


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Ideal for use with any other amplifier. The RA-310 costs £10.00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz. AM: 525-1605 kHz. FM Sensitivities: FM, 3µV; AM, 250µV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11 1/2" wide, 4" high, 7 1/2" deep.

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**ROC PRICE**  
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Tuner and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz  $\pm 3$ db. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

**REALISTIC SA-100B 8-WATT STEREO AMPLIFIER**

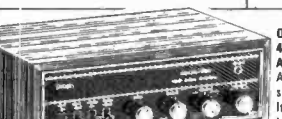
Here's a fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide x 3" high x 5 1/2" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/line and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz  $\pm 3$ db. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.



**EAGLE LC.05 STEREO MAGNETIC CARTRIDGE**  
For fabulous reproduction at a very low price, you'll find it hard to beat. 0.7 mil diamond stylus. Output: 6mV per channel. Frequency range: 30-18,000 Hz. Channel balance:  $\pm 1.5$ db. Channel separation: 20db. Recommended stylus pressure: 2.4 grams. Compliance: 3 x 10<sup>-6</sup> cm/dyne. **ROC PRICE** £4.75



**EAGLE LC.07 STEREO MOVING-MAGNET CARTRIDGE**  
Here's your opportunity to own a transcription cartridge for the price of a ceramic! Is specially designed to match top quality tone arms, and to get the very best from your hi-fi amplifier. 0.7 mil diamond stylus. Output: 7mV per channel. Frequency range: 20-21,000 Hz. Channel balance:  $\pm 1$ db. Channel separation: 28db. Compliance: 12 x 10<sup>-6</sup> cm/dyne. **ROC PRICE** £6.37



**ROC PRICE**  
**£24.10**  
Normal Price £39.50

An ideal unit for your new stereo separate system. It is more than £10.00 below the normal retail price! Making the Olson-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz  $\pm 3$ db. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3-0mV RIAA, crystal phono 100mV; tape 160mV; tuner 160mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well—sounds even better!

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

An ideal unit for your new stereo separate system. It is more than £10.00 below the normal retail price! Making the Olson-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz  $\pm 3$ db. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3-0mV RIAA, crystal phono 100mV; tape 160mV; tuner 160mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well—sounds even better!



**R.307 TRANSISTORIZED STEREO PRE-AMPLIFIER**  
Now your amplifier that could only reproduce ceramic or crystal pick-up cartridges, can accept signals from moving-magnet cartridges! The R.307 steps up signals from between 5-20mV to 200-800 mV. Input: 5-20mV. Equalisation: RIAA. Output: 220-800mV flat. Frequency range: 20-22,000 Hz. Dimensions: 3 1/2" x 1 1/2" x 2 1/2". Supply: 240 VAC. **ROC PRICE** £4.92



**15-FOOT STEREO HEADPHONE EXTENSION CORD R.362**  
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**R.361 STEREO HEADPHONE "Y" ADAPTOR**  
R.361 Enables you to use two sets of stereo headphones from a single socket. Fitted with male plug and two female sockets. **ROC PRICE** £1.30



**R.446 3-WAY MATCHED SPEAKERS**  
These will do justice to your amplifier—and to your pocket. At only £16.40 a pair, they are real value for money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a large dual cone base unit, plus a separate tweeter. Frequency range: 40 to 19,000 Hz. Size 14" high, 9" wide, 6 1/2" deep.



**ROC PRICE**  
**£10.50**  
Normal Price £15.70

**OLSON AM-357 4-WATT STEREO AMPLIFIER**  
Here's a marvellous value for someone just starting to set themselves up in audio! At only £10.50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz  $\pm 3$ db. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tuner/aux 80mV. Size 8" wide, 2 1/2" high, 4 1/2" wide.

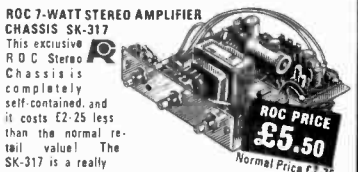


**ROC PRICE**  
**£27.25**  
Normal Price £39.95 each

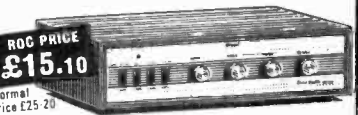
**25-WATT 3-WAY CRYSLER 'LIVING ACE-5b' SPEAKER CE-5b**  
This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units on 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s. into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10 1/2" x 7 1/2" x 8 1/2". Exactly right for matching the most modern decor.



**OLSON AM/FM/MPX STEREO TUNER AMPLIFIER SSA-18**  
This is one of the lowest priced stereo tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received—that's the time to switch to 'Stereo'! The SSA-18 has all the facilities you'd expect to find on tuners costing twice as much—separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz. AM 535-1605 kHz. Frequency response: 50-10,000 Hz  $\pm 3$ db. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4 1/2" high, 8" deep.



**ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317**  
This exclusive ROC Stereo Chassis is completely self-contained and it costs £2.25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5 1/2" wide, 1 1/2" high and 6 1/2" deep. It contains its own mains power supply, and has a ganged volume control and separate treble controls for each channel. Specification: frequency response 40-17,000 Hz  $\pm 3$ db; output 3.5 watts music power per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45db.

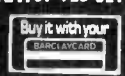


**ROC PRICE**  
**£15.10**  
Normal Price £25.20

**OLSON AM-372 18-WATT STEREO AMPLIFIER**  
Here's a really good amplifier at a really down-to-earth price—nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you—reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz  $\pm 3$ db. Output 8 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12 1/2" wide, 3 1/2" high, 7 1/2" deep.

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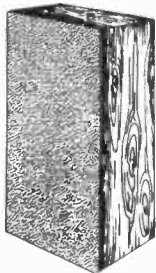
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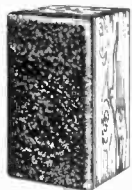
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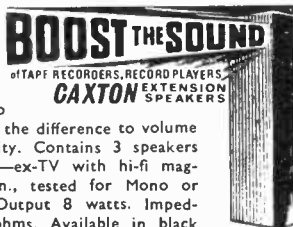
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EY86	0.28	PL84	0.29	12AX7	0.24
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# SHORT WAVES

## MONTHLY NEWS FOR DX LISTENERS

FOR a change this month I think it will be useful to all readers if we start with some news of DX stations around the world. The source of the information is Sweden Calling DXers and my own listening efforts.

**BOLIVIA:** The Bolivian station on 4845 is CP-72, *Radio Fides de La Paz*. This station is scheduled to broadcast from 1030 to 0330 GMT only but has been heard on an extended schedule. The station has also been heard in Europe on 4875kHz.

CP-103, *Radio 27 de Diciembre*, listed on 3350kHz is presently operating on 3439kHz with sign-off at 0215 GMT or later.

**BRAZIL:** The new European service from *Radio Nacional de Brasilia* has been noted on 15450kHz with weak signals and splash from VOA, *Monrovia*, on 15445kHz at 2245. The programme consists of Brazilian music and short talks in English, reports are requested.

**MONGOLIA:** *Radio Ulan Bator* has introduced a Russian service which is on the air on Tuesdays at 1030 and on Fridays at 1040. These broadcasts have been heard on 7260kHz, the station announces 41° 3, 48 and 1321 metres.

**PARAGUAY:** ZPA-1, *Radio Nacional, Asuncion* can be occasionally logged on 4615kHz with special sports newscasts in Spanish after 2200 hours.

**SWEDEN:** Due to heavy interference on 15105kHz during the broadcasts in English and Swedish to the Far East at 1230-1330, *Radio Sweden* has moved this transmission to 17815kHz as from Thursday 22nd June. Reports will be much appreciated. A change of frequency for South Asia at 1400-1530 is also being considered.

The first report this month comes from Mervyn Winters of Greenisland, Co. Antrim who used an AR88 with a 12 foot whip antenna to pull in several interesting stations including:

- 4980 *Ecos del Torbes* in Spanish at 2350
- 4995 *R. Brazil Central*, LA music at 2340.
- 6030 *RSA, South Africa* noted at 2355.
- 6140 *RNE, Spain*, English to NA at 0110.
- 9570 *R. Australia* noted at 0714.
- 11620 *AIR, Delhi*, India at 1930.
- 11720 *R. Nacional de Brasilia* at 2307.
- 15018 *R. Hanoi*, N. Vietnam in English at 2015.
- 15190 *R. Ankara*, Turkey in English at 2200.
- 21570 *R. Japan* in English to Europe at 0800.
- 21605 *R. Kuwait* in Arabic at 0900.

Roger Hunter of Carmarthen has added a PR 30 preselector to his Codar CR-70A receiver enabling him to hear the following stations:

- 6025 *R. Portugal* in English at 2058
- 6080 *R. Berlin International* at 2145.
- 7235 *R. Australia* with Newsreel at 1000.
- 9009 *Kol Israel*, 'In the Jewish World' at 2115.

## THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

- 9640 *TWR, Monte Carlo*, DX programme at 0945.
- 11755 *R. Finland* in English at 1815.
- 15105 *R. Japan*, news and comment at 2000.
- 17735 *R. Free Europe*, music at 1740.
- 21545 *R. Ghana*, talk in English at 1050.
- 21595 *CBC, Canada* in English at 1900.

Michael Berry of Dewsbury in Yorkshire has again used his outdoor vertical wire and Eddystone EB-35 receiver to good effect, hearing:—

- 3264 *R.T.V. Congolaise* noted at 1910.
- 4765 *R.T.V. Congolaise* in French at 2100.
- 4832 *R. Capital, Costa Rica* in Spanish at 0205.
- 4880 *R. Once Sesenta*, Peru in Spanish at 0335.
- 4940 *R. Yaracuy, Venezuela*, Spanish at 0135.
- 4965 *R. Santa Fe, Colombia*, Spanish at 0430.
- 4970 *R. Rumbos, Venezuela*, Spanish at 0435.
- 4980 *Ecos del Torbes, Ven.*, Spanish at 0025.
- 5030 *R. Reloj Continente, Ven.*, Spanish at 0310.
- 6255 *Schulungssender, Austria*, German at 1245.
- 11862 *R. Lubumbashi, Zaire* in French at 1655.
- 11865 *R. Club Pernambuco, Brazil* at 0330.

Nigel Knowlman of Cullompton in Devon has a Lafayette HA-600A and a 50 foot inverted L antenna, this combination enabled him to hear the following stations:—

- 11520 *R. Bangladesh* in English at 1745.
- 11720 *R. Nacional de Brasilia* in English at 0700.
- 11940 *R. Bucharest, Romania*, English at 1300.
- 11955 *FEBA, Seychelles* in English at 1730.
- 15170 *Beirut, Lebanon* in English at 1830.
- 15185 *Voice of Nigeria*, English at 0700.
- 17655 *R. Cairo, U.A.R.*, English at 1800
- 17815 *HCJB, Quito, Ecuador*, English at 1945.

Next month the series of instructional articles for newcomers will continue with a discussion of the various types of aerials. This will include details of construction and the advantages and disadvantages of the various types.

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

### OUR "CQ" COLUMN

If you wish to have a "CQ" request in *Practical Wireless*, we would be grateful if you could write it out in the same style we print it. This helps us to help you by saving time trying to take extracts from long letters and deciphering names and addresses.

# SHORT WAVES

## THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

IT'S September already and the summer has almost gone. This is sad news for the sun bathers but good news of the l.f. enthusiasts. How about having a really good "go" at topband this year? Once the leaves turn and the darker evenings arrive you can be sure of hearing a few interesting tweets on 160 metres. Quite a number of European countries are active as are stations from further afield. You only need to monitor the bottom 50kHz of the band (i.e. from 1800kHz to 1850kHz) to hear quite a bit of topband d.x. The American stations are usually active at the very edge of the band and usually on c.w. Stewart, W1BB, is a good one to listen for and a few VO and VE stations have put in an appearance from time to time.

Czechoslovakia is a country well represented on 160 metres. Apparently, novice licences are awarded and OL stations are limited to 10W on 160 and 2 metres. What a splendid idea. There was a time when the British Post Office exercised its wisdom and imposed a 10W limit plus c.w.—only for the first year—Ah, happy days. Rumour has it that LU (Argentine) EL and ZS will be in evidence on 160 metres which should offer a challenge from sitting comfortably on 14MHz and just letting the d.x. drop into ones lap.

Letter from Peter Martin (Nottingham) informs that KR6 stations are now signing KA6 and that 7P8AM is on from Lesotho—anyone heard him yet? He also mentions the RSGB news Bulletin Service. The latter is broadcast on Sundays on both eighty metres and two metres and is put out from various parts of the country, so you should have no problems in receiving all the latest information on Amateur radio, both for licensed operators and s.w.l.s. Time depends on which area you're in. However, try listening on 3.6MHz at 0930 for transmissions from Bromley in Kent.

Speaking of the RSGB, don't forget that many of its members put out special slow morse transmissions to help those trying to get up to the magic twelve words/minute. These stations are on from all over the country and at many different times. There is almost certainly somebody on in your locality—usually on topband. The RSGB will give you all the information (you get this and many other things all the time if you become a member).

Alan Smith (Nelson) took "one of my rare trips down on to eighty metres". Reward was ZD8RR at 5 and 7 but Alan queries the authenticity of this station. Any offers? Gear in use is a JR310 and a twiddle on twenty revealed squirts of s.s.b. from; CE3AIU, CO2FA, CX2AL, CX2BR, EL2GY, FC9VN, FM7WN, HC1HV, HC1SS, HC2HM, HK3COC, HK6CBS, HV3SJ, LU3FAQ, LX1DV, OD5HD, PY2BCQ, PY4EP, PZ6AA, SL2ZZM, TI2FCD, TI8PE, TR8GD, VE1RB, VE2WY, VE3BYI, VE5AZ, VE7MT, VE7YF, VK2AVA, VK2BHR, VK3MO, VK4SD, VK5DK, VK6TW, VK7RX, VO5GJ, VP1TB, VP2GB, VP2MZ, VP7NO, VP9HA, VQ9MC, VQ9R, VR1FL, VU2HLU, W8JXM, W9YRA, XE1DO, XE1EH, ZD3D,

ZD7SD, ZE1CS, ZE6JS, ZL1GY, ZL2FA, ZL4CO, ZM2TG, ZP5CF, 4X4NJ, 4X4VB, 8P6EK, 9J2DT, 9K2CA, 9K2CI, 9M2CP, 9M2CW, 9V1QJ. Antenna was a sneaky sixty foot end fed.

R. Dickens (Shepherds Bush) has a "modified" R1155 and a 20ft. aerial. He reports signals from many EU stations on 3.5MHz but also includes a couple of goodies heard in the form of M1B and 6W8DY. Best on 7MHz was 4U1ITU.

G. Benson (G8FBL) tells gleefully of contacts made by special station GB3CRC run by the Chad Radio Club, Lichfield. Over 300 contacts were made including chats on 21MHz with CT2BG, CX4CR, HC1RF, 7Q7BQ, 9H1DL, 9J2TB and 9Q5RA—no mention of mode. (Don't tell me, brightly coloured flags and it was a clear day!)

"I wonder how much of the inside is original", says an unsigned letter from Nicholas Dean of Loughborough. The antenna is a 20 metre bow tie (bet it suites you and, of course, you'll get d.x. in necks to no time) at 20ft and fed into an a.t.u. It is then pressed into service on 3.5MHz. Signals received from; CE8AA, CN8BQ, CT1HE, CT2BG, PY2FYQ, ZB2A, ZL6MP, ZS1MH, 4X4UF, 7X0GF, 9Q5BJ.

Graham Armstrong (Jedburgh) reports hearing some good EU d.x. on topband; DL5XF, GI3GRD, GW3UPK. He reports a station on c.w. signing 2LO which will doubtless raise a smile. (LO LO, what's all this then?). Anyone else hear this character? Apparently he was on for at least a week.

David Lawley (Gravesend) sends in some interesting sigs heard on 160 metres. Among the c.w. offerings are; DL9KR, EI9J, EL2CB, GC3ZES/A, GM2HCZ, GW3UCB, OK1HBT, OL1AOH, OL1APC, OL5APO, PA0PN (on s.s.b.).

B. Spencelayh (Enfield) has got his version of the Deluxe 9/12 receiver (PW April/May 1972) perking. First attempts on 21MHz brought sigs from; EA3SA, HB9AJQ, JA4BLY, OD5LX, VQ9MC, WA1JTT, W9YFV, 4X4HK, 4Z4MO, 5H3JL, 9J2SS, 9M2DQ.

Happenings for September include the Harlow Mobile Rally on September 24 at Magdalen Laver, near Harlow. Contests in my little black book include: September 9-10, WAE phone contest; 10, 3.5MHz field day; 17, final d.f. round at Oxford.

### ELECTRONICA 72

Electronica 72, recognised by many as the most important trade fair in the electronics industry, will take place this year at Munich, Germany, from November 23-29. Included in the exhibits will be components and assemblies, production facilities, testing apparatus, information and training. Running at the same time as the exhibition will be the conference Mikroelektronik consisting of some 40 lectures.

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complete with stereo cartridge	£11-50
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complete with KS40A stereo ceramic cartridge	£43-90
Garrard ZERO 100 Automatic	C & P £1-50
	£42-75
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Garrard ZERO 100S Single Player

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## 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 8 1/2" x 1 1/2" x 3 1/2".  
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This super compact two-band radio **ORIGINALLY COST £9-81!** The ideal pocket set for all ages. Receives all Med. wave and FM stations (local news, etc.)—separate tuning scales. Grey/chrome trim cabinet with carry strap. Excellent tone. Uses single PP3 type battery. Telescopic FM aerial. Size: 4 1/2" x 2 1/2" x 1 1/2". comp. with battery and ear-piece.  
LIST PRICE **LASKY'S PRICE £4-75** C & P £9-81 15p



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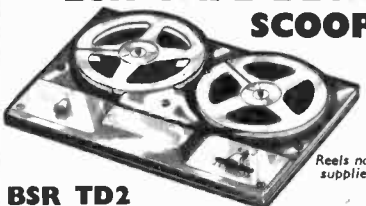
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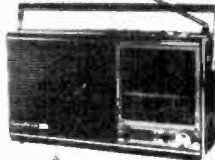
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ORIGINAL LIST PRICE £49-50

LASKY'S PRICE

**£36-50** C & P 25p



### Nordmende Galaxy 6000

ORIGINAL LIST PRICE £69-50

LASKY'S PRICE

**£44-50** C & P 35p



AM/FM/LW/SW Battery/Main Portable Radio

Covers medium and long waves, FM (local) and world-wide short waves cover in 6 band ranges. Size: 16 1/2" x 8" x 3 1/2". Filter switch, ext. speaker socket, tape record and record player socket. Batteries or 220/240v. Mains, 50/60Hz.

LASKY'S PRICE **£44-50** C & P 35p

LASKY'S PRICE

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DL94	45p	EF36	45p	PC834	40p
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DY87	32p	EF80	25p	PCF80	30p
DY802	48p	EF83	45p	PCF82	38p
EB80C/1	00	EF85	35p	PCF84	40p
EL180CC	42p	EF89	30p	PCF86	60p
EL181CC	00p	EF91	30p	PCF200	75p
EL182CC	00	EF92	35p	PCF201	75p
EL183CC	00	EF93	35p	PCF801	50p
EA50	20p	EF183	30p	PCF802	50p
EABC80	32p	EF184	35p	PCF805	60p
EAF42	65p	EF1200	75p	PCF806	70p
EB91	18p	EL34	50p	PCF808	85p
EB33	50p	EL41	60p	PCH200	70p
EB34	50p	EL42	58p	PCL81	47p
EB35	50p	EL43	58p	PCL82	35p
EB36	50p	EL44	58p	PCL83	65p
EB37	50p	EL45	58p	PCL84	45p
EB38	50p	EL46	58p	PCL85	45p
EB39	50p	EL47	58p	PCL86	60p
EB40	50p	EL48	40p	PFL200	68p
EB41	50p	EL49	40p	PL36	58p
EB42	50p	EL50	40p	PL41	50p
EB43	50p	EL51	40p	PL22	40p
EB44	50p	EL52	40p	PL33	42p
EB45	50p	EL53	40p	PL34	42p
EB46	50p	EL54	40p	PL35	42p
EB47	50p	EL55	40p	PL50	78p
EB48	50p	EL56	40p	PL504	75p
EB49	50p	EL57	40p	PX4	22.50
EB50	50p	EL58	40p	PY32	60p
EB51	50p	EL59	40p	PY80	35p
EB52	50p	EL60	40p	PY81	27p
EB53	50p	EL61	40p	PY82	35p
EB54	50p	EL62	40p	PY83	35p
EB55	50p	EL63	40p	PY88	37p
EB56	50p	EL64	40p	PY80	40p
EB57	50p	EL65	40p	PY901	60p

OAS	20p	OC71	12p	IN823A	1-10
OAI0	25p	OC72	20p	IN4785	50p
OAO70	10p	OC73	20p	IN2MT3	35p
OAO71	10p	OC74	20p	IN2MT10	35p
OAO73	7p	OC76	25p	IZT5	67p
OAO74	7p	OC81	20p	IZT10	65p
OAO78 (6D15)	10p	OC81D	20p	IZT15	65p
		OC81DM	20p	IZT20	65p
		OC82	25p	IZT25	65p
		OC82DM	25p	IZT30	65p
		OC83	25p	IZT35	65p
		OC83B	15p	IZT40	65p
		OC84	25p	IZT45	65p
		OC84	25p	IZT50	65p
		OC85	25p	IZT55	65p
		OC86	25p	IZT60	65p
		OC87	25p	IZT65	65p
		OC88	25p	IZT70	65p
		OC89	25p	IZT75	65p
		OC90	25p	IZT80	65p
		OC91	25p	IZT85	65p
		OC92	25p	IZT90	65p
		OC93	25p	IZT95	65p
		OC94	25p	IZT100	65p
		OC95	25p	IZT105	65p
		OC96	25p	IZT110	65p
		OC97	25p	IZT115	65p
		OC98	25p	IZT120	65p
		OC99	25p	IZT125	65p
		OC100	25p	IZT130	65p
		OC101	25p	IZT135	65p
		OC102	25p	IZT140	65p
		OC103	25p	IZT145	65p
		OC104	25p	IZT150	65p
		OC105	25p	IZT155	65p
		OC106	25p	IZT160	65p
		OC107	25p	IZT165	65p
		OC108	25p	IZT170	65p
		OC109	25p	IZT175	65p
		OC110	25p	IZT180	65p
		OC111	25p	IZT185	65p
		OC112	25p	IZT190	65p
		OC113	25p	IZT195	65p
		OC114	25p	IZT200	65p
		OC115	25p	IZT205	65p
		OC116	25p	IZT210	65p
		OC117	25p	IZT215	65p
		OC118	25p	IZT220	65p
		OC119	25p	IZT225	65p
		OC120	25p	IZT230	65p
		OC121	25p	IZT235	65p
		OC122	25p	IZT240	65p
		OC123	25p	IZT245	65p
		OC124	25p	IZT250	65p
		OC125	25p	IZT255	65p
		OC126	25p	IZT260	65p
		OC127	25p	IZT265	65p
		OC128	25p	IZT270	65p
		OC129	25p	IZT275	65p
		OC130	25p	IZT280	65p
		OC131	25p	IZT285	65p
		OC132	25p	IZT290	65p
		OC133	25p	IZT295	65p
		OC134	25p	IZT300	65p
		OC135	25p	IZT305	65p
		OC136	25p	IZT310	65p
		OC137	25p	IZT315	65p
		OC138	25p	IZT320	65p
		OC139	25p	IZT325	65p
		OC140	25p	IZT330	65p
		OC141	25p	IZT335	65p
		OC142	25p	IZT340	65p
		OC143	25p	IZT345	65p
		OC144	25p	IZT350	65p
		OC145	25p	IZT355	65p
		OC146	25p	IZT360	65p
		OC147	25p	IZT365	65p
		OC148	25p	IZT370	65p
		OC149	25p	IZT375	65p
		OC150	25p	IZT380	65p

