

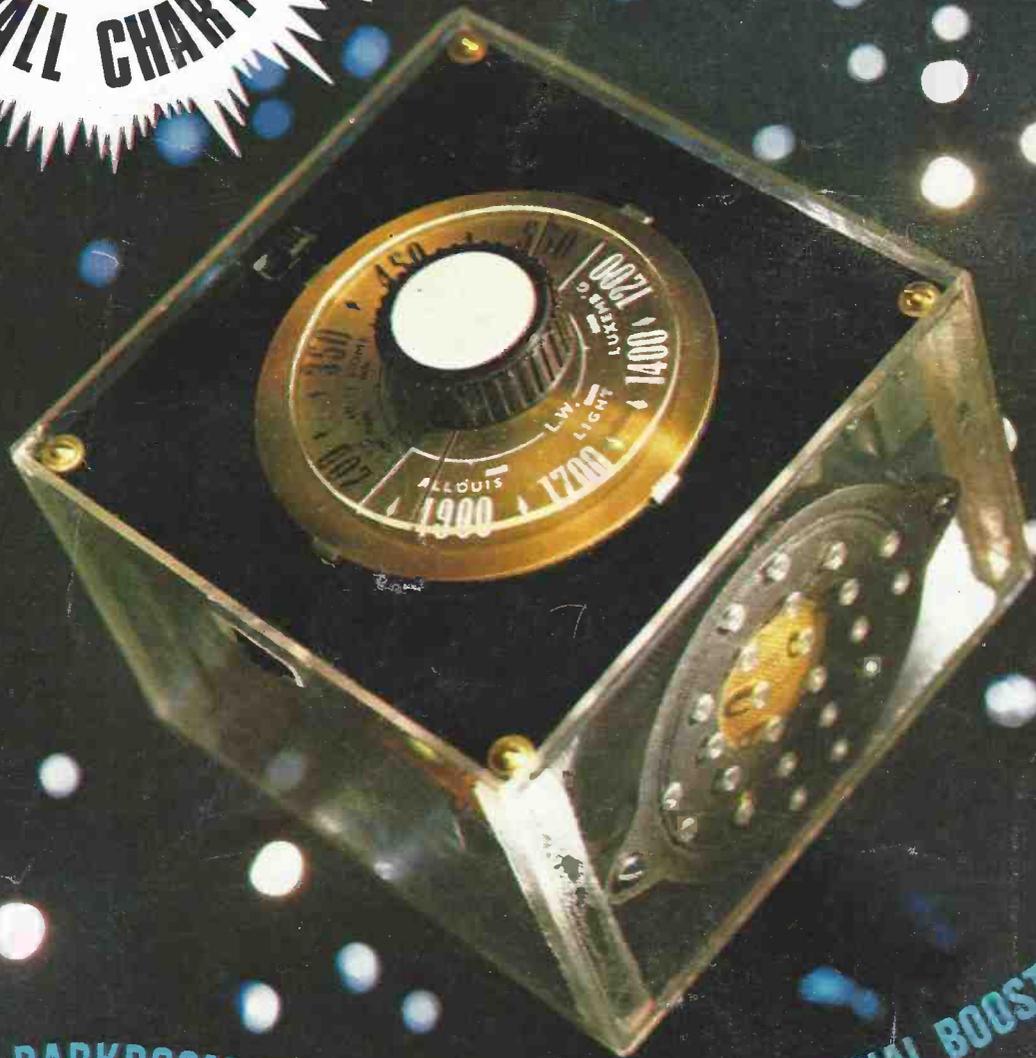
# PRACTICAL WIRELESS

MARCH  
1972

20p

FREE INSIDE  
**DX DATA**  
WALL CHART

build the PW  
**CUBE RADIO**  
7 transistor superhet



ALSO: DARKROOM THERMOMETER · CAR RADIO SIGNAL BOOSTER



# 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 CS90 Ceramic Pick-up Cartridge with diamond stylus
- ★ PAIR OF STANWAY II Speaker Units

Special Total Price **£79.80**  
Carr. £1.50

Terms: Deposit £12 and 9 monthly payments £8.55 (Total £88.95).



ATTRACTIVE TEAK OR AFRORMOSIA 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
- ★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
- ★ PAIR OF DORCHESTER Loudspeaker Units

Special Total Price **£58**

Or Deposit £7.15 and 9 monthly payments £6.35 (Total £64.30). Carr. £1.25  
Trans. Plastic Cover £3.15 extra.

- ★ 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 **£97.75**  
Carr. £1.50

Terms: Deposit £15 and 9 monthly payments £10.53 (Total £114.55).

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

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1.25

**£51.75**

Or Deposit £6 and 9 monthly payments £5.70 (Total £57.30)  
Trans. Plastic cover £3.15 extra.

### 'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

Moderate size only 25 x 14 x 10in. COMPLETE KIT Carr. 65p **£23**

- ★ Response 30-20,000 c.p.s. Impedance 15 ohms
- ★ Performance comparable with units costing considerably more.

Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8 x 5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quality 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).

### 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. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High Flux 13 x 8in. **£9.45** Carr. 40p.

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 **£17.85** Illustration

### RSC G66 MkII 6.5 WATT high quality STEREO AMPLIFIER

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

COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11.50** Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated **£15.99** or dep. **£3.20** and 9 monthly payments **£1.70** (Total **£18.50**).

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

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION HIGH FIDELITY OUTPUT OF 6.5 WATTS PER CHANNEL

Designed for optimum performance with any crystal or ceramic beam P.U. cartridge. Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. - 2dB ★ Harmonic Distortion 0.3% at 1,000 c.p.s. Hum and Noise - 70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & Knobs.

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. **£15.50** Carr. 40p. Factory built with **£19.50** Dep. **£3** and 9 mthly pymts **£2.15** (Total **£22.35**). Or in Teak veneer housing Dep. **£3** & 9 mthly payments **£2.55** (Total **£25.95**). Send S.A.E. for leaflet. **£23**

### AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction.

OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6.75** Carr. 35p

### HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. All sizes approx. Carr. 30p. per enclosure.

JES Size 16 x 11 x 9in. Pressurised. **£5.35** Carr. 30p. For optimum performance with any 8in. Hi-Fi speaker. Size 22 x 15 x 9in. Ported. **£6.47**

SE10 For outstanding results with 10in. Hi-Fi spkr. **£6.74** Carr. 40p. Size 24 x 15 x 10in. P.t'd.

SE12 For excelnt prfmece with 12in Hi-Fi speaker and Tweeter. **£7.87** Carr. 40p. Size 28 x 16 x 10 1/2 in.

### AUDIOTRINE HIGH FIDELITY SPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Treated 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	£4.75
HF102D	10"	10W	£3.40	HF126	12"	15W	£5.50
HF120	12"	15W	£4.25	HF126D	12"	15W	£5.90

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

TYPE BML. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2in. approx. Completely replaces batteries supplying 1.5v and 90v to battery radio where A.C. mains 200/250v. 50c/s is available.

COMPACT KIT WITH DIAGRAM **£3.25** FOR USE

ASSEMBLED READY **£3.75**

### FANE 807 HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω. STATE **£3.50** WHEN ORDERING

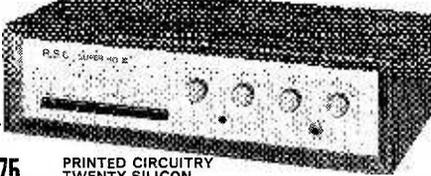
### R.S.C. TA6 6 Watt HI-FI AMPLIFIER

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 5 1/2 in. Attractive brushed silver finish facia plate 10 1/2 x 9 1/2 in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7.50** Carr. 40p.

OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE **£9.75**

# 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 **£27.25**).

Or FACTORY BUILT in cabinet as illustrated. Dep. **£8** and 9 monthly payments **£3.88** (Total **£40.74**)

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

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: -3dB 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: Mag. 2-5mV. 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.

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

**50 WATT SPEAKER** **RSC DISCOTHEQUE EQUIPMENT** **FAL**

**SAVINGS ON PACKAGE OFFER**

(1) FAL FGI/2 Console  
 (2) 100W Power Amplifier  
 (3) Pair High Quality Headphones  
 (4) Matching Microphone fitted to Headphones  
 (5) Pair 50W Speakers black rexine covered Size approx. 18" x 18" x 8"

**TOTAL COST OF ALL ILLUSTRATED UNITS Carr. £22.50** **£136**

Terms: Deposit £30 and 9 monthly payments of £13.25 (Total £149.25)

**50 WATT SPEAKER**  
**100 WATT AMPLIFIER**  
**TWIN TURNTABLE WITH PRE-AMP**

**HEADPHONES MICROPHONES**

**SEND S.A.E. FOR LEAFLET**

**F.G. 1/2 DISCO CONSOLE**  
 Incorporating twin Garrard SP25 Mk.III turntables and Goldring C850 Ceramic Cartridges with diamond stylus. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate Input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. Carr. £1.25 **£69**

Terms: Deposit £15 and 9 monthly payments of £8.75 (Total £75)

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

All types 15 Ohms covered in Rexine and Vynair

**TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN**

**TYPE C48S 25-30 WATTS**  
 Fitted four 8" high flux 8 watt speakers  
 Overall size approx. 48x10x6in  
 Terms: Dep. £3 and 9 monthly payments £2 (Total £31) Carr. 50p.

**TYPE C412S 50 WATTS**  
 Fitted four 12" 11,000 gauss 15 watt speakers. Overall size approx. 56x14x8in  
 Terms: Dep. £4 and 9 monthly payments £3 (Total £31) Carr. 75p. **£27.50**

**TYPE C4100 100 WATTS** inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58x16x10" Acoustically filled and pressurised. Terms: Dep. £7.50 and 9 mthly. pmts. £5.45 (Total £68.55). Carr. £1

**FAL ULTRA HIGH POWER LOUDSPEAKERS**

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE  
 High flux ceramic magnets. All carr. free

**'POP' 100**  
 18" 100Watt  
 14,000 gauss  
 8/15Ω  
**£22.50**  
 Dep. £6 and 9 mthly payments £2.15 (Total £25.35)

**'POP' 60**  
 15" 60 Watt  
 14,000 gauss  
 8/15Ω  
**£12.90**  
 Dep. £3.30 and 9 mthly payments £1.80 (Total £12.15)

**'POP' 50**  
 12" 50 Watt  
 13,000 gauss  
 15Ω  
**£10.50**  
 Dep. £2 and 9 mthly payments £1.15 (Total £12.85)

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, EF88, 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, Strings 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. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover **£19.90**. Or factory built with EL34 output valves and 12 months' guarantee for £19.75 Carr. 65p

**TERMS: Deposit £4 and 9 monthly payments of £2.10 (Total £22.90). Send S.A.E. for leaflet.**

**FAL LOUDSPEAKERS 'POP' 25/2 12" 25 WATT**

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ). **£6.75** Carr. or Dep. £1 and 9 mthly payments 75p (Total £7.75).

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

FULLY GUARANTEED. Impregnated and interleaved where necessary.

Primaries 200-250v. 50c/s. Screened

**MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 in.**

250v. 60mA. 5-3v. 2a. 99p  
 250-0-250v. 60mA. 6-3v. 2a. £1.05

**FULLY SHROUDED UPRIGHT MOUNTING**

250-0-250v. 60mA. 6-3v. 2a., 0-5-6-3v. 2a. £1.40  
 250-0-250v. 100mA. 6-3v. 4a., 0-5-6-3v. 2a. £2.20  
 300-0-300v. 100mA. 6-3v. 4a., 0-5-6-3v. 3a. £2.20  
 For Mullard 610 Amplifier £2.45

350-0-350v. 100mA. 6-3v. 4a., 0-5-6-3v. 2a. £2.20  
 350-0-350v. 150mA. 6-3v. 4a., 0-5-6-3v. 3a. £2.65  
 425-0-425v. 200mA. 6-3v. 4a., c.t., 5v. 3a. £2.95  
 425-0-425v. 200mA. 6-3v. 4a., 6-3v. 3a., 5v. 3a. £5.10  
 450-0-450v. 200mA. 6-3v. 4a., c.t., 5v. 3a. £5.50

**TOP SHROUDED DROP-TYPE TYPE**

250-0-250v. 70mA. 6-3v. 2a., 0-5-6-3v. 2a. £1.95  
 250-0-250v. 100mA. 6-3v. 3-5a. £1.65  
 250-0-250v. 100mA. 6-3v. 2a., 6-3v. 1a. £1.60  
 350-0-350v. 80mA. 6-3v. 2a., 0-5-6-3v. 2a. £1.65  
 250-0-250v. 100mA. 6-3v. 4a., 0-5-6-3v. 3a. £2.20  
 300-0-300v. 100mA. 6-3v. 4a., 0-5-6-3v. 3a. £2.20  
 300-0-300v. 130mA. 6-3v. 4a., c.t., 6-3v. 1a. £2.40  
 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

**PILAMENT OR TRANSISTOR POWER PACK**  
 Types 8-3v. 1-5a. 49p; 6-3v. 2a. 54p; 6-3v. 3a. 76p;  
 6-3v. 6a. £1.00; 12v. 1a. 55p; 12v. 3a. or 24v. 1.5a. £1.35; 0-9-18v 1 1/2a. £1.10; 0-12-25-42v 2A117L.  
**CHARGE TRANSFORMERS 0-9-15v. 1 1/2a. 99p;**  
 2 1/2a. £1.10; 3a. £1.25; 5a. £1.45; 6a. £1.65; 8a. £2.00  
**AUTO (STEP UP/STEP DOWN) TRANSFORMERS**  
 0-110/220v. 200-230-250v. 50-80 watts £1.10,  
 150 watts, £1.90 250 watts £2.75; 500 watts £5.75

**OUTPUT TRANSFORMERS**  
 Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p  
 Push-Pull 8 watts EL84 to 3 Ω or 15 Ω 88p  
 Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω £1.37  
 Push-Pull EL84 to 3 or 15 Ω 10-12 watts £1.85  
 Push-Pull Ultra Linear for Mullard 510, etc. £2.20  
 Push-Pull 15-18 watts, sectionally wound 6L6, K T66, etc. for 3 or 15 Ω £1.99  
 Push-Pull 20 watt high quality sectionally wound EL34, 6L6, K T66 etc. to 3 or 15 Ω £3.80

**SMOOTHING CHOKES 150mA, 7-10H, 250 Ω**  
 70p; 100mA, 10H, 200 Ω 90p; 80mA, 10H, 350 Ω 50p; 60mA, 10H, 400 Ω 25p.

**SELENIUM RECTIFIERS F. W. (Bridged)**  
 All 6/12v. D.C. output. Max. A.C. Input 18v.  
 1a. 25p. 2a. 35p. 3a. 50p. 4a. 65p. 6a. 80p.

**GROUP/DISCO EQUIPMENT PACKAGE OFFERS**

**F.A.L. PHASE 50 Mk.III AMPLIFIER** £34.75  
**PR. FAL POP 25/2 25W L/SPEAKERS** £18.50  
 Terms: Deposit £5.50 and 9 monthly payments of £4.75 (Total £48.95) **£45** carr. £1.25

**F.A.L. PHASE 50 Mk.III AMPLIFIER** £34.75  
**PR. FAL POP 50 L/SPEAKERS** £21  
 Terms: Deposit £12 and 9 monthly payments of £5 (Total £57.00) **£51** carr. £1

**F.A.L. PHASE 100 AMPLIFIER** £55.75  
**PR. L125 50W L/S in cabinets** £59.80  
 Terms: Deposit £22 and 9 monthly payments of £11.82 (Total £129.58) **£118** carr. £2.50

**F.A.L. PHASE 100 AMPLIFIER** £61.95  
**4 FAL POP 50 L/SPEAKERS** £42  
 Terms: Deposit £12.52 (Total £109.50) **£99** carr. £2

**HIGH QUALITY LOUSPEAKER UNITS**

**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. Or deposit £4 and 9 monthly payments of £3.85. Total £34.15

**L12 12" 25 WATT**  
 10,000 lines 15 ohms. Also supplied with Rexine covered Carr 45p

**L18 12" x 8" 10 Watt**  
 10,000 lines 3 or 15 ohms. State impedance required. **£5.25** carr. 40p

**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 shorts. Output for Speaker/s 3-30 ohms. Size 17" x 7" x 7 1/2"

200-250v. A.C. mains. Output 50 watts music rating. Or deposit £7.25 and 9 monthly payments £3.50. Total £38.75. **£34.75** Carr. 75p.

**LOW DEPOSIT CREDIT TERMS INTEREST CHARGES REFUNDED**

Available on purchases over £8 (Kits of parts excepted) on credit sales settled in 3 months.

**R.S.C. Branches listed below open all day Sats.**

**BRADFORD** 10 North Parade (Half-day Wed.). Tel. 25349

**BLACKPOOL** (Asent) O & C Electronics 227 Church Street

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

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

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

**EDINBURGH** 133 Leith St. (Half-day Wed.). Tel. 556 5766

**GLASGOW** 326 Argyle St. (Half-day Tues.). Tel. 248 4158

**HULL** 91 Paragon Street (Half-day Thurs.). Tel. 20505

**LEICESTER** 32 High Street (Half-day Thurs.). Tel. 56420

**LEEDS** 5-7 County (Mecca) Arcade, Brigate (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** 41 Blakett Street (opp Fenwicks Store) (Half-day Wed.). Tel. 21469

**NOTTINGHAM** 19/19A Market Street (Half-day Thurs.). Tel: 48068

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

**Another New Branch!**

**NOW OPEN AT—**  
**19/19A MARKET STREET**  
**NOTTINGHAM**  
 (Half Day Thursday) Tel: 48068

**RSC HI-FI CENTRES LTD.**

**MAIL ORDERS & EXPORT ENQUIRIES TO:—**  
 AUDIO HOUSE, HENCONNER LANE, LEEDS, 18. Tel: Pudsey (09785) 7781.

**TERMS C.W.O. or C.O.D. No C.O.D. under £1.**  
 Postage 25p extra under £2. 30p extra over £2 or as quoted.  
 Trade supplied. S.A.E. please with enquiries.  
 Suppliers to Govt. Depts, Education Authorities, Schools, Hospitals, H.M. Forces etc.

**MAIL ORDERS MUST NOT BE SENT TO SHOPS**

**R.S.C. BASS REGENT 50 WATT AMPLIFIER**

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

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

Credit Terms: Deposit £18 and 9 monthly payments of £5.75 (Total £67.75) **£60** Carr. £1.50

**30 WATT HI-FI AMPLIFIER**

**For Guitar, Vocal or Instrumental Group.**

A 4 input, 2 vol. control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £3.70 and 9 monthly payments of £2.10 (Total £22.60). **£19.95** Carr. 85p

# AT HOME SOLDERING ?

Our miniature irons are used all over the world in that most exacting market—the modern electronics industry, the rapidly developing technology of which has made possible the enormous growth of activities available to the technical hobbyist.

He now also requires equipment to the highest commercial standards. Like our soldering irons, for example.

Look at the ADAMIN Model 15. If there is a smaller iron for mains use, we haven't seen it. It weighs a mere  $\frac{1}{2}$  oz (less flex) and is about 7 inches long.

But it has a big performance. Used with interchangeable bits from  $\frac{3}{8}$ " to  $\frac{3}{16}$ " it is suitable for all work, from Hearing Aids to Colour Television.

Use the mains version at home or clip the 12 volt model to the car battery or 12 volt power unit (consumption only 1.25A).

Send for HOBBY PACK 10 consisting of Model 15 iron with four bits,  $\frac{3}{8}$ ",  $\frac{3}{16}$ ",  $\frac{3}{32}$ ",  $\frac{1}{8}$ ",  $\frac{1}{16}$ " and tube of Bit Lubricant. State voltage required—12v or 220/240v.

**PRICE: HOBBY PACK £2.30**  
p & p FREE

## LIGHT SOLDERING DEVELOPMENTS LTD.

28 Sydenham Road, Croydon, CR9 2LL  
Telephone 01-688 8589 and 4559



# JERMYN 50p BARGAIN PACKS

All fully coded, all from well-known manufacturers and now available, while stocks last, at better than bulk-buyer's prices! Cash with order only.

1N4148	Signal Diode	18 for 50p
(= 1N914)		
1N5060	1 Amp Rectifier 400V	
(= A14D)	avalanche protected	7 for 50p
2N2923	NPN Silicon Transistor	
	hfe 90-180 (25v)	7 for 50p
2N2926	NPN Silicon Transistor	
(Red)	hfe 55-110	8 for 50p
2N3391A	Si NPN Hi Gain (250-500)	
	low noise transistor	3 for 50p
2N3402	Medium power (driver)	
	900mw 25v Hfe 75-225	6 for 50p
C6U	1.6 amp general purpose	
	25v SCR in T05 case	3 for 50p

Post and packing 10p for 1 or 2 packs; 3 packs or more post free.

Order any quantity, till sold (but we regret packs cannot be subdivided).



P.O. or Cheque payable,  
Jermyn Industries,  
Vestry Estate,  
Sevenoaks, Kent.

Star Bargain  
Sprague (Pirgo) Triacs  
PT406S (6 amp 400v)  
48p each

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units, interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots / removable space dividers. Build up any size cabinet for wall, bench or table top.

**INTER-LOCKING PLASTIC STORAGE DRAWERS**

NEAT! HANDY! TIDY!

**DISCOUNT PRICES**

**SINGLE UNITS** (5" x 2 1/2" x 2 1/2") £1.35 Dozen  
**DOUBLE UNITS** £2.25 Dozen  
**TREBLE (3D)** £2.35 for 8  
**DOUBLE TREBLE** 2 draws in one outer case (6D2) £3.65 for 8 extra large size (6D1) £3.30 for 8.

**PLUS QUANTITY DISCOUNTS!** Order £5 and over Deduct 5% in the £. Order £10 and over Deduct 7 1/2% in the £. Order £20 and over Deduct 10% in the £. Pack./Post./Carr. Add 35p to all orders under £5. Orders over £5 P/P/C free.

**IVORYET LIMITED** (Dept. P.W.3 124 CRICKLEWOOD BROADWAY, LONDON N.W.2)

**5 SIZES ALL INTERLOCK**

**AMAZING MINI-DRILL**

Indispensable for precision drilling, grinding, polishing, etching, gouging, shaping. Precision power for the enthusiast. Shockproof. Completely portable power from 4 1/2 volt external battery. So much more scope with MINI-DRILL. Super Kit (extra power, interchangeable chuck) £4.50, p.p. 13p. De Luxe Professional Kit with 17 tools £7.00 p.p. 23p. Money ref. g'tee.

**FOR PRECISION MODEL WORK**

**+ 6 TOOLS**

**£2** P.&P. 10p

PW3/72

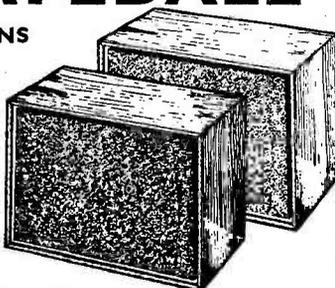
**MERLIN SUPPLY CO.**

Dept. PW372 Nailsea, Bristol BS19 2LP

# FANTASTIC! WHARFEDALE

## SPEAKER BARGAINS DENTON 2 SAVE £8.40

Sold in matched pairs for a perfectly balanced stereo system. Each Denton contains an 8in.-bass unit with 3in. pressure unit, coupled by a Wharfedale crossover network. Rated input: 18 watts maximum. Frequency response: 65-17,000 Hz. Impedance: 4/8 ohms. Cabinet 9½in. x 14in. x 8½in.



All speakers available in Teak or Walnut

List Price **LASKY'S** **£31.50** C & P  
£39.90 PRICE Per Pair £2.00

	List Price	Lasky's Price	C & P		List Price	Lasky's Price	C & P
LINTON 2 p.p.	£49.90	£39.95	£2	ROSEDALE ea.	£65.00	£50.00	£1
TRITON 3 p.p.	£65.00	£53.50	£2	UNIT 3 each	£12.50	£9.70	50p
MELTON 2 p.p.	£35.00	£25.50	£1	UNIT 4 each	£18.00	£12.50	50p
DOVEDALE 3 ea.	£45.00	£33.00	£1	UNIT 5 each	£26.00	£18.50	50p

## BSR McDONALD MP60

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

LASKY'S PRICE £10.95 C & P 50p

### BSR McDONALD UNITS & PACKAGES

A. Chassis only. B. Complete with Lasky's plinth and cover. C. Complete with Lasky's plinth, cover and AD76K cartridge. D. Comp. wired on BSR plinth with cover. E. As D plus AD76K cartridge.

MODEL	A	B	C	D	E
MP.60	10.95	15.50	18.50	18.75	22.00
HT.70	15.90	19.90	23.50	23.75	27.00
610	14.50	18.75	23.00	22.25	25.50
510	12.10	16.50	18.85	20.00	22.85
310	9.75	14.00	16.50	17.25	20.25
210					9.95
MP.60 TPD2 Styrene base				17.50	21.00



## GARRARD UNITS AND PACKAGES

### GARRARD SL 55B

Four speed autochanger

LASKY'S PRICE £10.25 C & P 50p

Now available ZERO 100S

£43.50, C & P £1.50

Garrard SP25 Mk. III. ... £11.50

Garrard SL40B	£9.95
Garrard AP76 without cart.	£20.95
Garrard 3000 with 9TA cart.	£10.50
Garrard 2025TC with KS40A cart.	£8.50



## GARRARD PACKAGES

Garrard AP76 with Micro M2100/e cart. and Lasky's plinth and cover	£31.50
Garrard AP76 with Shure M44E cart. and Lasky's plinth and cover	£33.75
Garrard SP25 Mk. III, AD76K cart. and Lasky's plinth and cover...	£18.50
Garrard SP25 Mk. III with Shure M3 cart. and Lasky's plinth and cover	£27.95

## LASKY'S NEW LOW NOISE CASSETTES FROM THE USA

Type	Singles	5	10	20
C-60	32p	£1.52	£2.96	£5.60
C-90	50p	£2.37	£4.62	£8.75
C-120	69p	£3.28	£6.38	£10.85

Carriage and packing: each-7p, 5-25p, 10-40p, 20-68p.

# Lasky's Radio Limited

Branches

207 EDGWARE ROAD, LONDON, W.2 Tel: 01-723 3271

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MAGNETIC RECORDING TAPE FROM THE U.S.A. AT LASKY'S RECORD LOW PRICES

3in. RT.20 Message Tape 225ft.	19p	5½in. RT.25 Triple play, 2,400ft.	£1.31
3½in. RT.21 Triple play, 600ft.	50p	7in. RT.22 Standard play, 1,200ft.	63p
5in. RT.23 Double play, 1,200ft.	75p	Acetate	
5in. RT.18 Long play, 900ft.	43p	Mylar	63p
Acetate	50p	7in. RT.10 Standard play, 1,200ft.	63p
5in. RT.17 Standard play 600ft.	43p	Mylar	63p
5½in. RT.15 Double play, 1,800ft.	£1.13	7in. RT.12 Long play, 1,800ft.	95p
Mylar		Mylar	95p
5½in. RT.16 Long play 1,200ft.	75p	7in. RT.13 Double play, 2,400ft.	£1.25
Acetate	75p	Mylar	£1.25
5½in. RT.24 Standard play 900ft.	60p	7in. RT.11 Long play, 1,800ft.	75p
P.V.C.	60p	Acetate	75p
5½in. RT.14 Long play 1,200ft.	75p	7in. RT.19 Triple play, 3,600ft.	£2.50
Mylar	75p	Mylar	£2.50
		3½in. RT.22 Quad play, 1,100ft.	£1.02

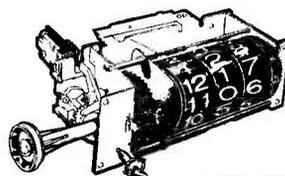
P. & P. 5p extra per reel, 4 reels & over Post Free. Special quotes for quantities

## OUT NOW! 1972 AUDIO TRONICS

The great new 1972 edition of Lasky's famous Audio-Tronics catalogue is now available—FREE on request. The 44 newspaper size pages—many in full colour—are packed with 1,000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast, Electronics hobbyist, Serviceman and Communications Man. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories and don't miss LASKY'S AUDIO TRONICS CREDIT CARD SCHEME offering holders one month's interest free credit up to £50. Send your name and address and 15p for post and inclusion on our regular mailing list.

ALSO the fantastic £1,000 plus SONY COLOUR TV Audio Tronics '72 Competition

## DIGITAL CLOCK SCOOP



EXCLUSIVELY FROM LASKY'S

For you to mount into any housing. The clock measures 4½ W x 1½ H x 3½ D (overall from front of drum to back of switch). SPEC.: 210/240V a.c., 50Hz operation; switch rating 250V, 3A. Complete with instructions, HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS.

LASKY'S PRICE £6.50

- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
  - MAINS OPERATION
  - 12-HOUR ALARM
  - AUTO "SLEEP" SWITCH
  - HOURS, MINUTES AND SECONDS READ-OFF
  - FORWARD AND BACKWARD TIME ADJUSTMENT
  - SILENT OPERATION
  - SYNCHRONOUS MOTOR
  - SHOCK AND VIBRATION PROOF
  - BUILT IN ALARM BUZZER
- SPECIAL QUOTES FOR QUANTITIES

C & P

52p

## BARGAIN SCOOP!

### PYE S.W. CAR RADIO CONVERTER MODEL 2649

High quality transistorised and ultra compact Shortwave Converter for use with any suitable MW (AM) Car Radio. Self powered for use on 12V positive or negative earth systems. The model 2649 is simply connected to the radio via the aerial socket and provides shortwave covering in 9 push button selected band spread ranges (13, 16, 19, 25, 31, 41, 49, 60 & 90 M) combined with the normal radio tuning to give full cover from 3.2MHz-21.75MHz. On/off switch and by-pass switch for normal M.V. radio use. Complete with mounting bracket fitting and alignment instructions. Black hammer crackle finished case—size: 6(W) x 1½(H) x 3½(D) in. C & P 20p.

Made to sell LASKY'S PRICE £8.75

approx. £20



# COMET

## HI-FI DISCOUNT WAREHOUSES

DRIVE-IN CAR PARK



	Rec. Price	Retail Price	Comet Price
<b>STEREO AMPLIFIERS</b>			
ALBA UA 700	34-50	24-95	
ALPHA 212 By Highgate	36-75	27-95	
AMSTRAD Stereo 8000 Mk 2	27-95	17-95	
AMSTRAD I.C. 2000	42-95	27-95	
ARMSTRONG 521	59-00	44-95	
DULCI 207	26-00	16-95	
DULCI 207M	32-00	19-95	
FERROGRAPH F307 Mk. II (cased)	64-00	43-95	
FERROGRAPH F307 Mk. II (Metal case)	60-00	43-95	
GOODMANS Maxamp	54-00	37-95	
LEAK Delta 30 (cased)	65-00	51-95	
LEAK Delta 70 (cased)	79-50	63-95	
METROSOUND ST20E	39-50	27-95	
METROSOUND ST60	70-00	49-95	
PHILIPS RH 581	79-00	54-95	
PHILIPS RH 580	52-00	36-95	
PHILIPS RH 580	29-00	19-95	
PIONEER SA500A	53-62	38-95	
PIONEER SA600	83-75	59-95	
PIONEER SA700	97-97	66-95	
PIONEER SA800	109-21	75-95	
PIONEER SA900	59-50	42-95	
PIONEER SA1000	137-56	95-95	
PIONEER Reverbation 202W	46-35	33-95	
RANK Rotel 310	47-50	35-95	
RANK Rotel 610	74-50	53-95	
RANK ROTEL 210	34-90	24-95	
ROGERS Ravensbourne	59-50	42-95	
ROGERS Ravensbourne (cased)	44-00	47-95	
ROGERS Ravensbrook Mk. II	47-50	36-95	
ROGERS Ravensbrook (cased) Mk. II	52-50	39-95	
SINCLAIR 2000	35-00	23-75	
SINCLAIR Project 60/2 x Z30/PZ5	23-90	15-95	
SINCLAIR PROJECT 60/2 x Z50/PZ8trans	34-86	23-25	
SINCLAIR PROJECT 60S	29-95	21-95	
SINCLAIR AFU	5-95	4-45	
SINCLAIR Neoteric	61-95	43-95	
SINCLAIR 3000	45-00	31-50	
TELETON SAQ 206	32-50	18-25	
TELETON 307	30-00	19-95	
VOLTEX 100W Stereo Disothetue	185-00	139-00	
8 electronically mixed inputs			
WHARFEDALE Linton Amplifier	60-00	47-95	
All take both ceramic and magnetic cartridges.			
<b>TUNERS</b>			
*ARMSTRONG 523 AM/FM	54-22	42-95	
*ARMSTRONG 524 FM	42-17	33-95	
ARMSTRONG M8 Decoder	9-50	7-70	
*DULCI FMT.7 FM	25-10	17-95	
DULCI FMT.7S Stereo	33-79	27-25	
GOODMANS Stereomax	80-07	47-95	
LEAK Delta FM	75-00	55-95	
LEAK Delta AM/FM	89-50	69-50	
PHILIPS RH 690	45-30	36-50	
PHILIPS RH 691	85-80	69-95	
PIONEER TX500 AM/FM	86-09	57-95	
PIONEER TX500 AM/FM	147-15	116-00	
RANK ROTEL 320	54-94	43-95	
ROGERS Ravensbourne chassis	59-63	46-95	
ROGERS Ravensbourne In teak case	64-45	48-95	
ROGERS Ravensbrook chassis	43-37	34-95	
ROGERS Ravensbrook (cased)	49-39	38-95	
SINCLAIR 2000	45-00	34-95	
SINCLAIR (S) 60 tuner (stereo)	25-00	19-95	
TELETON GT 101	43-93	30-95	
All above Tuners are complete with MPX Stereo Decoder except where starred.			
<b>TUNER/AMPLIFIERS</b>			
AKAI AA 8500	221-85	175-00	
AKAI 6600	137-34	108-00	
AKAI 6300	128-85	99-95	
AKAI 6200	91-56	79-95	
ARENA 2600	111-30	89-95	
ARENA T8000	303-45	285-00	
ARMSTRONG M8 Decoder	9-50	7-70	
ARMSTRONG 526	92-77	71-95	
ARMSTRONG 526	105-72	84-95	
GOODMANS Module 80, 35w. RMS	91-59	71-95	
GOODMANS Module 80 Compact	165-00	129-00	
GOODMANS Model 110 FM/MW/LW/SW 100W RMS	135-00	108-00	
LEAK Delta 75	165-00	139-95	
MIDLAND 19/542	49-58	37-50	
PHILIPS RH 790	134-00	79-95	
PIONEER SX770 AM/FM	139-23	109-95	
PIONEER SX900 AM/FM	187-83	129-95	
PIONEER 440	104-18	82-95	
ROGERS Ravensbrook Chassis	99-39	81-95	
ROGERS Ravensbrook (cased)	108-43	89-95	
ROTEL RX150	69-90	54-95	
TANDBERG 1171	110-00	91-95	
TANDBERG TR200	99-00	82-95	
TELETON F2000	51-50	28-95	
TELETON 10AT1 150w. RMS	160-00	94-00	
TELETON TFS50	79-65	52-95	
TELETON TFS50 LA MW/LW/FM	86-64	60-95	
TELETON CR55	125-26	67-95	
WHARFEDALE 100-1	139-00	89-95	
All the above Tuners and Tuner/Amplifiers take			



### COMET for after-sales service

THROUGHOUT THE U.K.  
 Pictured, Service Dept. at Clough Rd., Hull also at Leeds, Stockton, Goole, Wakefield, Doncaster, Bridlington, Birmingham, Edinburgh, Leicester and Rochdale

both ceramic and magnetic cartridges except Teleton F2000 which takes ceramic only. All include MPX Stereo Decoder with the exception of Armstrongs where decoder is extra as listed.

	Rec. Price	Retail Price	Comet Price
<b>CARTRIDGES</b>			
AUDIO TECHNICA LT66	6-47	4-50	
GOLDRING G800	12-55	6-75	
GOLDRING G800E	18-16	10-50	
GOLDRING G800 Super E	25-10	19-95	
*GOLDRING CS90 Stereo	5-02	4-10	
*GOLDRING CS91/E	7-53	6-00	
GOLDRING G850	6-27	3-95	
EMPIRE 1000ZE/X	60-34	51-25	
EMPIRE 999TE/X	43-00	34-95	
EMPIRE 999SE/X	25-09	21-00	
EMPIRE 999E/X	20-31	16-95	
EMPIRE 999E/X	15-89	12-50	
EMPIRE 999E/X	12-55	10-25	
EMPIRE 905E/X	11-87	9-95	
EMPIRE 905E/X	8-26	7-75	
EMPIRE 905E/X	9-56	7-95	
ORBIT Magnetic NM 22	Special Price	2-95	
ORTOFON SL15E	28-62	22-95	
ORTOFON 2 X 15K Transformer	7-00	4-95	
ORTOFON M15E	29-08	23-50	
SHURE M3DM	7-16	4-75	
SHURE M31E	11-63	8-70	
SHURE M32E	10-73	8-05	
SHURE M32-3	9-84	7-80	
SHURE M44-5	10-73	7-19	
SHURE M44-7	9-84	7-15	
SHURE M-44C	9-84	7-15	
SHURE M44E	11-83	7-95	
SHURE M55E	12-52	8-95	
SHURE M75G	16-99	13-75	
SHURE M75-6	16-10	12-45	
SHURE M75EJ	18-78	14-95	
SHURE M75E	20-57	13-50	
SHURE V15-11	39-35	27-95	
Starred cartridges above are ceramic. All others are magnetic.			
<b>PICKUP ARMS</b>			
GOLDRING Lenco 75	13-98	9-50	
GOLDRING Lenco L69	17-04	6-50	
SME 3009 with S2 Shell	33-26	24-95	
SME 3012 with S2 Shell	35-42	26-45	
<b>TURNTABLES</b>			
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 £18-95		
GARRARD SP25 Mk III with Shure M.44/7	Special Price £22-95		
GARRARD SP25 Mk III with Shure M.55E	Special Price £23-95		
GARRARD AP76 with Goldring G800	Special Price £32-95		
GARRARD AP76 with Shure M55E	Special Price £35-95		
GARRARD AP76 with Shure M75EJ	Special Price £39-95		
GARRARD 2025 with Sonotone 9TAHC	Special Price £14-50		
GARRARD SP25 Mk III	15-85	8-95	
GARRARD SL65 B	20-48	13-45	
GARRARD SL95 B	49-23	32-95	
GARRARD 401	39-26	27-45	
GARRARD SL72 B	31-83	23-95	
GARRARD Zero 100	56-25	42-95	
GARRARD Zero 100S	91-75	41-95	
GARRARD WB4 base Mk I/2 to fit Zero 100 & Zero 100S	6-40	4-95	
Base and Cover to fit GARRARD SP25, SL55, SL65B	Special Price 3-95		
GARRARD 40B	13-34	10-49	
GARRARD AP76	27-65	18-90	
GOLDRING 705/P with G850	26-00	16-95	

	Rec. Price	Retail Price	Comet Price
<b>SPEAKERS</b>			
ARENA HT 227 (pair)	42-00	26-95	
AKAI SW 155	58-48	39-95	
B & W Model 70	159-00	119-95	
B & W DM3	63-00	48-40	
B & W DM1 (per pair)	76-94	62-95	
CELESTION Dilton 120 (per pair)	57-70	45-95	
CELESTION Dilton 150	38-47	31-95	
CELESTION Dilton 25	65-00	46-95	
CELESTION Dilton 44	54-00	42-95	
GOODMANS Minister (per pair)	48-20	37-95	
GOODMANS Havant (per pair)	56-00	43-95	
GOODMANS Magister	62-50	41-95	
GOODMANS Double Maxim	33-00	25-95	
GOODMANS Mezzo 3	34-00	24-95	
GOODMANS Magnum K2	44-00	30-95	
GOODMANS Dimension 8	69-00	49-95	
GOODMANS DIN 20NT kit	12-54	9-95	
KELETRON KN400 2-speaker System (pair)	16-10	12-95	
KN600 3-speaker System (pair)	26-86	18-95	
KN800 3-speaker System	15-90	10-95	
KN1100 4-speaker System	20-40	14-20	
KN1600 3-speaker System	25-20	16-95	
KN2100 3-speaker System	30-60	20-95	
LEAK 150 (per pair)	49-90	37-95	
LEAK 250 (per pair)	65-00	49-95	
LEAK 600	49-50	35-95	
LOWTHER Ideal Baffle	37-50	32-95	
METROSOUND HFS 103 (pair)	48-00	32-95	
METROSOUND 202	21-50	15-95	
PHILIPS RH 411 (pair)	21-20	16-95	
PHILIPS RH 481 (pair)	21-20	16-95	
PHILIPS RH 482 (per pair)	34-70	28-95	
PHILIPS 496	38-00	30-95	
SINCLAIR Q16	24-00	16-95	
STE-MA 400	28-00	23-95	
TANDBERG TAN 7	38-00	31-95	
TANDBERG Tan 11 (per pair)	28-00	23-95	
VOLTEX (Teak) pair	20-50	14-95	
<b>WHARFEDALE Speakers</b>			
Denton Mark II (per pair)	39-90	31-95	
Linton Mark II (per pair)	49-90	39-95	
Melton Mark II	35-00	27-95	
Doveclad 3 (new model)	45-00	31-95	

(OVER 1,520 sq. yds.)

# OVER 1000 ITEMS ALWAYS IN STOCK

## ALL FULLY GUARANTEED— WITH AFTER-SALES SERVICE

All items offered are brand new, latest models in manufacturers' sealed cartons

	Rec. Price	Retail Price	Comet Price
Rosedale	85-04	48-50	
Trilon (pair)	72-16	37-95	
Unit 3 Speaker Kit	12-53	9-70	
Unit 4 Speaker Kit	18-00	12-50	
Unit 5 Speaker Kit	26-00	18-50	
<b>CHASSIS SPEAKERS</b>			
GOODMANS Twin-taxette 8	8-84	6-95	
GOODMANS Axiom 201	14-45	10-45	
GOODMANS Axiom 401	17-86	13-95	
GOODMANS Twin Axiom 10	9-86	7-50	
GOODMANS Audiom 8P	5-35	4-09	
GOODMANS Audiom 10P	5-83	4-50	
GOODMANS Audiom 12P	12-37	9-50	
GOODMANS Audiom 15P	20-00	16-50	
GOODMANS Audiom 18P	34-00	25-95	
GOODMANS ARU172	4-50	3-25	
GOODMANS Trebas 100	8-60	5-50	
GOODMANS Axiom 100	6-90	4-95	
GOODMANS Midax 650	12-95	8-50	
GOODMANS Attenuator	3-95	2-25	
GOODMANS Crossover Networks			
XO/950/5000	9-75	7-15	
GOODMANS Crossover Networks			
XO/950	7-40	5-50	
GOODMANS Crossover Networks			
XO/5000	2-65	1-85	
WHARFEDALE 8in. Bronze/RS/DD	4-82	3-50	
WHARFEDALE Super 8/RS/DD	8-19	6-75	
WHARFEDALE Super 10/RS/DD	11-20	9-50	
WHARFEDALE WMT1 Matching Transformer	0-84	0-70	
<b>HI-FI STEREO SYSTEMS COMPLETE</b>			
ALBA UA552	45-86	35-50	
DANSETTE Concert Stereo	33-74	29-95	
AMSTRAD Stereo 1000	48-00	36-95	
DECCA Sound 813	70-14	37-95	
DECCA Sound 814	86-55	54-95	
DECCA Sound 1204	89-44	72-95	
DECCA Compact 3	119-56	103-95	
DECCA 403	59-50	48-95	
ELIZABETHIAN L2101	59-95	42-95	
FERGUSON 3450 with radio	72-40	61-95	
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FIDELITY UA2 Music Master	44-50	34-95	
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<b>SPECIAL OFFER</b>			
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PHILCO Ford M1500	99-93	68-50	
PHILIPS 808	96-05	79-95	
PHILIPS 580/481/105	71-00	55-95	
PHILIPS GF 823	47-80	37-95	
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PHILIPS RF 833	67-10	52-95	
PHILIPS GF 834	66-40	66-95	
PYE Black Box Unit Stereo 1022	93-45	69-95	
STEEPLETONE Stereo system	41-75	33-95	
TELETON STP 8-track Stereo System	54-75	47-00	
ULTRA 6405	77-00	64-95	
<b>TAPE RECORDERS AND TAPE DECKS</b>			
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AKAI 4000D 4-track stereo deck	89-95	64-95	
AKAI CR80D 8-track stereo tape deck	79-95	55-95	
AKAI CR80 8-track stereo recorder	99-95	69-95	

	Rec. Price	Retail Price	Comet Price
AKAI X200D	145-95	105-00	
AKAI 1800SD	153-00	109-00	
AKAI 2000SD	289-00	216-00	
AKAI GXC 400 Cassette Tape Deck	87-50	67-95	
AKAI GXC 40 Cassette recorder	105-00	79-95	
BUSH Discassette DC70	21-19	16-95	
BUSH T70 Cassette, battery/mains tape recorder	28-91	23-50	
DANSETTE DCT 105 Cassette	21-40	14-95	
FERGUSON 3245 Twin track	36-70	26-95	
FERGUSON 3248 4-track	42-55	31-95	
FERGUSON 3247 4-track	47-95	35-95	
FERGUSON 3249 4-track	53-75	41-95	
FERGUSON 3252 4-track	100-52	80-95	
FERGUSON 3255 4-track	72-40	55-95	
FERROGRAPH 7022-2-track tape deck	220-22	185-00	
FERROGRAPH 704/W 4-track tape deck	220-22	185-00	
FERROGRAPH 702 Dolby	258-52	209-00	
FERROGRAPH 702	272-25	220-00	
FERROGRAPH 724	256-52	209-00	
FERROGRAPH 722 Dolby	308-55	262-00	
GRUNDIG C200 De Luxe Cassette	38-45	28-95	
GRUNDIG TK 121 twin track	57-90	42-95	
GRUNDIG TK 141 4-track	63-90	47-95	
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GRUNDIG TK 147 4-track Auto	95-75	79-95	
GRUNDIG C410 Cassette recorder	43-70	33-95	
PHILIPS 2202 cassette	26-90	21-95	
PHILIPS 2204 cassette, battery/mains	32-30	25-95	
PHILIPS 3302 cassette	23-05	17-50	
PHILIPS 4307 4-track	40-55	32-50	
PHILIPS 4308 De Luxe 4-track	47-80	36-95	
PHILIPS 4308 De Luxe 4-track	58-40	44-95	
PHILIPS 4404 4-track stereo recorder	91-70	69-95	
PHILIPS 4407 4-track stereo recorder	106-20	86-95	
PHILIPS 4500 4-track stereo tape deck	121-65	95-95	
PHILIPS 4608 4-track stereo	134-20	105-95	
PHILIPS 2503 Cassette Stereo tape deck	52-05	45-95	
PHILIPS 2400 stereo cassette less L/S	65-55	58-45	
PYE 9109 cassette	20-95	18-95	
PYE 9116 Stereo cassette	68-00	52-95	
TANDBERG 1641 4-track stereo tape deck	68-00	54-95	
TANDBERG 3021X twin track stereo	107-00	91-00	
TANDBERG 3041X 4-track stereo	107-00	85-95	
TANDBERG 4021X twin track stereo	174-00	145-00	
TANDBERG 4041X 4-track stereo	174-00	143-95	
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TELETON TC110 cassette battery/mains	26-79	18-95	
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<b>THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Delta 70 Amplifier, 2 Wharfedale Dovedale 3 Speakers</b>			
	234-33	175-95	
<b>TELETON STP 801 Stereo 8 track tape Audio system complete with speakers</b>			
	54-75	47-00	
<b>GARRARD AP76 with base and cover with Shure M55E cartridge Arena AM/FM and SW Tuner/amp and 2 Goodmans Mezzo III speakers</b>			
	229-43	149-00	
<b>GOLDRING GL75 complete with base and cover, G800 Cartridge, Wharfedale 100-1 Tuner/Amp and 2 Wharfedale Dovedale III speakers</b>			
	294-79	198-95	
<b>GOODMANS Module 80 Tuner/Amplifier, Garrard AP78 Turntable with Goldring G800 Cartridge and 2 Goodmans Minister Speakers</b>			
	189-95	137-95	
<b>GOLDRING 705P Turntable fully wired, complete with Goldring 800 Cartridge, Amstrad stereo 8500 amplifier and 2 Metrosound 103 speakers</b>			
	81-00	49-95	
<b>METROSOUND 448 8-track stereo play-back unit complete with 2 HFS 103 Speakers</b>			
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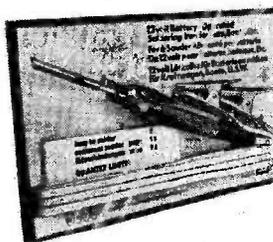
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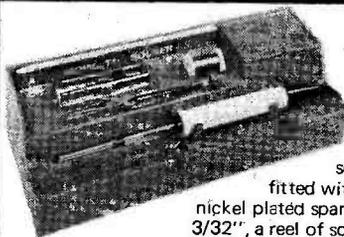
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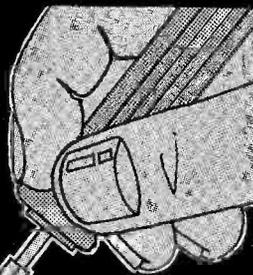


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EF89	12½p	PCF92	12½p	6F23	20p
ECC81	10p	PL36	20p	20P1	20p
ECC82	12½p	PL81	17½p	20P3	10p
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# "Where can I get exclusive ROC ELECTRONICS!"

## ACADEMY STEREO CASSETTE TAPE DECK, MODEL CS-20000

No hi-fi system is complete without one - hook it up to any ROC or other good quality amplifier, and the results are fantastic! The CS-20000 records and plays back. A big feature is its easy-to-use piano-key controls. Easy-to-get-at mic inputs are on top; line inputs and outputs at the rear. Dual-channel recording level meter. Pop-up cassette ejection. Stereo/Mono button. Tape counter. Pause control. Tape speed 1 7/8 ips (4-7.5 cms). Frequency response 100-10,000 Hz. Wow and flutter better than 0-3%. Rewind time better than 60 sec with C60 cassette. Engineered throughout to the highest electrical and mechanical standards. Size 16" wide, 4 1/2" high and 8" deep. Walnut cabinet with satin aluminium trims.

ROC PRICE  
**£54.95**

Including two pencil microphones and all connecting leads  
Normal Price £65.00

## REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500

A superb hi-fi amplifier with all the features you've ever wanted - for under £46.00. Saving over £10.00 on the normal retail value. Up-to-the-minute slider controls for bass and treble. Separate volume and balance controls. Headphone socket on front panel. Push-button input controls - magnetic phono (high/low) tuner, aux, mono, monitor. Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers. Noise filtering and tape monitoring facilities. Two auxiliary AC outlets. Frequency response 20-20,000 Hz  $\pm$  1 db at full power. 15 watts rms per channel. Walnut cabinet with satin aluminium trims. Inputs: phono 2.5mV and 5mV RIAA; tuner/aux 250mV. Hum and noise: phono - 50db; tuner/aux - 65db. How's that for a specification! Size 14 1/2" wide, 3 1/2" high, 10 1/2" deep.

ROC PRICE  
**£43.75**

Normal Price £55.50



## OLSON RA-310 AM/FM/MPX STEREO TUNER

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also 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, 3 $\mu$ V; AM, 250 $\mu$ V. Stereo separation 30dB at 1kHz. Image rejection 60dB. Size: 11 1/2" wide, 4" high, 7 1/2" deep.

ROC PRICE  
**£39.95**

Normal Price £50.00



## REALISTIC SA-100B 6-WATT STEREO AMPLIFIER

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

ROC PRICE  
**£14.50**

Normal Price £21.00

## REALISTIC TM-100 AM/FM/MPX STEREO TUNER

Here's another unit that gives you fabulous value in miniature! Designed specifically to match the Realistic SA-100B in both appearance, size and performance, the TM-100 is superb value-for-money. It gives you the full FM and AM ranges - FM, 88-108 MHz; AM, 535-1605 kHz. Sensitivities: FM 5 $\mu$ V; AM 250 $\mu$ V. Image rejection 50dB.



## OLSON AM-395 40-WATT STEREO AMPLIFIER

An ideal unit for your new stereo separate systems. It is more than £10.00 below the normal retail price! Making the AM-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 tapping 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  $\pm$  3db. 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!

ROC PRICE  
**£23.25**

Normal Price £28.80



ROC PRICE  
**£29.00**

Normal Price £39.80

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  $\pm$  3dB. Output 6 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.



ROC PRICE  
**£98.50**

Including connecting leads  
Normal Price £115.00

## REALISTIC HI-FI 36-WATT STEREO CONCERTMASTER FM-AM RECEIVER SYSTEM, MODEL 12-694

Brilliantly designed tuner/amplifier with two matching speakers. All three units in beautifully finished walnut cabinets with smart aluminium vertical trims. The tuning dial is franted by unique black glass. Figures light up in green when the unit is on. Separate easy-to-operate Left and Right volume controls. Headphones socket on front panel for easy access. Single tuning knob for FM and AM. Microswitch for on/off. Programme selector. Separate bass and treble control. Built-in aerials, facilities for external FM aerial. Illuminated dial. Stereo broadcast indicator light. Each speaker has 6 1/2" bass and 3" treble units. Output: 9 watts r.m.s. per channel into 8 ohms. Frequency response: 30 to 20,000 Hz. FM: frequency range 80-108 MHz, sensitivity 2.5 $\mu$ V, stereo separation 30dB, image rejection 40db. AM: frequency range 530-1605 kHz, sensitivity 100 $\mu$ V. Sizes: speakers 8" wide, 12" high and 9 1/2" deep; receiver 6" wide, 12" high and 9 1/2" deep. And their sophisticated appearance matches the excellence of the specification.

ROC PRICE  
**£76.50**

Normal Price £95.00



## REALISTIC 8-TRACK STEREO CARTRIDGE TAPE DECK, MODEL RP-1000ST

The popular Lear-Jet type recording unit is the heart of the fantastic RP-1000ST, which has full record and playback facilities. Automatic track change with manual override. Press to start button. Stereo headphone and Left and Right Mic sockets on front panel. Dual recording level meter, and Left and Right volume controls. Built-in pre-amp. Tape speed 3 1/2 ips (9.5 cms). Frequency response: playback 30-10,000 Hz; recording/playback 30-8,000 Hz. Line output: fully variable 0-500mV. The RP-1000ST incorporates all the features you'd expect in a top quality Cartridge Tape Deck. Size 16" wide, 4" high, 9" deep. Cabinet in walnut. Including connecting leads.

ROC PRICE  
**£39.95**

Normal Price £49.00

## 8-TRACK HOME STEREO CARTRIDGE PLAYER MODEL E1

With this unit, you can play any standard 8-track cartridge on the market - at a fraction of the normal retail value! It gives you a total of 5 watts of power, to feed into two 8-ohm speakers. The frequency response is 50 to 10,000 Hz, giving you a fine tonal quality that can't be bettered at anything near this price. The E1 has separate tone, balance and volume controls, giving you complete freedom to select the sound you want to hear. Tape speed is 3 1/2 ips, and wow and flutter are both less than 0-3%. Size: 11 1/2" wide, 5" high, 11" deep.

ROC PRICE  
**£16.40**

Normal Price £22.50 per pair.

## 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.

## 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  $\pm$  3dB. 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.

## 25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-5b

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

ROC PRICE  
**£27.25**

Normal Price £39.95 each.

ROC PRICE  
**£33.20**

Normal Price £42.00

## PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16

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-16 has all the facilities you'd expect to find on tuners costing twice as much - separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz; AM 535-1605 kHz. Frequency response: 50-10,000 Hz  $\pm$  3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4 1/2" high, 8" deep.

## ROC-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  $\pm$  3dB; output 3.5 watts music power per channel into 8 ohms; input, phono, 800mV; signal-to-noise ratio better than 45dB.

ROC PRICE  
**£5.50**

Normal Price £7.75

ROC PRICE  
**£18.25**

Normal Price £25.20

## OLSON AM-372 16-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  $\pm$  3dB. Output 6 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.

ROC PRICE  
**£10.50**

Normal Price £14.70

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Compare our prices with any other unit on the hi-fi market, and you'll find you won't beat ROC unit prices. No matter where you live, London or Land's End!

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exclusive unit

## TOP VALUE • TOP QUALITY ACCESSORIES THAT EVERY HI-FI ENTHUSIAST NEEDS TO COMPLETE HIS SYSTEM

Every item shown here is the best of its kind within its price range. Buy them separately or at the same time as the other top-value audio products listed.



**R.328 STEREO HEADPHONE**  
If you're starting in hi-fi, and you discover the need for a pair of really good stereo headphones. The R.328 is ideal, at a price you can afford. They have padded ear cushions, a 6-foot cord and jack plug. Frequency range 30-15,000 Hz. Impedance 8 ohms per channel.  
**ROC PRICE £2.95**



**EAGLE SE-80 STEREO HEADPHONE**  
Here's the ultimate in headphone design! Apart from its fantastic ability to reproduce all the frequencies from 20 to 20,000 Hz, the SE-80 has eliminated the discomfort and strain associated with traditional headphone design. Eagle have designed and produced a pair of headphones which breaks with all previous concepts. You hear all the sounds crisp and clear. In fact, the reproduction is so good, that it compares favourably with the most expensive hi-fi speaker systems. Separate slider volume control on each earpiece. Impedance: 8 ohm per channel.  
**ROC PRICE £14.90**



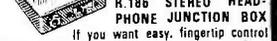
**EAGLE SE-30 STEREO HEADPHONE**  
This model is for the more discriminating listener. For a start the frequency range extends from 30 to 16,000 Hz. And you can adjust the volume of each earpiece independently. There's also a mono/stereo switch. For maximum comfort, the ear cushions are covered in soft leathers.  
**ROC PRICE £7.05**



**TEC HR-007 HEADPHONE RADIO**  
When you want to listen to the radio all by yourself. Then this will solve the problem. Separate volume and tuning controls with easy-to-use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW.  
**Normal Price £9.45 ROC PRICE £7.65**



**THORENS TD150AB/II Transcription Turntable**  
Complete with pick up arm, plinth and cover. **£52.31**



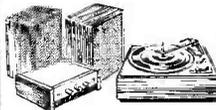
**R.186 STEREO HEADPHONE JUNCTION BOX**  
If you want easy, fingertip control of headphones and loudspeakers, here's the ideal solution to the problem. All you do is connect it to your speakers and amplifier, plug in your headphones - and you're ready to take over! At the flick of a slide switch, you can have headphones alone, or speakers alone, or both together. Input: suitable for use with amplifiers rated up to 20 watts. Size: 2 3/4" x 3 3/4" x 1 1/2".  
**ROC PRICE £1.50**



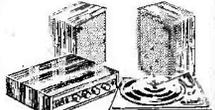
**R.151 STEREO CAR SPEAKERS**  
Smart black, tough, plastic cases, each containing a high flux 110mm diameter speaker unit. Just what you need to go with the CS.5 Cartridge Player or any other car stereo system. Fitted with over three yards of connecting cable. Dimensions: 6 1/2" x 5 1/2" x 3 1/2". Impedance: 8 ohms per speaker. Rating: 5 watts max per speaker. **ROC PRICE £3.72**

### HERE'S A RANGE OF AUDIO SYSTEMS BUILT AROUND EXCLUSIVE ROC AMPLIFIERS AND TUNERS

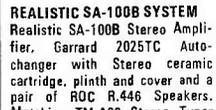
Now run your eye over the prices, select the System nearest to your budget - and you've hit on the best value that your money can buy! Supplied with all necessary leads and plugs, ready to use.