3N154	95p	BC108	10p	GET115	45p
3N159	1-45	BC113	10p	GET86	50p
3N165	45p	BC118	20p	GET66	1-50
3N170	45p	BC122	10p	NET292	20p
3N175	45p	BC127	10p	NK7304	50p
3N180	45p	BC132	10p	NK8310AF	50p
3N185	45p	BC137	10p	SD918	25p
3N190	45p	BC142	10p	SD928	31p
3N195	45p	BC147	10p	BS2	47p
3N200	45p	BC152	10p	BS29	20p
3N205	45p	BC157	10p	SD94	20p
3N210	45p	BC162	10p	BU100	1-80
3N215	45p	BC167	10p	SD98B	45p
3N220	45p	BC172	10p	BY213	25p
3N225	45p	BC177	10p	VA05A	40p
3N230	45p	BC182	10p	BY216	65p
3N235	45p	BC187	10p	ZZA511C	35p
3N240	45p	BC192	10p	CR113	38p
3N245	45p	BC197	10p	ZR21	42p
3N250	45p	BC202	10p	ZR22	42p
3N255	45p	BC207	10p	CR1120	35p
3N260	45p	BC212	10p	CR1130	45p
3N265	45p	BC217	10p	CR1135	45p
3N270	45p	BC222	10p	CR1140	45p
3N275	45p	BC227	10p	CR1145	45p
3N280	45p	BC232	10p	CR1150	45p
3N285	45p	BC237	10p	CR1155	45p
3N290	45p	BC242	10p	CR1160	45p
3N295	45p	BC247	10p	CR1165	45p
3N300	45p	BC252	10p	CR1170	45p
3N305	45p	BC257	10p	CR1175	45p
3N310	45p	BC262	10p	CR1180	45p
3N315	45p	BC267	10p	CR1185	45p
3N320	45p	BC272	10p	CR1190	45p
3N325	45p	BC277	10p	CR1195	45p
3N330	45p	BC282	10p	CR1200	45p
3N335	45p	BC287	10p	CR1205	45p
3N340	45p	BC292	10p	CR1210	45p
3N345	45p	BC297	10p	CR1215	45p
3N350	45p	BC302	10p	CR1220	45p
3N355	45p	BC307	10p	CR1225	45p
3N360	45p	BC312	10p	CR1230	45p
3N365	45p	BC317	10p	CR1235	45p
3N370	45p	BC322	10p	CR1240	45p
3N375	45p	BC327	10p	CR1245	45p
3N380	45p	BC332	10p	CR1250	45p
3N385	45p	BC337	10p	CR1255	45p
3N390	45p	BC342	10p	CR1260	45p
3N395	45p	BC347	10p	CR1265	45p
3N400	45p	BC352	10p	CR1270	45p
3N405	45p	BC357	10p	CR1275	45p
3N410	45p	BC362	10p	CR1280	45p
3N415	45p	BC367	10p	CR1285	45p
3N420	45p	BC372	10p	CR1290	45p
3N425	45p	BC377	10p	CR1295	45p
3N430	45p	BC382	10p	CR1300	45p
3N435	45p	BC387	10p	CR1305	45p
3N440	45p	BC392	10p	CR1310	45p
3N445	45p	BC397	10p	CR1315	45p
3N450	45p	BC402	10p	CR1320	45p
3N455	45p	BC407	10p	CR1325	45p
3N460	45p	BC412	10p	CR1330	45p
3N465	45p	BC417	10p	CR1335	45p
3N470	45p	BC422	10p	CR1340	45p
3N475	45p	BC427	10p	CR1345	45p
3N480	45p	BC432	10p	CR1350	45p
3N485	45p	BC437	10p	CR1355	45p
3N490	45p	BC442	10p	CR1360	45p
3N495	45p	BC447	10p	CR1365	45p
3N500	45p	BC452	10p	CR1370	45p

6J5GT	25p	19G3	24.25	6065	65p
6J6	20p	19G6	1-10	6080	1-1.50
6J7G	35p	19H4	25.00	6146	1-1.75
6J7M	40p	20P4	1-1.00	6020	22.25
6K5GT	50p	25L6GT	40p	9001	20p
6K6GT	50p	30C15	80p	9002	25p
6K7GT	50p	30C17	90p	9003	50p
6K8GT	40p	30C18	80p	9004	15p
6K9	20p	30F5	85p	9006	15p
6L25	70p	30FL1	75p		
6E8A7	40p	30FL2	75p		
6E8A7GT	35p	30FL3	1-1.20	C.R. Tubes	
6E8GT	35p	30PL13	50p	VCR97	
6E9T	35p	30FL14	85p		4.50
6E10T	35p	30L15	85p	VCR517B	
6E11T	35p	30L16	80p		25.80
6E12T	35p	30L17	80p	VCR517C	
6E13T	35p	30L18	80p		27.50
6E14T	35p	30L19	80p	5FF7	1-1.32
6E15T	35p	30L20	80p	88D	29.00
6E16T	35p	30L21	80p	88J	29.00
6E17T	35p	30L22	80p	88L	29.00
6E18T	35p	30L23	80p		
6E19T	35p	30L24	80p		
6E20T	35p	30L25	80p		
6E21T	35p	30L26	80p		
6E22T	35p	30L27	80p		
6E23T	35p	30L28	80p		
6E24T	35p	30L29	80p		
6E25T	35p				



# GAS FILLED VALVES and TUBES

I. R. SINCLAIR

discharge has started, it cannot be stopped by any voltage applied to the trigger electrode, only by dropping the anode-to-cathode voltage below a level called the "sustaining voltage." Fig. 10 shows the characteristics of a typical trigger tube, the H1VAC XC23.

## Applications

Figure 11 shows a trigger tube used as a pulse amplifier. The trigger pulse causes current to flow,

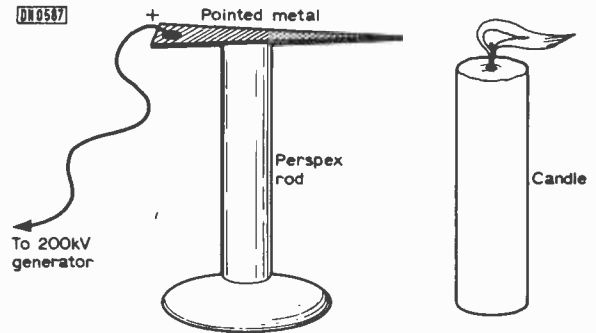


Fig. 9: The high concentration of electric charge around a point causes ionisation of the air. The movement of ions of the same sign away from the point creates a wind capable of blowing out a candle.

## PART TWO

### Trigger tubes

THE discharge between the anode and cathode in a gas-filled tube can be started in ways other than that of raising the voltage to striking voltage. One of these ways is to use a trigger electrode to generate ions which will then carry the current of the main discharge. The trigger electrode is a pointed wire very close to the unheated cathode and pointed to the cathode surface. Because of the close spacing, it is easy to start ionisation with a small voltage applied between trigger and cathode, as the creation of ions is dependent on field strength (volts per metre spacing).

In addition to this effect, ions are discharged at high speed from a pointed wire due to the particularly high field strength around points. The old electrostatic experiment of blowing out a candle with a point discharge from an electrostatic generator is an illustration of this effect (Fig. 9). With the voltage between anode and cathode less than the striking voltage but above the running voltage, current will start to flow only when the discharge is triggered by the injection of ions from the trigger circuit. This is achieved by applying a small positive pulse at the trigger electrode. The amplitude and width of this trigger pulse must be above certain critical values (depending on the shape and spacing of the electrodes) to start the main discharge. Once the main

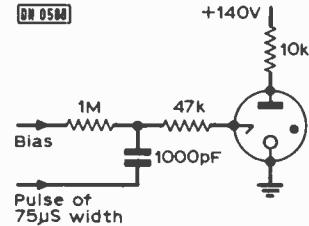


Fig. 10: Characteristics of the H1VAC XC23. With bias at 0V, pulse amplitude for transfer equals 91-98V; with bias of +80V, pulse required is 20V min.; trigger resistance equals 47kΩ. Deionisation time is 2mS (time for which  $V_a = 0$  to switch off tube).

so that a negative voltage pulse is generated in the anode load resistor and a positive pulse in the cathode load resistor. The voltage drop can be designed to be sufficient to cause the tube to extinguish at the peak of the pulse, so that the tube is ready to fire again at the next trigger pulse. The repetition rate which can be used is limited by the time which must be allowed for all the ions created in the first discharge to recombine before the full voltage is again applied between anode and cathode. For this reason, trigger tube circuits working at rates greater than 4kHz are seldom found, and the circuits are notable for the use of capacitors to spread pulse widths out rather than to sharpen them, as is usually the case.

Figure 12 shows a ring counter circuit using gas trigger tubes. This type of counter circuit is not so familiar to constructors as the binary counters used in transistor circuits, and a description of its opera-

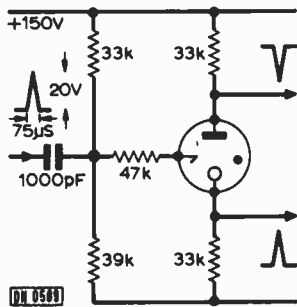


Fig. 11: If the negative pulse is not needed, a capacitor can be connected from anode to earth. The discharge of this will then provide the cathode pulse and the anode load can be raised so that the anode recovers slowly and the tube has ample time to switch off.

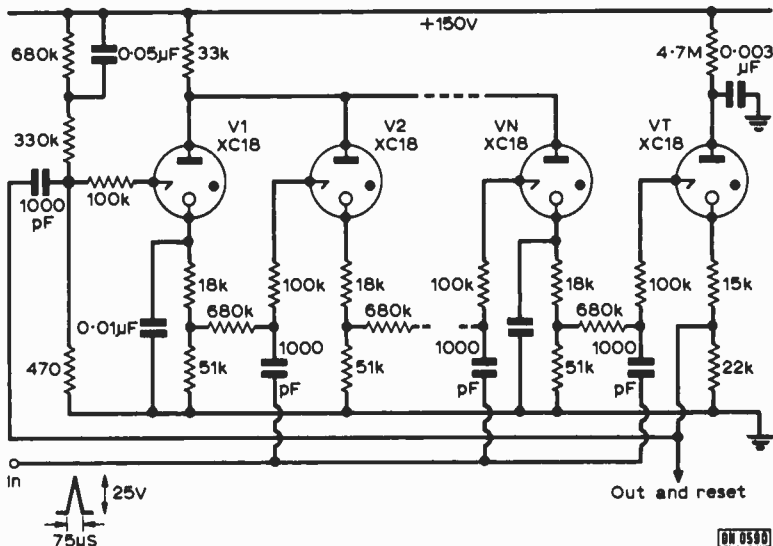


Fig. 12 (right): Ring counter circuit working at 500Hz.

tion might be of interest. The basic principle of any ring counter is that a set of bistable elements is connected in a closed ring in such a way that each trigger pulse fed to a common point turns on the element next to the one previously on, and also turns off that previous element. In the circuit of Fig. 12, imagine that V2 is passing current and that the rest of the tubes are not. Because of the current in V2, there will be a voltage positive to earth developed across the resistor in the cathode lead of V2, and this voltage will bias the trigger electrode of V3 (not shown, but wired in exactly the same way as V2) positive, not enough to fire the tube but enough to make certain that a trigger pulse of about 50V will fire V3. This value of trigger pulse is not sufficient to fire any tube whose trigger electrode is not raised in voltage already, so when a pulse is received at the common input terminal and applied to all the trigger electrodes, V3 is the only tube to fire. When V3 fires, however, the voltage in the common anode line drops, and this drop of voltage is sufficient to extinguish the discharge in V2. The result is that the discharge has moved one tube on with the receipt of one trigger pulse. This action continues from tube to tube as each pulse is received, until the last tube in the set, Vn, is glowing. In a ring-of-ten counter, this would be the tube indicating number nine, and wired to the number nine indicator of a display. This tube is connected to a transfer tube, Vt, and when the next trigger pulse is received, Vt will fire, causing a positive pulse to appear at its cathode load resistor. Vt will extinguish immediately after, however, as the value of its anode load is far too high to permit a continuous discharge, and the current which does flow is due to the capacitor between anode and earth discharging through the tube. The positive pulse at the cathode switches on V1, which has a positive bias on its trigger electrode already, and is also the zero indicator. The same positive pulse is also used as the output pulse of the counter stage, carrying to the next counting ring or to some other output.

## Counting tubes

The action of a trigger tube, in which the trigger

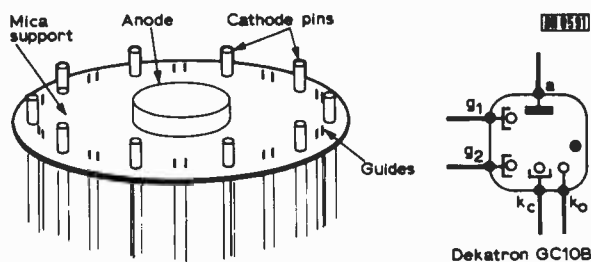


Fig. 13: On the left is shown the principle of construction of a Dekatron; the symbol of the Dekatron GC10B is shown right).

electrode starts off a discharge path which can then spread to the nearest anode, can be used in a tube in which the discharge is passed from one cathode to another, and which also makes use of the fact that the glow in a gas discharge is concentrated at the cathode. The best-known example of this technique is the well-known DEKATRON counting tube in which a central anode rod is surrounded by ten cathode rods (see Fig. 13). The structure of different types of Dekatrons differs in detail, but the type GC10B can be taken as an example of the way in which these fascinating tubes work. In the GC10B, the cathode pin which is used to indicate zero is taken to a base connection ( $k_0$ ), and all the other cathodes are connected together and taken to another base connection,  $k_c$ . At the opposite end, the pins are visible through the glass end of the tube, and the glow round any particular cathode can be clearly seen. Escutcheon plates with the numbers 0-9 can be fitted against the end of the tube and lined up so that the zero of the escutcheon is adjacent to the zero pin of the tube, and the other numbers line up with successive cathodes.

To transfer the discharge from one electrode to another, guide electrodes are used. These are pins located in pairs between the cathodes; all the first pins of each pair in clockwise order are connected together and taken to base connection  $G_1$ , and the second pins of each pair are brought together to the  $G_2$  base connection.

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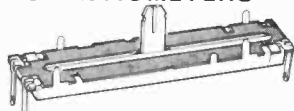
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C	1W	5%	4.7-10M	E12	2.5	2
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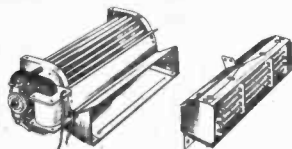
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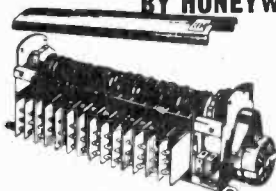
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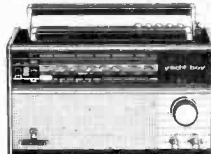
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The action is as follows (Fig. 14): with about 475V applied to the anode through an 820kΩ resistor, and other details as shown in Fig. 14, a discharge must exist between the anode and one cathode. Since all the cathodes are joined together, and since the running voltage of a gas discharge is well below the striking voltage, once one cathode has started a discharge it cannot spread to any other cathode except by the action of the guides which will be described, unless one cathode is made more negative than any other. The only cathode with which this can be done is the zero cathode which is taken to a separate pin, so that the Dekatron can be made to read zero when power is first applied, or when a fresh count is wanted.

If now all the first guides ( $G_1$ ) are pulsed negative, the glow will shift from the cathode to the nearest guide 1 and stay there. If the second guides are now pulsed negative just as the first guides are rising again in voltage, the discharge will shift to the nearest  $G_2$ , which will again be one step clockwise. When this guide's voltage rises again, the glow transfers to the next cathode, which is one cathode on from the starting point. The result is that every time a set of pulses is applied to the guides, the glow shifts clockwise from one cathode to the next, and so counting has been achieved. This process continues until the glow lands on the zero cathode, which is taken to the -20V line through a 150kΩ load resistor, so that a positive pulse is obtained across the resistor whenever the glow lands on zero. This can be used to transfer the count to the next stage, as the positive pulse can be inverted by a valve or trigger tube and processed to provide the double pulse needed for the next stage.

The Dekatron system is at present the most economical method of counting and displaying, since both operations are achieved in one tube. It is, however, essential that the circuits published by HIVAC should be adhered to exactly. Any variation in the pulse width and amplitude, or in the time lag between the pulses applied to guides 1 and 2 can cause misfiring, and most of the problems encountered in Dekatron circuits are easily cured by attention to the pulse system. Fig. 14 shows the circuits which should be used for driving with single pulses, double pulses and sine waves respectively. The sine wave circuit is of particular interest, as the 50Hz mains provide an accurate frequency standard for digital clocks, the design of which is particularly easy using Dekatrons.

Not every count is to ten, however, particularly in the case of digital clocks, and the Dekatron Selector tubes such as the type GS10C are designed with this in mind. Each cathode is taken to a separate pin on the 12-pin base, with the anode as a centre pin, and can be wired as a counter or as a transfer cathode. A transfer cathode is one which passes the count as a pulse to the next stage, and also acts as the zero to which some other cathode will reset. This enables us to have any count up to nine followed by a zero, and the range has been extended by tubes which count to 12. Another advantage of the selector type of tube is that it no longer ties us to the Dekatron type of display, but enables us to display on a Digitron type of tube, described later.

The standard range of Dekatrons includes counters and selectors working at rates up to 4kHz, but another range or Dekatrons using a third set of guides connected to the reset line through a 220kΩ resistor, and an output cathode guide connected to

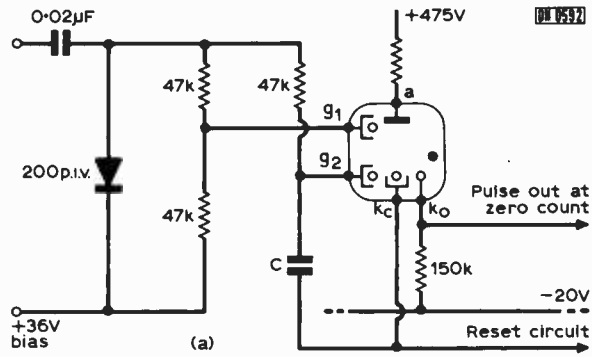


Fig. 14a: Integrated pulse drive. The value of C depends on the pulse width and repetition rate being used.

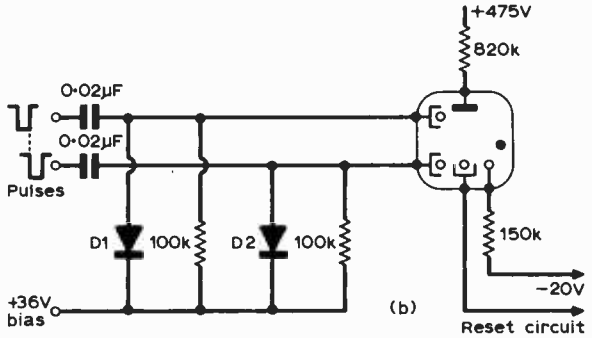


Fig. 14b: Double pulse drive for the GC10B.

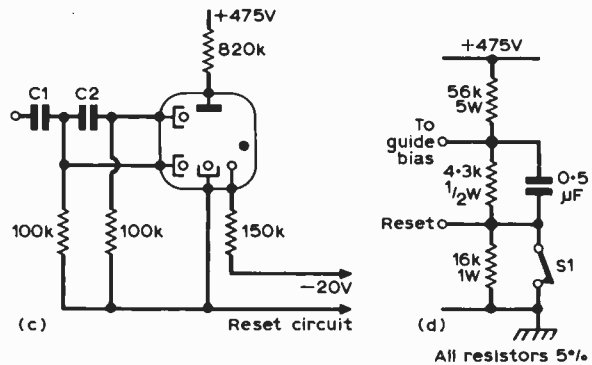


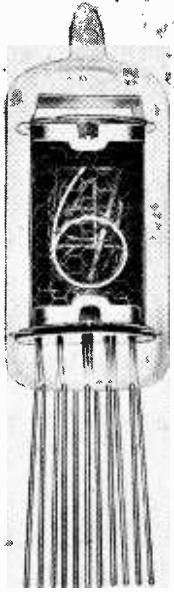
Fig. 14c: Sine-wave circuit (left)  
 Frequency 50Hz 100Hz 200Hz 500Hz 1kHz 2kHz 4kHz  
 C1 (μF) 1.5 0.82 0.33 0.15 0.082 0.033 0.015  
 C2 (μF) 0.1 0.05 0.02 0.01 0.005 0.002 680pF  
 Reset circuit is shown on right. To reset, S1 is opened, taking cathode Kc and guides to +120V and so transferring the glow to Ko.

the output cathode by a 220kΩ resistor, can be operated at speeds up to 20kHz.

## Alpha-numerical indicators

As we have seen earlier, when a voltage is applied between the anode and the cathode of a gas-filled tube, a glow appears round the cathode. When a.c. is applied, of course, both electrodes are seen to glow.





A typical gas filled read-out tube. When a voltage is applied between the anode and cathode a glow appears around the cathode. By making the cathode in the shape of numbers or letters, it will glow when the voltage is sufficiently negative to cause striking.

The glow is due to the recombination of ions which have been formed by collisions and is most noticeable at the cathode because this is the place where electrons are being rapidly accelerated in the face of negative ions moving in the opposite direction. The glow exactly surrounds the shape of the cathode, and does not extend to more positive electrodes.

If the cathode is made in the shape of a letter or a number, this figure or number will be seen as a glowing shape whenever the cathode is sufficiently negative to the anode to strike and run. If a number of separately connected wires are shaped in the form of numbers 0-9, each number will display only when the wire forming it is sufficiently negative to the anode to form a gas discharge.

The *Hivac* Numicators are tubes of this type, and the range of types is large. Tubes may be viewed end-on or side-on according to the type of construction of the tube. Numicators can be driven from Dekatrons, provided that trigger tubes or other inverter stages are used to change the positive pulses at the cathodes of the Dekatron to the negative pulses used at the cathodes of the Numicator. Perhaps "pulse" is a misleading word in this application, because the top of the pulse will be as long in the time sense as the figure is to be displayed.