**OLSON AM-357 SYSTEM**  
Olson AM-357 Stereo Amplifier, Garrard 2025 T/C Autochanger with Stereo ceramic cartridge, plinth and cover and a pair of ROC R.088 4 watt Speakers.  
**Normal Price £45.28 ROC PRICE £36.70**



**OLSON AM-372 SYSTEM**  
Olson AM-372 Stereo Amplifier, Garrard 2025 T/C Autochanger with Stereo ceramic cartridge, plinth and cover and a pair of ROC R.446 Speakers.  
**Normal Price £68.18 ROC PRICE £51.53**



**REALISTIC SA-100B SYSTEM**  
Realistic SA-100B Stereo Amplifier, Garrard 2025TC Autochanger with Stereo ceramic cartridge, plinth and cover and a pair of ROC R.446 Speakers. Matching TM-100 Stereo Tuner £23.25 extra if required.  
**Normal Price £63.98 ROC PRICE £47.60**



**PALACE SYSTEM**  
Palace SSA-16 Stereo Tuner Amplifier, Garrard 2025 T/C autochanger with stereo ceramic cartridge, plinth and cover and a pair of ROC R.446 Speakers.  
**Normal Price £84.98 ROC PRICE £66.30**



**REALISTIC 12-694 SYSTEM**  
Realistic 12-694 Stereo Tuner Amplifier with matching speakers and Garrard SP25 Mk III with Eagle LC.07 Stereo Magnetic Cartridge and plinth and cover.  
**Normal Price £144.05 ROC PRICE £124.50**



**OLSON AM-395 SYSTEM**  
Olson AM-395 Stereo Amplifier, Garrard SP25 Mk III Record Player with Eagle LC07 Stereo Magnetic Cartridge, plinth and cover and a pair of Eagle DL.67 Speakers. Matching RA.310 Stereo Tuner £39.95 extra if required.  
**Normal Price £106.65 ROC PRICE £92.60**



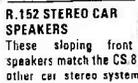
**REALISTIC SA-500 SYSTEM**  
Realistic SA-500 Stereo Amplifier, Garrard SP25 Mk III Single Record Player with Eagle LC.07 Stereo Magnetic Cartridge, plinth and cover and a pair of Chrysler CE-5b Speakers. **Normal Price £157.95 ROC PRICE £124.00**



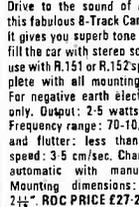
**ROC E1 SYSTEM**  
ROC E1 8 track Stereo Cartridge Player complete with a pair of ROC R.088 4 watt Speakers.  
**Normal Price £59.10 ROC PRICE £49.45**



**EAGLE 8-TRACK CAR STEREO PLAYER, CS.8**  
Drive to the sound of music - with this fabulous 8-Track Cartridge Player. It gives you superb tone and power to fill the car with stereo sound. Ideal for use with R.151 or R.152 speakers. Complete with all mounting accessories. For negative earth electrical systems only. Output: 2.5 watts per channel. Frequency range: 70-10,000 Hz. Wow and flutter: less than 0.3%. Tape speed: 3.5 cm/sec. Channel selector: automatic with manual override. Mounting dimensions: 5 3/4" x 5 1/2" x 2 1/4". **ROC PRICE £27.20**



**R.152 STEREO CAR SPEAKERS**  
These sloping front speakers match the CS.8 Cartridge Player or any other car stereo system. Fitted with high flux 110mm diameter speaker unit, and over three yards of connecting cable. Dimensions: 6 1/2" x 6 1/2" x 3 1/2". Impedance: 8 ohms per speaker. Rating: 5 watts max per speaker. **ROC PRICE £4.96**



**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: ±1.5dB. Channel separation: 20dB. Recommended stylus pressure: 2.4 grams. Compliance: 9 x 10<sup>-6</sup> cm/dyne. **ROC PRICE £4.75**



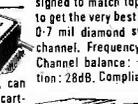
**EAGLE LC.07 STEREO MOVING-MAGNET CARTRIDGE**  
Here's your opportunity to own a transcription cartridge for the price of a ceramic! Is specially designed to match top quality tone arms, and to get the very best from your hi-li amplifier. 0.7 mil diamond stylus. Output: 7mV per channel. Frequency range: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



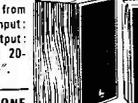
**RECORD CLEANERS**  
The original "Dust Bug" Automatic Record Cleaner keeps your records clean as they play. £1.20 Watts Disc Preener. Keeps new records like new - for perfect record reproduction. 35p



**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: 200-800mV flat. Frequency range: 20-22,000 Hz. Dimensions: 3 1/2" x 1 1/2" x 2 1/4". Supply: 240 VAC. **ROC PRICE £4.92**



**15-FOOT STEREO HEADPHONE EXTENSION CORD R.362**  
Fitted with heavy duty 3-circuit stereo plug at one end and a matching stereo socket at the other. **ROC PRICE £1.30**  
**R.361 STEREO HEADPHONE 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.088 MATCHED STEREO LOUD-SPEAKERS**  
Here's real value in stereo speakers! Each unit comes complete with 10-foot lead and phono plug, and look really smart. Power handling per speaker: 4 watts rms, 8 watts peak. Frequency range: 40-16,000 Hz. Flux density: 8,500 gauss. Impedance: 8 ohms. Dimensions: 9" high, 5 1/2" wide, 4 1/2" deep. **ROC PRICE £9.50 pair**

**EAGLE DL.67 HIGH COMPLIANCE 3-WAY TACK SPEAKER SYSTEM**  
From a rich, deep, 35 Hz bass to above the limit of human hearing - this fantastic response comes from such a small size - only 10" x 8" x 6 1/2"! The DL.67 is the end product of several years effort into the problems of full frequency response from small cabinets. The DL.67 has a dual cone high compliance bass mid range unit, and a horn tweeter. The speaker has a variable brilliance control to suit individual rooms - a feature normally only found on very expensive speaker systems. Power handling capacity: 10 watts rms, 20 watts peak. Frequency range: 35-20,000 Hz. Flux density: 11,000 gauss. Impedance: 8 ohms. Dimensions: 11 1/2" high x 8" wide x 6 1/2" deep. Finish: oiled teak. **ROC PRICE £18.80 each**

Return-of-post mail order service. Over £10 post free (UK only). Add 25p for p & to orders under £10. HP terms available for callers

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Rod Aerial .....	RA2W		72p
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Output Transformer .....	OPT1		58p
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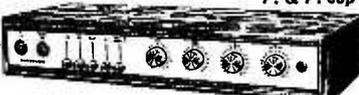
**FANTASTIC BARGAIN OFFER!**  
**TRANSEUROPEAN**

Transistorised Stereophonic High Fidelity AM/FM Tuner Amplifier System.



This system includes this elegantly styled solid state Teak finished cabinet tuner/amplifier. Covering VHF/FM. Short, medium and long wavebands. The latest 4 Speed B.S.R. Mono/Stereo record changer with 2-10in. x 6in. matching elliptical speakers. A complete Hi-Fi Stereo Radiogram at less than half normal price. **SPECIAL OFFER £44**  
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Hi-Fi stereo at a new low. System Ten-Ten; 4 speed BSR autochanger with cue and pause control plus solid state amplifier, 20 watt total output. Frequency response 20-20,000 Hz.

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2N916	17p	2N3715	11.25p	40468A	85p	BD121	35p	BCY80	47p	NKT80113	97p
2N918	30p	2N3716	11.25p	40469	80p	BD123	82p	BCY81	57p	NKT80114	11.12p
2N920	22p	2N3717	22.06p	AC107	80p	BD124	60p	BCY82	40p	NKT80211	92p
2N930	27p	2N3819	35p	AC126	20p	BD131	75p	BCY83	30p	NKT80212	92p
2N1090	22p	2N3823	97p	AC127	25p	BD132	85p	BCY84	40p	NKT80213	92p
2N1091	22p	2N3824	27p	AC128	20p	BDY10	11.87p	BCY85	47p	NKT80214	92p
2N1131	25p	2N3854A	27p	AC154	22p	BDY11	11.87p	BCY86	47p	NKT80215	92p
2N1132	25p	2N3855	27p	AC176	25p	BDY12	11.87p	BCY87	47p	NKT80216	92p
2N1302	17p	2N3856A	30p	AC187	62p	BDY18	11.75p	BCY88	52p	NKT80217	92p
2N1303	17p	2N3856	30p	AC188	37p	BDY19	11.97p	BCY89	42p	NKT80218	92p
2N1304	22p	2N3866A	35p	ACY17	27p	BDY20	11.12p	BCY90	42p	NKT80219	92p
2N1305	22p	2N3858	25p	ACY18	25p	BDY38	97p	BCY91	75p	NKT80220	92p
2N1306	25p	2N3868A	30p	ACY19	25p	BDY60	11.25p	BCY92	35p	NKT80221	92p
2N1307	32p	2N3869	27p	ACY20	25p	CA24	42p	BCY93	35p	NKT80222	92p
2N1308	30p	2N3869A	32p	ACY21	25p	CA25	40p	BCY94	35p	NKT80223	92p
2N1309	30p	2N3860	30p	ACY22	20p	BF115	25p	BCY95	35p	NKT80224	92p
2N1607	17p	2N3866	11.50p	ACY28	20p	BF117	47p	BCY96	35p	NKT80225	92p
2N1613	25p	2N3877	40p	ACY40	20p	BF163	37p	BCY97	35p	NKT80226	92p
2N1631	35p	2N3877A	40p	ACY41	20p	BF167	18p	BCY98	35p	NKT80227	92p
2N1632	30p	2N3900	37p	ACY44	40p	BF175	18p	BCY99	35p	NKT80228	92p
2N1638	27p	2N3901	37p	AD140	52p	BF177	40p	BCY00	35p	NKT80229	92p
2N1639	27p	2N3901	37p	AD149	57p	BF178	30p	BCY01	35p	NKT80230	92p
2N1671B	11.00p	2N3903	35p	AD150	62p	BF178	30p	BCY02	35p	NKT80231	92p
2N1711	25p	2N3904	35p	AD161	37p	BF180	35p	BCY03	35p	NKT80232	92p
2N1889	32p	2N3905	37p	AD162	37p	BF181	35p	BCY04	35p	NKT80233	92p
2N1893	37p	2N3906	37p	AF106	42p	BF184	25p	BCY05	35p	NKT80234	92p
2N1947	32p	2N4058	17p	AF114	25p	BF185	42p	BCY06	35p	NKT80235	92p
2N1948	37p	2N4059	10p	AF115	25p	BF194	17p	BCY07	35p	NKT80236	92p
2N1980	37p	2N4060	12p	AF116	25p	BF195	15p	BCY08	35p	NKT80237	92p
2N1984	37p	2N4061	12p	AF117	25p	BF196	42p	BCY09	35p	NKT80238	92p
2N1985	37p	2N4062	12p	AF118	25p	BF197	42p	BCY10	35p	NKT80239	92p
2N1986	37p	2N4063	12p	AF119	25p	BF198	42p	BCY11	35p	NKT80240	92p
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2N1988	37p	2N4065	12p	AF121	25p	BF200	42p	BCY13	35p	NKT80242	92p
2N1989	37p	2N4066	12p	AF122	25p	BF204	14p	BCY14	35p	NKT80243	92p
2N1990	37p	2N4067	12p	AF123	25p	BF205	15p	BCY15	35p	NKT80244	92p
2N1991	37p	2N4068	12p	AF124	25p	BF206	15p	BCY16	35p	NKT80245	92p
2N1992	37p	2N4069	12p	AF125	25p	BF207	15p	BCY17	35p	NKT80246	92p
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2N1994	37p	2N4071	12p	AF127	25p	BF209	15p	BCY19	35p	NKT80248	92p
2N1995	37p	2N4072	12p	AF128	25p	BF210	15p	BCY20	35p	NKT80249	92p
2N1996	37p	2N4073	12p	AF129	25p	BF211	15p	BCY21	35p	NKT80250	92p
2N1997	37p	2N4074	12p	AF130	25p	BF212	15p	BCY22	35p	NKT80251	92p
2N1998	37p	2N4075	12p	AF131	25p	BF213	15p	BCY23	35p	NKT80252	92p
2N1999	37p	2N4076	12p	AF132	25p	BF214	15p	BCY24	35p	NKT80253	92p
2N2000	37p	2N4077	12p	AF133	25p	BF215	15p	BCY25	35p	NKT80254	92p
2N2001	37p	2N4078	12p	AF134	25p	BF216	15p	BCY26	35p	NKT80255	92p
2N2002	37p	2N4079	12p	AF135	25p	BF217	15p	BCY27	35p	NKT80256	92p
2N2003	37p	2N4080	12p	AF136	25p	BF218	15p	BCY28	35p	NKT80257	92p
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2N2005	37p	2N4082	12p	AF138	25p	BF220	15p	BCY30	35p	NKT80259	92p
2N2006	37p	2N4083	12p	AF139	25p	BF221	15p	BCY31	35p	NKT80260	92p
2N2007	37p	2N4084	12p	AF140	25p	BF222	15p	BCY32	35p	NKT80261	92p
2N2008	37p	2N4085	12p	AF141	25p	BF223	15p	BCY33	35p	NKT80262	92p
2N2009	37p	2N4086	12p	AF142	25p	BF224	15p	BCY34	35p	NKT80263	92p
2N2010	37p	2N4087	12p	AF143	25p	BF225	15p	BCY35	35p	NKT80264	92p
2N2011	37p	2N4088	12p	AF144	25p	BF226	15p	BCY36	35p	NKT80265	92p
2N2012	37p	2N4089	12p	AF145	25p	BF227	15p	BCY37	35p	NKT80266	92p
2N2013	37p	2N4090	12p	AF146	25p	BF228	15p	BCY38	35p	NKT80267	92p
2N2014	37p	2N4091	12p	AF147	25p	BF229	15p	BCY39	35p	NKT80268	92p
2N2015	37p	2N4092	12p	AF148	25p	BF230	15p	BCY40	35p	NKT80269	92p
2N2016	37p	2N4093	12p	AF149	25p	BF231	15p	BCY41	35p	NKT80270	92p
2N2017	37p	2N4094	12p	AF150	25p	BF232	15p	BCY42	35p	NKT80271	92p
2N2018	37p	2N4095	12p	AF151	25p	BF233	15p	BCY43	35p	NKT80272	92p
2N2019	37p	2N4096	12p	AF152	25p	BF234	15p	BCY44	35p	NKT80273	92p
2N2020	37p	2N4097	12p	AF153	25p	BF235	15p	BCY45	35p	NKT80274	92p
2N2021	37p	2N4098	12p	AF154	25p	BF236	15p	BCY46	35p	NKT80275	92p
2N2022	37p	2N4099	12p	AF155	25p	BF237	15p	BCY47	35p	NKT80276	92p
2N2023	37p	2N4100	12p	AF156	25p	BF238	15p	BCY48	35p	NKT80277	92p
2N2024	37p	2N4101	12p	AF157	25p	BF239	15p	BCY49	35p	NKT80278	92p
2N2025	37p	2N4102	12p	AF158	25p	BF240	15p	BCY50	35p	NKT80279	92p
2N2026	37p	2N4103	12p	AF159	25p	BF241	15p	BCY51	35p	NKT80280	92p
2N2027	37p	2N4104	12p	AF160	25p	BF242	15p	BCY52	35p	NKT80281	92p
2N2028	37p	2N4105	12p	AF161	25p	BF243	15p	BCY53	35p	NKT80282	92p
2N2029	37p	2N4106	12p	AF162	25p	BF244	15p	BCY54	35p	NKT80283	92p
2N2030	37p	2N4107	12p	AF163	25p	BF245	15p	BCY55	35p	NKT80284	92p
2N2031	37p	2N4108	12p	AF164	25p	BF246	15p	BCY56	35p	NKT80285	92p
2N2032	37p	2N4109	12p	AF165	25p	BF247	15p	BCY57	35p	NKT80286	92p
2N2033	37p	2N4110	12p	AF166	25p	BF248	15p	BCY58	35p	NKT80287	92p
2N2034	37p	2N4111	12p	AF167	25p	BF249	15p	BCY59	35p	NKT80288	92p
2N2035	37p	2N4112	12p	AF168	25p	BF250	15p	BCY60	35p	NKT80289	92p
2N2036	37p	2N4113	12p	AF169	25p	BF251	15p	BCY61	35p	NKT80290	92p
2N2037	37p	2N4114	12p	AF170	25p	BF252	15p	BCY62	35p	NKT80291	92p
2N2038	37p	2N4115	12p	AF171	25p	BF253	15p	BCY63	35p	NKT80292	92p
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30 amp.	...	\$2-80
20V D.C.	...	\$2-80
50V D.C.	...	\$2-80
150V D.C.	...	\$2-80
300V D.C.	...	\$2-80
15V A.C.	...	\$2-80
300V A.C.	...	\$2-80
S Meter 1mA	...	\$2-87
VU Meter	...	\$2-60
1 amp. A.C.*	...	\$2-80
5 amp. A.C.*	...	\$2-80
10 amp. A.C.*	...	\$2-80
20 amp. A.C.*	...	\$2-80
30 amp. A.C.*	...	\$2-80

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50μA	...	\$2-10
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100μA	...	\$2-10
100-0-100μA	...	\$2-10
500μA	...	\$2-10
1mA	...	\$2-10
1-0-1mA	...	\$2-10
5mA	...	\$2-10
10mA	...	\$2-10
10V D.C.	...	\$2-80
20V D.C.	...	\$2-80
50V D.C.	...	\$2-80
300V D.C.	...	\$2-80
15V A.C.	...	\$2-10
300V A.C.	...	\$2-10
S Meter 1mA	...	\$2-10
VU Meter	...	\$2-10
1 amp. A.C.*	...	\$2-10
5 amp. A.C.*	...	\$2-10
10 amp. A.C.*	...	\$2-10
20 amp. A.C.*	...	\$2-10
30 amp. A.C.*	...	\$2-10

Type MR.52P. 2 1/2" x 3 1/2" square fronts.

50μA	...	\$2-10
50-0-50μA	...	\$2-60
100μA	...	\$2-60
100-0-100μA	...	\$2-60
500μA	...	\$2-60
1mA	...	\$2-60
5mA	...	\$2-60
10mA	...	\$2-60
50μA	...	\$2-60
100μA	...	\$2-60
500μA	...	\$2-60
1 amp.	...	\$2-60
5 amp.	...	\$2-60

Type MR.52P. 2 1/2" x 3 1/2" square fronts.

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50-0-50μA	...	\$2-60
100μA	...	\$2-60
100-0-100μA	...	\$2-60
500μA	...	\$2-60
1mA	...	\$2-60
5mA	...	\$2-60
10mA	...	\$2-60
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1 amp.	...	\$2-60
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50 amp.	...	\$1-90
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2G334	20p	2N3449	37p	2N5492	25p	BC148	15p	BFX44	22p	NK7256	22p
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2G337	20p	2N3452	37p	2N5495	25p	BC151	15p	BFX47	22p	NK7259	22p
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2G343	20p	2N3458	37p	2N5501	25p	BC157	15p	BFX53	22p	NK7265	22p
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2G369	20p	2N3484	37p	2N5527	25p	BC183	15p	BFX79	22p	NK7291	22p
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2G377	20p	2N3492	37p	2N5535	25p	BC191	15p	BFX87	22p	NK7299	22p
2G378	20p	2N3493	37p	2N5536	25p	BC192	15p	BFX88	22p	NK7300	22p
2G379	20p	2N3494	37p	2N5537	25p	BC193	15p	BFX89	22p	NK7301	22p
2G380	20p	2N3495	37p	2N5538	25p	BC194	15p	BFX90	22p	NK7302	22p
2G381	20p	2N3496	37p	2N5539	25p	BC195	15p	BFX91	22p	NK7303	22p
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2G385	20p	2N3500	37p	2N5543	25p	BC199	15p	BFX95	22p	NK7307	22p
2G386	20p	2N3501	37p	2N5544	25p	BC200	15p	BFX96	22p	NK7308	22p
2G387	20p	2N3502	37p	2N5545	25p	BC201	15p	BFX97	22p	NK7309	22p
2G388	20p	2N3503	37p	2N5546	25p	BC202	15p	BFX98	22p	NK7310	22p
2G389	20p	2N3504	37p	2N5547	25p	BC203	15p	BFX99	22p	NK7311	22p
2G390	20p	2N3505	37p	2N5548	25p	BC204	15p	BFX100	22p	NK7312	22p
2G391	20p	2N3506	37p	2N5549	25p	BC205	15p	BFX101	22p	NK7313	22p
2G392	20p	2N3507	37p	2N5550	25p	BC206	15p	BFX102	22p	NK7314	22p
2G393	20p	2N3508	37p	2N5551	25p	BC207	15p	BFX103	22p	NK7315	22p
2G394	20p	2N3509	37p	2N5552	25p	BC208	15p	BFX104	22p	NK7316	22p
2G395	20p	2N3510	37p	2N5553	25p	BC209	15p	BFX105	22p	NK7317	22p
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2G397	20p	2N3512	37p	2N5555	25p	BC211	15p	BFX107	22p	NK7319	22p
2G398	20p	2N3513	37p	2N5556	25p	BC212	15p	BFX108	22p	NK7320	22p
2G399	20p	2N3514	37p	2N5557	25p	BC213	15p	BFX109	22p	NK7321	22p
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Carriage 50p extra any model.

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2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. **214-75** Carr. 37p. Or with PZ6 power supply **218-85** Carr. 37p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. **220-25** Carr. 37p. Transformer for PZ8. **22-97p.** extra. Add to any of the above **24-87p.** for active filter unit and **218-90** for pair of Q15 speakers. Project 60 FM Tuner **220-25** Carr. 37p. All other Sinclair products in stock. 2000 Amp **223-75** Carr. 37p.; 3000 Amp **231-50** Carr. 37p.; Neoteric Amp **248-95** Carr. 37p. IC10/IC12 **22-50** Carr. 37p. NEW PROJECT 605 — **220-97p.** Carr. 37p.

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## TELETON SAQ-206B STEREO AMPLIFIER



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## ● SUGGESTED SYSTEM ●

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5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9 1/2" x 5" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono neg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K. **28-97p.** P. & P. 20p.

## HA-10 STEREO HEADPHONE AMPLIFIER



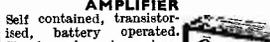
All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. **25-97p.** P. & P. 15p.

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## EA.41 REVERBERATION AMPLIFIER



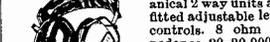
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0/12/6/3/12/30/120/600 V D.C. 0/6/30/120/600 V A.C. 0/12/600/1/12/300MA 1/12 AMP D.C. 0/10K/1 MEG/100 MEG. -20 to +50 db. 0-01 -2 MFD. Transistor tester measures Alpha, Beta and Ico. Complete with batteries, instructions and leads. **213-50** P. & P. 25p.

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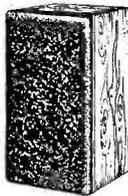
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An extension speaker of quality; 9 x 5 1/2 x 3 1/2 in. veneered in natural teak with smart gold and mottled Vynair front 3 ohm speaker. The baffle is half inch thick. A real bargain at £1-85 P. & P. 37 1/2 p.

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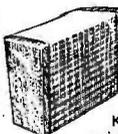
Size 21 x 11 x 6 1/2 in.

An extremely elegant speaker system made of 12mm. chipboard covered with black leathercloth with mottled Vynair front. This unique system uses three ex-TV speakers. Carefully matched and tested. Will handle 10 watts and will match 8 ohms impedance, if preferred the speakers can be wired in series parallel to match 3 ohms impedance. A real bargain at £4-95 plus 70p P. & P. MATCHING TRANSFORMER for 15 ohms 85p post free.



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Widths from 50 to 54 in., 75p yd. off roll. P. & P. 10p, 1/2 yard 40p. P. & P. 10p. Send 5p stamps for samples.



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Wedge shaped extension speaker 7 1/2 x 6 1/2 x 4 in. (max.). Covered in walnut wood grain cloth with mottled Vynair front. Keyhole slot at back. Fitted with 3 ohm speaker unit. Only £1-25. P. & P. 36p each

## CARTRIDGES-Mono

GP.91 Stereo Compatible £1-25. Acos GP67/2 will replace Collaro and Garrard Mono cartridges, 95p. T.T.C. Crystal High Gain, 75p. B.S.R. TC8H Jap. equivalent £1-25. P. & P. 7p.

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Simple unit connects direct to amplifier and speakers to give attenuated headphone output has 2 position switch to give headphones only, speakers only. Only £1-50. P. & P. 12 1/2 p.

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OF TAPE RECORDERS, RECORD PLAYERS, EXTENSION SPEAKERS

P. & P. 57p  
Makes all the difference to volume and quality. Contains 3 speakers in series—ex-TV with hi-fi flux magnet recon., tested for Mono or Stereo. Output 8 watts. Impedance 9 ohms. Available in black leathercloth. Size 23 1/2" x 5 1/2" x 5 1/2". Keyhole slot for wall mounting. Twin connecting cable 12yds., 35p min. Matching transformers if required for other output impedance 85p post free.

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E.M.I. 13 1/2 x 8in, 3 ohm £2-50, 15 ohm. P. & P. 30p. E.M.I. 13 1/2 x 8in, fitted two 2 1/2 in. tweeters, 15 ohm £4-50. P. & P. 30p. E.M.I. 13 1/2 x 8in. (15 ohm) Hi-Fi quality £6-25. P. & P. 35p. Bakers 12in. 25 watt 8 and 15 ohms £7. P. & P. 30p. Eagle Crossover £1-02p. P. & P. 5p.

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**AMPEX 7-5v. D.C. MOTOR.** This is an ultra-precision tape motor designed for use in the AMPEX model AG20 portable recorder. Torque 450GM/CM. Stall load at 500 ma. Draws 60 ma on run. 600 rpm + 5% speed adjustment. Internal AF/RF suppression 1/2" dia. 1" spindle, motor 3/4" dia. 1 1/2". Original cost £16-50. Our price £4-25. P. & P. 25p. Mu-metal enclosure available 75p each.

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**SMITHS, 250v. 50 Hz.** Available in the following R.P.M. 2-3-6-10-30-60. Price 75p each. Carr. paid.

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**MAINS INDUCTION MOTOR.** Open frame, 1/2" spindle, weight 1/2 lb. Powerful. 88p each. P. & P. 12p.

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**"CROUZET" TYPE 965. 115/240v. 50 Hz. 47/68 watts. 50 rpm.** Stoutly constructed. Size: 2 1/4" dia. x 3 1/4" long plus spindle, 1" x 1/2" dia. Anticlock. £2-75. P. & P. 25p.

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## PROGRAMME TIMER BY HONEYWELL.

A bank of 15 micro-switches, are each independently operated by 15 pairs of cams which in turn are individually adjustable to give switching periods of zero to 12 seconds with infinitely variable combinations. A mains synchronous motor drives the cam shaft at 1 rev. per 12 seconds (5 rpm) Originally cost £15-00 plus. Many applications such as lighting effects, etc. New in original makers precision. First class value at £5-75 plus 25p P. & P.

## PRECISION FAN CO (SMITHS INDUSTRIES) DOUBLE ENTRY CENTRIFUGAL FAN / BLOWER.

This is a beautifully balanced particularly quiet running unit giving approx. 90 cubic ft./min. The motor is a 2 pole shaded pole Mycalex, drawing only 240 ma on run. Weight 2 1/2 lbs. Sizes: case dia. 3-1 ins., width (case only) 3-125 ins. Width overall (inc.) 5-25 ins. Aperture 3-125 ins. x 1-85 ins. Offered well below makers price at £2-95. P. & P. 25p.

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Perspex enclosed, plug in, with base. Size: 1 1/2" x 1 1/2" x 2" MQ 308 6000 24v. 4 c/o. 60p each.

**SANGAMO WESTON.** Moving coil relay 3150 310µa, complete with base, 75p each.

**S.T.C. Midget Sealed Relay type 4109EC.** 12v. 40 ma 170Ω, single H.D. make. 53p each.

**"B. & R."** 3 c/o. 10 amp contacts (silver) operates on 2 volts D.C. Draws approx. 1 amp. Size: 2" x 1 1/2" x 1 1/2". £1-00.

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**"SORENG" MAINS SOLENOID.** 1" travel, 18lb. pull (approx.). Size: 2 1/2" long x 2 1/2" x 2 1/2" high. Powerful. £1-75. P. & P. 25p.

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**"MAGNETIC DEVICES"** Mains Solenoid. 2" x 1 1/2" x 1 1/2" approx. 2lb. pull. Plunger Travel 1 1/2". New in makers boxes; offered at half original cost. 75p. P. & P. 25p.

**SLIDER SWITCHES.** 3 amp. type D.P.D.T. 1" x 1/2" x 1/2" deep. 1 amp. type 3 P.D.T. 1" x 1/2" x 1/2" deep £1-25 per doz. Either type or mixed as required. Carr. Paid.

**BONNELLA "CHERRY" ROLLER LEVER OPERATED MICRO-SWITCH TYPE B23-30K.** 5 amp. c/o. 502 operating pressure. Length of Lever. 1/2". Pre-travel .062". £2-25 per doz.

**"HONEYWELL" V3 Series.** Flush micro-switch 10 amp. c/o. The side panel is insulated. End plate size: 2" x 8". £1-50 per. doz. Carriage paid.

**VINKOR POT CORE ASS. TYPE LA.2103.** Normal price £1-48. Our price 75p.

**L.T. TRANSFORMERS.** Prim. 0-110-240v. Sec. 4-5-0-4-5v. at 1 amp. Size: 1 1/2" x 1 1/2" x 1 1/2". 60p. P. & P. 15p.

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Prim. 200/240v. Sec. 0-1-56-58-60 at 3-5 amps plus 0-90 at 100 ma. Wax impregnated with screw term. blocks. Weight 10 lbs. £3-60, plus 40p P. & P.

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**"WODEN."** Prim. 0-110-200-220-240v. Sec. 34-36-38v. at 60va. £7-50, plus 50p P. & P.

**H.T. TRANSFORMER Prim. 240v. Sec. 0-380-400-420-440v. at 40va. £3. Carr. paid.**

**CURRENT FLOW INDICATOR.** Ideal for all types of battery operated equipment (portable machines, tape recorders, etc.). Four white segments appear when current flows. Coil is 600Ω 6/12v. Drawing only 8 ma on function. Neat in appearance. Size: dia. 1 1/2" x 1 1/2" deep. Fixing centres 1 1/2". £1-25 each. Carr. Paid.

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# 28watts, r.m.s. 40Hz to 40kHz $\pm$ 3dB



## Viscount III Audio Suite complete **£49**

There are two stereo amplifiers—the R100 for ceramic cartridges, the R101 for magnetic and ceramic. Both incorporate FETs (FIELD EFFECT TRANSISTORS), just like top-priced units. FETs give you more of the signal you want, and almost none of the background hiss you don't. Both units have a jack socket to plug in headphones and there's a separate output for tape recorder. Filters (an unusual feature in this price range) and tone controls give a wide range of bass and treble adjustment which compensate for input deficiencies and domestic acoustic conditions.