Most Numicators are designed for steady operation, but some are intended to be used in what is called the "anode stroking technique," often used in connection with digital counters.

Digital counters can readily be arranged to give a readout whenever a clock pulse is received, and the readout can be converted to decimal form and used to drive Numicators. Considerable economy in circuitry can be arranged if the decimal readout is attached to all the Numicator cathodes; for example, in a five figure readout, there would be one decimal converter with the zero output connected to all the five Numicator zeros, the "one" output to all the Numicator "ones", the "two" to all the "twos" etc. The decimal output and the tubes are then switched in sequence, so that the units tube has its anode volts pulsed just as the decimal output gives the unit figure pulse to all the Numicator cathodes, with the result that only the units tube displays a figure. On the next pulse, the tens tube is activated to display

the decimal output from another store, so that each tube flashes a digit in sequence. Because of the clock pulse rate used, the display looks continuous. This is not a technique which would be used in small counters, but it is extremely useful in small computers, particularly in conjunction with integrated circuit counters.

## Thyratrons

Thyratrons are the big brothers of trigger tubes. Like trigger tubes, they are made to conduct by the application of a positive pulse to a third electrode; unlike trigger tubes, they use hot cathodes and can operate at very high voltages indeed—one type listed by *English Electric* quotes a peak forward voltage of 120kV and with large currents, up to several thousand amps, flowing. Small thyratrons are made in glass envelopes and resemble output valves at first sight, the larger types have ceramic casings.

The small type of Thyratron has a heated cathode, a grid similar to the control grid of an output valve, and an anode which is often finned and connected to a thick pin set in the glass bulb for maximum heat dissipation. In operation, the heaters must be switched on before high voltage is applied, this is usually done automatically by means of a thermal delay circuit, since failure to observe the correct delay period would be fatal to the thyratron. When the heaters have reached full temperature, the grid voltage can be applied, this is a negative bias sufficient to prevent any electrons passing the grid, enough, in fact, to prevent electrons from being emitted to any noticeable extent from the cathode. The positive anode voltage can then be applied.

If the grid is now pulsed positive, the tube conducts strongly due to the ionisation of the gas by the electrons from the cathode, and this current will continue until the voltage at the anode is reduced to a low value. After a short "recovery time", the tube can be fired again if the anode voltage has also recovered to its previous value. What makes the thyratron unique is its ability to switch very high currents very rapidly and at a high forward voltage. By very rapidly, we mean delay times of around 20-120 nanoseconds in the most advanced types.

Thyratrons are used to control spot welders, to pulse radar transmitter magnetrons, and to operate other short time, high energy devices such as the *Kerr Cell* used in high speed photography. They also find extensive use in large invertors (converting a.c. to d.c.) such as are used at each end of the cross-channel d.c. cable. One intriguing use is as "electronic crowbars". In modern electronic equipment, protection against faults by means of fuses is not very effective because of the time which a fuse needs to blow. Even if this time is measured in milliseconds, much damage can be done, and the idea of the electronic crowbar is a device which will come into operation much more quickly than a fuse, shorting out the voltage across the circuits and taking the current which will eventually blow the fuse. This use demands a device which can be switched into conduction very quickly and which will take a large current in the time before a fuse blows—the Thyratron is ideal, though for the smaller sizes thyristors are taking over. ■

The Author gratefully wishes to acknowledge the help of HIVAC LTD. in the preparation of this article.

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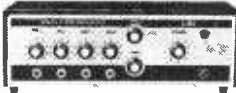
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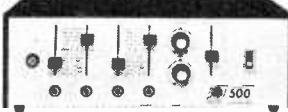
Speaker Impedance 8-16 ohms.

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) 15 1/2" x 5" x 6".

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OZ4	.25	6BW6	.72	6SA7M	.38	14S7	.75	5702	.80	EBL21	.60	EL87	.23	EL36	.74	PAFC80	.32	PM84	.31	UY85	.23	AC165	.25	BCY38	.23	OA90	.13
1A3	.23	6BW7	.50	6SCTGT	.33	19A5	.53	5763	.55	EC86	.59	EL88	.53	1A3	.23	PC86	.44	FX4	1.38	UY11	.23	AC166	.25	BCY39	.25	OA91	.09
1A7GT	.38	6B26	.31	6SGTGT	.33	19B9G6	.30	AC/PEN	.98	EC88	.59	ELL80	.75	1A7GT	.38	PC88	.44	FP33/2	.50	UI2/14	.38	AC176	.55	BF158	.29	OA200	.09
1B3GT	.35	6CB6A	.28	6SH7	.53	19G66	.50	AC2/PEN	.98	EC92	.34	EM80	.37	1B3GT	.35	PC95	.53	PY80	.38	U19	1.73	AC177	.55	BF159	.25	OA202	.10
1H5GT	.38	6C4	.28	6S8J	.35	20D4	1.05	DD	.98	ECC32	1.50	EM81	.37	1H5GT	.38	PC97	.36	PY81	.24	U22	.39	AC178	.25	BF163	.20	OC23	.38
1L4	.18	6C9	.73	6SK7GT	.23	20F2	.85	AC6/PEN	.38	ECC33	1.50	EM83	.75	1L4	.18	PC99	.29	PY82	.23	U25	.62	AC181	.20	BF173	.38	OC23	.38
1N6GT	.37	6CD6G	1.08	6SQTGT	.38	20L1	.98	AC/TH1	.50	ECC40	.80	EM84	.31	1N6GT	.37	PC84	.27	PY83	.26	U26	.53	AC191	.19	BF180	.30	OC24	.38
1R5	.28	6CG8A	.50	6U4GT	.60	20P1	.50	AC/TP	.98	ECC81	.16	EM85	1.00	1R5	.28	PC85	.24	PY84	.31	U45	.78	AC192	.18	BF181	.40	OC25	.38
1R4	.22	6CB6	.33	6V80	.17	20P3	.78	AL60	.78	ECC82	.19	EM87	.43	1R4	.22	PC86	.44	FX4	1.38	UY11	.23	AC193	.19	BF185	.45	OC28	.60
1U4	.29	6CL6	.48	6V6GT	.27	20P4	.59	ATP4	.12	ECC83	.21	EY1	.29	1U4	.29	PC87	.42	FP80	.31	U251	.65	AC198	.18	BF194	.15	OC29	.38
1U5	.48	6CM7	.50	6X4	.20	20P5	1.00	AZ1	.40	ECC84	.28	EY81	.35	1U5	.48	PC88	.44	FP80	.31	U251	.65	AC198	.18	BF194	.15	OC29	.38
2D21	.35	6C5U	.30	6X5GT	.25	25A6G	.29	AZ31	.46	ECC85	.32	EY83	.54	2D21	.35	PC89	.42	FP80	.31	U251	.65	AC198	.18	BF194	.15	OC29	.38
2GK5	.50	6C7	.63	7B6	.58	25L6G	.20	AZ41	.53	ECC88	.35	EY84	.50	2GK5	.50	PC92	.29	R17	.88	VU11	.44	AF124	.25	BY212	.25	OC75	.11
3A4	.25	6D18	.50	7B7	.52	25Y5G	.43	CL33	.90	ECC189	.48	EY87/6	.27	3A4	.25	PC93	.33	R19	.28	VU120	.60	AF124	.25	BY213	.25	OC76	.15
3D6	.19	6DT6A	.50	7H7	.28	25Z4G	.23	CV3	.53	ECC807	.59	EY88	.40	3D6	.19	PC94	.32	FP81	.33	VU120A	.60	AF125	.17	CG126	.20	OC77	.27
3Q4	.38	6EWF6	.55	7K7	.65	25Z5	.40	CV1C	.53	1.70	EZ40	.40	PC805/85	.38	3Q4	.38	PC95	.53	W107	.50	AF126	.18	FBY14	.23	OC78	.15	
3QG5T	.35	6F1	.59	7Y4	.80	25Z6G	.43	CV31	.29	EF80	.27	EZ41	.42	3QG5T	.35	PC96	.44	W107	.50	TP2620	.98	W107	.50	AF129	.18	FBY14A	.23
384	.23	6F6	.63	7Z4	.50	30A5	.44	DAF91	.20	EF82	.25	EZ80	.19	384	.23	PC97	.36	W107	.50	TP2620	.98	W107	.50	AF178	.68	GD9	.20
4CB6	.50	6F13	.38	9BW6	.50	30C15	.55	DAF96	.33	EF86	.64	EZ81	.20	4CB6	.50	PC98	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5CG8	.50	6F14	.40	9D7	.78	30C17	.74	DP91	.14	EF804	.34	FW4/800	.75	5CG8	.50	PC99	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5T4	.30	6F18	.45	10C2	.49	30C18	.58	DP96	.34	2.10	GY601	.75	1.38	5T4	.30	PC100	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5U4G	.30	6F23	.65	10DE7	.50	30F3	.61	DH76	.28	ECH21	.63	GZ30	.33	5U4G	.30	PC101	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5V4	.25	6G10	.65	10E7	.75	30F11	.58	DK40	.55	ECH42	.37	GZ32	.39	5V4	.25	PC102	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5Y3GT	.25	6E25	.51	10F9	.45	30F12	.58	DK92	.35	ECH81	.25	GZ33	.70	5Y3GT	.25	PC103	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5Z4G	.38	6E28	.60	10F18	.35	30F11.2	.67	DK96	.35	ECH83	.38	GZ34	.47	5Z4G	.38	PC104	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
5Z4GT	.38	6F32	.15	10LD11	.53	30F11.4	.66	DL96	.35	ECH84	.34	GZ37	.67	5Z4GT	.38	PC105	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6/30L2	.53	6G8A	.50	10P13	.54	30L15	.55	DM70	.30	ECL80	.28	HABC80	.44	6/30L2	.53	PC106	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6A8G	.38	6GK5	.50	10P14	1.08	30L17	.65	DM71	.38	ECL82	.28	HBC23D	.40	6A8G	.38	PC107	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AC7	.15	6G07	.50	12A6	.63	30P4MR	.95	DY87/6	.25	ECL83	.62	HL41DD	.98	6AC7	.15	PC108	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AG5	.25	6HGT	.40	12AC6	.15	30P12	.65	EY80	.29	ECL84	.54	HL42DD	.50	6AG5	.25	PC109	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AK6	.30	6J5GT	.29	12AE6	.48	30P4	.55	E80F	1.20	ECL86	.33	HVR2	.53	6AK6	.30	PC110	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AM8A	.50	6J6	.18	12AT6	.23	30PL1	.57	E83F	1.20	EF22	.63	HVR2A	.53	6AM8A	.50	PC111	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AN8	.49	6J7G	.24	12AT7	.16	30PL1.3	.75	E88CC	.60	EF40	.49	KT2	.26	6AN8	.49	PC112	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AQ5	.21	6J7(M)	.38	12AU6	.21	30PL1.4	.62	E92CC	.40	EF41	.58	KT4	.98	6AQ5	.21	PC113	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AR5	.30	6JUS4	.50	12AU7	.19	30PL1.5	.87	E180F	.90	EF42	.58	KT44	1.00	6AR5	.30	PC114	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AT6	.18	6K7G	.10	12AX6	.28	35A3	.43	E182CC1	.00	EF73	.75	KT6	.66	6AT6	.18	PC115	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AU6	.19	6K8G	.16	12AX7	.21	35L6GT	.42	E1148	.53	EF80	.21	KT81	2.00	6AU6	.19	PC116	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AV6	.28	6L1	.98	12BA6	.30	35W4	.23	EAT6	.88	EF93	.54	KTW61	.63	6AV6	.28	PC117	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AW8A	.54	6L6GT	.39	12BE6	.30	35Z4GT	.24	EABC80	.29	EF85	.25	KTW62	.63	6AW8A	.54	PC118	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6AX4	.39	6L7	.38	12BH7	.27	35Z5GT	.30	EAC91	.38	EF86	.27	KTW62	.63	6AX4	.39	PC119	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BG	.18	6L18	.44	12J7GT	.33	50CD6G	.50	EAF42	.45	EF89	.23	KTW62	.63	6BG	.18	PC120	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BA6	.19	6L19	1.38	12K5	.50	EAF801	.50	EP91	.17	EF90	.17	KTW62	.63	6BA6	.19	PC121	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BE8	.50	6LD20	.48	12K7GT	.34	50EH5	.55	EB34	.20	EF92	.28	KTW62	.63	6BE8	.50	PC122	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BE6	.20	6N7GT	.40	128C7	.35	50L6GT	.45	EB91	.10	EF98	.65	KTW62	.63	6BE6	.20	PC123	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BH6	.48	6G7GT	.48	128G7	.23	8A2	.43	EBCA1	.43	EF183	.25	KTW62	.63	6BH6	.48	PC124	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BJ6	.39	6Q7M	.48	12SH7	.15	8A3	.40	EBP81	.29	EF184	.27	KTW62	.63	6BJ6	.39	PC125	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20
6BQ7A	.38	6R7G	.35	12SJ7	.23	90C1	.59	EBF80	.30	EH90	.34	KTW62	.63	6BQ7A	.38	PC126	.44	W107	.50	TP2620	.98	W107	.50	AF180	.68	GET113	.20

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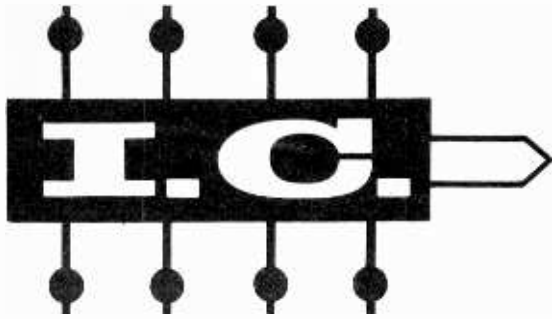
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# OF THE MONTH

L.A.J. IRELAND

Number 33

Motorola MFC6040 Electronic Attenuator

**A**COUSTIC feedback—that deafening howl which occurs when a microphone picks up the sound from the loudspeakers of a public address system and thereby completes a feedback loop, setting the whole system into oscillation—will be familiar to readers. It is particularly embarrassing when, for example, an announcer is using a microphone with a considerable length of cable, and by moving to a new location initiates this response from a previously well-behaved system. It would therefore be convenient if, in addition to his microphone, the announcer could have to hand the gain control of the amplifier, so that it could be adjusted for best results from his own position, without having an assistant constantly at the amplifier controls.

However, it is not a practical proposition to remove the volume control of the amplifier to the end of a long cable for such remote operation. There would be a considerable increase in the noise level of the system, despite the best efforts to screen the cable; there is also the consideration that the audio signal may have been amplified prior to the volume control, and at the higher level, may itself produce some feedback effects due to the stray capacitance of the cable.

It may be suggested that a volume control could be incorporated in the microphone case, to control the signal level before it is applied to the amplifier; however, the microphone may not be the sole signal source. It is common practice to use several inputs to a public address system, with part of the pre-amplifier stages acting as an audio mixer, so it would be desirable for the remote unit to control the gain of the "mixed" signal, rather than just that of the microphone channel.

What is required, therefore, is a method of remote control of amplifier gain which does not involve long signal-carrying cables, is therefore impervious to noise and does not introduce feedback or degrade signal quality. It is just this requirement which is satisfied by the new Motorola Electronic Attenuator integrated circuit, type MFC6040.

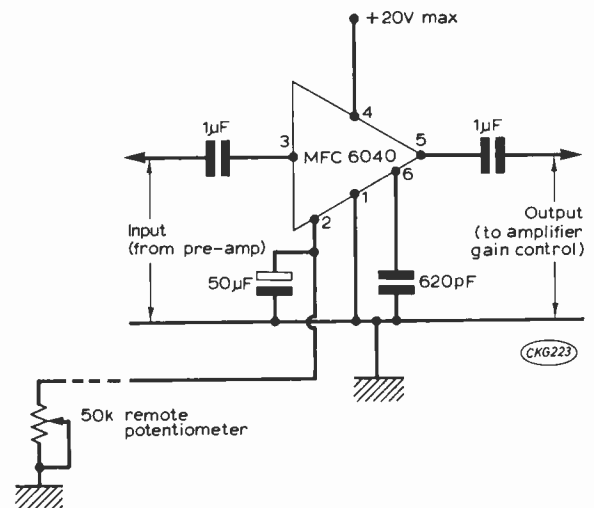
## Operation

In operation, the device is inserted in series with the master gain control of the mixer section of the preamplifier, and, depending on the setting of a remote potentiometer, attenuates the signal applied to its input terminal. Only a d.c. potential appears on the leads to the remote potentiometer; capacitive

effects are therefore irrelevant. The leads may be of any desired length and need not be screened. All the difficulties visualised above are therefore avoided.

## Practicalities

It is possible to obtain microphone cable in which two conductors are incorporated within the braiding. One of these may then be used in the conventional fashion, applying the microphone signal between it and the screening. The other can then be used for the remote control potentiometer, with the screening as an earth return. There is no question of capacitive crosstalk as the control connection is decoupled at the i.c. by a  $50\mu\text{F}$  capacitor.



Wiring for an amplifier remote gain control system using the Motorola MFC6040 integrated circuit.

The circuit indicates the connections and components required for the provision of the remote control facility outlined. A beginner should find little difficulty in assembling it on a piece of veroboard, and it can easily be accommodated close to the master gain control inside even the most compact amplifier. A d.c. supply of 20V max. is required to

operate the i.c.; this is commonly available in modern transistor amplifiers and for mobile operation the 12V car battery supply is adequate. The i.c. itself is presented in a miniature 6-pin epoxy package with pin 1 indexed.

## Alternatives

Alternative applications will be evident to the experimenter. The unit can clearly be employed as an audio automatic gain control by rectifying part of the output of the unit and applying it to pin 2 as a control voltage. Similarly, feedback systems can be designed which produce a control voltage dependent on signal frequency, for pre-emphasis or de-emphasis operations, or to investigate Dolby effects. A suitable low-frequency signal applied to pin 2 could be used for tremolo. It is clear, then, that the field for experiment with the MFC6040 is extremely wide, and we are likely to hear much more of it.

## 2 METRE Tx —continued from page 517

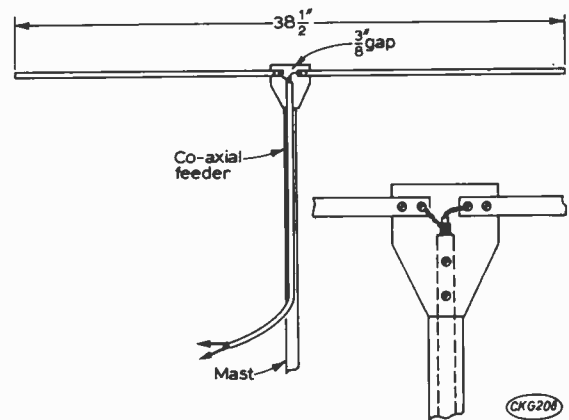


Fig. 2: Construction of a simple half wave dipole for 2 metres.

ranges. One can easily be made, using  $\frac{1}{4}$ in. aluminium tubing, as shown in Fig. 2, the elements being bolted to a piece of insulating material. A more weather-proof aerial can be made on the same lines, but using a closed box as fitted to TV and similar aeriels. This aerial is easily raised on a light mast or post, with the co-axial feeder running down to the transmitter. ■

# TELEVISION

## OCTOBER ISSUE

### COLOUR TV DELAY LINES

Why are delay lines necessary in a colour receiver, what do they do and how do they do it? We have not previously taken a close look at this aspect of colour television but we shall be doing so this month, in particular to see how the PAL delay line acts as a comb filter to separate the U and V components of the transmitted chrominance signal.

### RECEIVER-MONITOR

A simple conversion of a domestic receiver to act as a monitor, not only to accept CCTV signals—from a camera or videotape recorder—but also to provide demodulated off-air signals to drive other monitors, for mixing in a CCTV studio or to feed to a videotape recorder.

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### SERVICING TV RECEIVERS

The next chassis we are covering is that used in the Bush/Murphy TV141/TV148/V153/V159 series.

### COLOUR RECEIVER PROJECT

Details this month of cabinet construction.

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- ...May 1969 Practical Wireless.—T. Ardley, 17 Elmwood Road, North Shields, Northumberland.
- ...Issues of Practical Wireless containing article on Pedal Steel Guitar.—B. R. Currow, 31 Acorn Grove, Ditton, Maldstone, Kent.
- ...November 1971 Practical Wireless.—B. Featherstone, 24 Glenville Road, Rustington, Sussex.
- ...Issues of Practical Wireless containing article on Expander/Compressor.—S. Butt 6 Childs Gate, Shotley Gate, Ipswich, Suffolk.
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- ...all issues of Practical Wireless that contain "Transistor Circuitry for Beginners". B. P. Bamfield, 256 Stephenson Avenue, Leamore, Walsall, Staffs.
- ...March 1965 Practical Wireless.—W. A. Dorloff, Block A3 Flat, 6 Bleomendhal Flats, Kotehena, Colombo 13, Ceylon.
- ...Issues of Practical Wireless containing articles on Beginners Guide to Transistor Circuitry.—K. McIlroy, 24 Deramore Drive, Portadown, Co. Armagh.
- ...Practical Wireless November 1970, T.V. June 1971.—J. F. Glavin, North Lodge, Northlands, Salthill, Chichester, Sussex.
- ...Issues of Practical Wireless containing details of 19 set circuits.—C. A. Campbell 7 Fairfax Crescent, Barley, Bradford, 4, Yorks.
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- ...back issues of P.W. and P.E. required containing articles on electronic organs.—H. D. Briggs, 53 Gilkin Road, Admaston, Telford, Salop.
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- ...P.W. November 1971—Vol. 47, Nos. one, two, three, four, five, six—E. Blackman, 80 Myatt Avenue, Parkfields, Wolverhampton, WV2 2DN, Staffs.
- ...P.W. May 1971, and June 1971.—H. Hunt, 13 Chiltern Drive, Walshaw, Bury, Lancs.
- ...Issues of P.W. with article on F.E.T. Transistor Voltmeter.—F. M. Milburn Esq., Pitts Farm House, Vantly Lane, Linton, Kent.
- ...Issues of P.W. containing articles on decoders.—D. E. Rosa Esq., Lord Mayor Hospital, Allian, Herts.
- ...P.W. October 1967, December 1970, April 1971, August 1971.—R. J. S. Gowe Esq., Celtic Fields, Celtic Way, Bleadon Hill, Weston-Super-Mare, Som., BS24 0NA.
- ...Issues of P.W. containing details of the "Sixteen" multimeter.—H. E. Lupton Senior Lecturer in Educational Psychology, Saint Martin's College, Lancaster.
- ...January 1968 with details of P.W. clubman Mark I. Will buy or hire and will pay for postage.—M. Ferrall, 17 Priory Road, Cottesingham, Yorkshire.
- ...Dec. 1971 P.W.—P. A. Townaend, 24 Ronald Drive, Rayleigh, Essex.
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- ...P.W., August 1971.—C. J. Rayner, 6 Westley Road, Fornhal All Saints, Bury St. Edmunds, Suffolk.
- ...Issues of Practical Wireless containing the Explorer VHF Receiver or Just loan the above issue C1967.—A. J. Bartlett, 4 Keisall Close, Kidbrook, London, SE30 0JJ.
- ...P.W. for Jan. and Feb. 1971.—M. F. Bowen, 44 Elder Crescent, R.A.F. Wattisham Ipswich, Suffolk.
- ...August and September 1969 Issues of Practical Television.—N. F. Beardmore, 9 Aider Road, Precoat, Lancs. L34 2SG.
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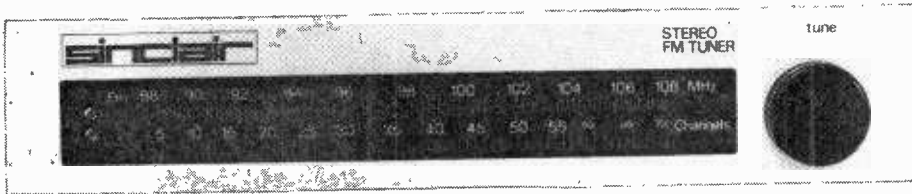
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2G306	0-30	Green	0-10	2N5245	0-43	AF125	0-20	BC308	0-08	BF274	0-21
2G309	0-30	Yellow	0-10	2N5190	0-22	AF126	0-20	BC308B	0-08	BF457	0-46
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2G381	0-25	2N3055	0-60	2N5195	1-46	AF178	0-55	BC313	0-30	BF829	0-22
2G417	0-20	2N3390	0-20	2N5245	0-43	AF179	0-55	BC327	0-21	BF898	0-27
2N109	0-49	2N3391	0-20	2N5457	0-35	AF180	0-50	BC328	0-19	BF898	0-30
2N174	1-40	2N3439	0-22	2N5458	0-33	AF186	0-40	BC337	0-17	PFW10	0-61
2N176	0-75	2N3392	0-18	2N5459	0-33	AF200	0-35	BC338	0-17	PFW11	0-61
2N274	0-75	2N3393	0-12	3N128	0-63	AF239	0-38	BCY32	0-60	BFX29	0-25
2N335	0-75	2N3394	0-12	3N138	1-37	AF240	0-38	BCY32	0-60	BFX30	0-25
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2N404	0-25	2N3415	0-10	3N152	0-79	AL103	0-70	BCY42	0-15	BFX85	0-29
2N456	0-75	2N3416	0-15	3N153	0-74	AY226	0-25	BCY43	0-15	BFX86	0-24
2N456A	0-75	2N3417	0-21	3N154	0-74	AY227	0-20	BCY48	0-18	BFX87	0-27
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2N491	3-25	2N3671	1-12	3N187	1-30	AY229	0-30	BCY66	0-58	BFX89	0-35
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2N699	0-29	2N3706	0-00	40309	0-28	BC108	0-11	BCY88	2-40	BFY20	0-60
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2N709	0-88	2N3710	0-90	40318	0-97	BC116	0-15	BD116	0-75	BFY40	0-16
2N711	0-30	2N3711	0-90	40322	1-00	BC116A	0-18	BD121	0-75	BFY51	0-16
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2N918	0-30	2N3774	3-33	40394	0-58	BC125	0-15	BD136	0-44	BFY77	0-24
2N919	0-20	2N3775	4-19	40406	0-50	BC126	0-20	BD137	0-47	BFY78	0-36
2N929	0-14	2N3776	5-95	40407	0-81	BC132	0-30	BD138	0-55	BFY90	0-55
2N930	0-14	2N3777	4-84	40408	0-41	BC135	0-11	BD139	0-82	BFY99	0-35
2N1090	0-30	2N3778	2-25	40409	0-49	BC136	0-15	BD140	0-73	BRX19	0-13
2N1091	0-32	2N3779	1-15	40410	0-53	BC137	0-15	BDY10	1-25	BRX20	0-14
2N1131	0-20	2N3780	4-50	40411	1-40	BC138	0-24	BDY11	1-50	BRX21	0-20
2N1132	0-20	2N3781	3-67	40414	1-44	BC140	0-30	BDY17	1-50	BRX26	0-34
2N1184	1-27	2N3782	3-37	40438	1-44	BC141	0-34	BDY18	1-75	BRX27	0-34
2N1302	0-18	2N3789	1-76	40467A	0-87	BC143	0-18	BDY19	1-97	BRX28	0-25
2N1303	0-16	2N3790	1-90	40468A	0-35	BC143	0-18	BDY20	1-35	BRX29	0-27
2N1304	0-20	2N3791	2-00	40680	0-87	BC144	0-24	BDY38	0-65	BRX30	0-25
2N1305	0-20	2N3792	2-20	40681	0-65	BC145	0-21	BDY60	0-90	BRX59	0-78
2N1306	0-22	2N3794	0-10	40691	0-40	BC147	0-10	BDY61	0-85	BRX60	0-54
2N1307	0-22	2N3819	0-26	40692	0-45	BC148	0-09	BDY62	0-75	BRX61	0-42
2N1308	0-25	2N3820	0-48	40694	0-33	BC149	0-11	BF115	0-25	BRX76	0-15
2N1309	0-25	2N3823	0-62	40696	0-33	BC149	0-11	BF117	0-43	BRX77	0-20
2N1485	0-80	2N3824	0-75	40673	0-60	BC154	0-09	BF119	0-48	BRX78	0-20
2N1487	0-80	2N3825	0-75	40673	0-35	BC157	0-11	BF121	0-25	BRW70	0-28
2N1613	0-20	2N3854	0-16	AC107	0-18	BC158	0-10	BF123	0-27	BSY24	0-20
2N1613	0-38	2N3854A	0-16	AC113	0-18	BC159	0-10	BF125	0-25	BSY26	0-20
2N1637	0-38	2N3855	0-16	AC117	0-20	BC160	0-11	BF127	0-27	BSY26	0-20
2N1638	0-38	2N3856	0-16	AC121	0-11	BC160	0-11	BF129	0-20	BSY27	0-15
2N1671	1-00	2N3856	0-16	AC126	0-20	BC168B	0-10	BF153	0-29	BSY28	0-15
2N1701	1-10	2N3856A	0-16	AC126	0-20	BC168C	0-10	BF154	0-16	BSY38	0-15
2N1702	2-15	2N3858	0-16	AC127	0-20	BC169B	0-11	BF158	0-23	BSY39	0-15
2N1711	0-17	2N3858A	0-16	AC128	0-20	BC169B	0-11	BF159	0-27	BSY51	0-25
2N1893	0-34	2N3859	0-16	AC142K	0-25	BC189C	0-11	BF160	0-23	BSY62	0-25
2N2102	0-30	2N3859A	0-16	AC151V	0-12	BC170	0-11	BF160	0-23	BSY62	0-25
2N2147	0-70	2N3860	0-75	AC152V	0-15	BC172	0-11	BF163	0-20	BSY63	0-25
2N2148	0-70	2N3860	0-75	AC153	0-19	BC182	0-10	BF166	0-85	BSY66	0-79
2N2192	0-40	2N3877	0-25	AC153	0-22	BC182L	0-10	BF167	0-18	BSY65	0-15
2N2192A	0-40	2N3877A	0-25	AC153K	0-22	BC183	0-09	BF173	0-19	BSY78	0-40
2N2193	0-58	2N3878	1-22	AC178	0-16	BC178	0-16	BF173	0-19	BSY79	0-40
2N2193A	0-61	2N3879	1-01	AC176K	0-17	BC183L	0-09	BF177	0-25	BSY79	0-40
2N2194	0-27	2N3900	0-20	AC154	0-20	BC184	0-17	BF178	0-31	BSY79	0-40
2N2194A	0-29	2N3900A	0-21	AC187K	0-17	BC184L	0-17	BF178	0-31	BSY79A	0-40
2N2195	0-37	2N3901	0-22	AC188K	0-23	BC186	0-25	BF180	0-35	BU104	1-25
2N2195A	0-18	2N3903	0-22	ACY17	0-25	BC187	0-25	BF181	0-84	BU105	2-25
2N2218A	0-18	2N3904	0-22	ACY18	0-15	BC204	0-11	BF182	0-40	C111	0-58
2N2219	0-20	2N3905	0-21	ACY20	0-20	BC205	0-10	BF183	0-40	C407	0-13
2N2219A	0-20	2N3906	0-22	ACY21	0-18	BC206	0-11	BF184	0-17	C424	0-15
2N2220	0-30	2N4036	0-40	ACY22	0-18	BC207	0-10	BF185	0-17	C425	0-39
2N2221	0-20	2N3934	0-10	ACY23	0-13	BC208	0-09	BF194	0-14	C426	0-25
2N2221A	0-22	2N4058	0-12	ACY28	0-18	BC209	0-10	BF195	0-15	C428	0-25
2N2222	0-20	2N3059	0-90	ACY39	0-42	BC211	0-30	BF196	0-15	C444	0-28
2N2222A	0-38	2N4060	0-11	ACY40	0-17	BC212K	0-10	BF197	0-16	D40N3	0-62
2N2368	0-11	2N4061	0-11	ACY41	0-17	BC212L	0-12	BF198	0-18	ET111	0-46
2N2369	0-12	2N4077	0-17	ACY44	0-14	BC214	0-14	BF199	0-18	ET113	0-25
2N2369A	0-17	2N4302	0-22	AD136V	0-84	BC236	0-18	BF200	0-40	ET114	0-20
2N2646	0-45	2N4303	0-25	AD136V	0-84	BC237	0-08	BF224J	0-14	ET115	0-20
2N2647	1-20	2N4913	0-80	AD140	0-60	BC238	0-08	BF225J	0-19	ET119	0-35
2N2711	0-12	2N4914	0-87	AD142	0-50	BC239	0-08	BF227	0-22	ET120	0-40
2N2712	0-12	2N4915	0-95	AD143	0-45	BC239	0-08	BF238	0-22	ET353	0-20
2N2713	0-17	2N4916	0-11	AD149V	0-58	BC253	0-23	BF245	0-33	ET356	0-20
2N2714	0-12	2N4917	0-77	AD149V	1-23	BC257	0-08	BF246	0-43	ET358	0-20
2N2904	0-18	2N4918	0-58	AD150	0-55	BC258	0-08	BF247	0-49	ET373	0-15
2N2904A	0-29	2N4919	0-53	AD151	0-33	BC259	0-11	BF254	0-1		

# Sinclair Project 60

## Project 60 Stereo FM Tuner



Built and tested.  
Post free.  
**£25**

### with phase lock-loop principle

Amongst the many advanced electronic features to be found in this remarkable stereo tuner, use of the phase lock loop principle ensures standards of audio quality better than from any other method of detection yet used. Varicap diode tuning, accurately formed printed circuit coils, an I.C. in the special stereo decoder section and switchable squelch circuit for silent tuning between stations contribute to the unsurpassed performance of this tuner, irrespective of price consideration. But the Project 60 FM Stereo Tuner is far from expensive – indeed, it offers fantastic value for money and will bring the thrill of stereo radio to many who previously may not have been able to afford it. The tuner may be used with any good system as well as Project 60, but if you use it with other Project 60 modules, you will find the matching front panels particularly impressive in appearance as well as function.

#### SPECIFICATIONS

**Number of transistors:** 16 plus 20 in I.C.  
**Tuning range:** 87.5 to 108MHz.  
**Sensitivity:** 7 $\mu$ V for lock-in over full deviation.  
**Squelch level:** typically 20 $\mu$ V  
**Signal to noise ratio:**  $\pm$  65dB.  
**Audio frequency response:** 10Hz–15KHz ( $\pm$  1dB).  
**Total harmonic distortion:** 0.15% for 30% modulation.  
**Stereo decoder operating level:** 2 $\mu$ V.  
**Cross talk:** 40dB.  
**Output voltage:** 2 - 150mV R.M.S max. (typically 2 - 50mV, stereo)  
**Operating voltage:** 25–30V DC at 100mA.  
**Indicators:** Stereo on; tuning  
**Size:** 93 x 40 - 207mm.

### 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 tran-

sistor 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), 6–8 $\Omega$ . **Frequency Response:** 5Hz to 100KHz  $\pm$  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.

# sinclair

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

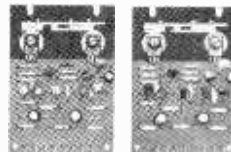
# the world's most advanced high fidelity modules

## 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.

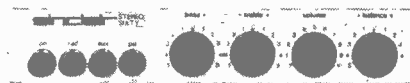


## Stereo 60 Pre-amp/control unit

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.

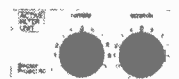
**SPECIFICATIONS—Input sensitivities:** Radio - up to 3mV Mag. p.u. 3mV correct to R.I.A.A. curve  $\pm 1$ dB - 20 to 25,000 Hz. Ceramic p.u. - up to 3mV. Aux - up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE - 12 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.



## A.F.U. High & Low Pass Filter Unit

Built, tested and guaranteed **£5.98**

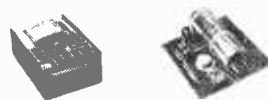
For use between Stereo 60 unit and two Z.30s or Z.50s. The unit is very easily mounted and is unique in that the cut-off frequencies are continuously variable. As attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. There are two filter sections - rumble (high pass) and scratch (low pass). H.F. cut-off (-3dB) variable from 28KHz to 5KHz. L.F. cut-off (-3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply) 0.02% at rated output. Operating voltage from 15 to 35V. Current 3mA. **Size:** 66 x 40 x 90mm.



## Power Supply Units

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

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

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.

SINCLAIR RADIONICS, ST IVES, HUNTINGDONSHIRE PE17 4HJ

Please send \_\_\_\_\_

I enclose cash/cheque/money order

Name \_\_\_\_\_

Address \_\_\_\_\_

PE 1072

# sinclair



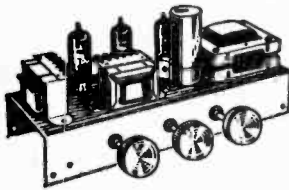
# SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts

r.m.s. into 8 ohm. Frequency response 12Hz-30KHz  $\pm$  3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-16 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7 1/2" deep. PRICE  $\pounds$ 10.50. P. & P. 25p.

## De Luxe Stereo Amplifier



A.C. mains 200-240 v. Using heavy duty fully isolated main transformer with full wave rectification giving a steady smoothing with negligible hum.

Valve line up:—2 x ECL86 Triode Pentodes. 1 x E280 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of a separate input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11" w x 4" d. Overall height including valves 5". Ready built & tested to a high standard. PRICE  $\pounds$ 28.92 P. & P. 45p.

## NEW! POWER SUPPLY UNIT

200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7 1/2v. and 9v. and 12v. at 1 amp continuous (1 amp intermittent). Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" x 3 1/2" x 2 1/2". Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested.

PRICE  $\pounds$ 4.50 P & P 35p.

**BLACK ANODISED 16g. ALUMINIUM HEAT SINKS.** For TO3, complete with mica's and bushes. Size 2 1/2" x 3" approx. 25p pair. P. & P. 5p.

**HIGH GRADE COPPER LAMINATE BOARDS.** 8 x 6 x 1/4 in. FIVE for 50p. P. & P. 13p.

**COILED SPRING BACK TELEPHONE CABLE.** Closed approx. 10" extends to 36". 4 core or 6 core. 25p each P. & P. 5p. 5 or more post free. LIMITED NUMBER!

**BRAND NEW MULTI-RATIO MAINS TRANSFORMERS** Giving 13 alternatives. Primary: 9-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-50v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long x 3 1/2in. wide x 3in. deep. Price  $\pounds$ 1.75 P. & P. 30p.

**MAINS TRANSFORMER.** For transistor power supplies. Pri 200/240v. Sec. 9-0-9 at 500mA. 70p. P. & P. 13p. Pri. 200/240v. Sec. 12-0-12 at 1 amp. 88p. P. & P. 13p. Pri. 200/240v. Sec. 10-0-10 at 2 amp. 1.38. P. & P. 30p.

**SPECIAL MAINS TRANSFORMER 200/240v.** A.C. Input 35v at 1 1/2 amp A.C. output overall size 2 1/2" x 2 1/2" x 3" approx. Suitable drop through or vertical mounting 75p. P. & P. 30p.

## HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A. European and Japanese transistors. ONLY 40p. Post 5p.

Open 9-5.30 Monday to Saturday  
Early closing Wed. 1 p.m.  
A few minutes from South Wimbledon Tube Station.

**4-SPEED RECORD PLAYER BARGAINS**  
Mains models. All brand new in maker's packing.  
**LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER.** With latest mono compatible cartridge  $\pounds$ 6.97 Carr. 50p. With stereo cartridge  $\pounds$ 7.97 Carr. 50p.  
**LATEST GARBARO MODELS. S.A.E. for latest Prices!**

**PRECISION ENGINEERED PLINTHS**  
Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL68B, AT60 etc. or B.S.R. C109, C129, A21 etc. Choice of Black leatherette or Teak grain finish. Size 12 1/2" x 14 1/2" x 3 1/2" high (approx. 7 1/2" high, including rigid smoked acrylic cover). PRICE  $\pounds$ 5.50. P. & P. 60p.

**LATEST ACOS GP91/18C mono compatible cartridge** with 1/0 stylus for LP/EP/78. Universal mounting bracket.  $\pounds$ 1.50 P. & P. 8p.

**SONOTONE STEREO COMPATIBLE STEREO CARTRIDGE** T/O stylus Diamond Stereo LP and Sapphire 78. ONLY  $\pounds$ 2.50 P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP.  $\pounds$ 3. P. & P. 10p.

**LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE** for EP/LP/Stereo/78.  $\pounds$ 1.63 P. & P. 10p.  
**LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE** for playing EP/LP/78 mono or stereo records on mono equipment. Only  $\pounds$ 1.50 P. & P. 10p.

**QUALITY RECORD PLAYER AMPLIFIER MK II**  
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide x 3in. deep x 6in. high. Ready built and tested. PRICE  $\pounds$ 3.75 P. & P. 40p.  
**ALSO AVAILABLE** mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE  $\pounds$ 4.88 P. & P. 50p.

**DELUXE QUALITY PORTABLE R/P CABINET MK II.** Uncut motor board size 14 1/2 x 12in. clearance 2in. below, 5 1/2in. above. Will take above amplifier and any B.S.R. or GARBARO changer or Single Player (except AT60 and SP25). Size 18 x 15 x 5in. PRICE  $\pounds$ 4.76. P. & P. 50p.

## SPECIAL OFFER! HI-FI LOUSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16 1/2" high x 10 1/2" wide x 5 1/2" deep. Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 8 or 15 ohms impedance.

**OUR PRICE  $\pounds$ 8.40 Carr. 65p**  
Cabinet Available Separately  $\pounds$ 4.50 Carr 60p  
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter  $\pounds$ 8.50 Carr. 65p

**LOUDSPEAKER BARGAINS**  
5in. 3 ohm  $\pounds$ 1.05. P. & P. 15p. 7 x 4in. 3 ohm  $\pounds$ 1.15. P. & P. 20p. 10 x 6in. 3 or 15 ohm  $\pounds$ 1.90. P. & P. 30p. E.M.I. 8" x 5in. 3 ohm with high flux magnet  $\pounds$ 1.62. P. & P. 20p. E.M.I. 13 1/2" x 8in. with high flux ceramic magnet 3, 8 or 15 ohm  $\pounds$ 3.20. P. & P. 30p. E.M.I. 13 x 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network  $\pounds$ 4.20. P. & P. 30p. E.M.I. 13 x 8in. twin cone (parasitic tweeter) 8 ohm  $\pounds$ 2.25. P. & P. 30p.

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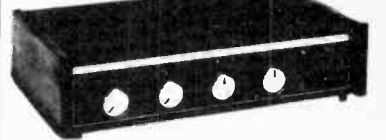
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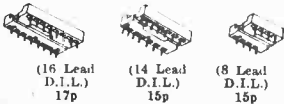
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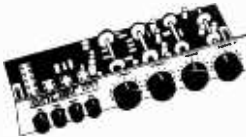
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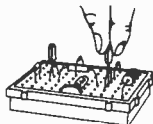
### PROJECT 60 KIT

Our extremely popular kit contains the extra capacitors, DIN plugs and sockets, cables and wire holder needed to complete Project 60 at the attractive price of £2.50.

### S-DECS AND T-DECS

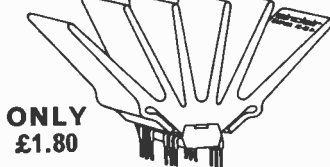
The breadboards for the transistor age.

S-DECS £1.40  
T-DECS £2.80  
µ-DEC A £3.00



Carriers with sockets to mount 14 and 16 pin in line ICs on T-DeC and µ-DeC A £1.25.

### SINCLAIR SUPER IC12



ONLY £1.80

Complete with free printed circuit board and 44 page instruction book.

### IC12 KITS

**POWER UNIT** Components for a 28V 0.5 Amp power unit ideal for all versions \*£2.00. Also suitable Sinclair PZ5 \*£3.70.

**LOUD SPEAKER** Specially chosen for the IC12. 5" x 8 ohm £1.00. 5" x 8" x 8 ohm £1.45. 10" x 6" 15 ohm \*£2.00.

**BASIC KIT** Contains components for the P.C. board and volume and simple tone controls. Mono version £1.10. Stereo model with balance control £2.39

**DELUXE KIT** Contains components for P.C. board and volume and full treble and bass controls. Should be used with one of preamps below. Mono unit £1.30. Stereo model with balance control £2.79.

**PREAMP KIT** Type 1 for magnetic pickups, mics and tuners, with 3 position equalization switch. Mono model £1.28. Stereo £2.28. Type 2 for ceramic or crystal pickups. Mono 48p. Stereo 96p.

## SWANLEY ELECTRONICS

32 Goldsel Rd., Swanley, Kent.

Mail order only. Postage 37p per order on orders containing one or more items with prices marked with an \*. Postage on other orders 10p.



## LOUDSPEAKER

### BARGAINS

Fane Pop 100 Watt 18" 8/15 ohm £19.50  
Fane Pop 60 Watt 15" 8/15 ohm £11.15  
Fane Pop 50 Watt 12" 8/15 ohm £9.25  
Fane Pop 25/2 12" 25 watts £5.40  
Fane Pop 15 12" 10 watts £4.00  
Baker Group 25 12" 3, 8 or 15 ohm £5.75  
Celebration PS8 for Unilux £2.35  
EMI 13 x 8, 3, 8 or 15 ohms £2.25  
EMI 13 x 8 d/cone 3, 8 or 15 ohms £2.60  
EMI 13 x 8 twin tweeter 3, 8 or 15 ohms £3.60  
Richard Allen 8" 3, 8 or 15 ohm £2.35  
Fane 8" dual cone 808T £2.85  
Fane 3" d/cone roll surround 807T £2.35  
Elac 59RM109 8" x 5" 15 ohm £2.70  
Elac 59RM114 9 x 5 8 ohm £2.70  
Elac 6 1/2 d/cone 8 ohm £2.25  
Elac 4" tweeter 8 ohm £1.50  
Crossover for above (post free) £1.50  
Richard Allen 12" 3 or 15 ohm £2.50  
Goodmans 8 P, 8 or 15 ohm £4.75  
Goodmans 10 P, 8 or 15 ohm £5.25  
Goodmans 12 P, 8 or 15 ohm £10.50  
Goodmans 15 P, 8 or 15 ohm £17.00  
Goodmans 18 P, 8 or 15 ohms £27.50  
2" 2 1/4" or 3" 80 ohm or 2 1/4" 64 ohm .65  
7" x 4" 3 or 8 ohm £1.50  
8" x 5" 3 or 8 ohm £1.50  
10" x 6" 3, 8 or 15 ohm £2.00  
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FREE with orders over £6—"Hi-Fi Loudspeaker Enclosures" book.