### PRICES SYSTEM 1

Viscount III R101 amplifier	£22.00+90p p&p
2 x Duo Type II speakers,	£14.00+£2 p&p
Garrard SP25 Mk. III with MAG.	
cartridge plinth and cover	£23.00+£1.50
	p&p
<b>Total</b>	<b>£59.00</b>

Available complete for only **£52.00+£3.50 p&p**

### SYSTEM 2

Viscount R101 amplifier	£22.00+90p p&p
2 x Duo Type III speakers	£32.00+£3 p&p
Garrard SP25 Mk. III with MAG.	
cartridge, plinth and cover	£23.00+£1.50
	p&p
<b>Total</b>	<b>£77.00</b>

Available complete for **£69+£4 p&p**

### SYSTEM 3

Viscount III Amplifier R100	£17.00+90p p&p
2 x Duo Type II speakers, pair	£14.00+£2 p&p
Garrard SP25 Mk. III with CER. diamond	
cartridge, plinth and cover	£21.00+£1.50
	p&p
<b>Total</b>	<b>£52.00</b>

Available complete for only **£49.00+£3.50 p&p**

### SPEAKERS Duo Type II

Size approx 17" x 10 $\frac{1}{2}$ " x 6 $\frac{1}{2}$ ". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts. 3 ohms. Simulated Teak cabinet. **£14 pair+£2 p&p.**

Duo Type III. Size approx 23 $\frac{1}{2}$ " x 11 $\frac{1}{2}$ " x 9 $\frac{1}{2}$ ". Drive unit 13 $\frac{1}{2}$ " x 8 $\frac{1}{2}$ " with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair+£3 p&p.**

### SPECIFICATION R101

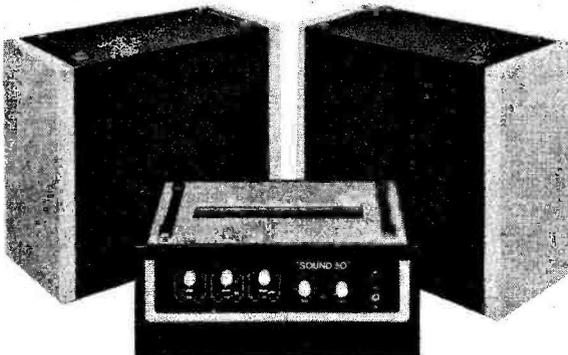
14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0.1%. P.U.1 (for ceramic cartridges). 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K. equalised within  $\pm$  1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities; headphone socket, power out 250mV per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. Signal to noise ratio: (all controls at max) R101—P.U.1 and radio—65dB. P.U.2. -58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. Cross talk better than -35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx 13 $\frac{3}{4}$ " x 9" x 3 $\frac{3}{4}$ ".

# R+TV

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323 Edgware Road, London, W.2. Mail orders to Acton. Terms C.W.O. All enquiries S.A.E.  
Goods not despatched outside U.K.

# SOUND 50

50 WATT AMPLIFIER & SPEAKER SYSTEM



The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

**Output Power:** 45 watts R.M.S. (Sine wave drive). **Frequency response:** -3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.

**Speaker Impedance:** 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10 KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.

To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.

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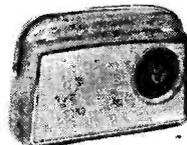


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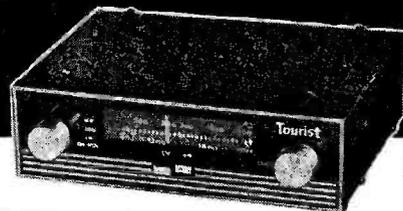
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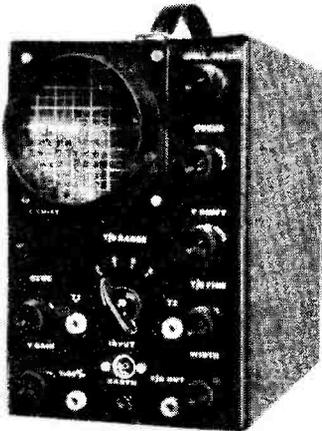
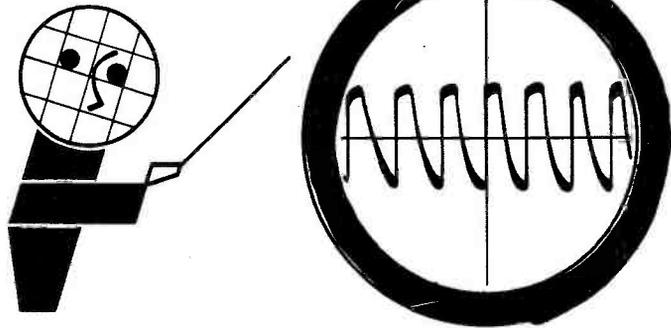
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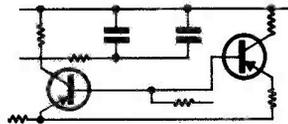
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# PRACTICAL WIRELESS

VOL 47 NO 11

Issue 781

MARCH 1972

## DX JUBILEE

ACCORDING to reliable eye (or ear?)-witnesses, such as our venerable columnist Henry and the antedeluvian researchers Colin Riches and Arthur Dow, founders of *Going Back* (official organ of the P.W. Darby and Joan Club), one of the major impacts at the dawn of broadcasting was not so much the material transmitted as the fascination of hearing something—anything—from a point far removed from the listener's ear.

Although they would have been horrified at the thought, these ancient radio listeners were, in fact, the first DX'ers. It is, of course, a far cry from pulling in 2LO with an adroit twiddle of the catswhisker in 1922 to phasing in an exotic Pacific station with the crystal filter in 1972. Nevertheless the motivation and reactions are similar.

Since the pioneer London broadcasting station 2LO officially opened in November 1922, this year we can celebrate (or mourn, according to taste) 50 years of broadcasting. More apposite to P.W. readers, we can hang out the bunting for 50 years of DXing. In that time, of course, many changes have taken place, not only in equipment but in the art and style of DX listening.

In the early stages of the hobby, the main criterion was actual distance—first the local stations, then Europe, then North America (all on medium waves), followed by the development of the short wave bands which permitted reception of the USA during daylight hours and extended the listening ear to all parts of the world. But then, as useable frequencies became higher, the old aim of maximum distance took a back seat, for on v.h.f., and later on u.h.f., a DX catch could be judged in hundreds instead of thousands of miles. One of the latest activities is DX television.

The style of transmissions has changed dramatically over the years; the early short wave programmes were of the pure entertainment type and they could be picked up on relatively simple receivers on bands that were blissfully uncluttered; amateurs had a wonderful time operating on low power—and getting through. The 30's, however, saw a change of direction. The Spanish Civil War brought with it jamming for the first time, together with the first invasion of amateur territory by propaganda broadcasting. The process has continued to the present day with its multitude of high powered political broadcasters, many disregarding international agreements, and the further erosion of amateur bands and consequent congestion.

Despite all these changes (many of them obviously for the worst), the DX bug still exerts its fascination.

We hope that the wall chart contained in this issue will be helpful to some of the newer recruits to the ranks of long distance listeners.

W. N. STEVENS—*Editor*.

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APRIL ISSUE WILL BE  
PUBLISHED ON MARCH 3rd

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# NEWS... NEWS... NEWS...

## The BBC Stereo Service

The BBC is planning to expand its stereo service considerably during the next few years. The extension beyond the present Radio 3 service will take place in three phases.

(1.) *The installation of stereo origination facilities for Radio 2 (with Radio 1) and Radio 4.* This has called for a major re-equipment programme involving modifications to the continuity suites and central control equipment in London as well as a considerable increase throughout the United Kingdom in the number of tape machines, gramophone desks, studios and outside broadcast units equipped for stereo. This phase is already in progress, and it is expected that it will be possible to originate a major proportion of stereo programmes on Radio 2 by the end of 1972, and also to make possible the transmission of some stereo programmes on Radio 4. Further increases in stereo capability will continue during the succeeding years.

(2.) *The extension of Radio 2 and Radio 4 stereo to those transmitters already radiating Radio 3 in stereo.* For this a new system of s.h.f. radio links is planned, using pulse code modulation (PCM) (see below). It is expected that the three-network service, which involves the construction of several new radio link sites on the main route, will be available in the London area and the Midlands by the end of 1972 and in the North of England during 1973. Rowridge, serving central southern England, will be included in this phase and a full stereo service from Belmont, serving Lincolnshire, will follow the extension to the North of England.

(3.) *The extension of the three network stereo service northwards to Central Scotland and westwards to the Bristol Channel area.* The Post Office Corporation and the BBC are working towards this phase which it is expected will start in 1974. The transmitters expected to be included are Kirk o'Shotts (Lanarkshire), Pontop Pike (Durham), Sandale (Cumberland), and Wenvoe (Glamorgan). It is hoped also to include North Hessary Tor (Devonshire) in this phase, as well as certain of the relay stations associated with the main transmitters mentioned.

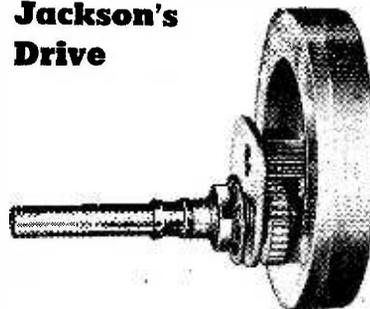
The PCM system to be used on the s.h.f. radio links has been developed by the BBC. It will carry 10 audio circuits. Each stereo programme will use two circuits, for the A and B channels, and the stereo coding will be carried out at each main transmitting station. The PCM system will provide improved quality in respect of both audio bandwidth and signal to noise ratio, from which mono as well as stereo listeners will benefit. It thus forms part of the BBC's plan to improve still further the quality of its v.h.f. transmissions throughout the country.

## Golden Silence



Picture shows Gloria Connell, actress daughter of the chairman of the Noise Abatement Society enjoying peace and quiet against a background of noise which would be intolerable without the Ear Defenders which reduce the noise of the road drills to a mere whisper. The Survey Meter's red lamp lights up when noise reaches danger levels. Ideal for "pop" fans who can't stand classical music and "classics" fans who can't stand pop music, the meter costs £10 and the Ear Defenders cost £5 from local stores or carriage paid from *Noise Abatement Society, 6 Old Bond Street, London W.1.*

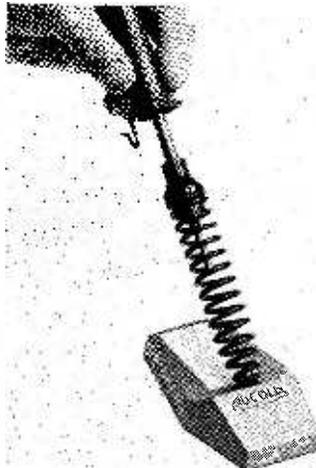
## Jackson's Drive



The *Accelerator Spinwheel Drive* is a cord drive unit intended for modern radio receivers with extra-long scales. It incorporates a 2 $\frac{1}{4}$ -inch-diameter (57mm) zinc-alloy flywheel driven through nylon-to-brass step-up gears at more than twice the speed of the drive-shaft. The complete unit weighs only 6oz (170g) but provides an inertial effect equivalent to a much larger flywheel, permitting rapid traverse of the scale. *Jackson Brothers (London) Ltd., Croydon CR9 4DG, England.*

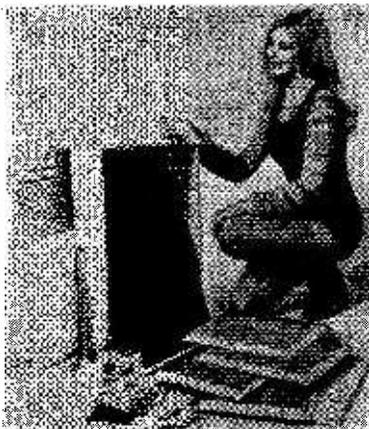
## Adcola Soldering Station

To complement the Invader range of soldering irons, Adcola Products Ltd has introduced the "Invader Soldering Station." It consists of a cast aluminium base, finished in hammered silver grey, containing an integral wiping sponge to facilitate the removal of solder from the tip of an instrument.



# NEWS... NEWS... NEWS...

## EMI Speaker Kits



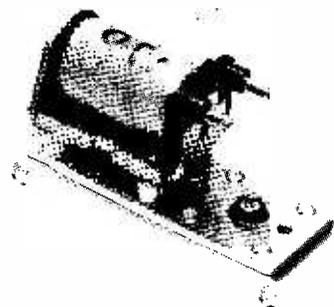
EMI has entered the loudspeaker enclosure market with a range of high quality enclosures in kit form. Available in polished wood veneers, the enclosures have been introduced by EMI Sound Products Limited, of Hayes, Middlesex, for use with its range of matched loudspeaker systems.

The enclosures are priced from £5.80, for a 12in. x 6in. x 8in. bookshelf model, to £29.50 for a large floor-standing enclosure measuring 33in. x 20in. x 15in. They have been designed to incorporate each of the eight different EMI loudspeaker systems which cover the 6 to 35 watts r.m.s. output range.

## Coax Relay

This is the Series 951 Co-axial Relay from Magnetic Devices for aerial switching at frequencies in the order of 450 megacycles.

For further information please contact *Magnetic Devices Limited, Newmarket, Suffolk. Telephone Newmarket 3451.*



## BBC Scholarship

*Mr I. G. Phillipps graduated with an upper second class honours degree in the Electrical Sciences Tripos at the University of Cambridge in 1971, and has been awarded a three-year BBC Research Scholarship to undertake research in the Department of Engineering at the University of Cambridge, under the supervision of Professor P. S. Brandon, MA. The subject of Mr Phillipps' research will be "ways of reducing the channel capacity required by a television signal or improving the quality of a television image within a given channel capacity, by the use of digital electronic techniques."*

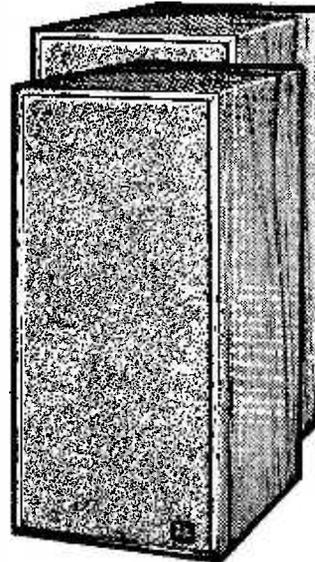
## Radio Amateur Invalid & Bedfast Club

The address to which all correspondence concerning the Radio Amateur Invalid & Bedfast Club should now be sent is: Mrs. Frances Woolley, G3LWY, Woodclose, Penselwood, Wincanton, Somerset.

Bedfast Club membership is almost at the 400 mark and covers 13 countries. Any handicapped licensed amateur or short-wave listener, wherever he or she may live, who does not already belong to the Club is invited to apply to the Hon. Secretary at the address above for full details of membership, enclosing a stamped, addressed envelope.

Readers will be interested to know that Mr. Cecil Lewis, of Bude, received three letters telling him of the R.A.I.B.C. following his appeal for help which we printed in *Practical Wireless* last year.

## Criterion Mk. X

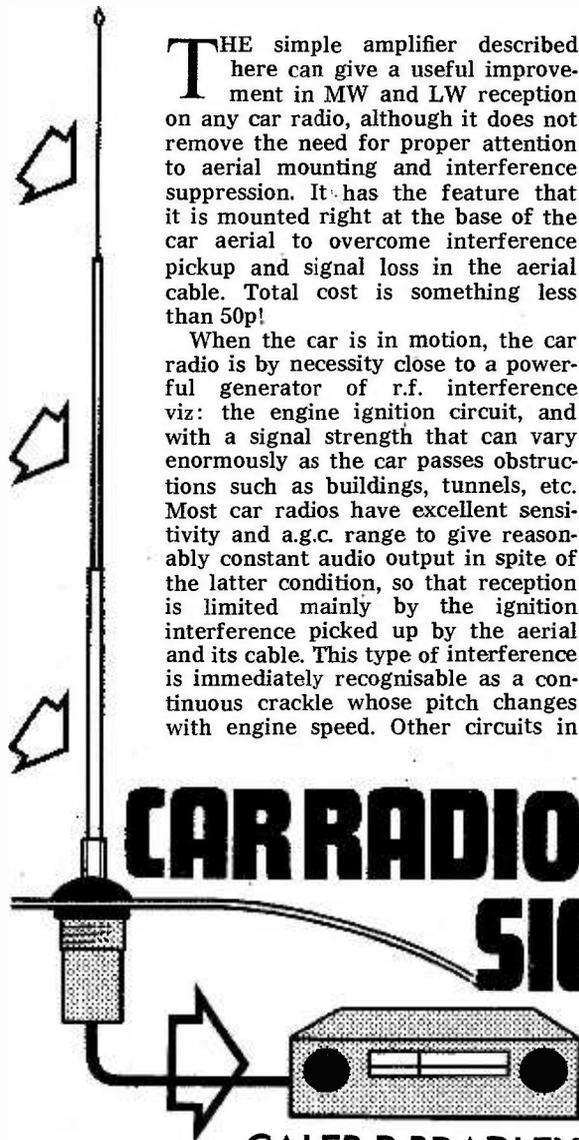


We recently had the opportunity to try the Lasky's Criterion Mk X speakers. They are bookshelf types employing the sealed infinite baffle enclosure principle and they are well worthy of consideration by the budget-conscious Hi-Fi enthusiast. An 8in. woofer, 5in. mid-range and 2½in. tweeter are used and the cabinets are oiled walnut with black woven speaker grilles. Frequency response is 40Hz-20kHz and maximum power handling capacity is 20W. The impedance is 8Ω. A useful feature of these speakers is that two types of speaker lead connection are supplied—phono or screw terminals. Cabinet size is 18¾ x 9⅞ x 9⅞in. and the very reasonable price is £25 the pair. Postage is 50p and the speakers are available singly for £13.50. *Lasky's Radio Limited, 3-15 Cavell Street, Tower Hamlets, London, E.1. Tel. 01-790-4821.*

## The Practical Wireless CQ! Column

Items in the CQ! Column are carried free of charge as a service to readers. We only ask that those making use of the service answer all correspondence resulting and reimburse postage and all reasonable expenses. We cannot guarantee inclusion and requests for inclusion will not be acknowledged and will be dealt with in strict rotation. It would also help if readers could write out their "CQ!" in the style used in P.W. as this would help to speed things up.

Material for inclusion should be sent to Practical Wireless Editorial, Fleetway House, Farringdon Street, London, EC4A 4AD.



**T**HE simple amplifier described here can give a useful improvement in MW and LW reception on any car radio, although it does not remove the need for proper attention to aerial mounting and interference suppression. It has the feature that it is mounted right at the base of the car aerial to overcome interference pickup and signal loss in the aerial cable. Total cost is something less than 50p!

When the car is in motion, the car radio is by necessity close to a powerful generator of r.f. interference viz: the engine ignition circuit, and with a signal strength that can vary enormously as the car passes obstructions such as buildings, tunnels, etc. Most car radios have excellent sensitivity and a.g.c. range to give reasonably constant audio output in spite of the latter condition, so that reception is limited mainly by the ignition interference picked up by the aerial and its cable. This type of interference is immediately recognisable as a continuous crackle whose pitch changes with engine speed. Other circuits in

h.t. cable. Add-on suppressor resistors, typically 50k $\Omega$ , are sold for older cars or addition to others, and can be screwed into the middle of the h.t. lead from coil to distributor (e.g. Belling-Lee Sparkmaster L.1274/S). In conjunction with stray capacitance, such resistors form a top-cut filter which bypasses the r.f. component of the fast-rising spark voltage but has negligible effect on the strength of the spark.

The metalwork of the engine compartment helps screen ignition interference from the aerial, but poor bonding between the body, the bonnet and the engine block can reduce its effectiveness. The engine compartments of fibreglass bodied cars have to be lined with metal foil to obtain this screening. For ultimate interference suppression it is possible to replace all the h.t. wiring with coaxial cable. Use solid-dielectric TV co-ax as low-loss cellular dielectric type will not withstand the ignition voltage (perhaps 30kV peak), and earth all the screens to the coil mounting bracket. Such measures though are hardly necessary for domestic reception.

Another type of interference is a whine which also changes with engine speed and is caused by the generator. This is cured by connecting a standard car suppressor capacitor (still called *condenser* in the motor trade) between chassis and the brush (larger) terminal. Switches, both manual and automatic such as the brake pressure switch, and the motors of the wipers and heater can similarly be silenced by capacitors across their terminals. Car suppressor capacitors are usually about 0.5 $\mu$ F and are built much more ruggedly than corresponding electronics components.

Other circuits, such as the lights, should not cause

the car can also contribute interference and in the author's experience capacitor-discharge transistor ignition systems can be especially troublesome.

## INTERFERENCE REDUCTION

The car aerial should be mounted as far from the engine as possible. With front-engined vehicles this means on a rear wing, or at least on the roof. If the existing aerial cable needs to be extended, a 10ft. coaxial cable already fitted with appropriate plug and socket can be purchased (Norman type SL11).

The cable screen must make a good electrical connection to the car body at the aerial end. Paint must be scraped off to permit this and the underside of the aerial mounting should be sealed against road filth as rust can ruin the connection.

All modern cars are fitted by law with ignition suppression in the form of resistance in the high voltage paths, possibly in the form of spark plug connectors incorporating resistors, or special resistive

# SIGNAL BOOSTER

interference unless there is an intermittent connection somewhere. Indicator flashers normally contain their own suppressor capacitors.

## HEAD AMPLIFIER

The circuit of the unit is shown in Fig. 1 (negative earth cars) and Fig. 2 (positive earth cars). The difference lies only in the way the h.t. supply is derived, and the voltage readings with respect to chassis are different of course.

Two silicon planar transistors are used with d.c. feedback to stabilise the circuit against wide changes of temperature and supply voltage. Common-emitter stage Tr1 operates at low collector current (100 $\mu$ A) and provides the voltage gain of the circuit. Tuned circuits and chokes could have been used to give more amplification and less noise but in practice a small amount of untuned amplification is quite adequate and avoids overloading the aerial circuit of the car radio. Emitter resistor R2 gives Tr1 a high input impedance to minimise loading of the aerial. The amplified signal across R1 is direct-coupled to emitter follower Tr2 which provides no voltage amplification but acts as an impedance converter, giving a low impedance output to the aerial cable. Bias for Tr1 base is taken from the divider R4/R5 in Tr2 emitter to give negative feedback; R3 has a high value to preserve the high input impedance.

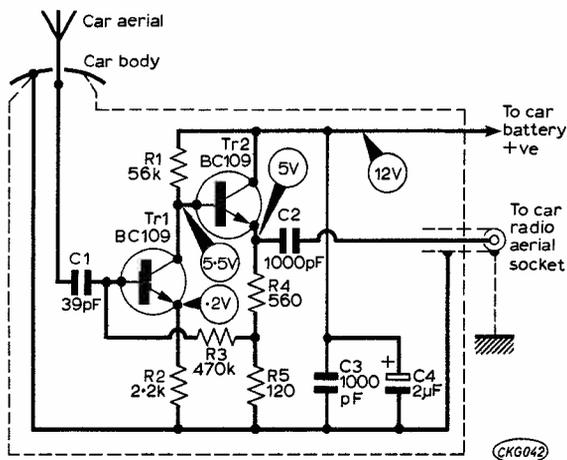


Fig. 1: Circuit suitable for negative chassis cars. All resistors are  $\frac{1}{4}W$ , 5% and the capacitors should be at least 20V working.

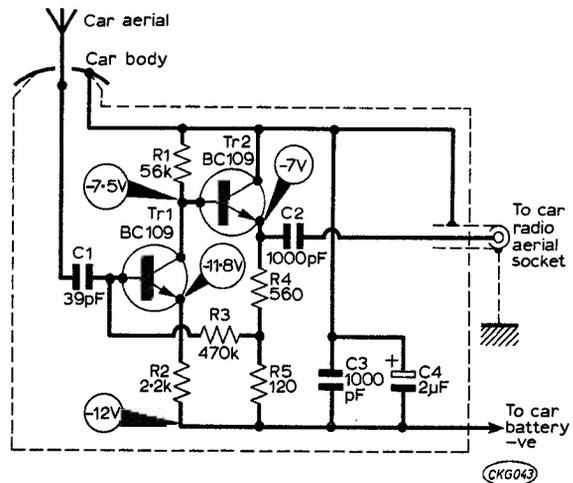


Fig. 2: The modified circuit designed for use with cars having a positive chassis.

The output isolating capacitor C2 is not essential since the radio will probably have an aerial isolating capacitor, but it does protect Tr2 against shorts in the cable or plug. It may seem curious that the h.t. supply is decoupled by both a large value electrolytic capacitor C4 and a small value ceramic C3. This is because the electrolytic may not be as effective at r.f. due to its own stray inductance; C3 ensures effective decoupling at r.f.

## CONSTRUCTION

While conventional wiring on, say, a piece of Veroboard can be employed, the method used by the author is simplicity itself. The components are simply wired together and encapsulated in candle wax inside a 35mm film cassette tin which serves as a screen. The arrangement is shown in Fig. 3. If you have a choice of cans use an Ilford tin as it has

slightly more room than the Kodak one. The tin cap is held under the aerial mounting nut (with insulating washer between) so it makes good contact with the car chassis. The body of the tin is then screwed onto the cap from underneath. The aerial cable and power wire leave through holes in the base of the tin. The input end of C1 is anchored under the aerial nut with sufficient lead to allow the tin to be screwed through about  $\frac{3}{4}$  turn, all that is required. The chassis connection to the circuit is by a short length of wire that can conveniently be trapped between the body and the cap threads. Note that if this connection is not made the circuit will still amplify, due to the chassis return via the aerial cable screen, but interference will be at a high level.

There is no need to switch the amplifier with the radio since the drain on the battery is negligible; the power lead can therefore be connected to the same point from which the radio gets its supply, often the ignition or light switch. Plug the aerial cable into the radio and unscrew fully the aerial trimmer if the radio has one. Since there is now plenty of signal, this can be done to minimise the loading on the first tuned circuit to improve selectivity.

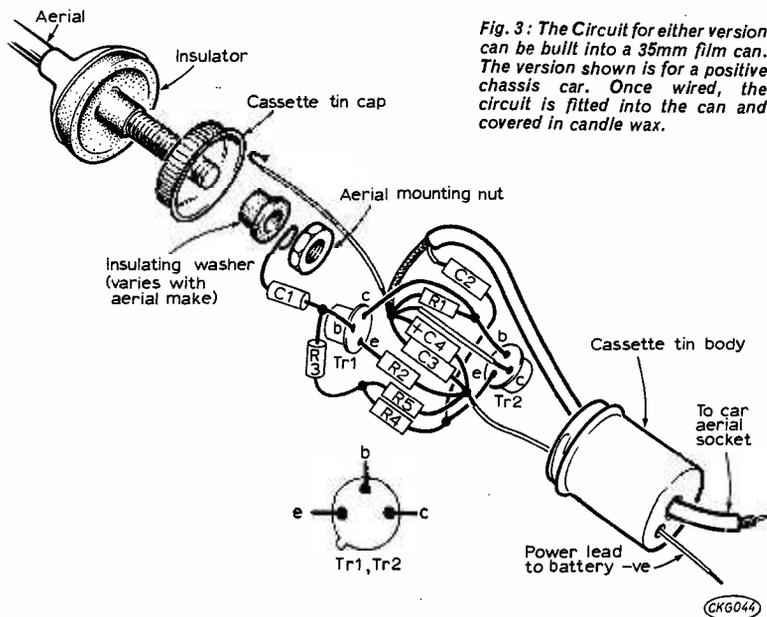


Fig. 3: The Circuit for either version can be built into a 35mm film can. The version shown is for a positive chassis car. Once wired, the circuit is fitted into the can and covered in candle wax.

## PERFORMANCE

The design of the amplifier was prompted by the author's difficulty in receiving news bulletins while driving through London, where tall steel-framed buildings prove effective Faraday screens, and in receiving British broadcasts on the continent. While the amplifier cannot cure completely non-existent signals or interference from other vehicles, the improvement is remarkable; it is now just possible to hear uninterrupted Radio 1 while driving under the Holborn Viaduct outside the PW offices (should one ever feel this to be necessary!). ■



# A DARKROOM THERMOMETER

R.A. BOTTOMLEY

THE conventional mercury or spirit filled thermometer is a thoroughly reliable instrument but, especially from the photographic worker's point of view, it is less than ideal on two counts. In the first instance the scale can be difficult to read in daylight let alone in the subdued light of the darkroom. Again, even those which incorporate a magnifying lens have to be viewed from a fairly critical angle and this can be exasperating. Secondly, the slow response time of the conventional thermometer can be an inconvenience. It was with these two points in mind that it was decided to build a thermometer incorporating a thermistor. The thermistor has an almost immediate response time and by use of the appropriate circuitry its measurement of temperature can be presented on the scale of a panel meter which is very much more easily read.

## Principle of operation

The thermistor is a resistor with a very pronounced negative temperature co-efficient. In other words its resistance decreases with increasing temperature. By measuring the value of its resistance, one can arrive at the temperature of the medium in which the thermistor is immersed. One might, as with an ordinary resistor, apply a known voltage and measure the resultant current which flows . . . the principle of the simple ohmmeter. A more precise way to measure resistance, however, is to incorporate the unknown in one arm of a Wheatstone bridge and this is the principle which has been adopted in the instrument to be described. By a suitable choice of component values an expanded scale has been achieved and this scale, as far as can be determined, is linear. The scale can be read to an accuracy of  $\pm 0.1^{\circ}\text{C}$  and, with  $20^{\circ}\text{C}$  at mid scale and plus and minus  $6^{\circ}\text{C}$  spread over the rest of the scale, it should meet most of the darkroom workers' needs.

SPECIFICATION	
Temperature range	$33^{\circ}\text{C}$ to $29^{\circ}\text{C}$
Mid-scale	$30^{\circ}\text{C}$
Reading accuracy	$\pm 1^{\circ}\text{C}$ (Hand cal. scale)
"	$\pm 0.1^{\circ}\text{C}$ (From graph)
"	(Straight line graph, microamps v. temp)
Inherent accuracy	As good as standard thermometer used for calibration
Battery consumption	12mA
Stability	Readings unaffected until battery drops below 8V
Life of battery	Very extended with average use

## Circuit description

A 9V battery (type PP6) powers the instrument. This is preferable to a mains unit since the instrument is going to be handled in proximity to a water supply. This voltage is reduced by way of two zener diodes, ZD1, ZD2, to approximately 3.3V. There are two reasons for this. By adopting a relatively low voltage to energise the bridge, self-heating effects

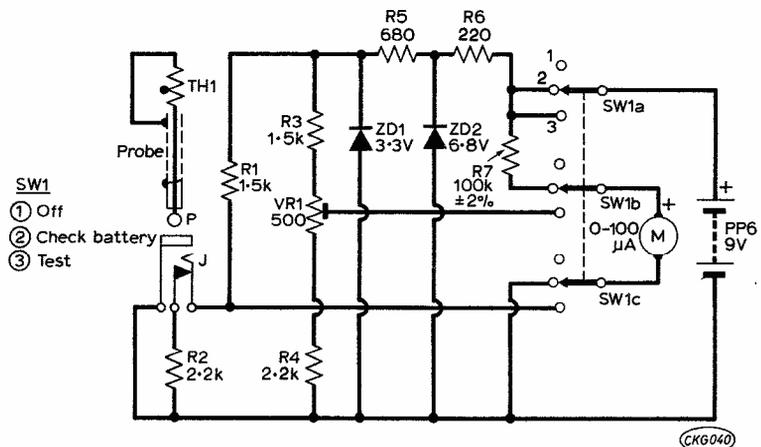
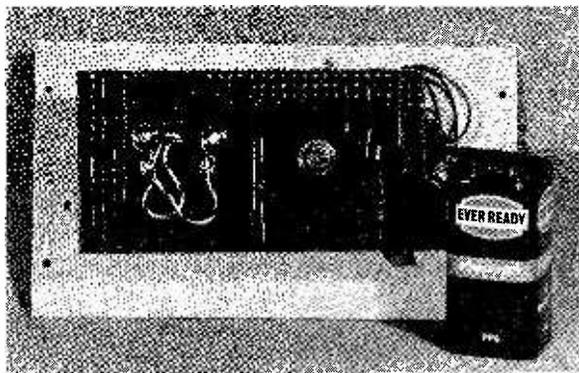


Fig. 1: The circuit of the thermometer.

of the thermistor are minimised. Additionally, the cascaded zener diodes stabilise the bridge voltage effectively so that there is no variation of the instrument's indications over the useful life of the battery. The bridge itself is formed by the components TH1, R1, R3, R4 and VR1, and it is in balance at approximately 14°C as indicated by zero deflection of the meter at this temperature. As the temperature rises, so the resistance of the thermistor falls and the pointer of the meter moves up scale accordingly. At this point it might be as well to describe the function of R2. It is only brought into circuit when the probe is disconnected. Were it not for its presence, an excessive current would pass through the meter under this condition. However, it also serves the dual purpose of reference standard whose resistance approximately equals the resistance of the thermistor at 20°C. If all is well, the pointer of the meter will always take up the same position on the scale when the probe is disconnected. A note can be kept of this reading or a "calibration" mark can be inscribed on the scale. The switch SW1 has three positions. In position "1" the instrument is off. In position "2" the meter, in conjunction with R7, is converted to a voltmeter so that one can have an indication of the state of the battery. In position "3" the meter is connected across the detector points of the bridge for temperature measurement.

### ★ components list

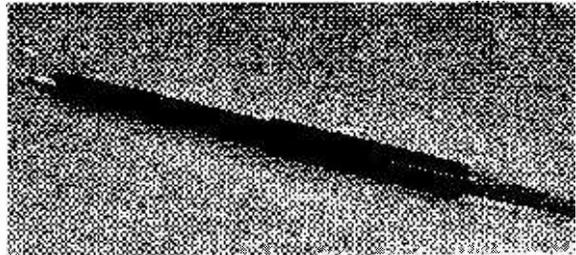
<b>Resistors</b>	
R1 1.5kΩ 5%	R6 500Ω 5%
R2 2.2kΩ 5%	R8 220Ω 5%
R3 1.5kΩ 5%	R7 100kΩ 2%
R4 3.3kΩ 5%	
All resistors 1/4W, high stability carbon film.	
VR1 500Ω potentiometer preset	
<b>Zener diodes</b>	
ZD1 3.3V at 5mA	ZD2 6.8V at 5mA
<b>Thermistor</b>	
TH1 Type 125 (RTT) (Available direct from I.T.T. Electronic Services, Edinburgh Way, Harlow, Essex. Price £1.30 plus 50p postage. Quote Cambridge No. 159X1132D)	
<b>Miscellaneous</b>	
Meter 5-100 μA (resistance 1,050Ω) Eagle KM65.	
Switch 2-pole, 3-way, jack plug and socket, 3.5mm.	



An internal view showing the Veroboard mounted on the meter terminals.

### Construction

The circuit is so simple that there is no need to elaborate upon its construction. There is absolutely nothing critical about its layout and tag strip, tag board or Veroboard (as in the prototype) can be employed. If a Veroboard layout is adopted there should scarcely be any need to stress that the copper strip should be cleared away around the meter terminals. All the components, with the exception of the switch and the jack, are mounted on the Veroboard panel which is supported by the meter terminals. The meter, switch and jack are mounted on a small aluminium panel and this panel is mounted in a small plywood box covered with leatherette. The thermistor itself is mounted into a suitable housing with the aid of Araldite. In the



The thermistor can be mounted into a test probe or a ballpoint pen case.

case of the prototype, this housing took the form of a redundant test-meter probe, turned to a smaller diameter at one end. The case of a spent ballpoint pen suggests itself as another suitable container and in this instance the thermistor tip would be protected, when not in use, by the cap of the pen.

There is nothing difficult about calibration but it should be borne in mind that the final accuracy of the instrument depends both on the care with which this is done and upon the accuracy of the thermometer which is used as standard. It is also worth noting that hot and cold water, like most dissimilar liquids, do not mix immediately. It is for this reason that it is recommended that a fairly large basin be used when calibrating and that the water be stirred thoroughly before making a reading. First the water bath should be adjusted to 20°C exactly and, when this is stabilised, VR1 should be adjusted so that the meter indicates exactly 50 μA or mid scale. Once again adjust the temperature of the water bath, this time to 15°C and when this is stable note the reading on the meter. Increase the temperature of the water bath to 25°C and, once again, note the reading. When plotted on a graph these three points will be found to lie on a straight line and the intermediate points on the scale can be determined from this graph. In the case of the prototype an increase of 1°C was represented by an increase of 8 μA, which is four divisions on the meter scale. Thus it can be seen that it is not difficult to read to 0.1°C.

One final note. If the water is not thoroughly mixed during the calibration procedure, the pointer of the meter will be seen to oscillate. This is because the thermistor is so sensitive and has such a fast response time that it indicates the variation in temperature of the water bath due to convection currents.

The instrument is so sensitive that it can even determine the slight temperature gradient between the bottom and top of a 35mm developing tank. ■

# DX reception of VHF 'LOCAL' radio

KEITH PITT

THE extension of the BBC local radio network to 20 stations has made available an additional service to about 74% of the population of England. Inevitably, in addition to many areas with no official coverage from any of the locals, there are other areas with signals available from a number of transmitters. The promised new IBA network of 60 commercial stations will add to the choice of programmes in many areas.

The BBC local radio stations are, at present, on v.h.f. mainly in the band 94.6 to 97.0MHz. The main BBC networks, Radios 2, 3 and 4, transmit almost exclusively between 88.1 and 94.5MHz.

The powers used for the local radio transmitters range from 9W for the Rotherham relay to 16.5kW for Radio London. The complete list of stations is given in Table 1. All except Blackburn, Derby and Manchester, use horizontal polarisation. These three use slant polarisation. Very little loss of quality will be observed, except in the weakest signal strength areas, if horizontal aerials are used to receive slant polarisation.

## COVERAGE

The coverage of a v.h.f. station in Band 2 is controlled by a number of factors. Like the other v.h.f. bands its signals behave rather like light waves and are obstructed by objects such as hills where the signal strength on the side away from the transmitter is much reduced. However, unlike Band 3 and u.h.f. which are used for television, a significant amount of signal is diffracted over a hill or the horizon. This then gives considerably greater coverage than might be expected from simple predictions.

One of the most important factors in determining signal strength at any point is the distance from the transmitter, since the field strength is inversely proportional to the square of the distance. Transmitter power, however, has less effect than might be expected, as the signal is proportional to the square root of the power. The height of both aerials is also of prime importance since these will determine whether or not the receiver is within the radio horizon. Signal strength diminishes quite rapidly beyond it because only diffracted waves bend over it. To a close approximation the distance of the horizon in miles is given by 1.3 times the square root of the height in feet. To approximate still further, the sum of the distances for the receiving and transmitting aerials gives the radio line of sight between them, assuming there are no major obstacles in the way.

To determine whether worthwhile results may be obtained from any given station, the following actions are necessary. First, the approximate receiving and transmitting aerial heights should be found. Secondly, using an Ordnance Survey map, measure their distance apart and determine whether any large hills get in the way. Thirdly, determine the transmitter

power. In practice, a low power station, under half a kilowatt will not be effective for more than 25-30 miles, except under very favourable conditions. Medium power, up to 10-20 kW, will often give reasonable results up to 40-50 miles. A high power station may often be receivable regularly at distances of up to 100 miles.

As a general rule, for long distance reception, the higher the receiving aerial above sea level, the greater the chance of good reception. The author lives in North London at about 350ft. above sea level and regularly has reliable reception from both Rowridge and Tacolnaston at about 80-90 miles. Of the 'local' stations, both London and Medway, which

TABLE 1 BBC LOCAL RADIO STATIONS

Station	Frequency (MHz)	Max. ERP (kW)	Aerial height (ft.) (a.s.l.)
Sheffield	95.6	0.03*	200
Durham	94.5	2.0	1400
Stoke-on-Trent	94.6	2.5	700
Leeds	94.6	0.14*	
Notttingham	94.6	0.14*	
Oxford	95.0	4.5	800
Rotherham	95.05	0.005	
Manchester	95.1	4.05	2210
Liverpool	95.2	0.185*	
London	95.3	16.5	
Humberside	95.3	4.0	
Bristol	95.4	5.0	1000
Newcastle	95.4	3.5	1400
Birmingham	95.6	3.5	1250
Brighton	95.8	0.5	550
Merseyway	95.9	5.0	
Solent	96.7	5.0†	300
Blackburn	96.4	1.55	
Derby	96.5	5.85	
Teeside	96.6	5.0	
Medway	97.0	5.5	

All transmitters except those marked \* have directional aerials. Stations marked S have slant polarisation.

are transmitted from Wrotham, are received well. (It should be noted that quoted powers are usually the maximum, but that the power radiated may be very low in some directions to avoid interference with other stations or to reduce wastage where coverage is not required.) For this reason, Medway is relatively weak, despite being within line of sight, because its power in a NW direction is very low, while London is beamed strongly in that direction.

Consistent signals are also obtained from Solent at about 85 miles, while Oxford with the same power and half the distance, is very weak. This is because nearby hills obstruct the latter but the former is quite clear for nearly 40 miles.

## AERIALS

Most BBC local radio stations radiate horizontally polarised signals. This means that a single dipole

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H12	50	NKT155/259 Germ. diodes, brand new stock clearance	50p
H18	10	OC71/75 uncoated black glass type PNP Germ.	50p
H19	10	OC81/81D uncoated white glass type PNP Germ.	50p
H28	20	OC200/1/2/3 PNP Silicon uncoated TO-5 can	50p
H29	20	OA47 gold bonded diodes coded MCS2	50p

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B86	50	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
H6	40	250mV. Zener Diodes DO-7 Min. Glass Type	50p
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H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
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H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	50p

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AC176	0-25	2G301	0-13
ACV17	0-15	2G303	0-13
AF239	0-37	2N711	0-50
AF186	0-50	2N1302-3	0-20
AF139	0-37	2N1304-5	0-25
BC154	0-25	2N1306-7	0-30
BC107	0-13	2N1308-9	0-35
BC108	0-13	2N3819FET	0-45
BC109	0-14		
BF194	0-15	<b>Power Transistors</b>	
BF274	0-15	OC20	0-50
BFY50	0-20	OC23	0-30
BSY25	0-87	OC25	0-25
BSY26	0-13	OC25	0-25
BSY27	0-13	OC26	0-25
BSY28	0-13	OC28	0-30
BSY29	0-13	OC35	0-25
BSY95A	0-15	OC36	0-30
OC41	0-13	AD149	0-30
OC44	0-13	AU710	1-25
OC45	0-13	25034	0-25
OC71	0-13	2N3055	0-50
OC72	0-13	<b>Diodes</b>	
OC81	0-13	AAY42	0-10
OC81D	0-13	OA95	0-19
OC83	0-20	OA79	0-09
OC139	0-13	OA81	0-09
OC140	0-17	IN9114	0-07

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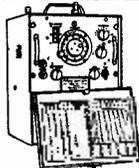
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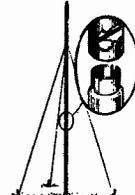


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3 pin Din Plug . . . . . 13p each  
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 3 pin Din Line Socket . . . . . 13p "  
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**PAINTON PLUG SOCKETS** Type 159 series working voltage 350v AC/DC current max. 3 amp AC/DC 7 pin plug & socket 50p pp 6p. 15 pin plug & socket £1 pp 6p. 31 WAX PLUG & SOCKET. £1.50. pp 10p.

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 Adjacent Elstree Mainline Station  
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has some directional properties and thus does not receive equally well from all directions. The maximum signal strength is obtained with the aerial at right angles to a line joining the transmitter and the receiver. An improvement in directivity and gain can be obtained by the addition of a reflector and, perhaps, one or more directors.

Figure 1 shows the dimensions of a simple Band 2 aerial. No attempt has been made to allow for mismatch at the dipole caused by the addition of two directors and a reflector. If need be, the dipole can be folded when the input impedance will then afford a reasonable match to 72Ω coaxial feeder. If the object of the exercise is to obtain as many stations as possible, then, while the additional gain is very useful, the aerial will need re-alignment towards each one. A rotary system would then be worthwhile, but a simple expedient is to use two simple dipoles at right angles with two feeder cables and to switch over to the more effective one when tuning in a station.

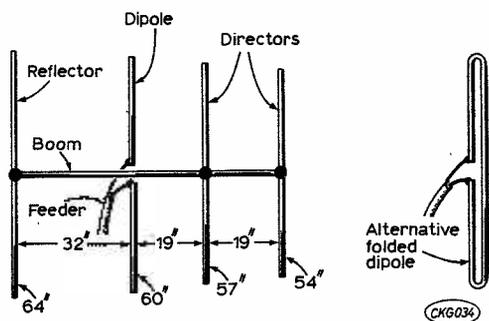


Fig. 1: A four element Yagi beam. If the dipole is folded it will provide a better match to 70Ω feeder. If constructed of metal tubing the centres of the directors and reflector may be clamped directly to the boom.

In practice, if only one aerial is possible, whether indoors or outside, it should be mounted as high as possible. Its direction should be chosen so that it gives the maximum possible pickup of the weakest of the available stations consistent with minimum loss on any of the others. The author uses two separate aerials, a four element for Solent, which still gives acceptable results on Medway and London, and a single dipole for Oxford. The latter is insufficient to reduce the interference from the adjacent Radio London. This raises the other critical point in reception of v.h.f. stations; receiver properties.

## RECEIVERS

Most commercial v.l.f. receivers can resolve clearly two adjacent stations 0.5MHz apart, but, in some cases, the spread of a local may be so great that it can cover almost a whole MHz of the spectrum, rendering adjacent stations very difficult to find and resolve. On one portable the author could just separate Oxford on 95MHz from London on 95.3MHz and listen to the former, and yet the same set produced some traces of London on Solent on 96.1MHz. Similarly, other sets spread Wrotham Radio 4 on 93.5MHz from just over 93 to 94MHz. BBC 4 Oxford on 93.9MHz cannot be separated from Wrotham on any of the four sets the author has tried. This

spread rather limits the usefulness of some of the weaker stations.

Reception is also made worse by "spurious signals" which sometimes appear at places on the dial where there is no true signal, although this is more a function of the quality of the receiver. Quite often portables give better results using their own aerial, carefully positioned for maximum signal than when using a high outside aerial. This is because spurious signals appear to be produced in many sets much more strongly when an external aerial is used.

In conclusion, there will be many areas where satisfactory results will be obtained from two or more "local" radio stations. Unless they are very strong, a good aerial system will probably be required to give the best results. It will, however, happen that in some cases spread within the set may spoil the reception of weaker signals close to a local.

# TELEVISION

## MARCH ISSUE

### RENOVATING THE RENTALS

A large number of ex-rental sets are now appearing on the second-hand market and with judicious renovation can be made to give useful service for some time—particularly for the booming market in second sets. Many of these sets exhibit common stock faults and in this new series we shall be passing on tips and advice to help get—and keep—these sets going.

### LINE TIMEBASES OF THE FUTURE

One of the developments that is likely to be with us before long is the slimline colour set, i.e. one fitted with a 110° shadowmask tube. The main technical difficulty concerns the line scanning and this month we shall be examining an interesting development—a thyristor line output stage—that has been evolved for this application.

### COLOUR RECEIVER INSIGHT

A great deal of uncommon circuitry is to be found in colour chassis—the sort of thing you've not come across before and can spend hours puzzling over. So we've decided to take the lid off, so to speak, and explain in detail just what those apparent circuit mazes do. Starting with the ITT-KB CVC5 chassis.

### SERVICING TELEVISION RECEIVERS

The next chassis to be covered in this popular feature is the Bush TV103/TV105 series.

### PLUS ALL THE REGULAR FEATURES

**Advance News:** Starting in the April issue, the TELEVISION Colour Receiver for the Constructor.

**ON SALE FEBRUARY 21**

# TAKE 20

JULIAN ANDERSON

**P**ART of the fun of electronics is in being able to 'amaze and mystify' members of the family and friends with little tricks. Those unfamiliar with the mysteries of electronics invariably assume that anyone who has tackled even the simplest crystal set is a true genius and, even when they see how few parts are employed, refuse to believe that 'that's all there is to it'. When they can't see the components that make an item tick they are even more impressed—let us not shatter their illusions, let us allow the uninitiated to marvel at our unquestionable brilliance!

Our project this month is purely for fun; to my knowledge it has no practical use whatsoever but it should amuse and it does fall within our budget of £1.

Using the constructional layout shown none of the component leads need be cut short and this will allow the components to be employed later for some more practical purpose.

The title of magic candle is self explanatory: the wick and flame are replaced by a small light bulb; when a lighted match or cigarette lighter is moved near it the bulb lights up and remains alight until "snuffed" by turning it off.

Apart from the battery, only four components are used: a light dependent resistor (LDR), a thyristor (SCR), a potentiometer (VR1) and the bulb itself. At normal light levels the resistance of the LDR will be several hundred ohms (though this varies enormously with the specimen and the actual light level) and with VR1 at maximum setting there will not be sufficient current flowing in the gate circuit to trigger the SCR. However, if VR1 is reduced in value and the light level on the LDR increases there will be an increase in current, the SCR will turn on and apply the battery volts across the bulb. Because of the action of an SCR, even when the triggering current falls away completely, current will still be passed in the anode-cathode circuit.

VR1 acts as the sensitivity control; when it is set to minimum resistance and with a sensitive LDR, even quite low light levels will trigger the circuit. At maximum resistance the bulb will probably not light at all.

Ideally one would use both a battery and a bulb of the same voltage but SCRs don't seem to work well at voltages much below 9V and 9V bulbs with low current consumption are not widely available. If one can be obtained (note that the current should be no higher than 60mA) the circuit is exactly as shown. However 6V, 40mA bulbs are available and cheap but to avoid blowing it a 68Ω resistor should be wired in series with the bulb at the point marked both in the circuit and the constructional layout.

The circuit is best built to look something like a wax candle. A cardboard tube, such as aluminium foil is supplied on, is suitable. The battery sits on the bottom to give stability with VR1 just above this. For ease of wiring it is best to wire up VR1 first with three long leads, two to come out of the top and one that goes down to the battery and then to fit it into a hole cut out of the side.

## No. 34 MAGIC CANDLE

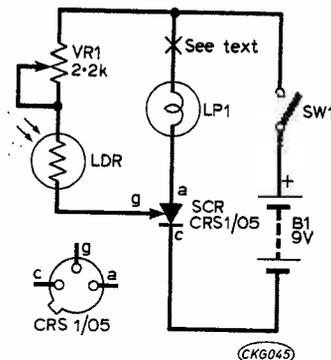


Fig. 1: Circuit of the 'Magic Candle'.

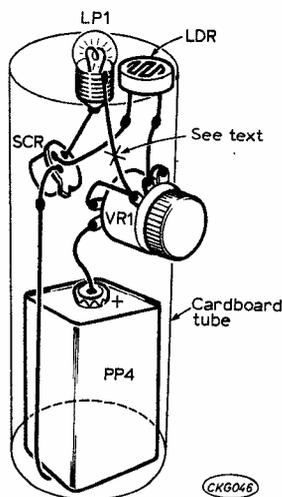


Fig. 2: The components can all be mounted inside a cardboard tube.

### ★ components list

VR1 2.2kΩ lin. pot with switch .. ..	24p
LDR Light dependent resistor .. ..	43p
SCR CRS1/05 Thyristor, 50V, 1A .. ..	23p
LP1 6V, 40mA bulb, see text .. ..	5p
	<hr/>
	95p

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

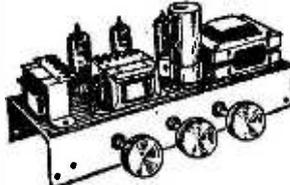
A stout card disc, cut to go over the top, can then be fitted with the bulb and the LDR which should be lightly glued under a small hole about ¼in. in diameter. This should be as near to the bulb as possible. The SCR can be either left floating as shown or it can be glued to the top cardboard disc. A long wire should be fitted to the cathode which is fed down the tube to the battery negative terminal. Once working the tube and top may be painted white to give the appearance of a candle. ■

## 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 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7 1/2" deep. AC 200/250V. PRICE £10.50. P. & P. 25p.

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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 2 ohm speaker. Size 7in. wide x 3in. deep x 6in. high. Ready built and tested. PRICE £8.75 P. & P. 40p.

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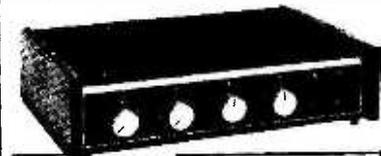
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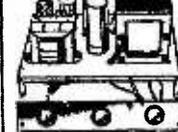
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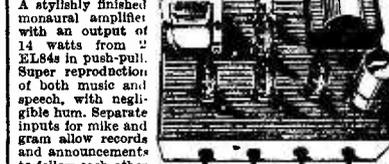
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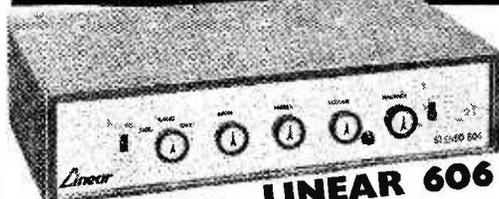
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3S4	28	30C18	81	EB41	40	EM84	82	PCL85	38	UBP89	34
3V4	37	30C3	64	EB91	10	EM87	34	PCL86	38	UBR89	38
5U4G	31	30FL1	61	EBC33	40	EY31	33	PCL88	65	UCC84	32
5Y4G	35	30FL12	69	EBC41	54	EY36	39	PCL800	75	UCC85	32
5Y3GT	38	30FL14	68	EBC90	32	EZ40	48	PEN A4	77	UCF80	38
5Z4G	35	30L1	29	EBF80	32	EZ41	43	PEN36C	70	UCI42	58
6Y80L2	54	30L15	57	EBF89	32	EZ50	39	PFL200	82	UCH81	32
6AL5	11	30L17	87	ECC81	17	EZ81	23	PL36	49	UCL82	32
6AM6	13	30P4	57	ECC82	20	GZ30	34	PL81	44	UCL83	55
6AQ5	22	30P12	72	ECC83	35	GZ32	40	PL81A	47	UF41	56
6AT6	20	30P19	57	ECC85	34	GZ34	48	PL82	81	UF89	30
6AU6	20	30PL1	60	ECC804	54	KT41	77	PL83	38	UL41	57
6BA6	20	30PL13	80	ECP80	31	KT81	55	PL84	30	UL44	£1-00
6BE6	21	30PL14	85	ECP82	28	KT86	78	PL500	85	UL84	30
6BJ6	41	35L6GT	45	ECH35	55	LN319	63	PL604	63	UM84	22
6BW7	52	35W4	25	EOH42	50	LN329	78	PM84	33	UY41	42
6FL4	40	35Z4GT	26	ECH81	38	LN336	63	PX25	25	UY85	25
6F23	68	50T	45	ECH83	40	N75	87	PY22	55	VP4B	77
6F25	58	60G3	62	ECH84	35	P81	40	PY33	55	W77	43
6J7G	24	AC/VP3	77	ECL80	30	PABC30	34	PY81	25	Z77	22
6K7G	12	B349	65	ECL82	31	PC86	47	PY82	25	Transistors	
6K8G	17	B729	62	ECL86	35	PC88	47	PY83	28	AC107	17
6Q7G	35	COH35	67	EP39	38	PC86	42	PY88	38	AC127	18
6SN7GT	30	CY31	36	EF41	40	PC87	59	PY800	34	AD149	37
6V6G	23	DAF91	22	EF50	28	PC800	31	PY801	34	AF115	20
6V8GT	28	DAF96	28	EF85	28	PCC84	39	R19	30	AF116	20
6X4	23	DF33	38	EF86	30	PCC85	25	R20	56	AF117	20
6X5GT	28	DF91	18	EP89	28	PCC88	40	U25	64	AF118	28
10P13	58	DF96	36	EF91	13	PCC89	45	U26	56	AF125	17
12AT7	17	DH77	20	EF92	30	PC189	46	U47	64	AF127	17
12AU6	20	DK32	33	EF98	35	PCC805	58	U49	55	OC28	25
12AU7	20	DK91	28	EF183	28	PCF80	28	U50	36	OC44	18
12AX7	22	DK92	38	EF184	31	PCF82	31	U52	31	OC45	18
19BG6G	80	DL35	40	EL33	55	PCF800	68	U191	59	OC72	18
20F3	67	DL92	26	EL34	45	PCF801	28	U193	42	OC75	18
20P3	77	DL94	37	EL41	54	PCF803	40	U251	64	OC81	18
20P4	92	DL96	38	EL84	28	PCF805	61	U301	38	OC82	18
25L6GT	19	DY88	24	EL90	26	PCF806	58	U329	66	OC82D	18
25U4GT	57	DY87	24	EL95	33	PCF808	68	U801	30	OC170	28

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### **HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES**

Published by Babani Press  
78 pages, 7 × 4in. Price: 40p.

ONE hardly needs to review a book of this type—the title itself (and the modest price) is enough to make the mouth water. Such a book has long been needed and congratulations to the publishers for introducing it.

Personally I have never met anyone who has known more than a handful of the transistor types available and as far as substitutes are concerned no one has worked out the perfect way of presenting these. This handbook has, however, made a brave attempt (and largely successful one) to give equivalents of transistors in a thoroughly practical way. Equivalents, by the way, only refers to parameters and ignores encapsulation, a sensible thing to do as it opens the field considerably.

About 3,000 types have their equivalents given and in most cases several alternatives are shown; take for instance the OC71, an old fashioned but very well known transistor, here 15 equivalents are shown and this is not untypical.

One of the best points (and if all the other virtues were missing this only would make the book a good buy) is the inclusion of a mass of Japanese types. There must be hundreds of thousands of small transistor radios imported from the Far East which have been written off because a dud transistor is unidentifiable. I have never come across a better list of these types.

Altogether an excellent handbook and, for those who need to find equivalents, indispensable. **H.W.M.**

### **PUBLIC ADDRESS HANDBOOK**

By Vivian Capel  
Published by Fountain Press,  
46 Chancery Lane, London. WC2.  
208 pages, 8 × 5in. Price: £3.00.

VIVA Vivian! This contribution to the literature of audio is like a light in darkness. With the growing world of discos, clubs and semi-pro 'do's' at the local Church Hall, some guidance is necessary for the well-meaning PA operator. Until now, his only recourse was to very specialist works that told him a lot about the acoustics of the City Hall in Walamazoo but little about hooking up an ailing 10W amplifier to the vicar's home-made loudspeakers.

Public Address Handbook is very soundly based on the author's practical experience. Anyone who has attempted PA will know that the most unexpected problems can crop up. Mr. Capel has worked in small halls and large, on private jamborees and public demonstrations and passes on to us the benefit of his know-how.

There is little theoretical depth. The author argues that you would not be reading the handbook if you

had not at least a glimmering of the background and the acumen to seek out more in the appropriate places. But he takes full cognisance of our probable ignorance where public address is concerned and guides us through the mysteries of microphones and mixers, amplifiers and loudspeakers—always from a practical point of view.

The author is a practising musician and this becomes apparent when one reads his Chapter 10, 'Live Music.' His advice is firsthand and authentic. Practical systems are described in another chapter; nine working hookups based on requirements that vary between the small hall and the football stadium, taking in a factory canteen on the way.