All units guaranteed new and perfect. Prompt despatch p. & p. 25p per speaker.

## WILMSLOW AUDIO, Dept. PW

10 Swan St., Wilmslow, Cheshire, SK9 1HF

### EX-RENTAL TV's (UNTESTED)

Complete with 13 channel tuners. Good cabinets. Carriage £1.50 extra.

19"/21" slimline (110° tube) .. £5.00  
23" slimline .. .. £7.50  
19" BBC 2 sets .. .. £14.50

### TUBES EX EQUIPMENT (Tested)

**SINGLE PANEL**

19"/21" any type .. .. £3.00  
23" any type .. .. £4.00

**TWIN PANEL (BONDED)**

19" bonded .. .. £5.00  
All tubes add £1 carriage.

### VALVES EX EQUIPMENT

EB91	5p	30L15	12p	PL36	22p
EBF80	12p	30P4	12p	PL81	17p
EC282	12p	PC97	17p	PY81	18p
EC180	7p	PCF86	17p	PY800	18p
EF80	12p	PC84	7p	PY82	7p
EF85	12p	PCF80	7p	PY33	22p
EF183	12p	PC089	12p	U191	17p
EF184	12p	PCL86	22p	8P23	17p
EY86	17p	PCL82	17p	30PL1	22p
30PL13	20p	PCL86	17p	30P12	20p
630LZ	12p	PCL83	12p	130F5	10p

Add 24p per valve p. & p., orders over £1 p. & p. free

### UHF TUNERS

For Ferguson 850 900 chassis. Adaptable for most UHF Chassis £2.50, p. & p. 50p.

### SLOT METERS

Smiths reconditioned switchmaster MK III. Decimalized. Perfect working order. 12 for £25 delivered. For sample send £2.50 c.w.o.

## TRADE DISPOSALS (Dept. PW/TS)

Thorbury Roundabout, Leeds Ed., Bradford. Telephone 0274/865670

### BARGAIN PRICE

BRAND NEW HARTLEY OSCILLOSCOPES CT916 in original packing. Band width up to 6 Mc/s. Mains supply. Price £40, p. & p. £1.50p.

NEW 8in. SPEAKERS 15 ohms 75p. p. & p. 10p.

BARGAIN PARCELS 14lb at £1.45 plus 32p p.p.: 28lb at £2.75 plus 52p p.p.: 56lb at £4.50 plus £1.25 p.p. Contain pots, Res, Valves, Diodes, Tagboards, Chassis, Valveholders, etc. Good value save £££. Lucky Dip Service.

FANTASTIC BARGAIN. New 6 inch tubes. E460 4/B/16 4VH, medium Persistence, green. Ideal scope tube. Also 09J 4 1/4 in. dia. Length 15in. Also 7BP7 and 3FP7 All unused as new. Price £1.40 post paid.

NEW HEAVY COAX CABLE dia. 1" 70 ohms approx. 50ft. lengths £1.40, p. & p. 30p. 100 ft. lengths £2.70, p. & p. 50p.

AERIALS New Condition Whip Type. 4ft. 20p; 11ft. 75p, all collapsible type. P. & p. 4ft. 10p, 11ft. 15p. New bases on adjustable clamp for the above, 62p, p. & p. 25p. New matching unit coax connection for above, 80p, p. & p. 5p.

MARCONI HEADPHONES. Boxed as new 60 ohms £1.25 carriage paid.

CRYSTALS AS NEW: Hc 6a, 5,345; 5,030; 5,005; 4,945; 4,875; 4,840; 4,795; 4,580; 4,660; 4,520; 4,510; 2,300; 2,295 Kc/s. 50p each plus 8p. p.

TRIMMER BARGAINS. These are 10PF sub-min. air-spaced trimmers on board with min. wire ended Xtal. Brand new. No details: Contents 12 trimmers, some ceramic caps. Xtal frequency 3RD overtone 249 mc/s-260 Mc/s, 255 Mc/s. No choice. Trimmers without Xtal—60p per doz. plus 17p p.p. Trimmers with Xtal—75p per doz. plus 17p p.p.

ANY HEIGHT AERIAL TUBULAR SECTIONS 1" dia x 3 ft. long. Brass screw in ends, copper coated and painted. Good condition. 20p, p. & p. 5p each. Minimum order 6.

AS NEW AERIAL TUNER UNIT No. 6 BF, consisting of 1 1/2 inch 500 micro/ampmeter 3 gang tuner 75 PF geared BNC type socket size 5 1/2" x 4 1/2" x 5". Price £1.50 carriage paid.

HEADPHONES DI. High impedance. Good condition 75p, p. & p. 10p.

R209. Set of valves 62p, p.p. 25p.

NEW AERIAL WIRE ON BOARDS 7/8 UNCOVERED. 75ft. 40p, 90ft. 47p, 100ft. 50p, p. & p. 20p.

### MUIRHEAD DECADE A.F. SIGNAL GENERATOR.

This precision instrument can be used:

1. To Measure Gain up to 50 dba.
2. To Measure Loss up to 45 dba.
3. To Compare Power levels (A.F.).
4. As an Audio Frequency Generator covering 100 Hz. to 41 kHz. With a dial setting accuracy of ±0.5 Hz. Output: -1 M/W into 600 Ω. Complete with mains power unit. Tested. Good Condition. £12, p. & p. 75p.

AERIAL MAST POLES approx. 5ft high 2" dia. Interlocking ends. Minimum order three. New condition. £1 each section. Carriage 35p each section.

1" 75 ohms Coax in 50ft coils with BNC plugs good condition. price £1 + 30p. p.p.

8in. METERS. 0-50 volts. 0-40 amps. 0-20 amps. All moving coil. 62p, p.p. 12p.

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

### QUOTATIONS FOR QUANTITY.

AS NEW UNUSED REJECTOR UNITS for rejecting unwanted signals. Four ranges 1-2-10 Mc/s. £1.50 p. & p. 20p each.

AS NEW UNUSED AERIAL VARIOMETER. Cylinder design 10" x 4 1/2", suitable for tuning most aerials for signal strength. £1.50 p. & p. 20p.

NEW HEADPHONES AND MIKE RUBBER muff type low impedance 97p p. & p. 17p.

TF1449 SIGNAL GENERATORS. Good condition £18 p. & p. £1.50

C.W.O. CARRIAGE CHARGES MAINLAND ONLY

WOULD CUSTOMERS PLEASE ENSURE THAT ALL ORDERS ARE PRINTED IN BLOCK CAPITALS AND INCLUDE YOUR ADDRESS.


## A. H. THACKER,

Radio Dept.  
HIGH STREET, CHESLYN HAY.  
Nr. Walsall, Staffs.


**DRILL CONTROLLER NEW IKW MODEL**  
Electrically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. \$1.50 plus 13p post and insurance. Made up model also available. \$2.25 plus 13p post & p.



**MAINS OPERATED CONTACTOR**  
220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2 1/2 x 3 x 2 1/2. \$1.50 each.



**NEED A SPECIAL SWITCH?**  
Double Leaf Contact. Very slight pressure closes both contacts. 6p each, 60p doz. Plastic push-rod suitable for operating, 6p each, 45p doz.



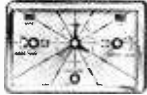
**MICRO SWITCH**  
5 amp changeover contacts, 9p each, 13 amp model 10p each or \$1.05 doz.



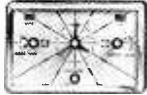
**MINIATURE WAFER SWITCHES**  
2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 2 way—3 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at 20p each, \$1.80 for ten, your assortment.




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




**ISA ELECTRICAL PROGRAMMER**  
Learn in your sleep. Have radio playing and kettle boiling as you awake—switch on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an electrical programmer Clock by famous maker with 15 amp, on/off switch. Switch on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price \$1.95 + 20p p & p or with glass front chrome bezel 75p extra.




**TREASURE TRACER MARK II**  
Complete Kit (except wooden batteries) to make the metal detector similar to the circuit in Practical Wireless August issue. \$3.95 plus 20p post and insurance.




**SNAP ACTION SLIDE SWITCH**  
Rated 5a. 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 5p each, 10 for 45p.




**NUMICATOR TUBES**  
For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3, Price \$1.45 each, 10 for \$13.



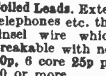
**12 WAY SUB-MINIATURE MULTI-CORE CABLE**  
7-0076 copper cores each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in. thick. Price 20p per yard.



**LIGHT CELL**  
Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin cased. Size approx. 1in. dia. by 1/2in. thick. Bated at 500 MW, wire ended, 48p with circuit. Also ORP 12 light cell 46p.



**MAINS TRANSISTOR POWER PACK**  
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only \$1 plus 20p postage.



**GOOD COMPANION**  
We can now offer these again in modular version using Mullard AF & IF Modules and Radio-mobile Permeability Tuner. Shouldn't take more than an evening to make. Cabinet size approx. 11" wide x 8" high x 3" deep. Complete assembly instructions—\$4.75 plus 20p post & ins.



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




**STANDARD WAFER SWITCHES**


Standard 1/4" wafer—silver-plated 5-amp contact, standard 1" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
3 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
4 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
5 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
6 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
7 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
8 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
9 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
10 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
11 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p
12 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p

**THYRISTOR LIGHT DIMMER**  
For any lamp up to 200 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price \$2.50 plus 20p post and insurance.




**MULLARD AUDIO AMPLIFIER MODULE**  
Uses 4 transistors, and has an output of 500mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up 9V battery operated. Size 2in long x 1 1/2in wide x 1 1/2in high. SPECIAL SNIP PRICE 65p each, 10 for \$5.80.



**THIS MONTH'S SNIP**


**REPEATING TIME SWITCH**  
1 or 2 on/off per 24 hours. Repeats until re-programmed. Switches up to 15 amp. Switching time completely adjustable through 24 hours. Precision made with 24 hour dial. Miniature—will fit into 2" cube. Mains operated clock but switch may be isolated for switching battery sets. Ideal for—shop window lighting, anti-theft devices, central heating control and many other automatic processes. Price with instructions \$2 each + 20p post and insurance.



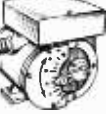
**HORSTMANN 'TIME & SET' SWITCH**  
(A30 Amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc. up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around \$5. Special snip price \$1.50 Post and ins. 23p.



**HONEYWELL THERMOSTAT**  
Made by Honeywell for normal air temperatures 40°-90°F (5-25°C). This is a precision instrument with a differential which can be adjusted to better than 1/2°F. A mercury switch breaks on temp. rise—the switch is operated by a coiled bi-metal element and adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows thermometer above and control processing. Regular price probably around \$5. Special snip price \$1.25 each or ten for \$11.25.



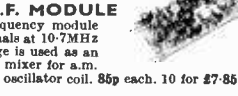
**ZPM—MODULATION MOTOR**  
Could also be used to open ventilators, doors, valve, damper etc. particularly suitable for remote control. Made by Satchwell. Essentially a reversible geared motor fitted with internal limit switches to stop it at the end of its travel. Size approx. 6" x 6" x 5 1/2" and weighing approx. 10 lbs. This is extremely powerful and would lift a heavy door or open a long line of ventilators. To operate this motor you put the 50 cycle supply through a change over switch. For instance a thermostat with change-over contacts could automatically regulate the temperature in a growing house, chicken hatchery etc. An indicator on the motor graduated 0-10 shows the state of open or close. Also internally fitted is a variable resistor; wires from this to a volt meter would give a remote indication of the open or close position. A very expensive motor if both direct from Satchwell, our price complete with step down Transformer is \$15.



**INTEGRATED CIRCUIT BARGAIN**  
A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPV matched pair. Regular price of parcel well over \$5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only \$1 post paid. **DON'T MISS THIS TERRIFIC BARGAIN.**



**MULLARD I.F. MODULE**  
This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10-7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 85p each, 10 for \$7.85 100 for \$62.50p. With connection dig.



**EDUCATIONAL KITS—all with pictorial instructions**

**THIS BALANCE KIT FREE**  
Eagle educational kits. Japanese made these are even better value for money. We do not expect to be able to repeat this offer once stocks are sold. Brief description of each kit is given below and with 3 kits or more we give FREE an accurate 11 piece balance kit. Price of kits 40p each post paid. Special price for all 7 kits \$2.50 with free balance kit.



**KA2 Lens Kit.** Eleven parts, including candle one concave lens, one convex lens, stage and all frame, etc. Watch light rays bend as they pass through different lenses.

**KA3 Water Pump Kit.** Thirteen parts. Top of pump is transparent so that operating parts may be observed. Small parts are brightly coloured to be seen easily while working. Three types of pump may be made: Lift pump, Force Pump and Force Pump with reservoir and nozzle.

**KA4 Buzzer Kit.** Eleven parts. Transparent covers allow the operation of buzzer to be seen. Illustrates and teaches how electromagnetism with an automatic switch result in an operating buzzer.

**KA5-2 Pole Motor Kit.** Twenty-four parts, including enamel wire, armature and pole piece, etc. Motor operates from 1 1/2 volt battery. Illustrates and teaches how electro-magnetism operates a motor.

**KA7 Electro-Magnet Kit.** Fifteen parts, includes compass. Makes two electro-magnets, one with one layer of wire and one with several layers of wire. Picks up tacks, nails and any small parts showing how magnetism works.

**KA8 Current and Resistance Kit.** Twenty-nine parts, including bench and light bulb. Conduct illustrates and educational projects to learn the application of "OHM'S LAW" and see the difference in current and resistance with different types and lengths of wire.

**KA9 Bell Kit.** Eight parts, including bell and push button switch. Build a complete electric bell and see how the hammer is triggered to make the bell ring.

**TAPE HEADS**  
Miniature size 1/2" square front x 1/2" deep. Under-stand made for Truvox. Double wound, maybe wired in series or parallel for high or low impedance working. Each supplied with matching erase head. 2 track 60p pair, 4 track 75p pair. Less 10% 10 or more pairs.

**KA10 Morse Key buzzer and bell kit.** 25 part kit easy to construct, simple to operate.

**Instrument Motors fitted with Gear Box.** These made by Smiths Industries are as fitted into electric clocks, chart recorders etc. Motor size approx. 1 1/2" dia. x 1" deep. Gear box attached approx. 2" diameter x 1/2" thick with good length of spindle. Most motors are fitted with a 1/2" long x 1/2" diameter drive spindle. Suitable for 200/240v mains 50 c.p.s. unless marked otherwise. Following speeds available—3 revs per min., 15 revs per min., 30 revs per hour, 6 revs per hour (60 cycles), 4 revs per hour (60 cycles), 2 revs per hour, 8 revs per hour, 6 revs per day. All \$1 each or 10 for \$8.

**Micro Switch.** Made by Burgess. 15 amp on/off—normally closed. Size 1 1/2" x 1/2" x 1". Price 15p each or 10 for \$1.35. Operation is by pressure on tiny ball.

**2 Amp Switched Sockets.** Oblong, brown bakelite surface mounting—2 pin Standard domestic type. 10p each or 10 for 90p.

**Surface Switches.** 5 amp British make. Brown bakelite—oblong—1 way 10p each, 2 way 15p each.

**Torch Bulbs.** Empire made. 2.5v and 3.5v. Boxes of 25—25p or 10 boxes for \$2.25.

**3 Core Maroon Cotton Covered Flex.** Very best makers but old coloured code. 6 amp—23/36 x 100 yd coil \$2 plus 50p, 15 amp—70/36 x 60yd coil \$2.95 plus 50p post.

**Delay Switch.** Glass tubular encased on 4 pin base gives a delay of 60 secs. when 3v are applied to the electrically isolated heater. Delay can be shortened to approx 1 second by increasing the heater voltage up to 6 or 7v. Price 50p each or 10 for \$4.50.

**Miniature Tubes.** These are approx. 1/2" diameter and need miniature bi-pin end connectors. 3 sizes available:—9" 6 watt, 12" 8 watt, 21" 13 watt. All are 65p each. Less 10% on 10 or more.

**A.C. Mains Buzzer.** These are open constructions intended for fitting into instruments etc. Size approx. 1 1/2" x 1 1/2" x 1" deep x 1/2" wide. 25p each, 10 for \$2.25.

**4 Watt Amplifier Module.** Made by Mullard Ref. No. EP9000. Part of the Unilex system. This has an output of 4 watt speech and music into a 12-15 ohm speaker. A powerful amplifier with a thousand uses—completely encased. Size approx. 2 1/2" x 1 1/2" x 1 1/2". Screw down input and output terminals. Price \$1.45 each or 10 for \$13.05.

**Pre-Amplifier Module.** 2 channel for Stereo. Input sensitivity 320mV. Part of the Mullard Unilex system and completely encased. Size 4" x 4" x 1". Screw down input and output terminals. Price \$1.80 each or 10 for \$16.20.

Where postage is not stated then orders over 25 are post free. Below 25 add 20p  
Semiconductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

**J. BULL (ELECTRICAL) LTD.**  
(Dept. P.W.), 7 Park Street, Croydon CRO 1YD  
Callers to: 102/3 Tamworth Road, Croydon.

**All prices in pounds and new pence**

VALVES		6BA6		25 6J6		20 7C5		11-13 128R7		40 137		40 DAF91		30 EBL31		60 N108		11-50 PL508		90 UABC80			
1A7GT	45	6B46	30	6J7M	45	7C6	75	14H7	50	42	40	DAF96	40	ECC80	35	EL92	65	OA2	35	PL509	11-10	UAF42	55
1CP31	57-00	6B6	70	6J7GT	45	7D5	60	19AQ5	50	50B5	50	DAP96	50	ECC81	35	EL94	25	OC3	38	PL802	95	UBC41	50
1D5	50	6B7A	45	6K8GT	45	7H7	60	20P1	50	50C5	50	DAP96	50	ECC82	30	EL95	35	OC4	40	PX4	52-50	UBC81	40
1H5	50	6BR8	90	6K7M	40	7H7	75	20P2	70	50CD6G	11-20	DF70	45	ECC83	30	ELL80	11-00	PC86	60	PX25	52-50	UBF80	40
1NSGT	55	6BR7	11-80	6K7GT	35	9BW6	60	20P5	11-20	78	45	DF92	50	ECC84	30	EM80	45	PC87	60	PY33	63	UBF89	35
IR5	40	6BW6	85	6K8M	60	10C2	63	25A6	35	80	55	DF96	45	ECC85	40	EM81	60	PC97	50	PY81	30	UCB4	45
IR4	30	6BW7	80	6K8G	40	10P1	75	25L8GT	50	85A2	50	DF96	45	ECC86	40	EM84	35	PC84	40	PY82	35	UCB8	40
IR5	30	6C4	33	6K8GT	50	10F3	60	20Y5	65	150B2	60	DK32	45	ECH42	75	EZ35	40	PCF80	30	PY800	40	UCH41	40
IT4	30	6C9G	35	6K25	75	10F9	60	25Z4	30	150C4	60	DK91	40	ECH81	30	EZ40	50	PCF82	35	PY801	50	UCL82	35
3Q4	40	6C6	25	6L6G	50	10F18	50	25Z5GT	55	801	60	DK92	55	ECH83	45	EZ41	50	PCF84	60	R2	75	UCL83	60
3Q5	50	6C6DG	11-25	6L18	45	10LD11	65	25Z6	65	807	50	DK96	50	ECL80	45	EZ80	27	PCF86	60	R19	50	UCL84	30
3Q5	50	6CH6	60	6Q7G	40	10P13	60	30C1	30	813USA	53-75	DL66	11-25	ECL82	35	EZ91	29	PCF801	50	8130	11-75	UP41	60
384	35	6CW4	65	6Q7GT	42	11E3	54-00	30C15	30	30C18	80	DL92	35	ECL83	40	GZ30	80	PCF802	50	8P4	60	UL14	65
3V4	43	6D6	35	6S47M	40	12A7E	30	30C17	90	941	60	DL93	40	ECL84	40	GZ31	48	PCF805	70	8P61	75	UM80	30
5R4GY	75	6E5	80	68C7M	75	12A7T	30	30C18	80	1025	55	DL94	48	ECL800	GZ32	48	PCF808	85	8TV280/80	U06	11-75	UM80	30
5U4G	35	6F1	70	6S07M	40	12A7U	30	30FL1	75	5763	70	DL96	45	EF9	75	HN309	11-50	PCL82	35	110-00	U07	11-75	
5Y3GT	40	6F6G	35	68H7M	40	12A7V	30	30FL12	11-20	7193	30	DM70	45	EF37A	11-20	KT36	11-00	PCL83	35	8U25	11-00	U08	11-75
5Z4G	40	6F8G	50	68K7GT	40	12BA6	40	30FL14	35	7475	50	DY86	38	EF39	50	KT61	11-25	PCL84	45	8U26	11-00	U09	50
6J30L2	80	6F11	40	68L7GT	35	12BE6	40	30FL15	35	A81	48	DY87	38	EF41	55	KT81	11-25	PCL85	40	T41	11-00	UY21	50
6A7	75	6F13	45	68N7GT	35	12C8GT	35	30FL17	50	ATP4	60	E850	20	EF80	25	KT81(7C5)	PD500	11-30	U10	75	UY84	48	
6A8G	40	6F14	70	68Q7GT	40	12E1	52-20	30P4	11-12	ATP5	60	EABCB80	35	EF85	35	11-13	PEN44	11-00	U14	75	VMP4G	85	
6AK5	35	6F23	85	6U4GT	65	12J5GT	30	30P12	30	ATP7	60	EABF42	55	EF86	30	KT88	22-00	PEN44	11-00	U19	53-00	VP4B	11-25
6AM5	35	6F24	75	6U5G	40	12J7GT	50	30P19	85	AU2	54-00	EABF42	55	EF89	28	KTW61	11-00	PEN45	75	U25	80	VR105/30	38
6AM6	38	6F28	65	6V6G	60	12K8GT	50	30P13	93	AZ1	55	EBC33	50	EF91	38	KTZ41	50	PEN46	40	U28	35	VR150/30	35
6AQ5	38	6F32	25	6V8GT	40	12Q7GT	40	30P14	90	AZ31	55	EBC41	55	EF92	35	ML4	85	PL8	50	U191	75	VR111	75
6AR7G	85	6G6	25	6X4	35	12S47GT	50	35A6	50	35A6	75	CB131	11-00	EB90	35	ML6	40	PL81	50	U191	75	VR150/30	35
6AT6	35	6H6	23	6X5G	40	12A07	35	35W4	35	CL33	11-30	EBF83	40	EF183	30	M8P4	50	PL82	45	U251	80	VR120	11-00
6AU6	25	6J5M	50	6X5GT	40	12B7	75	35Z3	70	CY30	63	EBF89	30	EL32	50	MU14	75	PL83	45	U301	63	VU508	63
6BA4	11-00	6J5G	50	7B6	70	12H7	40	35Z4GT	60	CY31	43	EBL1	11-00	EL33	11-25	MX40	63	PL84	40	U403	60	W81M	63
6B9G	25	6J5GT	30	7B7	50	12K7	60	35Z5	60	DAC32	50	EBL21	60	EL34	50	N78	11-50	PL504	80	U801	11-18	Y63	50