Still more practical, the final two chapters deal with fault-finding and setting-up. I was tickled pink by Mr. Capel's advice on page 80: 'Never panic, even though the programme may be held up while you try to rectify matters!' There speaks the voice of experience as it does, indeed, throughout this excellent and rare book on a little-known and infrequently explored subject. For amateur and professional both, this public address handbook is to be recommended. **H.W.H.**

### **GUIDE TO PRINTED CIRCUITS**

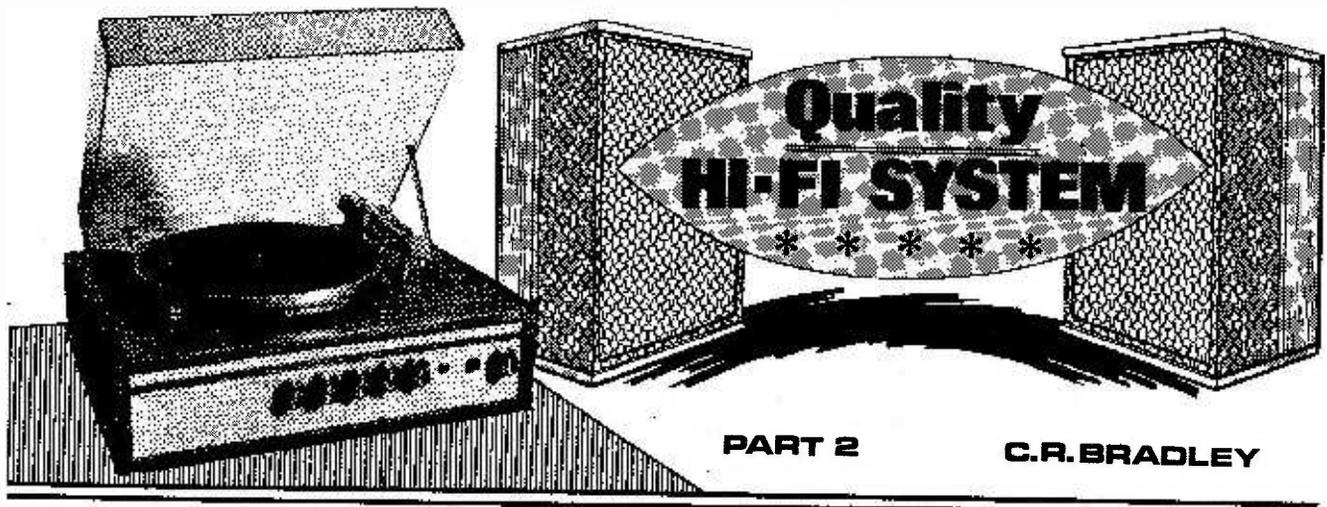
By Gordon J. King  
Published by Fountain Press  
148 pages, 8½ × 5½in. Price: £2.50

AN excellent and timely book, written, as the author says, "with the enthusiastic amateur, experimenter and the radio service apprentice and technician in mind."

The six chapters begin with the reasons for the introduction of the printed circuit board and the early problems involved and continues with the design methods and manufacture of boards in the electronic industry. For the reviewer the chapter on "rolling one's own" printed circuit boards was the most interesting with its detailed advice and guidance. Interest was maintained at a high level in the following chapter which covers the alternative systems to the pcb, such as Veroboard, Cir-Kit and S-DeC. Many readers will find the information on converting a circuit diagram into a finished circuit board of the greatest use.

A book such as this would not be complete without detailed information on the methods of servicing pcb's. The author, who has accumulated many years of servicing expertise, has been able to incorporate some of that experience into Chapter Five. Other useful guidance covers the field of soldering irons and guns, solders and soldering aids and the few other accessories which will enable the amateur to turn out a professional pcb.

The book is well written with many photographs and line drawings. £2.50 is little enough to pay for such a mine of information. **A.E.D.**



*Continued from the February issue*

The circuit of the plinth is shown in Fig. 6. This comprises the power supply, the left and right power amplifier modules and the left and right preamplifiers. The preamplifiers are separately constructed on pieces of Veroboard which plug into two 24-way edge connectors on the back of the control panel. In return for their small extra cost, the use of edge connectors has some important advantages.

First, construction is simplified since construction of each preamplifier and the fairly complicated wiring around the controls can be separately completed and checked, with improved accessibility in both cases. Secondly, either preamplifier board can be removed in seconds for fault finding; it is very helpful when tracing a fault to be able to swap the preamplifiers and observe whether the fault changes channel. Thirdly, all the small-signal carrying wires are kept as short as possible and run close to the aluminium front panel so that fewer wires have to be screened to avoid instability, hum pickup and crosstalk problems. The latter is especially important since the equipment uses silicon transistors throughout which individually have responses extending far beyond audio into radio frequencies.

### Preamplifier Circuit

This will be fully described as it contains some unusual features. The BC109 transistor was an obvious choice for all stages since it has a very low noise factor and is commendably cheap. Non-branded BC109's may not be as good.

The low level signal is received by the equalisation stage Tr1 and Tr2. These are connected as a d.c. coupled pair in which Tr1 runs at a low collector current of  $75\mu\text{A}$  to minimise the electrical noise introduced at this vital point. D.C. stabilisation is performed by R8 since if Tr1 collector current should rise, Tr2 base voltage drops, Tr2 emitter voltage follows and Tr1 base bias is therefore reduced. R8 also provides some signal feedback but the main signal feedback path is from Tr2 collector through C3 and the components selected by S1b to Tr1 emit-

ter. For radio tuner input the feedback through R11 provides flat frequency response and 150mV sensitivity at the input. For magnetic cartridge input R13/C5/C6 provide frequency conscious feedback to obtain the standard RIAA disc playback response—see Fig. 8. Almost any desired input sensitivity and impedance can be made available at the AUXILIARY position of S1 by choosing component values from Table 1. Clearly there is scope for arranging any desired selection of inputs by S1 from the values given, although if planning to introduce more complex switching it is important to bear in mind that this area of circuit is where hum pickup and crosstalk are most likely to occur. For the purpose of the components list it is assumed that the AUXILIARY position is fitted with components for 300mV input sensitivity, useful for, say, the low level outputs from a stereo tape recorder.

TABLE 1  
Component values for different AUXILIARY input characteristics

R1	Rx	Sensitivity	Input Impedance	Suitable for:
470k $\Omega$	0	300mV	500k $\Omega$	Tape recorder
0	62k $\Omega$	3.5mV	22k $\Omega$	Dynamic mic.
1M $\Omega$	62k $\Omega$	300mV	1M $\Omega$	Crystal mic. or pickup

Virtually all of the preamplifier gain is provided by Tr1 and Tr2 which are followed by the stereo volume control VR1. For this a linear track component is chosen rather than the logarithmic type usually used in this position. This has the advantage that the two ganged sections will be better matched than in a cheap logarithmic control so channel balance will be maintained at different volume settings. The preset gain controls VR2 in each channel are a means of overcoming the usual disadvantage of linear volume controls i.e. most of the subjective volume range being compressed into the first few degrees of rotation. The preset controls are intended to be set to give the maximum likely listening

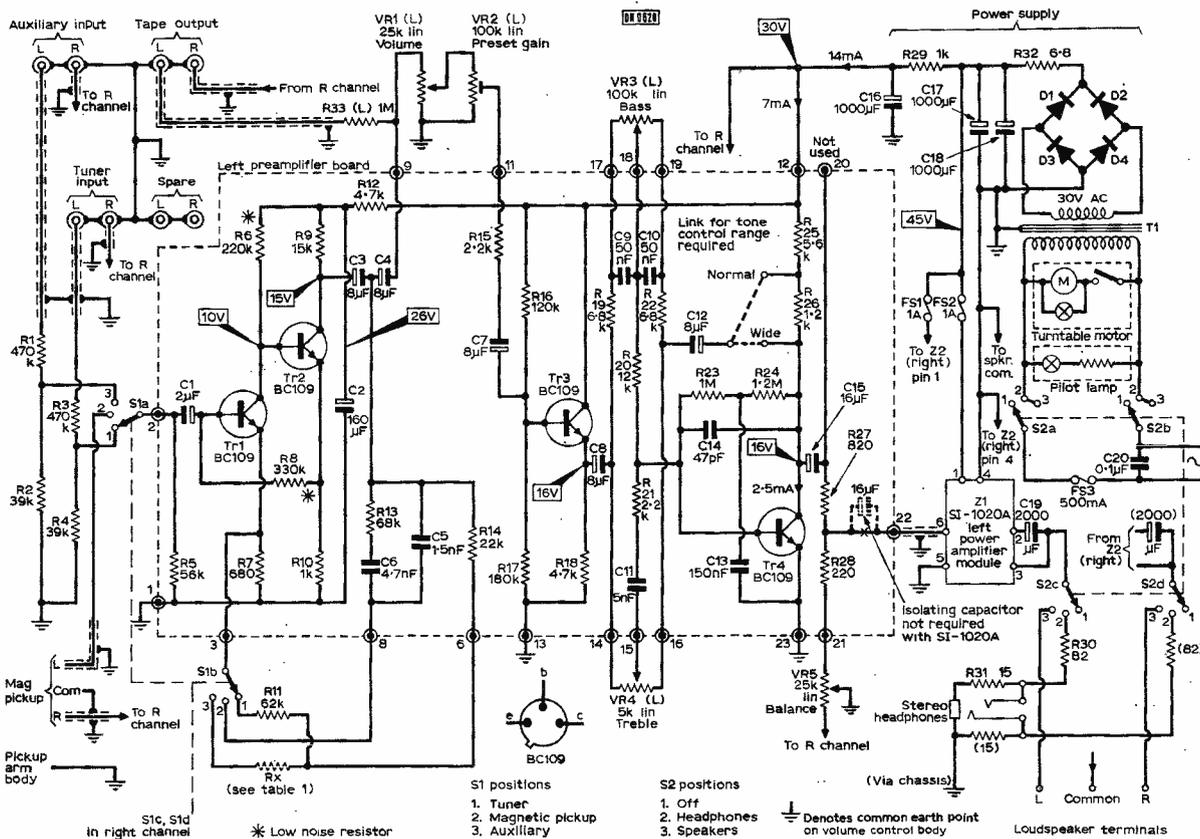


Fig. 6: Circuit of plinth unit. Preamplifier and power amplifier for left channel only are shown, plus balance control VR5. Some components in right channel speaker output shown for clarity. Right channel is identical. All voltages are positive with respect to chassis.

volume with the manual control at maximum, so that its whole range can be utilised. They also allow any difference in the gains of the left and right channels, due to component tolerances, to be compensated so that the manual balance control normally rests midway.

### Emitter Follower Buffer

In most preamplifier designs a Baxandall tone control stage follows immediately after the equalisation stage. Here however an extra emitter follower stage Tr3 is used as a buffer between the equalisation stage Tr1/Tr2 and the tone control stage Tr4. This reduces distortion since the high input impedance of the emitter follower minimises the loading (via the volume controls) on Tr2, and the low output impedance ensures a constant-voltage drive to the varying load presented by the tone controls.

### Tone Controls

Although the Baxandall tone control circuit, with its familiar bass and treble boost and cut characteristic shown in Fig. 9, is used with minor variation in almost all modern high fidelity equipment, its operation is seldom explained and is not obvious. It is best

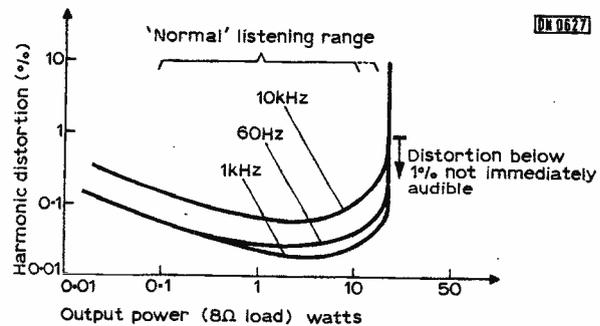


Fig. 7: Distortion curves for Sanken SI-1020A amplifier module, taken from manufacturer's data sheet

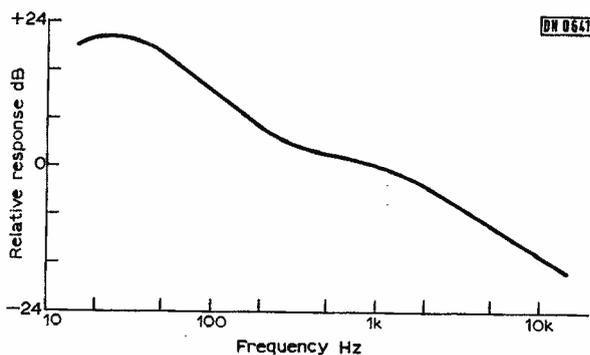


Fig. 8: On modern L.P. recordings high frequencies are boosted to a standard (RIAA) specification to overcome surface noise. The output of a magnetic pickup must be passed through a preamplifier whose response shown above is a mirror image of the recording response i.e. boost at low frequencies, to regain the original sound.

understood by separately considering how the circuit appears at high and low frequencies.

Resistors present the same impedance to signals of all frequencies whereas the impedance of capacitors decreases with rising frequency. Hence at very high frequencies C9/C10/C11 are virtually short circuits and the circuit reduces to Fig. 10a. Conversely at very low frequencies the same capacitors are virtually open circuits and the circuit reduces to Fig. 10b. In both these simplified circuits the components which are ineffective are dotted.

Now both the simplified circuits are just elaborations of Fig. 10c in which a transistor base is fed from the slider of a potentiometer connected between input and output. Assuming the transistor itself has sufficiently high gain, the stage gain is  $R_b$  (which

simple relation is the root of all operational amplifier theory). This confirms what is fairly obvious, that the gain is high when the slider is at the input

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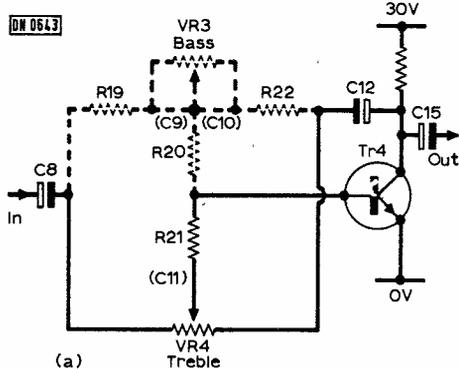


Fig. 10a: Active parts of tone control circuit at very high audio frequencies

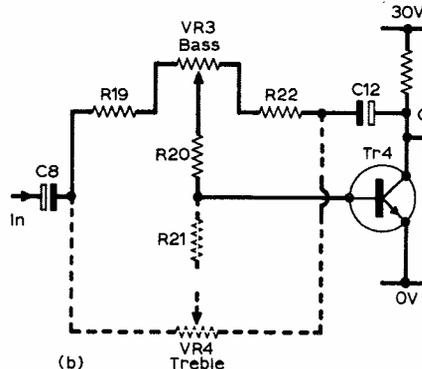


Fig. 10b: Active parts of tone control at very low audio frequencies

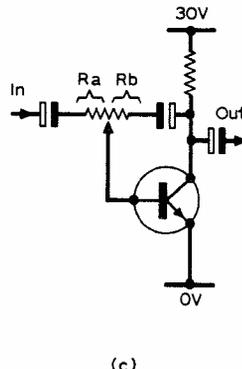


Fig. 10c: Simplified operation of both Figs 10a and 10b.

end of the track and drops as it moves to the right due to increasing negative feedback from the output. Thus in Figs. 10a and 10b the active potentiometer simply acts as a gain control at the frequency concerned while the dotted control has no effect. The arrows across the sliders indicate the direction of clockwise rotation and boost. At other than very high or low frequencies the assumptions made about the action of the capacitors become less true and it is only a matter of choosing component values to make the controls progressively effective over desired frequency ranges.

Figs. 10 do not show the base bias arrangement for Tr4 which is a bleed via R23/R24 from its collector with decoupling by C13 to prevent signal feedback by this route. Stability at all tone control settings is ensured by top-cut capacitor C14.

C12 prevents d.c. flowing in the tone controls and is large enough for its impedance to be negligible at all audio frequencies. It is normally connected to the junction of R25 and R26. It can alternatively be connected directly to Tr4 collector whereupon the range of the tone controls becomes wider than the specification since they have more negative feedback to "play" with. For normal listening however there is no need for great extremes of tone control.

The signal at Tr4 collector is taken to a spare pin on the edge connector in case a mono-stereo switch is required. This would just link pin 20 on the left and right preamplifiers for mono operation. But for

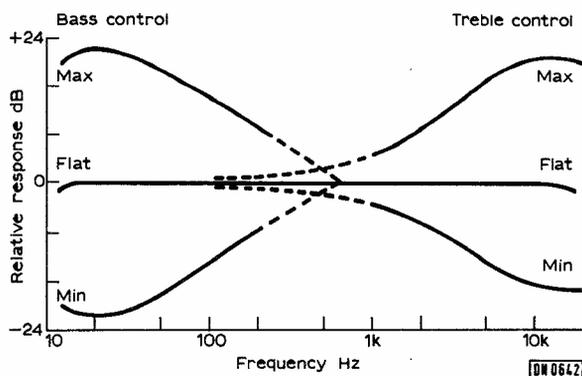


Fig. 9: Tone control response with C12 linked to NORMAL. Curves are dotted over mid-frequency range where both Bass and Treble controls have some effect.

record playing at least, where a mono record reproduces through both channels anyway, such a switch seems superfluous. If occasionally one wishes to feed an external mono signal (e.g. from an a.m. radio tuner) into both channels, this can be done by making up a suitable linking adaptor to plug into the auxiliary input sockets.

The left and right preamplifier outputs are taken from a resistor divider whose mid-point is the earthed slider of the Balance control. In anticipation that this preamplifier may be used with other power amplifiers there is provision in the board layout for an isolating capacitor at the output. This is not needed (though does no harm) with the Sanken amplifiers specified which contain their own input blocking capacitors.

## Power Amplifiers Z1, Z2

The Sanken SI-1020A monolithic power amplifier has already been described in "IC of the Month" and its internal (and inaccessible) circuit is the conventional quasi-complementary Class AB push-pull arrangement. The convenience of its packaging is far more remarkable since its metal case can be bolted directly to a heatsink without any electrical isolation. This i.c. was possibly overshadowed at its introduction by its 50 watt sister (SI-1050) but its excellent distortion claims are the reason for choosing it for the system.

Fig. 6 shows an unusual arrangement at the loudspeaker outputs which solves two problems common to high power push-pull amplifiers. Firstly one may inadvertently overload stereo headphones with resulting distress to ears and/or headphones. Secondly there is the familiar thump from each speaker when the amplifier is switched on, caused by the output capacitor (C19) charging through the speaker. This may or may not be damaging to the speakers but one is certainly better off without it. Accordingly the on/off switch S2 is arranged to pass through a HEADPHONES position between OFF and SPEAKERS. If it is switched through this intermediate position not too fast, C19 will have charged up via R30 and R31 before being connected to its speaker, so there will be no thump. These resistors also attenuate the headphone signal level to give a reasonable range of volume.

### Power Supply

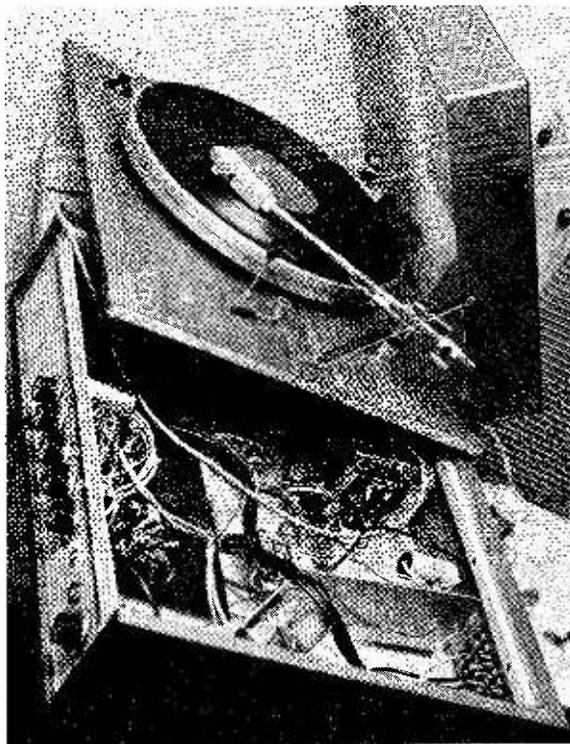
The simple unstabilised power supply in Fig. 6 delivers 45V via separate fuses FS1/FS2 to the power amplifiers, and a well smoothed common 30V supply to the preamplifier boards. The mains input is also fused. A reservoir capacity of 2000 $\mu$ F is required and can be made up from two 1000 $\mu$ F capacitors in parallel as shown (C17, C18) or a single component used if available. In either case the capacitor(s) should be good quality components intended for power supply use since there is a hefty 100Hz ripple current from the bridge rectifier D1-4. The current surge as the capacitors charge up at switch-on is limited to a safe value by R32 which should not be omitted.

The mains input is switched by S2a/b to the power supply transformer T1, the turntable (which has its own switch and pilot lamp) and to a neon pilot lamp on the front panel. C20 may be of some use in suppressing r.f. interference from the mains; it is most important that no suppressor capacitor is connected between mains live and the chassis since this would make exposed metal parts live if ever the mains earth connection were broken.

### Turntable, Arm and Pickup

The choice of these three can be left to the constructor since any good quality equipment can be used. Comparative judgments on magnetic cartridges especially are rather subjective.

The author's equipment illustrated uses a Connoisseur Craftsman turntable (very simply but soundly made), Goldring L75 pickup arm and Eagle LC07 moving magnet cartridge. The latter is a fairly recent Japanese product which the author regards as a "best buy" at about £7 since its performance on a test record is comparable to, say, a Goldring G800E at several pounds more. Tracking is at 1 $\frac{1}{2}$ gm, which can be set accurately on the Goldring arm without a gauge. Readers might well find the Connoisseur BD1 "do-it-yourself" turntable kit a good buy for the system. For economy one of the better BSR or Garrard players would give fair results but a cheap autochanger should certainly not be used since



Photograph shows inside of assembled plinth

the amount of wow and flutter would be unacceptable.

### Plinth Construction

The carpentry is straightforward, the cabinet being made up from five pieces of  $\frac{1}{2}$ in. chipboard fixed by countersunk screws to  $\frac{1}{2}$ in. square corner battens—see Fig. 11. A rectangular aperture is cut in the rear board for the rear panel. The turntable mounting board is cut out to suit the unit and arm chosen after having made sure everything will fit under the Goldring perspex lid. The space available here is about 17 $\frac{1}{4}$ in. wide  $\times$  13 $\frac{1}{2}$ in. deep  $\times$  2 $\frac{3}{4}$ in. high and it was only barely possible to fit in the author's units, the Craftsman turntable having to be positioned with the motor at rear left. It is not essential for the turntable board to be screwed down to the battens on which it rests, so there need be no screw heads visible after all exposed wood surfaces have been veneered. For access to the electronics the turntable board is simply lifted clear.

Two eyelet screws can be bent to serve as hinges for the rear of the perspex cover and screwed to the turntable board as shown in Fig. 11. A small wood wedge is glued to the board to support the prop-up arm which is part of the lid.

The front panel is an aluminium sheet cut as shown in Fig. 12a. A length of L-shaped aluminium girder is used to hold the two preamplifier edge connectors behind the front panel (or some other support can be arranged) and has tabs ready for

# ★ components list

**PLINTH**

**Resistors:**  
 All 10% 1W carbon unless otherwise specified

†R1 470kΩ	†R17 180kΩ
†R2 39kΩ	†R18 4.7kΩ
†R3 470kΩ	†R19 6.8kΩ
†R4 39kΩ	†R20 12kΩ
†R5 56kΩ	†R21 2.2kΩ
†R6 220kΩ 1W 5% high stability	†R22 6.8kΩ
†R7 680Ω	†R23 1MΩ
†R8 390kΩ 1W 5% high stability	†R24 1.2MΩ
†R9 15kΩ	†R25 5.0kΩ
†R10 1kΩ	†R26 1.2kΩ
†R11 62kΩ	†R27 820Ω
†R12 4.7kΩ	†R28 220Ω
†R13 68kΩ	†R29 1kΩ
†R14 22kΩ	†R30 82Ω 1W carbon
†R15 2.2kΩ	†R31 15Ω
†R16 129kΩ	R32 6.8Ω 5W wirewound
VR1 25kΩ + 25kΩ linear double-ganged carbon potentiometer	†R33 1MΩ
†VR2 100kΩ linear miniature skeleton preset potentiometer	
VR3 100kΩ + 100kΩ linear double-ganged carbon potentiometer	
VR4 5kΩ + 5kΩ linear double-ganged carbon potentiometer	
VR5 25kΩ linear carbon potentiometer	

**Capacitors:**

†C1 2μF 8V electrolytic
†C2 100μF 25V electrolytic
†C3 8μF 15V electrolytic
†C4 8μF 15V electrolytic
†C5 1.5nF ceramic or polyester
†C6 4.7nF ceramic or polyester
†C7 8μF 15V electrolytic
†C8 8μF 15V electrolytic
†C9 50 (or 47) nF ceramic
†C10 50 (or 47) nF ceramic
†C11 5 (or 4.7) nF ceramic or polyester
†C12 8μF 15V electrolytic
†C13 350nF ceramic or metallised film
†C14 47nF ceramic
†C15 12.5 (or 10) μF 25V electrolytic
C16 1000μF 30V electrolytic
C17 1000μF 50V electrolytic
C18 1000μF 50V electrolytic
†C19 2000μF 25V electrolytic
C20 0.1μF 500V paper tubular

**Semiconductors:**  
 1Tr1, 1Tr2, 1Tr3, 1Tr4 BC109  
 D1, D2, D3, D4 100 PIV 2A silicon diodes  
 Z1, Z2 Sanken SL1020A  
 (Photo Controls Ltd.,  
 Randalls Road,  
 Leatherhead, Surrey)  
 † indicates one needed for each channel.

**Switches:**  
 S1 4P 3W rotary S2 4P 3W rotary

**Fuses:**  
 FS1, FS2 1/4in. 1A (or 500MA—see text)  
 FS3 1/4in. 500MA  
 † fuseholders to suit

**Sockets:**  
 Stereo jack socket (Eagle SS34)  
 8 phono sockets (or 4 stereo pairs)

**Transformer:**  
 T1 Mains primary 200/250V a.c., secondary 30V-2A  
 e.g. Douglas MT3AT

**Miscellaneous:** Veroboard, 2 24-way Veroboard edge connectors (0.1in. pitch), knobs, mains pilot neon, screened cable, wood, aluminium, etc.

**ENCLOSURE (components for each channel)**

**Resistors:**  
 R1, R2, R3, R4 10kΩ 1W carbon (not wirewound)

**Switch:**  
 S1 2P 5W rotary

**Crossover:**  
 Eagle CN28 B12

**Woofer:**  
 Baker Major 30

**Tweeter:**  
 Eagle MHT10 B1

**Miscellaneous:** Hardboard, wood, sand, fret, fibre eggbox, carpet felt, knobs, screw terminals (2) aluminium panel, etc.

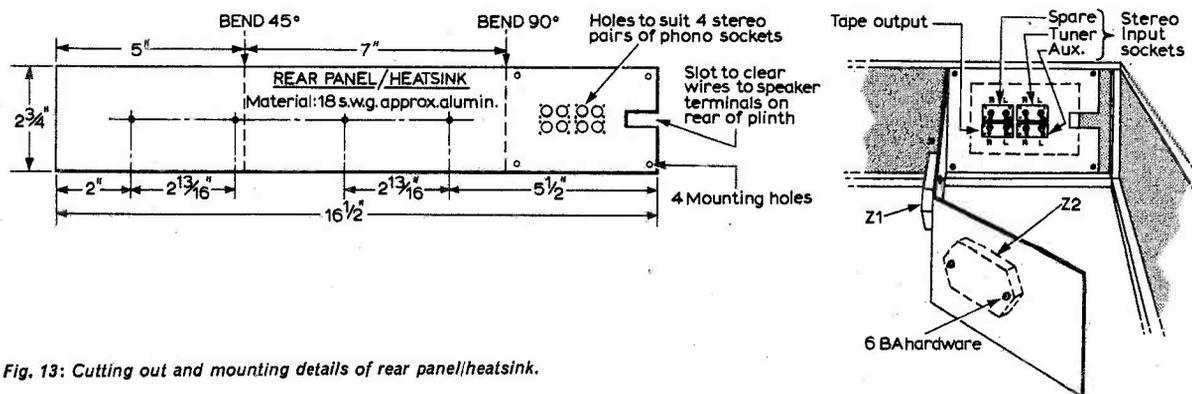


Fig. 13: Cutting out and mounting details of rear panel/heatsink.

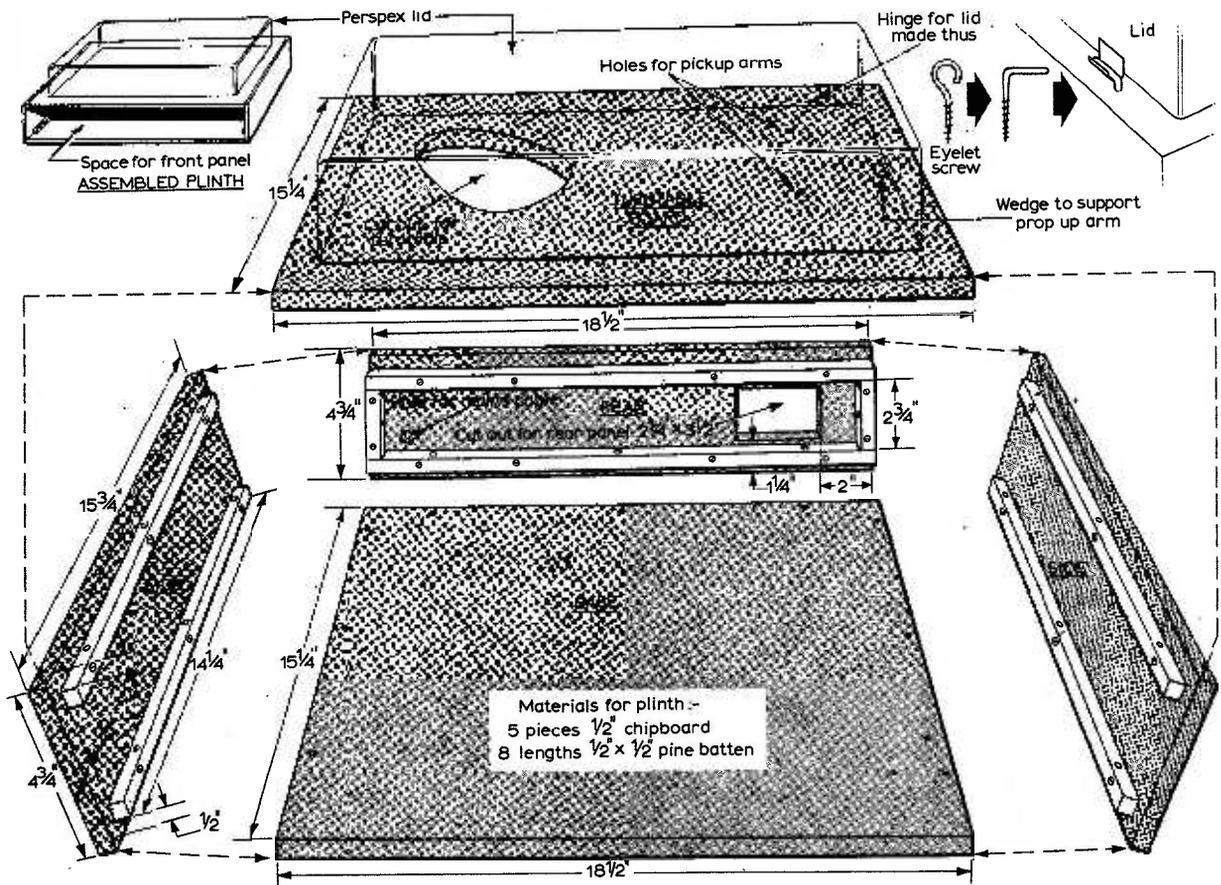


Fig. 11: Construction of plinth

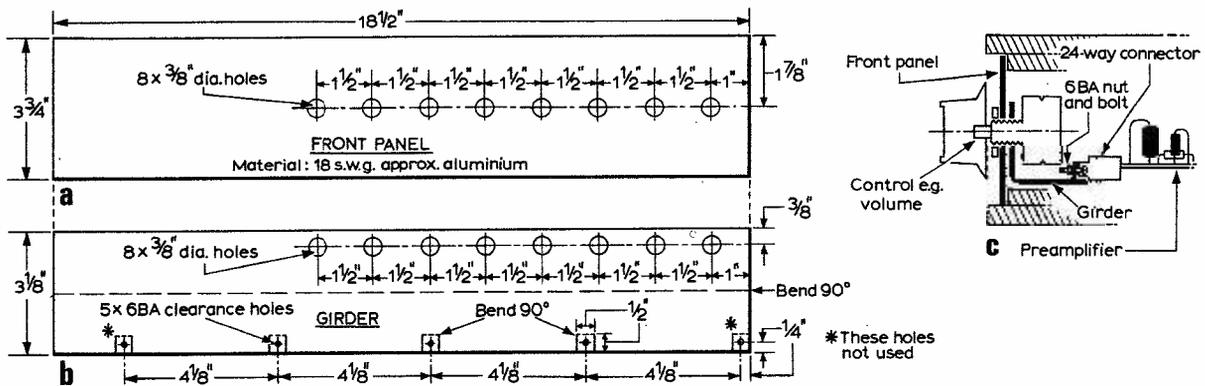


Fig. 12(a): Front panel (front view). Fig. 12(b): Girder. Fig. 12(c): Cross section of front panel and girder showing method of fixing connectors.

mounting two more edge connectors in case of future needs—see Fig. 12b and c. The girder is held to the front panel by the controls so no screw heads need show at the front. The front panel assembly should fit snugly enough in its slightly recessed position to need no fixing to the cabinet.

A second aluminium sheet forms the heatsink for Z1 and Z2 and also the rear panel carrying four stereo pairs of phono sockets—see Fig. 13. It is fixed to the cabinet by four screws from the inside. The amplifiers should be bolted tightly to the aluminium making sure they make contact over the whole of their bases. A thermally conductive grease can be used to improve the heat transfer but this is not essential for normal listening use.

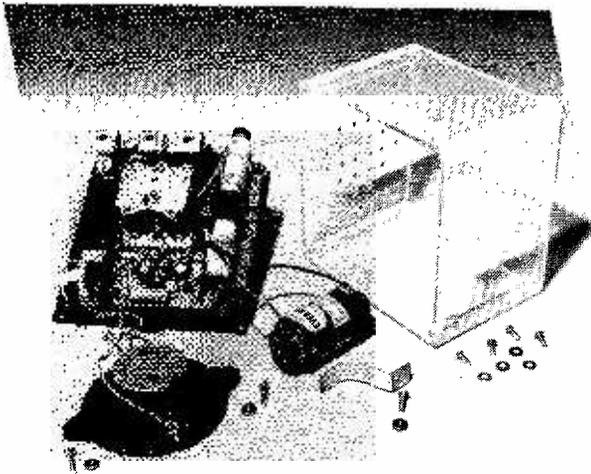
#### NOTE

On page 905 of the February issue, reference is made to strip "S in Fig. 1." This should have referred to Fig. 2.

To the materials list on page 907, the following should be added to the FRAME: 4 off 16 in.  $\times$   $\frac{7}{8}$  in.  $\times$   $\frac{7}{8}$  in. pine.

The construction details of the inner sheets on page 907 show screw holes in the vertical corner edges of the hardboard—these should be ignored. It would be impossible to use wood screws in this position and they are in fact unnecessary.

**TO BE CONTINUED**



# The **pw** Cube Radio

## 7 Transistor Superheterodyne

R.F. GR

**T**HIS is an attractive 7-transistor receiver of straightforward construction, tuning long and medium waves. The receiver is assembled as a complete working unit on a single piece of Vero-board (except for the loudspeaker) and actual building is simplified by using a small, ready-made audio amplifier module. Thus only the mixer and i.f. amplifier are built from separate components.

### CIRCUIT

Fig. 1 is the circuit, and a brief description should be helpful to beginners.

**Ferrite Aerial.** The ferrite rod has medium wave section L1 and long wave section L2. Switch S1 shorts out the l.w. section for m.w. reception. VC1 tunes the aerial together with trimmer TC1. Trimmer TC3 is for l.w. trimming. A coupling winding on L1 and tapping on L2 applies the signal to Tr1 base via C1. Tr1 is an OC44 mixer/oscillator.

**Oscillator Coil L3.** This is tuned by VC2, with

trimmer TC2. Capacitor C4 provides "tracking" so that the oscillator circuit always tunes 470kHz higher in frequency than the aerial circuit. With S1 in the l.w. position C3 and TC4 are across the oscillator winding for long wave reception.

**Intermediate Frequency Amplifier.** The 470kHz output of Tr1 passes to the first intermediate frequency transformer IFT1. Signals pass to the first i.f. amplifier Tr2 an AF117, then from IFT2 to Tr3, another AF117. The three IFTs are tuned to 470kHz by means of adjustable cores.

**Emitter Detector.** The OC71 Tr4 demodulates the output of IFT3 and amplified audio signals appear at the collector and are taken via C11 to the volume control VR1.

**Automatic Gain Control.** Strong signals increase Tr4 collector current causing an increased voltage drop across R10. The base potential of Tr2 thus becomes more positive, the change in voltage being applied via R6. As a result, amplification provided by Tr2 is reduced when strong signals are present,

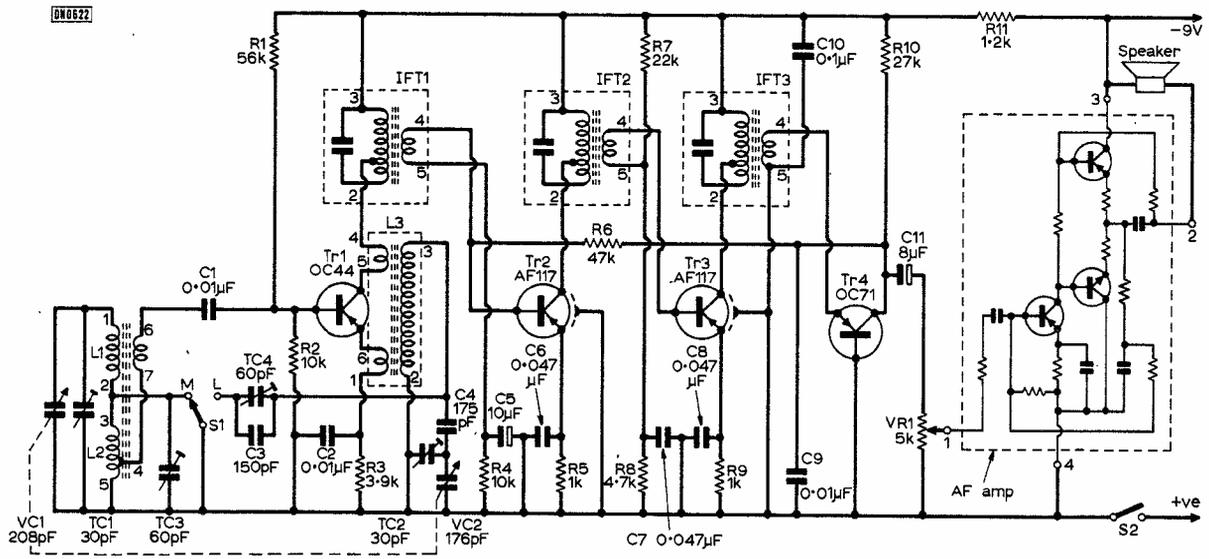
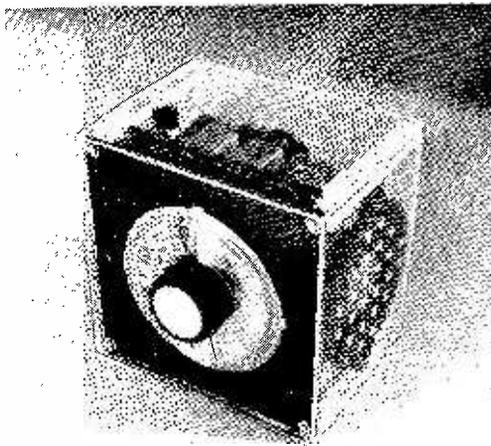


Fig. 1: Circuit of the Cube Radio. The audio amplifier is obtained as a module, the circuit being given here for reference purposes only.



and the output of the i.f. amplifier is relatively constant, despite changes in signal level.

**Audio Section.** The slider of VR1 is taken to pin 1 of the a.f. module which is a small separate unit, mounted on the receiver board, and having only four external connections. The module contains a driver/amplifier, followed by a pair of transistors in a complementary single-ended push-pull circuit. This drives a 40 ohm or similar miniature speaker, 2<sup>1</sup>/<sub>2</sub>in in diameter.

### CIRCUIT BOARD

The plain Veroboard is 3<sup>7</sup>/<sub>8</sub> × 3<sup>3</sup>/<sub>8</sub>in. to fit inside the 4 × 4in. case. It is cut to clear the corner strips and speaker as in Fig. 2.

Holes are drilled or enlarged to match the pins and screening can tags of L3 and the IFT's, noting that L3 will be fitted in the way which results in pins located as in Fig. 2.

Holes are also drilled for TC3 and TC4, the rod

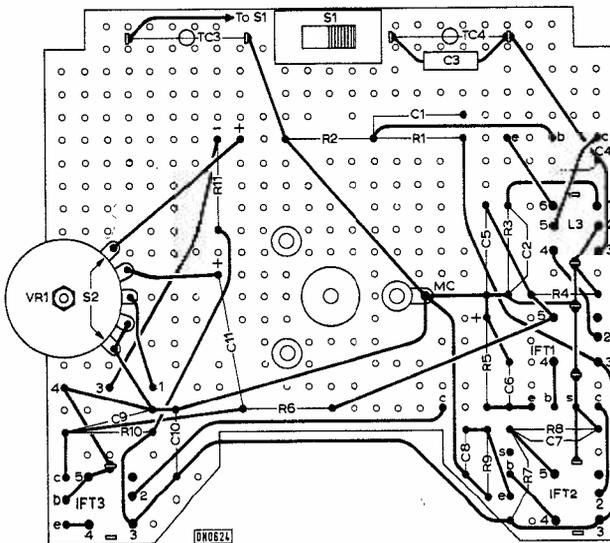


Fig. 2 : Wiring details of the underside of the Veroboard panel on which the receiver is constructed.

mounting and 6BA bolts holding the a.f. amplifier. A clearance hole is needed for VC1/2, and three holes which match up with the tapped holes in the front of the capacitor frame.

In many places resistor ends and other leads are soldered to Vero pins inserted in the board. These are most easily inserted with the correct tool, which resembles a small screwdriver with a hole, so that when a pin is pushed in it projects equally each side of the board. With Tr2, Tr3 and Tr4 it is more convenient to put the wire ends through the holes, anchoring only the collector of Tr3 at a pin.

When wiring is complete, the Veroboard is secured to a 4 × 4in. panel of 1/16in. black polished paxolin with about 7/16in. space between the two, to clear wiring, pins and VR1. VC1/2 is secured with 4BA bolts or studding which can project about 1/16in. on the capacitor side of the board. Longer bolts will damage the capacitor plates. Another way is to secure the capacitor with short bolts, with washers under their heads, if required. Panel and board are then drilled with matching holes to take three 6BA bolts. These are countersunk at the panel, and have extra lock nuts, so that panel and board will be held about 7/16in. apart. The positions of the bolts does not matter, provided they clear resistors, etc., since their heads will be covered by the metal dial.

### FERRITE AERIAL

As the ferrite rod normally supplied is too long for the case, it was snapped off at about 3<sup>1</sup>/<sub>2</sub>in. by securing it in a vice and giving the rod a sharp tap.

L1 is placed so that the base winding 6-7 is towards the middle of the rod. Thin sleeving was put on all leads. Lead 1, Fig. 3, goes to the larger section (front) of the capacitor, VC1/2. Lead 2 runs to the wavechange switch S1.

L2 is put on the rod so that its turns are in the same direction as those of L1, which can be seen by looking at the windings. If L2 is reversed, i.v. alignment is impossible, and the winding should be taken off the rod, turned round, and replaced. The

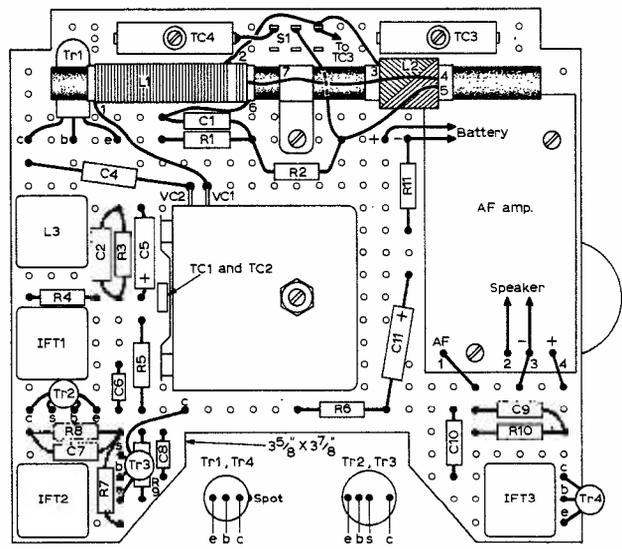


Fig. 3 : Topside of board showing location of the major components. Ensure that IFT's and L3 are correctly orientated to give pin positions shown in Fig. 2.

outer lead 3 of L2 joins lead 2 at the switch. The lead 5 taken to positive line must be that which is adjacent to tap 4, which is not at the centre of the winding.

Those lead ends which are single strand wire can be cut, if necessary, carefully scraped, and soldered. But the finely stranded (Litz) wire is difficult to deal with, so the ready tinned ends should be left. Excess length can be taken round the rod in the same direction as the winding.

The rod is mounted by means of a strip of plastic material clamped round it, with a 3/4 in. 6BA bolt and spacer, or extra nuts, so that it easily clears TC3, TC4, etc. It is as well to leave fitting of the rod until last.

## WIRING

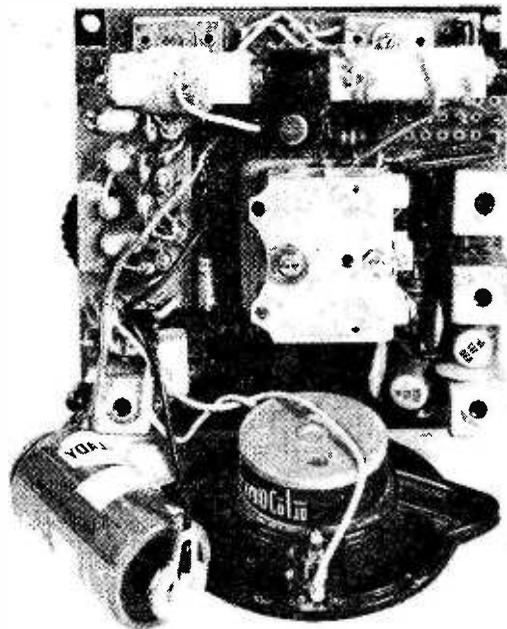
Switch S1 is mounted by passing its tags through holes in the board. The tag MC is securely held at one of the fixing screws of VC1/2.

Place transistors so that their leads come as in Fig. 3, with sleeving on the wires. Put suitable lengths of sleeving on the wires which project, bend these over, and solder to the IFT's etc. as in Fig. 2.

The screening can tags of the IFT's and L3 must be connected to the positive line, as in Fig. 2. It proves helpful to use red sleeving on this circuit, black on negative circuits, and some other colour on other wiring; 26s.w.g. or similar tinned copper wire and small sleeving will be convenient.

## ★ components list

<b>Resistors:</b>		
R1 56kΩ	R5 1kΩ	R9 1kΩ
R2 10kΩ	R6 47kΩ	R10 27kΩ
R3 3.9kΩ	R7 22kΩ	R11 1.2kΩ
R4 10kΩ	R8 4.7kΩ	
All 1/2W 10%		
VR1 5kΩ miniature pot. with switch (S2)		
<b>Capacitors</b>		
C1 0.01μF	C7 0.047μF	
C2 0.01μF	C8 0.047μF	
C3 150pF 2% SM	C9 0.01μF	
C4 175pF 2% SM	C10 0.1μF	
C5 10μF	C11 8μF	
C6 0.047μF		
Minimum working voltage, 9V		
TC1/2 part of VC1/2		
TC3 50pF compression trimmer		
TC4 50pF compression trimmer		
VC1/2 208 + 175pF, slow motion, with trimmers (Jackson)		
<b>Semiconductors</b>		
Tr1 OC44	Tr3 AF117	
Tr2 AF117	Tr4 OC71	
<b>Inductors</b>		
L1/2 Ferrite rod aerial (Denco MW/LW5FR)		
L3 Oscillator coil (Denco TOC1)		
IFT1 IF Transformer (Denco IFT13)		
IFT2 IF Transformer (Denco IFT13)		
IFT3 IF Transformer (Denco IFT14)		
<b>Miscellaneous</b>		
Switch S1, two-way slide switch. Audio amplifier 125mW (Newmarket PC1). Dial and knob (Home Radio DL64 and KN64). Plain veroboard 0.15in. matrix, 3 1/2 × 3 1/2 in. Speaker, 2 1/2 in. diameter, 30 to 80 ohms.		



A general view of the completed receiver. It may be tested and aligned in this form before finally fitting it into its case.

Volume control VR1 is fixed with a small bolt and connected as in Fig. 2. Solder the correct clips to red and black flex for the battery.

## AF AMPLIFIER

Connections shown in Fig. 3 are when looking at the amplifier from the components side. Thread thin wires down through the small holes, and solder to the foil below.

Mount the amplifier with bolts, using a few washers to avoid contact with the bolt holding VR1. Take lead 1 through the board to VR1 slider (centre tag). Twist leads 2 and 3 together, leaving these long enough to reach the speaker. Take a second lead 3 through the board to battery negative, Fig. 2. Lead 4 goes to the positive line.

Leads 2 and 3 should be soldered to the speaker so that the receiver can be tested before adding the panel.

## IF ALIGNMENT

Use a Denco TT5 or other correct tool for adjusting the IFT's and L3 since a screwdriver or wedge-shaped blade may easily break the cores.

If a signal generator is to hand, set it to 470kHz, connect it to C1, and adjust the IFT cores for best volume, keeping this low by reducing generator input.

If no generator is available, alignment may be made with any signal tuned in, following by more careful adjustment with a weak signal, if necessary. Do not use strong signals, with VR1 turned towards minimum volume, because the a.g.c. action tends to make adjustment of the cores seem flat with no sharp peak.

When IF alignment is finished, these cores need not be touched again.

## MW ALIGNMENT

The core of L3 has a considerable influence on band coverage. With S1 at m.w., tune in a station with VC1/2 near maximum capacity and move L1 on the rod for maximum. If dial readings are badly in error, rotate the core of L3, following the signal with VC1/2, to correct this and re-adjust L1 on the rod.

Move to the h.f. end of the band (VC1/2 nearly fully open) and set TC2 for a suitable dial indication, peaking TC1 for maximum volume.

These adjustments should be repeated a few times until no further improvement is obtained. If a generator is available use it at suitable frequencies instead of selecting actual stations.

## LW ALIGNMENT

With S1 at l.w., tune in any transmission, and move L2 on the rod for best volume. Subsequently, it will be found that oscillator coverage can be adjusted with TC4, so that the setting of TC4 and core position of L3 governs band coverage. Then TC3 is peaked for best results towards the h.f. end of the band, and L2 is moved on the rod at the l.f. end of the band.

If any slight adjustment is made to the core of L3, m.w. alignment will have to be repeated. Otherwise merely touch up m.w. adjustments, after completing l.w. alignment.

## CABINET

The cabinet is made of clear Perspex for its novelty effect. The bottom is 4×4in. and  $\frac{1}{8}$ in. thick while the sides are 4×3in. and  $\frac{1}{8}$ in. thick. Front and back are also  $\frac{1}{8}$ in. thick, but are  $4\frac{1}{8}$ ×3in. to overlap the sides. The front is drilled to take the speaker with a grid of holes over the cone area.

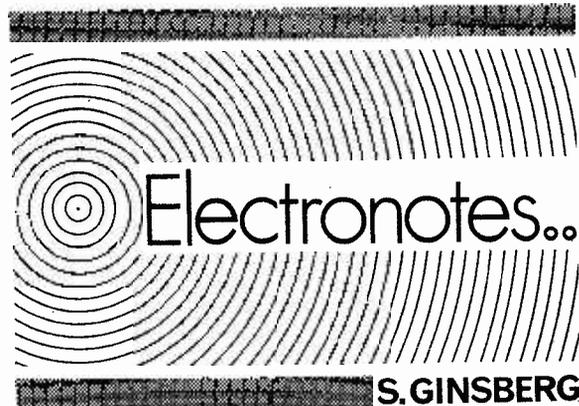
The pieces should be accurately cut and the edges smoothed with a file. After cementing together a strip  $\frac{1}{4}$ × $\frac{1}{4}$ in. and 2 $\frac{3}{4}$ in. long is cemented in each corner to strengthen the box. The strips were tapped 6BA at the top, to take four bolts which pass through the receiver panel, which is slightly inset in the case top. The Perspex could be drilled for self-tapping screws.

A clip is made and fixed to the case bottom with a countersunk bolt, to hold the battery. The speaker leads are long enough to allow the receiver to be lifted out leaving the speaker in the case. A slot is filed to clear the knob of the volume control. Another slot is required for the wave-change switch.

## DIAL

The dial listed has four metal lugs, which pass through slots in the panel. The slots can be made by drilling two or three small holes very closely together and finishing with a very small flat file.

The panel is fixed in the manner described earlier and the dial then put on the lugs being turned over behind the panel. The tuning indicator fitted was a disc of  $\frac{1}{8}$ in. Perspex, with a black line each side to travel over the m.w. and l.w. scales, and fixed to a brass bush which is locked on the capacitor spindle with a set-screw. A Perspex disc is readily cut with an adjustable tank cutter and the bush made by sawing through a  $\frac{1}{4}$ in. brass shaft coupling. An alternative is to use a stout wire pointer. ■



**H**AVE you ever thought just how those complex integrated circuits are made? These innocent looking little slabs of plastic with some 16 pins sticking out of the side are now common to most shops selling components for the constructor.

One of the most difficult parts of the whole process is aligning masks. A slice of silicon is taken and coated with a photoresist. A photographic mask is then laid carefully over the slice and an exposure made. The resultant image is transferred to the slice which, in turn is then taken for processing.

After this first processing, the slice is given the same treatment again; another coating and exposure, then further processing. There may be several printing exposures made during the manufacture of the slice which can quite easily contain thousands of individual tiny semiconductors.

As can be appreciated, because individual devices on the chip are so very very tiny, it is absolutely imperative that during the printing of the individual masks, these must be aligned very, very precisely.

A normal method is to have an operative peering at the chip and the relevant mask through a high powered microscope and the mask guided into position by the operative. While this is successful it does take time since, if the mask is not aligned accurately, several hundred integrated circuits on the slice may be ruined.

A British company has now developed a machine which will align the mask and chip automatically. The secret is the printing of two minute crosses between the pattern for the circuit required. These crosses have their members made up of shaded lines. The machine uses these to align subsequent masks to within 10 micro-inches. Circuit patterns down to 0.0001in. can be printed. The entire printing process from when the operative puts the new slice into the holder to the time it is ejected is only 25 seconds.

A further advantage of this British invention is that the masks are not in direct contact with the slice. Thus there is no abrasion on either slice or mask and the life of the masks, which are very expensive indeed to produce, is considerably prolonged.

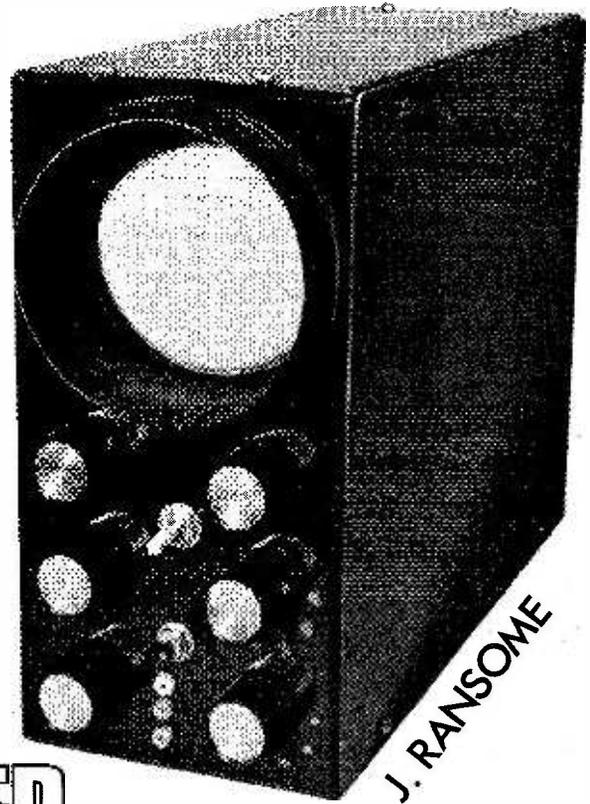
Once set up, the machine needs no further attention during the run. The slices are lifted automatically in and out of the photo-electric system by precision mechanical arms. The machine is also self-checking and will stop and/or throw up warning lights if anything goes wrong. For example, if there were no slice in the input receptacle the machine would stop. If a slice were to be damaged the machine would stop and flash a light.

Last month the first part of this article described the case, power supply, display units and initial testing. This second part concludes the article.

## DEFLECTION AMPLIFIERS

The next phase of the construction is concerned with the deflection amplifiers. Two of these are required, one each for the X and Y plates. The deflection sensitivity of the CRT used is such that about 100V peak-to-peak is required to give a full scan on the tube. Most cathode ray tubes require push-pull deflection to give a scan which is free from trapezium distortion. In order to give something extra in hand on scanning ability the push-pull deflection amplifiers have been designed to give 140V peak-to-peak scan.

The theoretical circuit of the deflection amplifiers is shown in Fig. 10. Tr3a acts as a phase splitter and low gain amplifier. Counterphase signals of equal amplitude appear across R15a and R16a. The only disadvantage of this type of phase splitter is that the two signals have differing source impedances. We therefore push the outputs from the phase splitters into the emitter followers of Tr4a and Tr6a which have a high impedance and are not fussy about signal source impedance. The emitter followers serve a further purpose of controlling the working points



# TRANSISTORISED

## PART 2

# OSCILLOSCOPE

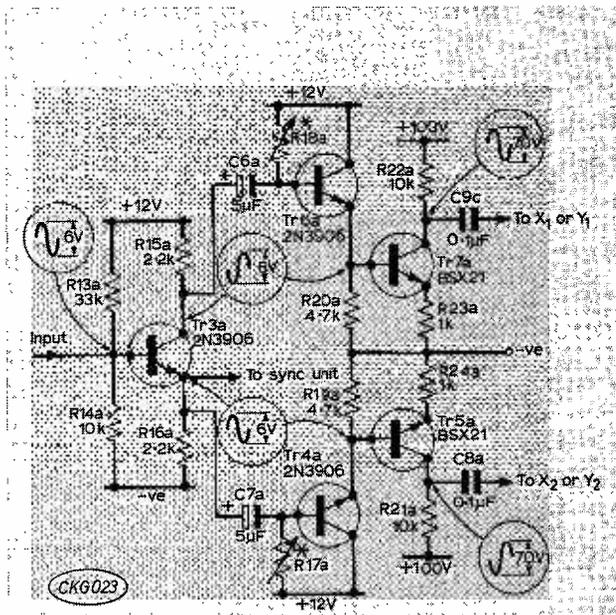


Fig. 10: Circuit of the deflection amplifiers—two are required, one for the X and one for the Y amp. See text regarding R17 and R18.

of the output transistors Tr5a and Tr7a by means of the standing currents in R19a and R20a. Tr5a and Tr7a are directly coupled to these emitter followers. The voltage gain of the complete amplifier is 12 when referred to a single ended output or 24 when referred to the push-pull output. As the transistors Tr4a and Tr6a control the working points of the output transistors they must be low leakage types. Suspect transistors must be avoided at all costs.

## CONSTRUCTION

The remaining units are built up on a 0.1in matrix Veroboard panel. The board used in the prototype was 6 $\frac{1}{2}$ in  $\times$  4in. It is recommended that at this stage all the breaks in the copper strip should be milled out before construction commences. This prevents disasters due to cross wiring as a result of forgetting a hole (here again the voice of experience speaks). The Veroboard layout, also including the Timebase and Y preamplifier, is shown in Fig. 13.