Transistors		BFY50		22 OA91		07 OC170		25		Integrated Circuits		7437		65 7473		40 7493		75 74123		11-35		74176		11-35	
1N914	07	2N3702	10	BZY88	15	OAZ207	47	OC7P1	87	7410	20	7423	48	7460	20	7482	87	74107	20	74156	22-50	74176	11-60	74190	11-95
18113	25	2N3819	10	CR61-40	47	OAZ210	52	ORP12	50	7401	20	7425	48	7451	20	7483	21-00	74107	60	74154	11-50	74191	11-95	74192	22-00
18202	23	2N4209	30	GET102	30	OAZ224	45	Z8170	10	7402	20	7427	48	7453	20	7484	90	74110	80	74155	11-55	74195	11-95	74196	11-50
2G302	22	AAZ12	15	GET882	25	OAZ224	45	Z8170	10	7403	20	7428	50	7454	20	7485	90	74111	21-45	74156	11-55	74196	11-50	74197	11-50
2G371	22	AC126	20	GET882	25	OAZ241	22	ZTX107	18	7404	20	7428	50	7454	20	7485	90	74111	21-45	74156	11-55	74196	11-50	74197	11-50
2N404	20	AC127	25	GJ7M	37	OAZ246	23	ZTX108	12	7405	20	7428	50	7454	20	7485	90	74111	21-45	74156	11-55	74196	11-50	74197	11-50
2N697	15	AC128	20	K8100A	20	OAZ246	23	ZTX109	12	7406	20	7430	20	7454	20	7485	90	74111	21-45	74156	11-55	74196	11-50	74197	11-50
2N706	10	AC129	20	MJE230	20	OC35	50	ZTX109	12	7407	20	7432	42	7470	30	7490	75	74118	11-00	74157	11-50	74197	11-50	74198	11-50
2N1132	25	ACY39	30	MJE285	50	OC44	17	ZTX109	12	7408	20	7432	42	7470	30	7491AN	11-00	74119	11-00	74170	11-10	74198	11-50	74199	11-50
2N1305	22	AD140	20	MJE285	50	OC44	17	ZTX500	16	7406	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74200	11-50
2N2147	75	AD149	50	MJE3055	87	OC57	60	ZTX503	17	7407	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74201	11-50
2N2160	60	AD161	37	NKT212	27	OC58	60	ZTX531	25	7408	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74202	11-50
2N2218	20	AF115	25	NKT214	15	OC59	65			7409	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74203	11-50
2N2219	20	AF117	25	NKT223	33	OC79	12			7410	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74204	11-50
2N2369A	15	AS Y28	25	NKT223	33	OC79	12			7411	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74205	11-50
2N2444	11-61	BC107	10	NKT251	24	OC72	20			7412	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74206	11-50
2N2446	45	BC108	10	OA70	10	OC81D	20			7413	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74207	11-50
2N2904	20	BC109	10	OA71	10	OC82	25			7414	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74208	11-50
2N2926	10	BC169C	15	OA81	08	OC82D	20			7415	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74209	11-50
2N3055	75	BF898	28	OA85	12	OC84	25			7416	20	7433	70	7472	30	7492	75	74121	60	74174	22-00	74199	11-50	74210	11-50

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# SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.  
 ● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

## NEW "SEW" DESIGNS!

### CLEAR PLASTIC METERS

**TYPE SW.100**  
100 x 80 mm.

50μA	23-60	20V. D.C.	23-10
50-0-50μA	23-45	50V. D.C.	23-10
100μA	23-45	300V. D.C.	23-10
100-0-100μA	23-35	1 amp. D.C.	23-10
500μA	23-20	5 amp. D.C.	23-10
1mA	23-10	300V. A.C.	23-10
		VU Meter	23-75

### BAKELITE PANEL METERS

**TYPE S-80**  
80 mm. square fronts

50μA	23-20	50V. D.C.	23-60
50-0-50μA	23-10	300V. D.C.	23-60
100μA	23-10	1 amp. D.C.	23-60
100-0-100μA	23-00	5 amp. D.C.	23-60
500μA	23-75	300V. A.C.	23-60
1mA	23-60	20V. D.C.	23-20
		VU Meter	23-37

## "SEW" CLEAR PLASTIC METERS

Type MR.55P. 4 1/4 in. x 4 1/4 in. fronts.

50μA	23-60	10V. D.C.	23-60
50-0-50μA	23-10	20V. D.C.	23-60
100μA	23-60	50V. D.C.	23-60
100-0-100μA	23-50	150V. D.C.	23-60
500μA	23-60	300V. A.C.	23-60
1mA	23-60	15V. A.C.	23-60
100-0-100μA	23-00	300V. A.C.	23-60
200μA	23-00	8 Meter 1mA	23-87
500μA	23-60	VU Meter	23-60
500-0-500μA	23-60	1 amp. A.C.	23-60
1mA	23-60	5 amp. A.C.	23-60
1-0-1mA	23-60	10 amp. A.C.	23-60
5mA	23-60	20 amp. A.C.	23-60
10mA	23-60	30 amp. A.C.	23-60

Type MR.55P. 2 1/2 in. square fronts.

50μA	23-10	10V. D.C.	23-60
50-0-50μA	23-60	20V. D.C.	23-60
100μA	23-60	50V. D.C.	23-60
100-0-100μA	23-50	150V. D.C.	23-60
500μA	23-60	300V. A.C.	23-60
1mA	23-60	15V. A.C.	23-60
5mA	23-60	8 Meter 1mA	23-10
10mA	23-60	VU Meter	23-80
50mA	23-60	1 amp. A.C.	23-60
100mA	23-60	5 amp. A.C.	23-60
1 amp.	23-60	10 amp. A.C.	23-60
5 amp.	23-60	20 amp. A.C.	23-60
		30 amp. A.C.	23-60

Type MR.55P. 3 1/4 in. x 3 1/4 in. fronts.

50μA	23-37	10V. D.C.	23-20
50-0-50μA	23-75	20V. D.C.	23-20
100μA	23-75	50V. D.C.	23-20
100-0-100μA	23-65	150V. D.C.	23-20
200μA	23-65	300V. D.C.	23-20
500μA	23-40	15V. A.C.	23-20
500-0-500μA	23-20	50V. A.C.	23-20
1mA	23-20	150V. A.C.	23-20
5mA	23-20	300V. A.C.	23-20
10mA	23-20	300V. A.C.	23-20
50mA	23-20	5 Meter 1mA	23-27
100mA	23-20	15V. A.C.	23-87
200mA	23-20	50mA A.C.	23-20
1 amp.	23-20	100mA A.C.	23-20
5 amp.	23-20	200mA A.C.	23-20
10 amp.	23-20	500mA A.C.	23-20
15 amp.	23-20	1 amp. A.C.	23-20
20 amp.	23-20	5 amp. A.C.	23-20
30 amp.	23-20	10 amp. A.C.	23-20
50 amp.	23-20	20 amp. A.C.	23-20
5V. D.C.	23-20	30 amp. A.C.	23-20

**\* MOVING-IRON**  
**ALL OTHERS MOVING COIL**  
 Please add postage

## SEW EDUCATIONAL METERS



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

A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50μA	25-00	20V. d.c.	24-80
100μA	24-85	50V. d.c.	24-40
1mA	24-40	300V. d.c.	24-40
50-0-50μA	24-65		
1A d.c.	24-40	Dual range	
5A d.c.	24-40	500mA/5A d.c.	24-65
10V. d.c.	24-40	5V/50V d.c.	24-65

Type MR.35P. 1 21/32 in. square fronts.

200mA	21-60	300mA	21-60
500mA	21-60	500mA	21-60
750mA	21-60	1 amp.	21-60
2 amp.	21-60	5 amp.	21-60
10 amp.	21-60	3V. D.C.	21-60
3V. D.C.	21-60	10V. D.C.	21-60
10V. D.C.	21-60	15V. D.C.	21-60
20V. D.C.	21-60	20V. D.C.	21-60
300V. D.C.	21-60	100V. D.C.	21-60
150V. D.C.	21-60	500μA	21-65
300V. D.C.	21-60	500-0-500μA	21-60
150V. D.C.	21-60	1mA	21-60
750V. D.C.	21-60	1-0-1mA	21-60
150V. A.C.	21-60	5mA	21-60
50V. A.C.	21-70	10mA	21-60
150V. A.C.	21-70	20mA	21-60
300V. A.C.	21-70	50mA	21-60
500V. A.C.	21-70	100mA	21-60
8 Meter 1mA	21-70	150mA	21-60
VU Meter	21-80		

Type MR.45P. 2 1/2 in. square fronts.

50μA	22-25	5 amp.	21-70
50-0-50μA	22-10	10V. D.C.	21-60
100μA	22-10	20V. D.C.	21-60
100-0-100μA	21-87	50V. D.C.	21-60
200μA	21-87	300V. D.C.	21-60
500μA	21-75	15V. A.C.	21-80
500-0-500μA	21-70	300V. A.C.	21-80
1mA	21-70	8 Meter 1mA	21-85
5mA	21-70	VU Meter	22-25
10mA	21-70	1 amp. A.C.	21-70
50mA	21-70	5 amp. A.C.	21-70
100mA	21-70	10 amp. A.C.	21-70
500mA	21-70	20 amp. A.C.	21-70
1 amp.	21-70	30 amp. A.C.	21-70

## "SEW" BAKELITE PANEL METERS

Type MR.65. 3 1/4 in. square fronts.

1 amp.	21-95	1 amp.	21-95
2 amp.	21-95	5 amp.	21-95
5 amp.	21-95	15 amp.	21-95
30 amp.	21-95	50 amp.	21-95
50 amp.	21-95	5V. D.C.	21-95
10V. D.C.	21-95	10V. D.C.	21-95
20V. D.C.	21-95	60V. D.C.	21-95
60V. D.C.	21-95	150V. D.C.	21-95
300V. D.C.	21-95	300V. A.C.	21-95
50V. A.C.	21-95	50V. A.C.	21-95
150V. A.C.	21-95	100-0-100μA	23-25
300V. A.C.	21-95	500μA	23-20
500mA A.C.	21-95	1mA	21-95
1 amp. A.C.	21-95	1-0-1mA	21-95
5 amp. A.C.	21-95	5mA	21-95
10 amp. A.C.	21-95	10mA	21-95
20 amp. A.C.	21-95	50mA	21-95
30 amp. A.C.	21-95	100mA	21-95
50 amp. A.C.	21-95	500μA	21-95
VU Meter	23-10		

## EDGWISE METERS

Type PE.70. 3 1/8 17/32 in. x 1 15/32 in. x 2 1/2 in. deep

50μA	23-10	500μA	22-75
50-0-50μA	23-00	1mA	22-45
100μA	23-00	300V. A.C.	22-45
100-0-100μA	22-90		
200μA	22-90	VU Meter	23-40

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

# MULTIMETERS for EVERY purpose!



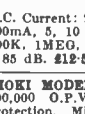
**HIOKI MODEL 720X**  
 20,000 O.P.V.  
 Overload protection  
 5/25/100/500/1000 VDC.  
 10/50/250/1000 VAC.  
 50μA/250mA. 20K/2 meg  
 ohm. -5 to +62db.  
 24-97. P. & P. 15p.



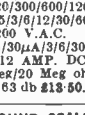
**MODEL PL436**  
 20KΩ/Volt D.C.  
 8KΩ/Volt A.C.  
 Mirror scale.  
 -6/3/12/30/120/600V  
 D.C. 3/30/120/600V  
 A.C. 50/600A/60/  
 600 mA. 10/100K/  
 Meg/10 Mms/5  
 -20 to +46db. 24-97J P & P 12p



**MODEL 5025 57 Ranges**,  
 Giant 5 1/4 in. 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, 501A, 2.5, 5, 25, 50, 250,  
 500mA, 5, 10 amp. Resistance: 2K, 10K,  
 100K, 1MEG, 10 MEG. Decibels: -20 to  
 +85 db. 21-50. P. & P. 17p.



**HIOKI MODEL 700X**  
 100,000 O.P.V. Overload  
 protection. Mirror scale.  
 -3/8/1-2/1-5/3/6/12/30/60/  
 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  
 +63 db 21-50. 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  
 ONLY 21-97 P. & P. 13p



**TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER**  
 Battery operated,  
 11 meg input, 28  
 ranges. Large 4 1/2"  
 mirror scale. Size  
 3 1/2" x 4 1/2" x 2 1/2".  
 DC VOLTS 0.3-  
 1200V. AC VOLTS  
 3-300V RMS. 8-0-  
 800V P-P. DC CUR-  
 RENT 12-12MA.  
 Resistance up to 2000ohm.  
 -20 to +51 db. Complete with leads/instructions.  
 21-70. P. & P. 20p.



**TE-20D RF SIGNAL GENERATOR**  
 Accurate wide range signal  
 generator covering  
 120 Kcs-500 Mc/s on  
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 Xtal socket for calibra-  
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 Brand new with instruc-  
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 Size 140 x 215 x 107  
 mm.



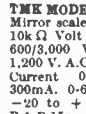
**TE22 SINE SQUARE WAVE AUDIO GENERATORS**  
 Sine: 20cps to 200  
 kc/s on 4 bands.  
 Square: 20cps to  
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 impedance 5,000  
 ohms, 200/250V.  
 A.C. operation.  
 Supplier's brand  
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 tion manual and leads. 21-75. Carr. 37p.



**TE-20RF SIGNAL GENERATOR**  
 Accurate wide range signal generator covering  
 120 kc/s-260  
 Mc/s on 6 bands.  
 Directly calibrated  
 variable R.F. at-  
 tenuator. Operation  
 200/240V A.C.  
 Brand new with in-  
 struction. \$15  
 P. & P. 37p. S.A.E.  
 for details.



**MODEL LT.101 1000 O.P.V.**  
 0/10/250/500/1000. D.C.  
 0/10/50/250/1000 V. A.C.  
 0/1/100 M.A. 0/150 K ohms.  
 21-97. P. & P. 15p.



**TMK MODEL MD.150**  
 Mirror scale. 20K/Volt D.C.  
 10K/Volt A.C. 30/60/300/  
 600/3,000 V. D.C. 6/12/20/  
 1,200 V.A.C.  
 Current 0-60μA/0-12/0  
 300mA. 0-60K/0-6 MegΩ.  
 -20 to +63 db. 24-82J  
 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.  
 0/60K/8 Meg/60 Meg Ω.  
 28-87J. Post paid.



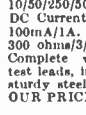
**TMK LAB TESTER.**  
 100,000 O.P.V. 6 1/4 in.  
 Scale Buzzer Short Cir-  
 cuit Check. Sensitivity:  
 100,000 O.P.V. D.C. 5K/  
 Volt A.C. 10 D.C. Volt:  
 5, 2.5, 1.0, 50, 250, 1,000  
 V. A.C. Volts: 3, 10, 50,  
 50, 250, 500, 1,000V.  
 D.C. Current: 10, 100μA,  
 10, 100, 500mA, 2.5, 10  
 amp. Resistance: 1K, 10K, 100K, 10MEG,  
 100MEG Ω. -20 to +49 db.  
 Plastic Case with Carrying Handle. Size:  
 7 1/4 in. x 6 1/4 in. x 3 1/4 in. 21-90. P. & P. 25p



**RUSSIAN 22 RANGE MULTIMETER**  
 Model U457 10,000 o.p.v.  
 A first class versatile in-  
 strument manufactured in  
 U.S.S.R. to the highest  
 standards. Range: 2-5/10/  
 50/250/500/1000V D.C. 2-5/  
 10/50/250/500/1000V A.C.  
 DC Current 100 μA/1/10/  
 100mA/1A. Resistance  
 300 ohms/3/30/300K/3m Ω.  
 Complete with batteries-  
 test leads, instructions and  
 sturdy steel carrying case.  
 OUR PRICE 25-97 P. & P. 25p.



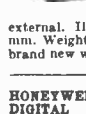
**TO-3 PORTABLE OSCILLOSCOPE**  
 3in. tube, Y amp. Sensitiv-  
 ity 0.1v p-p/CM. Band-  
 width 1.5 cps-1.5 MHz.  
 Input Imp. 2 meg Ω 25pF  
 X amp. Sensitivity 0.9v.  
 p-p/CM. Bandwidth 1.5cps  
 -800KHz. Input Imp. 2  
 meg Ω 20pF. Time base.  
 5 ranges 10 cps-300KHz.  
 Synchronization. Internal/  
 external. Illuminated scale: 140 x 215 x 330  
 mm. Weight 15 1/2 lb. 220/240V. A.C. Supplied  
 brand new with handbook. 240-00. Carr. 50p.



**HONEYWELL DIGITAL VOLTMETER VT.100**  
 Can be panel or  
 bench mounted.  
 Basic meter meas-  
 ures 1 volt D.C.  
 but can be used to measure a wide range of  
 AC and DC volt. current and ohms with  
 optional plug in cards. Specification: Accu-  
 racy: ±0.2 ±1 digit. Resolution: 1mV.  
 Number of digits: 3 plus fourth overrange  
 digit. Overrange: 100% (up to 1.999). Input  
 Impedance: 1000 Meg ohm. Measuring cycle:  
 1 per second. Adjustment: Automatic zero-  
 ing, full scale adjustment against an internal  
 reference voltage. Overload: to 100V. D.C.  
 Input: Fully floating (3 poles). Input power:  
 110-230V. A.C. 50/60 cycles. Overall size:  
 6 1/4 in. x 2 1/2 in. x 8 3/16 in. AVAILABLE  
 BRAND NEW AND FULLY GUARAN-  
 TEED AT APPROX. HALF PRICE.  
 249-97J. Carr. 50p.



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



**240° Wide Angle 1mA Meters**  
 MW1-6 60mm square 23-97J  
 MW1-8 80mm square 24-97J  
 P. &

# SEM-CONDUCTOR VALVES

## ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors		BC114		BFW90		NKT219	
2G301	2N3415	22p	2N5458	35p	BC115	15p	BPW91
2G302	2N3416	37p	2N5459	40p	BC116	15p	BPX12
2G303	2N3417	37p	2N5460	40p	BC117	15p	BPX13
2G304	2N3418	37p	2N5461	40p	BC118	15p	BPX14
2G305	2N3419	37p	2N5462	40p	BC119	15p	BPX15
2G306	2N3420	37p	2N5463	40p	BC120	15p	BPX16
2G307	2N3421	37p	2N5464	40p	BC121	15p	BPX17
2G308	2N3422	37p	2N5465	40p	BC122	15p	BPX18
2G309	2N3423	37p	2N5466	40p	BC123	15p	BPX19
2G310	2N3424	37p	2N5467	40p	BC124	15p	BPX20
2G311	2N3425	37p	2N5468	40p	BC125	15p	BPX21
2G312	2N3426	37p	2N5469	40p	BC126	15p	BPX22
2G313	2N3427	37p	2N5470	40p	BC127	15p	BPX23
2G314	2N3428	37p	2N5471	40p	BC128	15p	BPX24
2G315	2N3429	37p	2N5472	40p	BC129	15p	BPX25
2G316	2N3430	37p	2N5473	40p	BC130	15p	BPX26
2G317	2N3431	37p	2N5474	40p	BC131	15p	BPX27
2G318	2N3432	37p	2N5475	40p	BC132	15p	BPX28
2G319	2N3433	37p	2N5476	40p	BC133	15p	BPX29
2G320	2N3434	37p	2N5477	40p	BC134	15p	BPX30
2G321	2N3435	37p	2N5478	40p	BC135	15p	BPX31
2G322	2N3436	37p	2N5479	40p	BC136	15p	BPX32
2G323	2N3437	37p	2N5480	40p	BC137	15p	BPX33
2G324	2N3438	37p	2N5481	40p	BC138	15p	BPX34
2G325	2N3439	37p	2N5482	40p	BC139	15p	BPX35
2G326	2N3440	37p	2N5483	40p	BC140	15p	BPX36
2G327	2N3441	37p	2N5484	40p	BC141	15p	BPX37
2G328	2N3442	37p	2N5485	40p	BC142	15p	BPX38
2G329	2N3443	37p	2N5486	40p	BC143	15p	BPX39
2G330	2N3444	37p	2N5487	40p	BC144	15p	BPX40
2G331	2N3445	37p	2N5488	40p	BC145	15p	BPX41
2G332	2N3446	37p	2N5489	40p	BC146	15p	BPX42
2G333	2N3447	37p	2N5490	40p	BC147	15p	BPX43
2G334	2N3448	37p	2N5491	40p	BC148	15p	BPX44
2G335	2N3449	37p	2N5492	40p	BC149	15p	BPX45
2G336	2N3450	37p	2N5493	40p	BC150	15p	BPX46
2G337	2N3451	37p	2N5494	40p	BC151	15p	BPX47
2G338	2N3452	37p	2N5495	40p	BC152	15p	BPX48
2G339	2N3453	37p	2N5496	40p	BC153	15p	BPX49
2G340	2N3454	37p	2N5497	40p	BC154	15p	BPX50
2G341	2N3455	37p	2N5498	40p	BC155	15p	BPX51
2G342	2N3456	37p	2N5499	40p	BC156	15p	BPX52
2G343	2N3457	37p	2N5500	40p	BC157	15p	BPX53
2G344	2N3458	37p	2N5501	40p	BC158	15p	BPX54
2G345	2N3459	37p	2N5502	40p	BC159	15p	BPX55
2G346	2N3460	37p	2N5503	40p	BC160	15p	BPX56
2G347	2N3461	37p	2N5504	40p	BC161	15p	BPX57
2G348	2N3462	37p	2N5505	40p	BC162	15p	BPX58
2G349	2N3463	37p	2N5506	40p	BC163	15p	BPX59
2G350	2N3464	37p	2N5507	40p	BC164	15p	BPX60
2G351	2N3465	37p	2N5508	40p	BC165	15p	BPX61
2G352	2N3466	37p	2N5509	40p	BC166	15p	BPX62
2G353	2N3467	37p	2N5510	40p	BC167	15p	BPX63
2G354	2N3468	37p	2N5511	40p	BC168	15p	BPX64
2G355	2N3469	37p	2N5512	40p	BC169	15p	BPX65
2G356	2N3470	37p	2N5513	40p	BC170	15p	BPX66
2G357	2N3471	37p	2N5514	40p	BC171	15p	BPX67
2G358	2N3472	37p	2N5515	40p	BC172	15p	BPX68
2G359	2N3473	37p	2N5516	40p	BC173	15p	BPX69
2G360	2N3474	37p	2N5517	40p	BC174	15p	BPX70
2G361	2N3475	37p	2N5518	40p	BC175	15p	BPX71
2G362	2N3476	37p	2N5519	40p	BC176	15p	BPX72
2G363	2N3477	37p	2N5520	40p	BC177	15p	BPX73
2G364	2N3478	37p	2N5521	40p	BC178	15p	BPX74
2G365	2N3479	37p	2N5522	40p	BC179	15p	BPX75
2G366	2N3480	37p	2N5523	40p	BC180	15p	BPX76
2G367	2N3481	37p	2N5524	40p	BC181	15p	BPX77
2G368	2N3482	37p	2N5525	40p	BC182	15p	BPX78
2G369	2N3483	37p	2N5526	40p	BC183	15p	BPX79
2G370	2N3484	37p	2N5527	40p	BC184	15p	BPX80
2G371	2N3485	37p	2N5528	40p	BC185	15p	BPX81
2G372	2N3486	37p	2N5529	40p	BC186	15p	BPX82
2G373	2N3487	37p	2N5530	40p	BC187	15p	BPX83
2G374	2N3488	37p	2N5531	40p	BC188	15p	BPX84
2G375	2N3489	37p	2N5532	40p	BC189	15p	BPX85
2G376	2N3490	37p	2N5533	40p	BC190	15p	BPX86
2G377	2N3491	37p	2N5534	40p	BC191	15p	BPX87
2G378	2N3492	37p	2N5535	40p	BC192	15p	BPX88
2G379	2N3493	37p	2N5536	40p	BC193	15p	BPX89
2G380	2N3494	37p	2N5537	40p	BC194	15p	BPX90
2G381	2N3495	37p	2N5538	40p	BC195	15p	BPX91
2G382	2N3496	37p	2N5539	40p	BC196	15p	BPX92
2G383	2N3497	37p	2N5540	40p	BC197	15p	BPX93
2G384	2N3498	37p	2N5541	40p	BC198	15p	BPX94
2G385	2N3499	37p	2N5542	40p	BC199	15p	BPX95
2G386	2N3500	37p	2N5543	40p	BC200	15p	BPX96
2G387	2N3501	37p	2N5544	40p	BC201	15p	BPX97
2G388	2N3502	37p	2N5545	40p	BC202	15p	BPX98
2G389	2N3503	37p	2N5546	40p	BC203	15p	BPX99
2G390	2N3504	37p	2N5547	40p	BC204	15p	BPX100
2G391	2N3505	37p	2N5548	40p	BC205	15p	BPX101
2G392	2N3506	37p	2N5549	40p	BC206	15p	BPX102
2G393	2N3507	37p	2N5550	40p	BC207	15p	BPX103
2G394	2N3508	37p	2N5551	40p	BC208	15p	BPX104
2G395	2N3509	37p	2N5552	40p	BC209	15p	BPX105
2G396	2N3510	37p	2N5553	40p	BC210	15p	BPX106
2G397	2N3511	37p	2N5554	40p	BC211	15p	BPX107
2G398	2N3512	37p	2N5555	40p	BC212	15p	BPX108
2G399	2N3513	37p	2N5556	40p	BC213	15p	BPX109
2G400	2N3514	37p	2N5557	40p	BC214	15p	BPX110
2G401	2N3515	37p	2N5558	40p	BC215	15p	BPX111
2G402	2N3516	37p	2N5559	40p	BC216	15p	BPX112
2G403	2N3517	37p	2N5560	40p	BC217	15p	BPX113
2G404	2N3518	37p	2N5561	40p	BC218	15p	BPX114
2G405	2N3519	37p	2N5562	40p	BC219	15p	BPX115
2G406	2N3520	37p	2N5563	40p	BC220	15p	BPX116
2G407	2N3521	37p	2N5564	40p	BC221	15p	BPX117
2G408	2N3522	37p	2N5565	40p	BC222	15p	BPX118
2G409	2N3523	37p	2N5566	40p	BC223	15p	BPX119
2G410	2N3524	37p	2N5567	40p	BC224	15p	BPX120
2G411	2N3525	37p	2N5568	40p	BC225	15p	BPX121
2G412	2N3526	37p	2N5569	40p	BC226	15p	BPX122
2G413	2N3527	37p	2N5570	40p	BC227	15p	BPX123
2G414	2N3528	37p	2N5571	40p	BC228	15p	BPX124
2G415	2N3529	37p	2N5572	40p	BC229	15p	BPX125
2G416	2N3530	37p	2N5573	40p	BC230	15p	BPX126
2G417	2N3531	37p	2N5574	40p	BC231	15p	BPX127
2G418	2N3532	37p	2N5575	40p	BC232	15p	BPX128
2G419	2N3533	37p	2N5576	40p	BC233	15p	BPX129
2G420	2N3534	37p	2N5577	40p	BC234	15p	BPX130
2G421	2N3535	37p	2N5578	40p	BC235	15p	BPX131
2G422	2N3536	37p	2N5579	40p	BC236	15p	BPX132
2G423	2N3537	37p	2N5580	40p	BC237	15p	BPX133
2G424	2N3538	37p	2N5581	40p	BC238	15p	BPX134
2G425	2N3539	37p	2N5582	40p	BC239	15p	BPX135
2G426	2N3540	37p	2N5583	40p	BC240	15p	BPX136
2G427	2N3541	37p	2N5584	40p	BC241	15p	BPX137
2G428	2N3542	37p	2N5585	40p	BC242	15p	BPX138
2G429	2N3543	37p	2N5586	40p	BC243	15p	BPX139
2G430	2N3544	37p	2N5587	40p	BC244	15p	BPX140
2G431	2N3545	37p	2N5588	40p	BC245	15p	BPX141
2G432	2N3546	37p	2N5589	40p	BC246	15p	BPX142
2G433	2N3547	37p	2N5590	40p	BC247	15p	BPX143
2G434	2N3548	37p	2N5591	40p	BC248	15p	BPX144
2G435	2N3549	37p	2N5592	40p	BC249	15p	BPX145
2G436	2N3550	37p	2N5593	40p	BC250	15p	BPX146
2G437	2N3551	37p	2N5594	40p	BC251</		

# HI-FI EQUIPMENT

SAVE UP TO  
**33 1/2% OR MORE**  
SEND S.A.E. FOR  
DISCOUNT PRICE LISTS  
AND PACKAGE OFFERS!

## RECORD DECKS

BSR UA50†	\$4-97
C129†	\$8-50
MP60	\$10-40
610	\$14-07
610	\$11-50
610	\$9-45
610	\$33-45
MP60/G800*	\$18-90
MP60 TPD1	\$17-18
MP60 TPD1/G800*	\$19-50
MP60 TPD2	\$15-40
610 TPD1	\$20-25
610 TPD1	\$18-50
210 Package*	\$29-55
HT 70	\$14-99
HT70/G800*	\$17-25
HT 70 Pack	\$21-60
HT70 Pack/G800*	\$23-95



GOLDRING GL69/2	\$18-97
GL69/2/P	\$24-90
GL72	\$22-50
GL72/P	\$20-55
GL75	\$21-25
GL75/P	\$23-65
LID75	\$3-95
LID72	\$3-55
G99	\$23-20
GI-85P/C	\$25-25
LID85	\$5-25
G101	\$23-20

PIONEER PL12AC	\$25-15
PL16C	\$20-25
PLA25	\$22-85

GARRARD 2025 T/C*	\$8-50
401*	\$10-25
SP25 III	\$13-45
SL45B	\$13-45
AP76	\$18-85
BL72B	\$28-95
BL95B	\$33-50
401	\$26-60
ZERO 100A	\$29-95
ZERO 100B	\$27-50

THORNS TD125	\$27-50
TD125AB	\$102-50
TX25	\$7-40
TD150	\$29-50
TD150A II	\$38-95
TD150AB II	\$29-95
150 Plinth	\$3-80
TX11	\$3-80

\* Stereo Cartridge † Mono All others tape cartridge Carriage 50p extra any model.

## RECORD DECK PACKAGES

Decks supplied with cartridge ready wired in teak veneered plinth with cover.

Garrard 2025TC/9TAHCD \$12-95  
Garrard SP25 III/9TAHCD \$18-95  
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Garrard SP25 III/M44-7 \$19-75  
Garrard SP25 III/M44-E \$20-95  
SP25 III/G800 (Play-on P&C) \$19-75  
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Garrard AP76/M75-6 \$30-25  
Garrard AP76/M55B \$32-25  
Garrard AP76/M75EJ \$32-25  
BSR McDonald MP60/G800 \$19-95  
BSR McDonald MP60/M44-7 \$20-95  
BSR McDonald MP60/M44-E \$21-50  
Goldring GL72/G800 \$24-50  
Goldring GL75/G800 \$41-95  
Goldring GL75/G800E \$44-95  
Carriage 50p any item



SKYWOOD CX203 COMMUNICATION RECEIVER



Solid state. Coverage on 5 bands 200-420 KHz and 55 to 30 MHz. Illuminated slide rule dial. Bandspeed. Aerial tuning. BFO. AVC. ANL. 'S' meter. AM/CW/88B. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 x 268 x 150 mm. Complete with instructions and circuit. \$28-50. Carr. 50p

## TELETON F.2000 AM/FM STEREO TUNER AMPLIFIER



Probably the most popular budget Tuner/ Amp. and now offered at a ridiculous low price. 5 watts r.m.s. per channel. Tape/Cer phono inputs. AFC/Built-in MPX. List \$21. OUR PRICE \$28-75. Carr. 50p.

● SUGGESTED SYSTEM ●  
F.2000, Garrard 2025T/C Changer fitted stereo cartridge, with plinth and cover and pair of G.W.S. Speakers. Total Res. Price \$97-73½. OUR PRICE \$52-96. Carr. £1-50

## ★ TRANSISTORISED FM TUNER

6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6 x 4 x 2 1/4 in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 V battery. Coverage 88-108Mc/s. Ready built ready for use. Fantastic value for money. \$2-37½. P. & F. 12½p. Stereo multiplex adaptors \$4-97½.

## MP7 MIXER PREAMPLIFIER

6 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9 1/4" x 5" x 3". Input Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K. \$2-97. P. & F. 20p.

## SINCLAIR IC-12



List Price £2-98  
OUR £1-80 PRICE  
P. & F. 10p

## NS-1600W STEREO AMPLIFIER

Exceptional budget price amplifier. All silicon transistor. Handsome Walnut case. Switched input selector, separate balance, volume, treble, bass controls. Output 2 x 6W RMS. Inputs Mag. Tape. Xtal, Tuner, Tape Out. \$14-75. Carr. 37p.

## BH.001 HEAD SET AND BOOM MICROPHONE

Moving coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms. \$4-82. P. & F. 15p.

## SEND NOW

ONLY 40p P & P 10p

## Mode I-S100TR MULTIMETER TRANSISTOR TESTER 100,000 o.p.v. MIRROR SCALE OVERLOAD PROTECTION

0-12/6/3/12/30/120/600 V DC. 0/6/30/120/600 V AC. 0/12/60µA/12/300MA/12 AMP DC. 0/10K/1 MΩ/1 000 MΩ. -20 to +50 db. 100-1M 2 MFD. Transistor tester measures Alpha, Beta and Ico. Complete with batteries, instructions and leads. \$18-50. P. & F. 25p.



MCA 220 AUTOMATIC VOLTAGE STABILISER  
Input 89-125 VAC. or 175-250VAC. Output 120V AC, or 240 VAC. 200 VA rating. \$11-97. carr. 50p.



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

Sine 18-200,000 Hz; Square 18-50,000 Hz  
Output max. +10 dBm (10 K ohms)  
Operation internal batteries  
Attractive 2-tone case 7 1/2" x 5" x 2". Price £17-50. Carr. 17p.

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

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω-11.1 meg Ω L. 1µ-111 L. 1µ-111

HENRY'S 6 Ranges 2- %C. 10P ± 1110mFd 6 Ranges ± 2%. TURNS RATIO 1:1/1000:1:1100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive 2 tone metal case. Size 7 1/2 x 5 x 2 in. \$20. P. & F. 25p

## E.H.T. TESTER 0-30KV

Completely self contained with built-in voltmeter. Easy to read, very accurate, robust construction. An essential for colour television servicing, etc. Size 360mm long. 50mm dia. \$2-95 P. & F. 25p.

## 250V/240V SMITHS SYNCHRONOUS GEARED MOTORS

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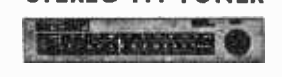
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1R4	0.50	6AW8A	0.55	6P23	0.90	10L1	0.60
1R5	0.45	6BA6	0.28	6P24	0.80	10LD11	0.70
1R4	0.30	6BE6	0.32	6P25	1.00	10P13	0.75
1R5	0.30	6BF6	0.55	6P26	1.35	12AB5	0.70
1T4	0.30	6BH6	0.75	6P28	0.70	12AC1	0.60
1U4	0.40	6B6	0.45	6GK6	0.60	12AD6	0.60
1U5	0.75	6BK7A	0.75	6J4	0.90	12AE6	0.80
1V2	0.55	6BN5	0.43	6J5GT	0.40	12AL5	0.55
1X2B	0.55	6BN6	0.60	6J6	0.30	12AQ5	0.50
2A3	0.50	6BQ6	0.25	6J7	0.45	12AT6	0.40
2CW4	0.75	6BR8	0.75	6KGGT	0.75	12AT7	0.40
2D21	0.40	6B7	0.50	6KZ	0.43	12UG	0.45
3A4	0.45	6BW6	0.90	6K8G	0.45	12AV7	0.33
3B1	3.50	6BX6	0.25	6L6GT	0.55	12AV7	0.70
3S4	0.40	6BZ6	0.45	6L7	0.45	12AX7	0.33
5R4QY	0.75	6C4	0.35	6L18	0.50	12AY7	0.75
5U4G	0.40	6CGT	0.55	6LD20	0.50	12AT7	0.45
5Y3GT	0.50	6CDB6A	0.40	6ND7G	0.40	12BA6	0.45
5Z3	0.75	1.80	0.60	6P27	0.50	12BA7	0.50
5Z4G	0.45	6CG7	0.60	6P28	0.45	12B7	0.50
6J30L2	0.90	6CI6	0.80	6G87	0.45	12B7	0.50
6AB4	0.45	6CL6	0.60	6R8K	0.50	12K7	1.00
6AP4A	0.60	6CL6	0.50	6SL7G	0.45	12K7G	0.50
6AG5	0.25	6CW4	0.50	6S7GT	0.45	12QGT	0.45
6AG7	0.45	6CY5	0.50	6S87	0.50	12R7	0.50
6AH6	0.80	6CV7	0.75	6SR7	0.50	20D1	0.60
6AJ8	0.30	6D3	0.55	6T8	0.38	20L1	1.10
6AK5	0.40	6D6	0.80	6U4GT	0.70	20P1	0.50
6AK6	0.60	6DK6	0.50	6U5G	0.75	35W4	0.40
6AL3	0.43	6DQ8	0.75	6T8A	0.45	3Z3	0.75
6AL5	0.22	6D84	0.25	6V6GT	0.45	3Z4G	0.40
6AM5	0.40	6EA8	0.65	6X4	0.40	3Z6GT	0.70
6AM6	0.37	6EH7	0.30	6XGT	0.45	50A5	0.80
6AQ6	0.40	6EJ7	0.35	6X8	0.85	50B5	0.70
6AQ6	0.72	6EW6	0.70	6Y6G	0.80	50C5	0.80
				6Y6G	0.80	50A6	0.60

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30AE3	0.40	50EH5	0.85	DK96	0.80	ECC84	0.80
30C1	0.80	50L6GT	0.60	DL96	0.55	ECC85	0.40
30C15	1.00	50A2	0.55	DM70	0.60	ECC88	0.40
30C17	1.10	50AG	2.40	DM160	0.65	ECC89	0.50
30C18	0.50	50AV	2.50	DY51	0.55	ECC91	0.30
30F5	1.00	50C1	0.75	DY86	0.35	EL222	1.40
30FL1	0.80	50CV	2.40	DY87	0.36	ECC807	1.00
30FL12	1.10	807	0.80	DY802	0.37	ECF80	0.35
30FL14	0.90	813	4.00	E88CC	0.70	ECF82	0.35
30L1	0.40	866A	0.85	E180F	1.00	ECF84	0.65
30L15	0.95	8642	0.70	E180F	2.90	ECF81	0.30
30L17	0.95	8670	0.60	E180F	2.90	ECH83	0.45
30P12	1.00	6080	1.75	EAF42	0.60	ECH84	0.45
30P19	0.95	6146	1.80	EBC33	0.60	ECL80	0.50
30P21	0.95	6146B	2.50	EBC41	0.65	ECL81	0.50
30PL13	1.10	6360	1.25	EBC81	0.38	ECL82	0.35
30PL14	1.25	6369	2.25	EBF80	0.40	ECL83	0.70
30A3	0.60	7199	0.85	EBC83	0.40	ECL84	0.55
30A5	0.85	7360	2.20	EBF89	0.32	ECL85	0.55
30B5	0.85	7886	1.50	EBL31	1.50	ECL86	0.40
30C5	0.80	7896	1.50	EC33	0.50	ECL800	
30D5	0.75	9025	0.45	EC86	0.60	EF40	2.20
30E6	0.75	A2293	2.20	EC88	0.80	EF41	0.85
30E7	0.80	AZ31	0.55	EC90	0.35	EF42	0.70
30G4	0.40	CBL1	0.90	EC93	0.60	EF80	0.30
30H1	1.00	CBL31	1.00	ECC35	1.00	EF85	0.35
30J1	0.50	CY31	0.50	ECC40	0.70	EF86	0.30
30J6	0.50	DAF96	0.50	ECC81	0.40	EF89	0.28
30K5	0.80	DP96	0.50	ECC82	0.33	EF91	0.37
30L6	0.80	DK92	0.70	ECC83	0.33	EF92	0.35

EP95	0.40	GZ32	0.50	PL33	0.40	U403	0.70
EP97	0.85	GZ33	0.75	PL36	0.55	U404	0.70
EP98	0.75	GZ34	0.60	PL31	0.50	U301	0.80
EP83	0.30	HABC800.55		PL32	0.45	UABC80	
EF184	0.35	HK90	0.50	PL83	0.45		0.40
EF804	1.25	KT66	2.35	PL84	0.40	UAF41	0.70
EK90	0.32	KT88	2.25	PL302	0.95	UAF42	0.60
EL34	0.50	N78	1.80	PL504	0.75	UB41	0.65
EL36	0.50	PABC800.40		PL508	0.90	UB42	0.65
EL37	1.70	PC86	0.60	PL509	1.10	UBC81	0.45
EL41	0.75	PC88	0.60	PL801	1.00	UP80	0.40
EL81	0.55	PC92	0.50	PL802	0.95	UP89	0.40
EL83	0.50	PC97	0.50	PM84	0.60	UBL1	0.70
EL84	0.25	PC900	0.48	PY31	0.35	UBL2	0.70
EL85	0.43	PCC84	0.40	PY33	0.33	UC92	0.45
EL86	0.40	PCC85	0.40	PY80	0.40	UC98	0.45
EL90	0.48	PCC88	0.55	PY81	0.30	UC98	0.70
EL95	0.35	PC89	0.55	PY82	0.35	UCH21	0.60
EL921	0.80	PCC189	0.60	PY83	0.38	UCH42	0.70
EL922	1.40	PCC805.95		PY88	0.40	UCH81	0.40
EL980	1.75	PCC806.95		PY600	1.00	UCL81	0.80
EM34	1.00	PCF80	0.30	PY800	0.47	UCL82	0.85
EM71	0.80	PCF82	0.35	PY801	0.50	UCL83	0.85
EM80	0.45	PCF84	0.60	PZ30	0.38	UP8	0.85
EM81	0.80	PCF86	0.80	QVQV0-6		UF11	0.80
EM83	0.50	PCF87	1.10		2.25	UF41	0.85
EM84	0.35	PCF801.50		QQV03-10		UF42	0.85
EM85	1.00	PCF802.50			1.25	UF43	0.85
EM87	0.70	PCF805.90		QQV03-20A		UF80	0.85
EN91	0.40	PCF807.70			5.25	UF85	0.40
EN91	0.40	PCF809.90		TT21	3.40	UF89	0.40
EN91	0.40	PCF809.90		TT22	3.60	UL41	0.85
EN91	0.40	PCF809.90		UL18-20	0.75	UL84	0.48
EN91	0.40	PCF809.90		PCL81	0.50	UL85	0.48
EN91	0.40	PCF809.90		PCL82	0.35	UM84	0.80
EN91	0.40	PCF809.90		PCL83	0.65	U26	0.85
EN91	0.40	PCF809.90		PCL84	0.45	UY11	0.50
EN91	0.40	PCF809.90		PCL85	0.50	UY11	1.00
EN91	0.40	PCF809.90		PCL86	0.45	UY2	0.40
EN91	0.40	PCF809.90		PCL88	1.25	UY6	0.40
EN91	0.40	PCF809.90		PCL800	1.10	UY8	0.40
EN91	0.40	PCF809.90		PCL801.95		UY9	0.75
EN91	0.40	PCF809.90		PCL801.95		UY19	0.75
EN91	0.40	PCF809.90		PCL801.95		U301	0.60
EN91	0.40	PCF809.90		PCL801.95		U31	0.55
EN91	0.40	PCF809.90		PCL801.95		U32	0.55
EN91	0.40	PCF809.90		PCL801.95		U33	0.55
EN91	0.40	PCF809.90		PCL801.95		U34	0.55
EN91	0.40	PCF809.90		PCL801.95		U35	0.55
EN91	0.40	PCF809.90		PCL801.95		U36	0.55
EN91	0.40	PCF809.90		PCL801.95		U37	0.55
EN91	0.40	PCF809.90		PCL801.95		U38	0.55
EN91	0.40	PCF809.90		PCL801.95		U39	0.55
EN91	0.40	PCF809.90		PCL801.95		U40	0.55
EN91	0.40	PCF809.90		PCL801.95		U41	0.55
EN91	0.40	PCF809.90		PCL801.95		U42	0.55
EN91	0.40	PCF809.90		PCL801.95		U43	0.55
EN91	0.40	PCF809.90		PCL801.95		U44	0.55
EN91	0.40	PCF809.90		PCL801.95		U45	0.55
EN91	0.40	PCF809.90		PCL801.95		U46	0.55
EN91	0.40	PCF809.90		PCL801.95		U47	0.55
EN91	0.40	PCF809.90		PCL801.95		U48	0.55
EN91	0.40	PCF809.90		PCL801.95		U49	0.55
EN91	0.40	PCF809.90		PCL801.95		U50	0.55

## TRANSISTORS

2N696	0.15	AC128	0.15	BD123	0.80
2N697	0.15	AC132	0.85	BD124	0.60
2N698	0.80	AC153	0.20	BD131	0.75
2N705	0.70	AC184	0.15	BD132	0.80
2N706	0.10	AC157	0.17	BF115	0.20
2N708	0.15	AC169	0.10	BF167	0.18
2N763	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
2N967	0.30	AC197	0.25	BF181	0.30
2N1131	0.25	AC198	0.20	BF184	0.20
2N1132	0.25	AC199	0.25	BF186	0.20
2N1184	1.25	AC200	0.20	BF194	0.14
2N1302	0.17	AC211	0.20	BF196	0.14
2N1303	0.17	AC222	0.10	BF196	0.12
2N1304	0.20	AD140	0.50	BF197	0.12
2N1305	0.20	AD149	0.45	BP200	0.35
2N1306	0.25	AD161	0.35	BFW87	0.25
2N1807	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
2N1813	0.17	AF114	0.17	BFY88	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



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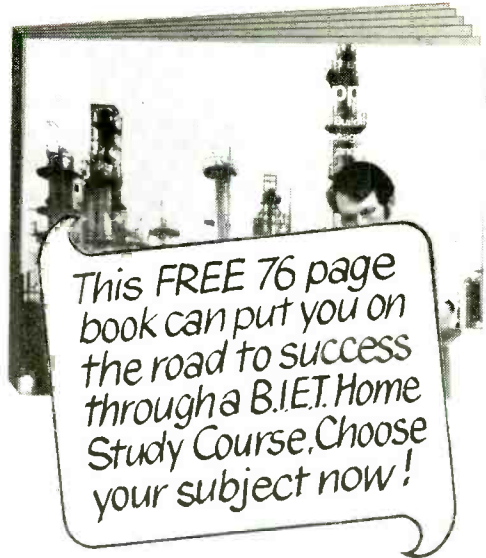
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| <p><b>ELECTRICAL &amp; ELECTRONIC</b><br/>A.M.S.E. (Elec.)<br/>C &amp; G Elec. Eng.<br/>C &amp; G Elec. Inst.<br/>C &amp; G Elec. Tech.<br/>Computer Elect.<br/>Elec. Maths<br/>Elec. Science<br/>Electronic Eng.<br/>Electrical Eng.<br/>Install. &amp; Wiring<br/>Meters<br/>&amp; Measuring Instruments</p>   | <p><b>RADIO &amp; TELE-COMMUNICATIONS</b><br/>Colour TV<br/>C &amp; G Radio/TV/Electronics<br/>C &amp; G Telecomm. Tech.<br/>Prac. Radio &amp; Elec. (with kit)<br/>Radio Amateurs Exam.<br/>Radio Servicing &amp; Repairs<br/>Radio &amp; TV Eng.<br/>Transistor Course<br/>TV Main. &amp; Serv.</p>                       | <p><b>GENERAL</b><br/>Agricultural Eng.<br/>Council of Eng. Inst.<br/>Farm Science<br/>General Education<br/>Gen. Plastics<br/>Pract. Maths<br/>Pract. Slide Rule<br/>Pure &amp; Applied Maths<br/>Refrigeration<br/>Rubber Technology<br/>Sales Engineers<br/>Tech. Report Writing<br/>Timber Trade<br/>University Ent.</p>   |
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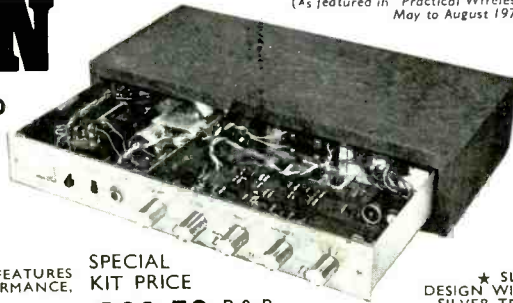
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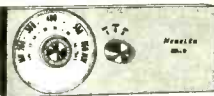
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POLISHED CABINETS 150, 150TC 450 £4 60. Post 30p.



### ML3 MW/LW TUNER TO BUILD

Uses Mullard Module. Slow motion tuning. Built in battery. Ferrite aerial. Overall size 7" x 2 1/2" x 3 1/4". TOTAL COST TO BUILD £4 85. Post 15p. All parts sold separately. Leaflet No. 6

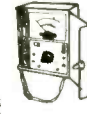
### "BANDSPREAD" PORTABLE TO BUILD



Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bandspread for extra selectivity. Also slow motion geared tuning, 600 mW push-pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance. TOTAL COST TO BUILD £7 98. p.p. 32p. (Battery 22p). All parts sold separately—Leaflet No. 2

### TEST EQUIPMENT

SE250B	Pocket Pencil Signal Injector	£1 90
SE500	Pocket Pencil Signal Tracer	£1 50
TE15	Grid Dip Meter 440 KHz-280 MHz	£13 45
500	30 K/V Multimeter	£9 25
	With leather case	£10 50
200H	20K/V Multimeter	£4 20
	With case	£4 95
AF105	50K/V Multimeter	£8 50
	With case	£9 50
U4341	AC/DC Multimeter with transistor tester with steel case	£10 50
TE20D	RF Generator 120KHz-500MHz	£15 95
	Carr.	35p
TE22D	Audio Generator 20Hz-200KHz	£17 50
	Carr.	35p
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	Carr.	50p
CI-5	3" Pulse Scope 10Hz-10MHz	£39 00
	Carr.	50p
TE65	Valve Voltmeter 28 ranges	£17 50
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	Matching cartridge SC5M	£2 62
	FIBRE OPTICS, LIGHTING EFFECTS, PROJECTORS, SPOTS, DIMMERS, MIXERS. Everything for PA—Disco—Lighting. FREE Stock List Ref. No. 18.	

### BUILD THIS VHF FM TUNER

5 TRANSISTORS 300 kc/s BANDWIDTH, PRINTED CIRCUIT, HIGH FIDELITY REPRODUCTION. MONO AND STEREO.  
 A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it—VHF FM gives the REAL sound. All parts sold separately. Free Leaflet No. 3 & 7.  
**TOTAL £6 97**, p.p. 20p. Decoder Kit £5 97.  
 Tuning meter unit £1 75  
 Mains unit (optional) Model PS900 £2 47. Post 20p  
 Mains unit for Tuner and Decoder PS1200 £2 62. Post 20p



### SINCLAIR PROJECT 60 MODULES —SAVE POUNDS!

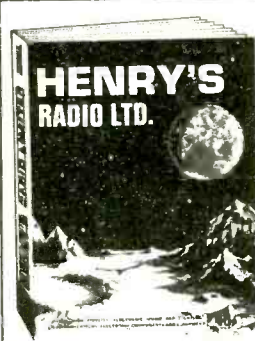
Z30	£3 57	Z50	£4 37	
STEREO 60	PZ5	£3 97		
		£7 97	PZ8	£4 77



PZ6 £6 37;  
 Transformer for PZ8 £2 95  
 Active Filter Unit £4 45  
 Stereo FM Tuner £16 95  
 IC12 £1 80; OI6's £15 pr.  
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### PACKAGE DEALS

2xZ30, Stereo 60, PZ5	£15 95
2xZ30, Stereo 60, PZ6	£18 00
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PROJECT 605 KIT	£19 95



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# **Aerial Data Chart**

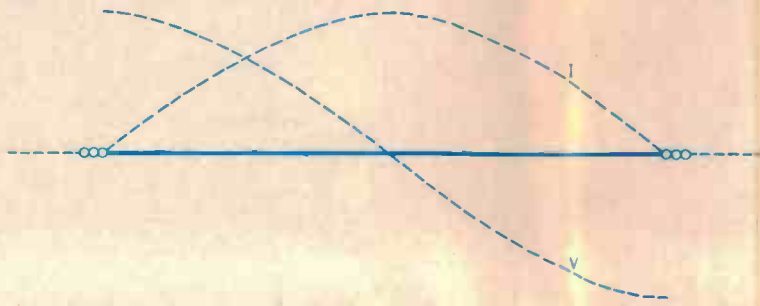


# PRACTICAL AERIAL DATA CHART



PRESENTED FREE WITH PRACTICAL WIRELESS OCTOBER 1972

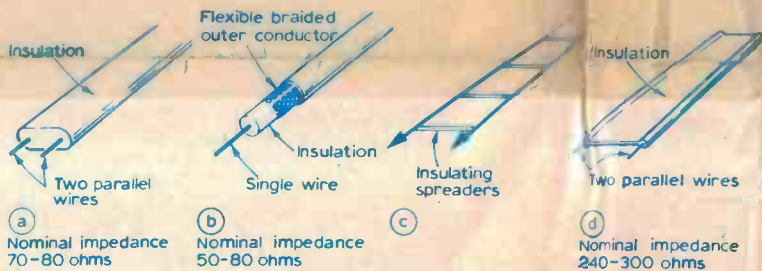
## BASICS



The basic horizontal half wave aerial ( $\frac{1}{2}\lambda$ ). In practice, the physical length required for resonance is reduced by a factor of 0.95 ( $0.95 \times \frac{1}{2}\lambda$ ) due to the effect of insulators and nearby objects. A simple formula for the practical half

wave aerial is  $468/F(\text{MHz})$  feet. At resonance the induced voltage  $V$  will be maximum at the ends of the aerial (high impedance) while the current  $I$  will be maximum at the centre.

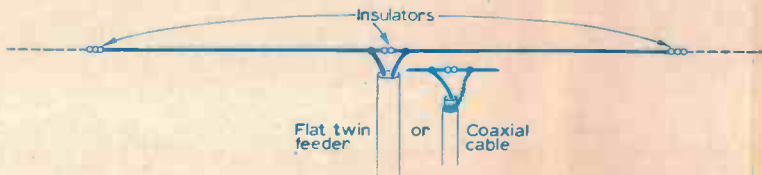
## FEEDERS



Since the aerial should be located in the clear and generally as high as possible to produce maximum signal strength it is necessary to use a feeder to connect the aerial to the receiver. Low impedance

feeders may be flat twin (a), coaxial (b) or flat ribbon (d). High impedance feeders consist of two wires spaced apart by insulators every foot or so (c).

## HALF WAVE DIPOLE

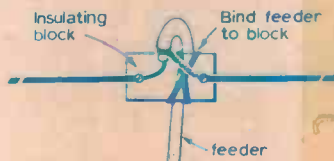


As the impedance at the centre of a half wave aerial is approximately 70 ohms feeders (a) or (b) will provide a good impedance match to the aerial ensuring maximum signal transference. The

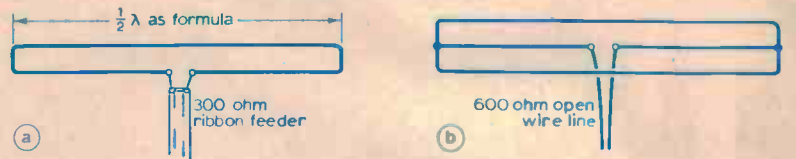
aerial, length calculated from the formula given, is cut at the centre and an insulator inserted, the wires of the feeder being connected either side of the insulator.

## CONSTRUCTION

A practical method of feeding the aerial with low impedance feeder. The loop in the top of the feeder is essential to prevent the ingress of rain and dirt. The end of coaxial cable can be sealed with plastic insulating tape or compound.



## FOLDED DIPOLE

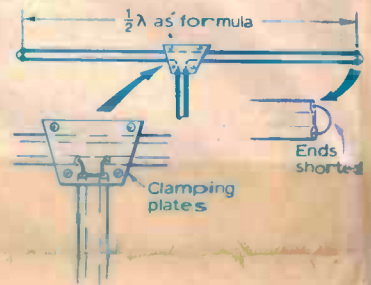


The folded dipole (a) will transform the input impedance by a factor of  $2^2$  or  $4 \times 70 = 280$  ohms so that it can be fed with a flat ribbon feeder of 300 ohms impedance, provided the wires forming

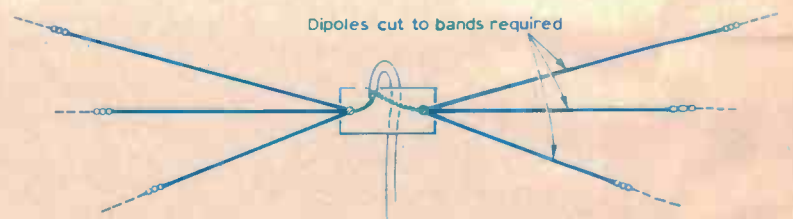
the folded dipole are the same diameter. If a three fold dipole is used the input impedance will be  $70 \times 3^2 = 630$  ohms which will provide a good match to an open line feeder.

## FOLDED DIPOLE CONSTRUCTION

A practical folded dipole using 300 ohm ribbon feeder for both the aerial and the feeder. One conductor only of the aerial is cut at the centre and the feeder inserted and the joints soldered. The junction should be clamped between pieces of insulating material and properly waterproofed.



## MULTIBAND DIPOLE



If dipoles are required for optimum performance on several frequency bands they can be connected in parallel at their centres, and fed with a common feeder thus providing multiband facilities in a minimum of space. The ends of the dipoles may be tied off to any convenient

supports and the dipoles need not all be in the same plane. Note that a dipole cut for, say, the 7MHz amateur band, will be three half waves on the 21MHz amateur band thus eliminating the need for a separate aerial for that band.

## DIPOLE DIMENSIONS

The table gives the length of a half wave aerial in the various HF amateur and broadcast bands.

Broadcast		Amateur	
Band	Length	Band	Length
11m	18ft 2in	160m	256ft
13m	21ft 7in	80m	128ft
16m	26ft	40m	66ft
19m	30ft	20m	33ft
25m	39ft 4in	15m	22ft
31m	48ft	10m	16ft
41m	65ft		
49m	76ft		

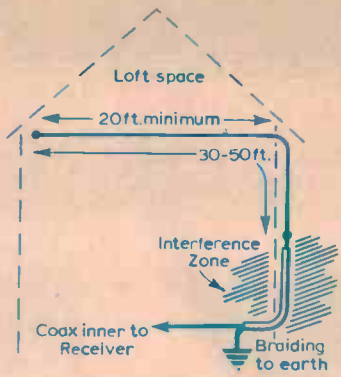
## LONG WIRE

A long length of copper wire, with one end connected to the receiver, is probably the most commonly used aerial. This is often fitted onto a picture rail and even quite a small room will enable a 40ft. length to be used. One convenient form of aerial can be obtained by using the coaxial cable of a TV aerial, the outer braiding being connected to the aerial socket of the receiver. Important! disconnect the TV aerial from the TV set before using it in this form. Probably the best and only true long wire aerial is the Beveridge. This is used by many major monitoring stations. It comprises a straight wire about a mile long mounted on short poles over the ground. One end goes to the receiver and the other to earth via a resistor. It is very directional and provides excellent reception but there are few who have sufficiently long back gardens to accommodate this one!



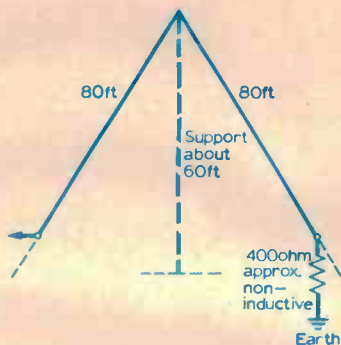
# INVERTED L

A simple, general purpose aerial which, when connected to an ATU, will give good results. The length should be between 30ft and 50ft. of which the horizontal part should be at least 20ft. A wire across the loft and running down the outside of the house is a simple method of arranging this. In areas of high local interference the vertical portion can be screened using coaxial cable, the outer braid being taken to the earth terminal on the receiver and thence to an outside earth.



# INVERTED V

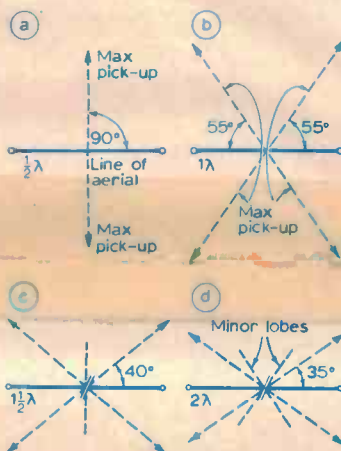
With only a single support required this form of "Inverted Vee" can be very effective. The 400 ohm resistor renders the system aperiodic i.e. not resonant at any particular frequency. It will be useful over most of the HF bands favouring signals in the plane of the aerial.



# DIRECTIVITY

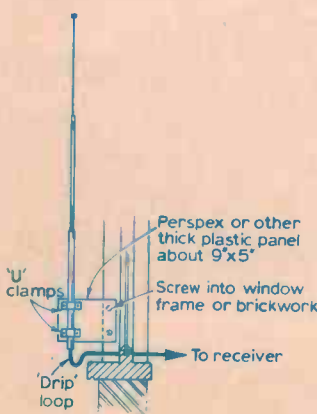
Signal pick-up of a half wave aerial is maximum at right angles to the line of the wire (a). If the wire is one wavelength long maximum pick-up is from four directions (b). By choosing the right length of aerial and adjusting its orientation the maximum pick-up lobes can be made to cover all the land areas of the world.

Longer aerials result in the appearance of minor lobes (c) and (d) which reduce directivity and improve all round coverage. With an aerial many wavelengths long maximum reception is along the line of the wire.



# WHIP TYPES

Whip aerials come in a variety of forms, many being ex-Government and very cheap. They can be telescopic, lengths of rod which screw into each other or several tubular sections with a single wire running through them which holds the sections rigid when tightened. In certain locations a whip aerial is about the only practical type since it can simply be mounted outside a window, as shown. The whip should be as long as possible, but very tall ones present mounting problems due to wind pressure. Generally a whip aerial will be non-resonant on the HF bands and should, ideally, be connected to an ATU. If not it may be connected to the aerial terminal directly or via a variable capacitor.

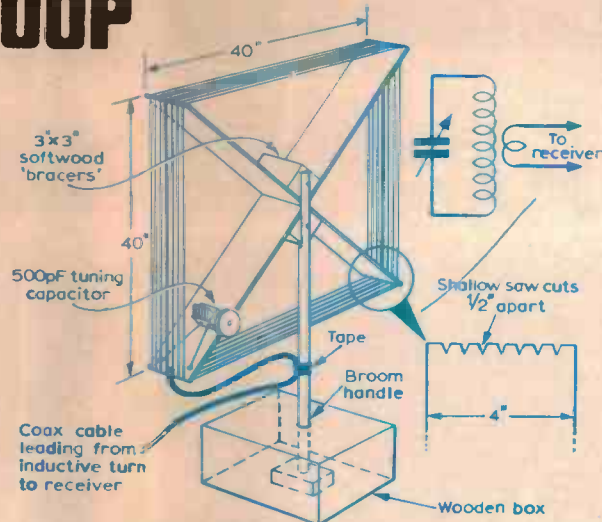


# TV AERIALS

It is hardly worth making a TV aerial since commercial ones generally cost much less than the materials would cost to buy. Band I aerials (Channels 1-5) are nearly always cut for an individual channel and take the form of a simple dipole or an H or X arrangement. Band III aerials are available for individual channels, semi-broad-band encompassing three channels or broad-band (Channels 6-13). These aerials are generally more elaborate than Band I types due to the poorer propagation at these frequencies and incorporate one or more directors. The UHF frequencies

(Channels 21-68) are divided into groups for aerial purposes: A, B, C, D and E and the correct type must be used in a particular area. Broadband UHF aerials, usually log-periodic, are also available but their gain is rather less than with conventional types. UHF aerials are much smaller than VHF types and usually incorporate from 3 to 19 directors plus a reflector in order to increase the gain. The dimensions are fairly critical and this, together with the low cost of the commercial product, makes home construction an unrealistic proposition.

# M W LOOP



For frequencies between 500kHz and 2MHz the loop aerial takes a lot of heating. It consists of 7 turns of wire (5 or 6 turns for higher frequencies) around a wooden framework as illustrated. The ends of the wire connect to a 500pF tuning capacitor. A second wire, wound around the centre turn connects to a coax cable which goes to the aerial and earth sockets on the receiver or preferably to a balanced input.

The loop forms a tuned circuit in conjunction with the capacitor with the inductive loop providing a low impedance feed to the receiver. The capacitor has to be tuned for each frequency and the selectivity is excellent. The loop is highly directional and by rotating it, interfering stations can be virtually eliminated. The tuning is very sharp and it is advantageous to fit either a slow

motion drive to the capacitor or to wire a small value variable trimmer in parallel with it (10pF to 20pF).

The gain is not as high as that of a long wire aerial but this is more than outweighed by the much improved signal-to-noise ratio and the directional characteristics. The direction of a station can be determined within a few degrees by nulling it out to take its bearing. The broom-handle can be fitted into a recessed slot to prevent it slipping.

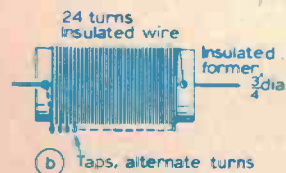
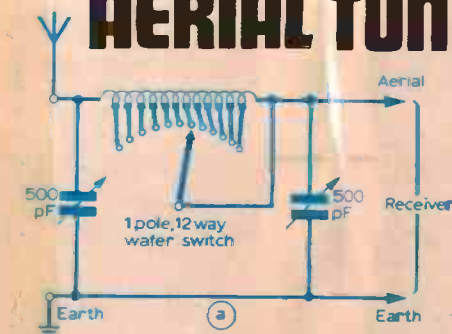
The main frame can be made of 6mm (1/4 in.) plywood or softwood. The wires should be wound very tight and should be kept that way (under tension the wire tends to stretch slightly). The softwood blocks merely act as bracers and as supports for the broom handle.

# WINDOM

A useful general coverage aerial for the HF bands is the Windom which has a single wire feeder tapped on to the horizontal wire. An aerial length of about 80 feet will work especially well on the 13, 25 and 49 metre bands.



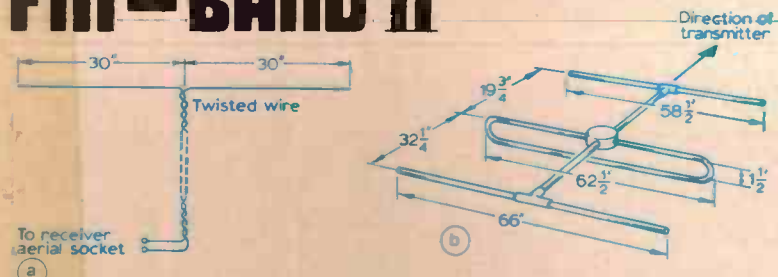
# AERIAL TUNING UNIT



For best results an end fed wire aerial or rod aerial should be matched to the receiver input circuit with an Aerial Tuning Unit (a). The inductor (b) is wound making a loop every other turn, the loops then being soldered to the switch tags. Fit each tuning capacitor

with a calibrated knob or dial and number the switch positions. Adjust the capacitors and switch position for maximum signal strength noting that the three adjustments are very much interdependent. Log dial and switch readings for future reference.

# FM - BAND II



The signal strength of FM broadcasting stations is quite high over most of the country and elaborate aerials are rarely necessary. Many receivers are now fitted with telescopic aerials for FM but these will be poor in some areas. A very simple FM aerial can be made from ordinary twisted bell-wire, as shown. One end should be unwound and pinned along a picture rail to form a dipole. The dimensions given are for 95MHz. If within range of a BBC local radio

station, the dipole should be modified to resonate at the frequency of this station as the signal strength is likely to be comparatively low. Length of each leg in inches = 2808 / Frequency in MHz. For DX FM reception or in difficult areas, more elaborate roof or loft mounted arrays should be used. Dimensions of a typical array are given although these aerials usually are cheaper to buy ready made.