When using 0.1in matrix Veroboard, some care is necessary to avoid shorting out between conductor strips and when the wiring is complete, run a pen-knife along between the strips to make sure that no solder overlaps the conductors and that no small blobs of solder are shorting out any of the copper

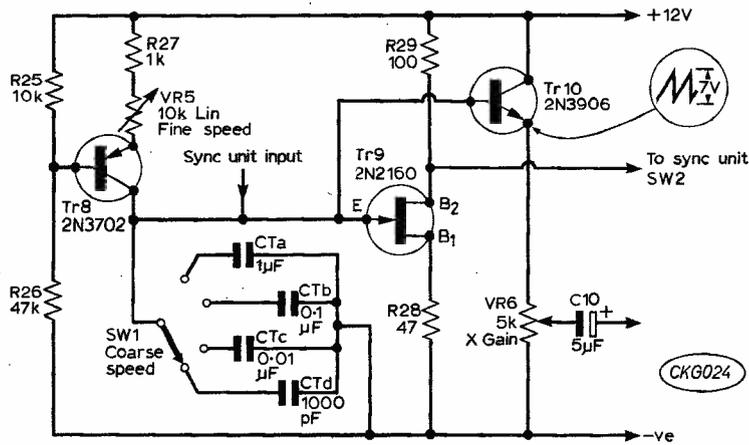


Fig. 11: The Timebase unit circuit.

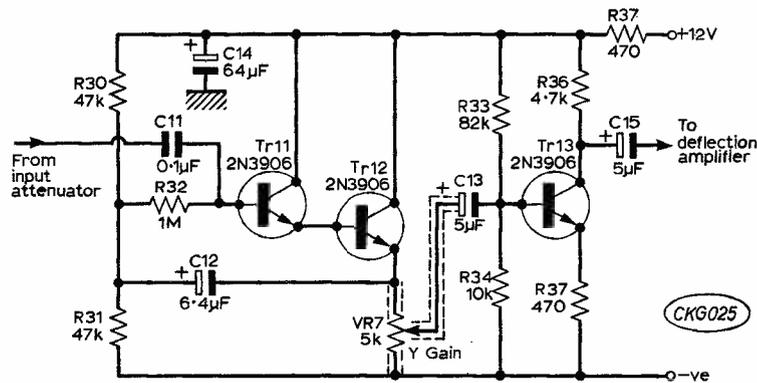
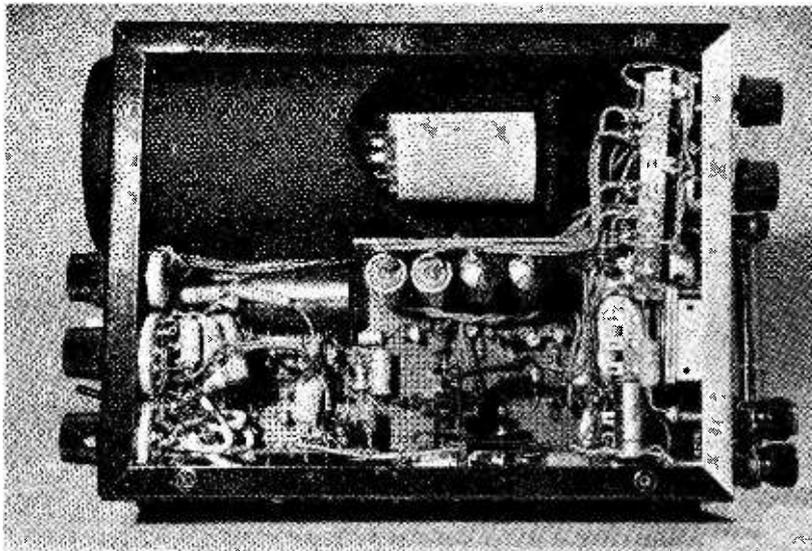


Fig. 12: The Y-preamp circuit. Note that the emitter resistor of Tr13 should be shown as R35, not as R37; the value shown is correct.



An internal view of the completed prototype. The main circuit board can be seen face on while C8 and C9 (a and b) can be seen mounted below the c.r.t. The sync unit is mounted on the base and cannot be seen.

strips. Wire in all the components with the exception of R17a and b and R18a and b when fixed resistors are preferred as their value must be determined empirically. Do not connect in the h.t. ends of the resistors R21a and b and R22a and b.

VR5 and R27. The output from the constant current source is used to charge the timing capacitor CT selected by SW1. The charge on the capacitor rises until the voltage on the capacitor is sufficient to cause the unijunction transistor Tr9 to fire. When

Connect the meter between R21a and the h.t. line and switch on. Only a very small leakage current should be indicated on the meter ( $250\mu\text{A}$  maximum). If the current is more than this, switch off and check the wiring. If the wiring looks satisfactory, check Tr4a for leakage. If all is well R17a may be wired in place and adjusted to give a standing current of  $4\text{mA}$  in the collector of Tr5a. For those wishing to use a fixed resistor for R17a the following procedure should be followed. Take a  $330\text{k}\Omega$  resistor and bridge between the base of Tr4(a) and the  $12\text{V}$  line. Note the current taken. If the current taken by Tr5a is more than  $4\text{mA}$ , increase the value of the bridging resistor until there is a standing current of  $4\text{mA}$  through the collector of Tr5a if the current is less than this figure—decrease the value of this resistor. Repeat the above procedure for R18a and Tr7a.

The construction and testing of the second deflection amplifier (b components) follows exactly that outlined above.

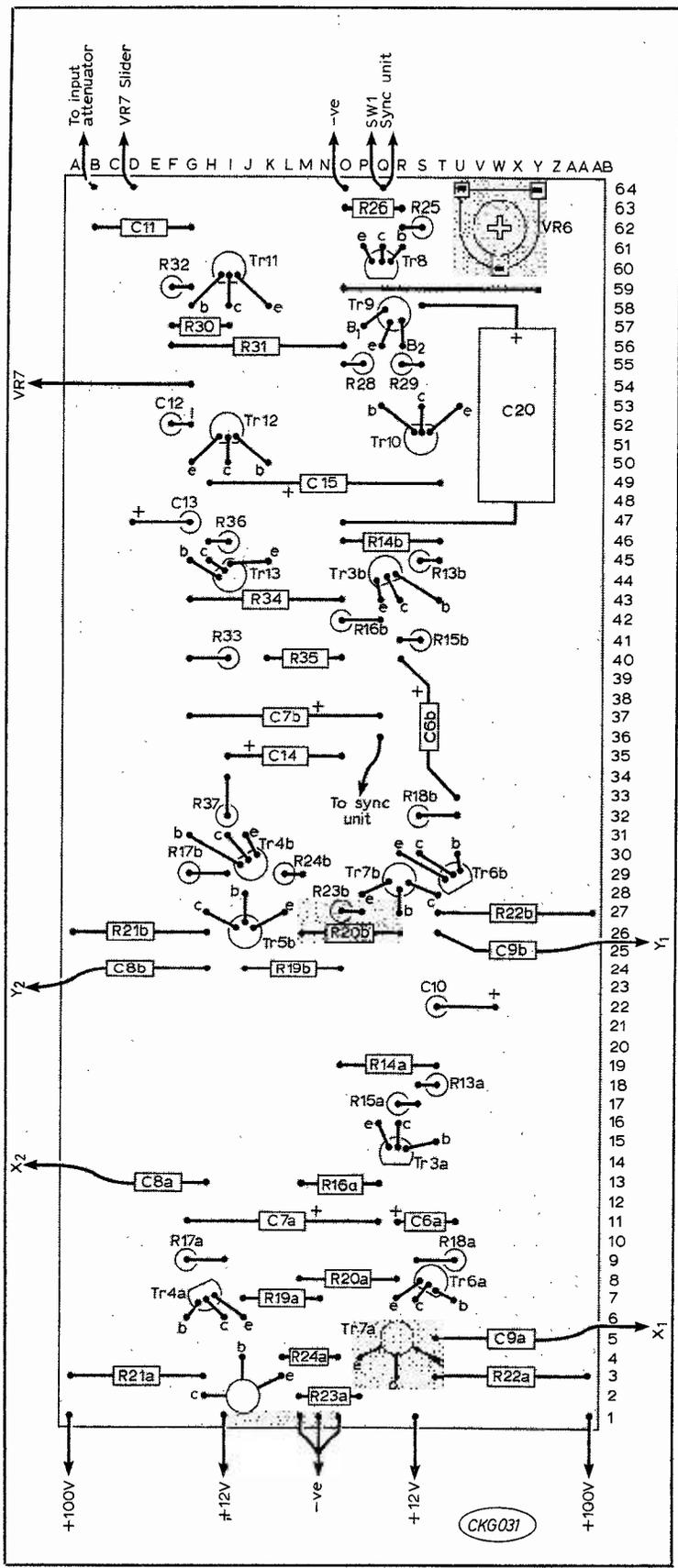
When all is satisfactory connect the output capacitors to the relevant input terminations on the display unit.

## TESTING

Switch on the complete unit and connect the low level signal to the X amplifier input. A horizontal line of approximately  $4\text{cm}$  long should be shown on the tube face. Next apply the signal to the Y amplifier input when a similar line in the vertical plane should be displayed. Next couple the X and Y inputs to the test unit via two  $0.1\mu\text{F}$  capacitors when a circle or ellipse similar in shape to that shown when testing the display unit should be seen. Whatever shape is displayed it should be regular with no flats, ripples or waves in it. Any distortions which do occur will almost certainly be due to incorrect selection of the bias resistors R17a and b and R18a and b.

## TIMEBASE UNIT

The theoretical diagram of the ramp generator is shown in Fig. 11. Tr8 acts as a constant current source—the current being determined by the variable resistor



Tr9 fires it discharges the capacitor and the cycle repeats. The voltage across the capacitor takes the form of an almost pure saw-tooth waveform. Tr10 is employed as an emitter follower—serving to isolate the timing capacitor from the loading effects of the deflection amplifier. VR6 varies the voltage output and, therefore, the scan width. The main advantage of the circuit is that the amplitude of the output waveform is independent of operating frequency for all practical purposes.

Fig. 13 (left): The main component board. The deflection amplifiers are in the middle and at the bottom; the Y-preamp is top left and the Timebase top right.

### CONSTRUCTION

The scan generator is built on the same piece of Veroboard as the main deflection amplifiers and comprises the components on the top right-hand side of Fig. 13. SW1 and the frequency control resistor VR5 are mounted on the front chassis and flying leads taken back to the Veroboard. The timing capacitors CT are mounted around the course frequency control SW1. Note that Tr8 is a PNP type and is, therefore, connected upside-down in the circuit.

The timing capacitors CTa to CTd are the subject of individual choice but for general purpose audio work the values shown in Fig. 11 should suffice.

Having connected the timebase unit to the X amplifier switch the coarse speed control switch SW1 to select the 1 $\mu$ F capacitor. Connect the power supply and set VR6 to the top end (emitter end) of its travel. A horizontal line should now be traced across the screen. Adjust VR6 until the ends of the trace are just visible at each end of the tube. Some adjustment of the X shift control may be required. Apply a signal from the low level output of the test generator to the input of the Y amplifier. A sine-wave should now be displayed on the tube face. The number of waves seen will depend on the setting of the fine speed control VR5. It may be that the peaks of the sine-waves may disappear over the top and bottom of the tube—this is quite in order—the tops of the sine-waves should, however, not be flat. Any flattening of the trace is due to incorrect adjustment of the standing current in the Y amplifier output transistors.

The performance of the X amplifier may also be checked for correct biasing by applying the timebase output to the Y amplifier and the test signal to the X amplifier and following the above procedure.

## Y PREAMPLIFIER

The theoretical circuit of the Y pre-amplifier is shown in Fig. 12. Tr11 and Tr12 are employed as a bootstrapped amplifier. This configuration offers a very high input impedance (most desirable for an oscilloscope) but gives very little gain, as a consequence the bootstrapped amplifier is followed by the voltage amplifier of Tr13. The gain of the pre-amplifier is controlled by VR7 which is placed in the low impedance part of the circuit to minimise stray current pick-up in the connecting leads.

The input impedance of the original unit was measured as  $1.8M\Omega$  and the voltage gain 7.

## CONSTRUCTION

The pre-amplifier is built on the main Veroboard panel shown in Fig. 13. The components around Tr11 and Tr12 must have leads which are as short as possible as a precaution against pick-up of stray signals. Screened leads must be used for the connection to VR7 earthing the outer braid to the chassis line at one point only. If the leads of the input capacitor are longer than 10mm each these too should be screened.

## TESTING

This is probably the easiest circuit to test! Switch on the whole unit and apply a finger to the input capacitor C11. With a  $1\mu F$  capacitor switched in on the time base unit, a series of sine-waves will be displayed on the tube face (the amplitude of which may be varied by VR7). The input capacitor C11 should now be shorted to chassis—no vertical trace should be seen on the CRT face. If a trace can be seen then more attention must be paid to input screening. The area to concentrate on is the circuitry around Tr11 and Tr12.

## INPUT ATTENUATOR

The circuit of the input attenuator is shown in Fig. 14. The attenuation provides two decades of attenuation—10 and 100. As is the convention, the 100 stage is assigned the level 1 and the two other switch positions are referred to this and represent  $\times 10$  and  $\times 100$  gain. In the  $\times 1$  position the sensitivity is 20V/cm, 2V/cm in the  $\times 10$  and 200mV/cm in  $\times 100$  position.

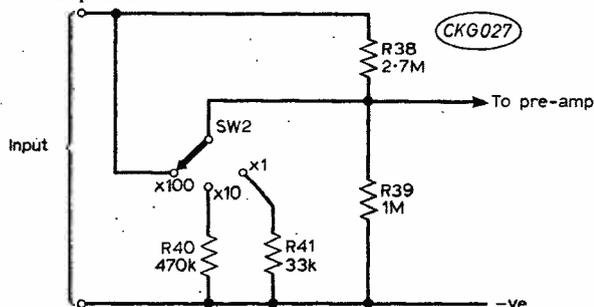


Fig. 14: The input attenuator circuit.

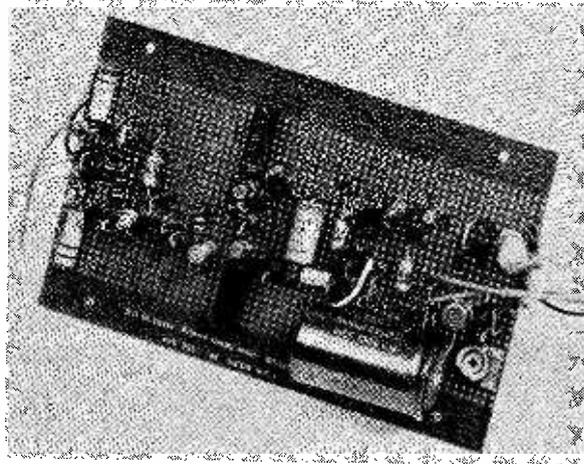
## CONSTRUCTION

All components are mounted on the switch. As the layout is absolutely straight forward and depends to a large extent on the components used, no wiring diagram is shown.

## SYNC CIRCUIT

The theoretical circuit of the sync unit is shown in Fig. 15. The function of the sync unit is to present a stable trace on the CRT screen. While this can be achieved by careful adjustment of the fine frequency control, the sync unit enables traces of waveforms of varying frequency to be displayed.

Tr17 acts as a switch and is effectively wired across



The main component board; compare this with Fig. 13.

the timing capacitor CT. When Tr17 is switched on, CT is shorted and cannot charge from the constant current source. As soon as the base of Tr17 is open circuited Tr17 then becomes effectively a high resistance across CT allowing CT to charge in the normal way. The resistance of Tr17 in the open circuit mode is sufficiently high not to affect the charge in CT.

Tr17 is switched by the bistable built around Tr15 and Tr16. Negative pulses applied to the base of Tr16 switch off Tr17. Negative pulses applied to Tr15 base switch Tr17 on.

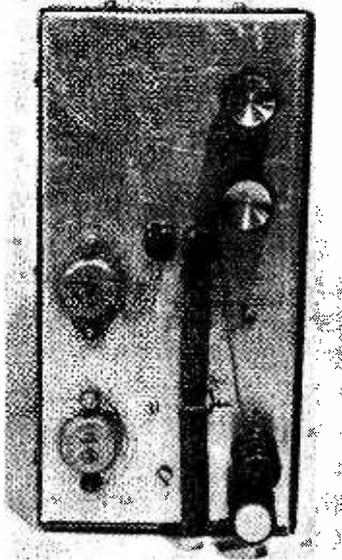
The operational sequence is as follows: as the unijunction Tr9 fires and discharges the timing capacitor CT, a negative pulse is developed across R29. This pulse is fed to the base of Tr15 and this switches Tr17 on—shorting out the timing capacitor CT. The timebase is now switched off and will not start again until a negative pulse is applied to the base of Tr16, thereby "opening the gate". These negative opening pulses are effectively the sync pulses and are derived from the Y amplifier circuit.

The sync pulses are derived from the Y amplifier by means of the squarer circuit around Tr14. Tr14 is an over-driven amplifier producing square waves from any sine-wave or square wave input. The square-wave produced across R42 is put into the differentiator circuit of C16 and R43. From the differentiator circuit two sets of pulses are produced—one set positive going and the other negative going. The positive pulses are rejected by D7 and only negative going pulses are applied to Tr15. It must be noted that the resistor R43 does not repre-



speed of the timebase on the higher ranges.

Using the calibrated Y input set the output of the multivibrator to 1V peak-to-peak and seal the output potentiometer VR301 and the timing resistor VR300. The calibrator may then be built into the oscilloscope unit if required. No constructional details are given of this simple circuit.



A rear view of the completed unit showing the resistors making up R12.

## GENERAL

As stated in the introduction, a wide range of transistors may be used in the circuit. With the exception of the deflection output transistors all the NPN transistors can be almost any type satisfying the following criteria:

- a Silicon construction (or low leakage germanium)
- b  $V_{\infty}$  greater than 15V
- c Dissipation greater than 250mW
- d Gain greater than 40

The PNP transistors must be of silicon construction as the circuits in which they are employed rely on the transistors having low leakage. Within this limit any silicon PNP working at a low voltage greater than 15V will be satisfactory.

The output transistors can be any type having a  $V_{\infty}$  greater than 120V and a gain greater than 20. ■

## Back Numbers

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

To ensure obtaining regular copies of these magazines readers are strongly urged to place a regular order with their local newsagent, or to take out an annual postal subscription.

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

# COMPREHENSIVE MULTIBAND RECEIVER

(PW Nov-Dec. 1971)

## FURTHER NOTES

By  
**F. G. RAYER**

On the short wave ranges, coverage is approximately 1.7-5.0MHz, 5-15MHz and 11-31MHz, similar to that provided with many receivers. As plug-in coils are used, it is easy to split up coverage to include one extra range. This opens out tuning a little, but its main advantage arises if a v.h.f. convertor requiring continuous tuning from 4-6MHz is added, as this then falls in a single range, avoiding coil-changing.

To add this range, adjust the coil cores for ranges of 1.6-3.8MHz, 7-14.5MHz and 13-31MHz. The new or additional range is 2.5-6.0MHz. The coils for this coverage are as follows:

**Aerial.** "Blue" Range 3. Remove 12 turns from the tuned section, and re-solder.

**Mixer.** "Yellow" Range 3. Modify as for aerial coil.

**Oscillator.** Use a "White" Range 3 oscillator coil, instead of the "Red" Range 3 oscillator coil, padder values and connections remaining unchanged.

Proper ganging will be obtained, after adjusting the aerial and mixer coil cores in the way described.

## TUNING METER

Space is available to the left of the tuning scales for a 42mm square S-Meter (1mA f.s.d.), and a suitable circuit is shown in Fig. 1. With aerial shorted to earth, VR1 is rotated until the S-Meter reads zero. When a signal is tuned in, the a.g.c. voltage reduces the i.f. stage cathode current through R1. Less voltage is dropped across R1, causing the negative terminal of the meter to become negative, so that a reading is produced. Sensitivity can be modified by changing the value of R2.

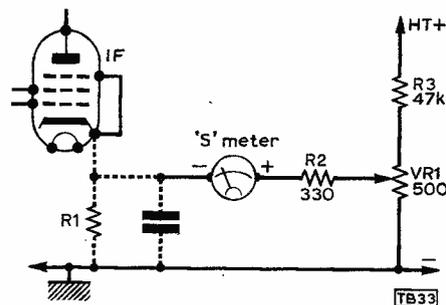
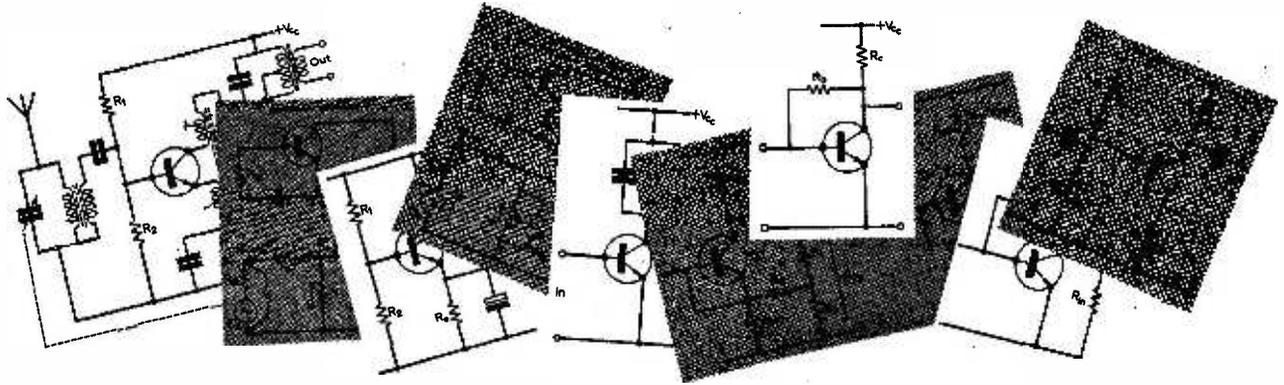


Fig. 1: Additional circuitry required for installing the S-meter

All trimming or other receiver adjustments are directed towards obtaining the highest meter reading. External improvements, as to the aerial-earth system, will also increase meter readings. ■



# TRANSISTOR CIRCUITRY for beginners

## PART 6

H.W. HELLYER & MICHAEL HOLLIER

### Upper and Lower-case

Those of you who are still with us, and old hands at transistor circuit building, may not need reminding; newcomers may wonder what the heck I am talking about; but recent correspondence reveals that it is necessary to recap on one vital point—the use of upper-case (capital) and lower-case (small) letters when we are discussing transistor parameters.

More than ever necessary when we ourselves are guilty of the cardinal error of using them wrongly. My excuse could easily be that I could not read Michael's scribble that accompanied the little module that we made the subject of Part 5. But I should have spotted that in the section headed "input Impedance", the second sentence of the second paragraph began . . . "H parameters again, but  $h_{ie}$  simply means. . . ."

That capital H should have been a small one, of course, and I should have rewritten the sentence so that it did not kick off with "H".

Later on, talking about the base bias, I committed a similar crime. "The base current  $I_B$  is found from

the formula  $I_B = \frac{I_C}{H_{FE}}$  where  $H_{FE}$  is the d.c. current gain of the transistor.

Our capitals are quite right on the suffix—FE refers to the d.c. current gain, certainly, while fe is the forward current gain with output shorted and in the common emitter mode. But the capital H is wrong. As you will have noted from the December 1971 issue, page 711, hybrid parameters have their own strict code of symbolism, and we use h, as in  $h_{ie}$  or  $h_{te}$  or  $h_{FE}$ , and so on. On another page, friend Henry, who is probably poking gentle fun at our floundering, would be quick to tell you that capital H means something quite different!

### Super Alpha

Back then to our subject, the Darlington Pair of transistors, or, to give them their alternative title, the Super Alpha circuit. Their purpose, to recap to the end of Part 5, to increase the input impedance of our buffer amplifier circuit, without despoiling any other of its good points. Remember, we pointed

out that good matching was more easily achieved if the impedance of the device into which the signal was being fed was ten times or more that of the output which was feeding it.

There is no cast-iron rule about this, but the generalisation needs stating, for, so often, manufacturers fail to agree with any known standard in stating their specifications, and 100k $\Omega$  might mean the input "wants to see" 100k $\Omega$ , and is actually considerably higher if measured, or might mean that it actually is 100k $\Omega$ .

Then, you see, if you try to match some circuits with 100k $\Omega$  output into this "specified" input, you simply would not get the conditions that the specifications might have led you to expect.

This is a practical problem, and I make no apology for introducing it at this point, for the Darlington circuit, on the face of it, looks like a complicated way of achieving what could be done much more simply. Not so, as we shall demonstrate by a step-by-step design exercise.

### Why high?

Accept, first of all, that we need a high impedance input. Harking back to the prototype that Mike built, we were able to measure 105k $\Omega$  input impedance on the built-up model, and could probably have improved somewhat on this with a bit of fiddling. But did you notice the underlined remark that followed? To summarise, frequency limits are affected by the source impedance.

There are occasions when we want to match something whose source impedance is (a) much higher than a tenth, or even a fifth, of our input impedance, or (b) alters drastically with frequency, i.e., is reactive. A perfect case in point is the crystal microphone. There are a lot of these about, and they are often capable of giving much better results than they do when matched into the tape recorders or "Disco" mixers with which they are sold. Don't always blame the microphone: if you don't believe me, ask Cosmocord Ltd., who market a wide range of these devices under the Acos label and get very hot under the collar when they think of some of the ways in which their products are used—or mis-used!

So, what are the limiting factors that prevent us achieving a higher input impedance, or, to be technical  $Z_{in}$ ? First, the forward current gain,  $h_{fe}$ . The larger this is, the greater the input resistance will be,  $h_{ie}$ . Check back with part 5 to see the significance of this and go on to  $r_e$ . This (often overlooked) internal resistance of the transistor itself matters a lot. Because it doesn't show up on circuit diagrams, the clever dicks who simply alter calculated circuits, like the well-engineered Mullard, Ferranti or Motorola published circuits, find their finished construction behaving in unpredictable ways. It is a fixed value. It cannot be altered, but, though small in relation to  $R_E$ , it has to be allowed for.

$R_E$ , the external resistance, seems to give us scope for manoeuvre. Increase this and, as we have seen, we increase the input impedance. Lovely—except that an increase in resistance here will mean an increase in the voltage dropped across the resistor, so we now need a higher supply. Even if this can be made available, it is not always desirable for input stages, where, in general, the higher the operating voltages, the more the noise problem rears its ugly head.

Base bias resistors also have to be considered. Remember, in Part 5, we were very concerned with their effect on the overall circuit. To put it into plain language, if you calculate them to get the best d.c. conditions, you may very well find your circuit unable to cope with the a.c. conditions or the matching—which, after all, is why the darned thing is being built!

If the values of base bias resistors are increased, we can reduce their shunting effect on the transistor input d.c. resistance ( $h_{ie}$ ). But under a.c. conditions, we may very well find the stability of the circuit seriously affected.

So, accepting that there are limits to what we can do in the way of altering components and voltages of a common emitter amplifier circuit in order to achieve a high input impedance, let's turn immediately to the solution, and see what, in fact, it does.

## Darlington Pair

There is nothing magical about the term Darlington. Without delving into the historical context, we are simply referring to a method of combining two transistors in such a way that they effectively form one, but with different characteristics.

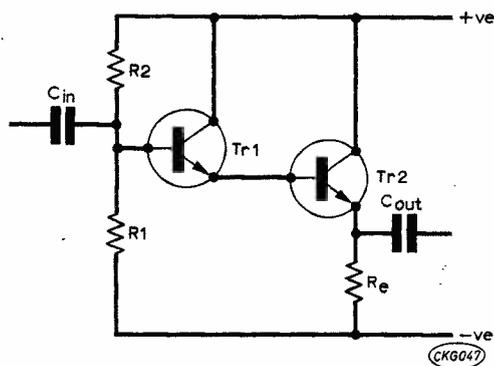


Fig. 26: The rudiments of the Darlington Pair circuit.

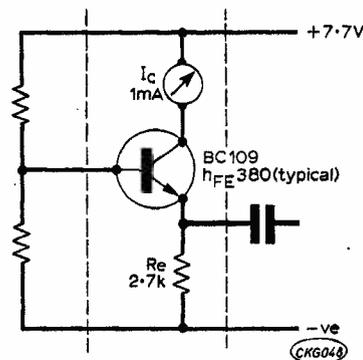


Fig. 27: Consider only Tr2, isolated from the rest of the circuit, with imaginary bias.

Take a look at Fig. 26, and you will see this done in the emitter follower mode. As I hope to show later, this is not the only configuration in which it applies, but it suits our purpose at the moment to rip it to bits and discuss the design.

If you want to make a buffer circuit yourself, with a high impedance output, then the following notes may help you adapt your own bits and pieces rather than have to mourn about "those lucky blokes at PW who can lay their hands on anything they want" as a recent correspondent said.

Fig. 26 shows two n.p.n. transistors, connected so that both collectors are taken to the positive rail, the input to the base of the first, Tr1, is biased in the way we have already seen, but whose emitter is taken to the base of Tr2. Looked at one way Tr2 forms the emitter load of Tr1; another way, Tr1 and its operating conditions, determine the base input conditions of Tr2.

Looking first at Tr2, and referring to Part 5, we see that the output is taken across  $R_E$ , the emitter resistor, via  $C_{out}$ , but the base bias, instead of being derived from two resistors (as with Tr1) depends on Tr1 and its operation. So let's pretend for a moment that Tr1 doesn't exist, and that Tr2 has conventional biasing, repeating last month's circuit, but with dotted lines to show that the BC109 between them is really the Tr2 of our present Fig. 26. We now have Fig. 27, where some values are inserted and a few more details are given.

## Calculations

Recapping again, we chose a typical transistor and typical operating conditions, so in Fig. 27 we state an  $I_c$  of 1mA, an  $h_{FE}$  of 380 and as the base current  $I_b$  is the former divided by the latter,

$$I_b = \frac{I_c}{h_{FE}} \text{ or } \frac{1\text{mA}}{380}$$

which is  $2.6\mu\text{A}$ .

If now we refer back to Fig. 26, and connect Tr1 in the base circuit of Tr2, making them similar transistors, as it happens, though they don't necessarily have to be, we shall see that base current of Tr2 will flow through Tr1 emitter, so we can immediately say that the emitter current of Tr1 is  $2.6\mu\text{A}$ .

Unfortunately—there's always a catch, isn't there?—at such a low current, almost all forms of transistor likely to be used in our buffer circuits

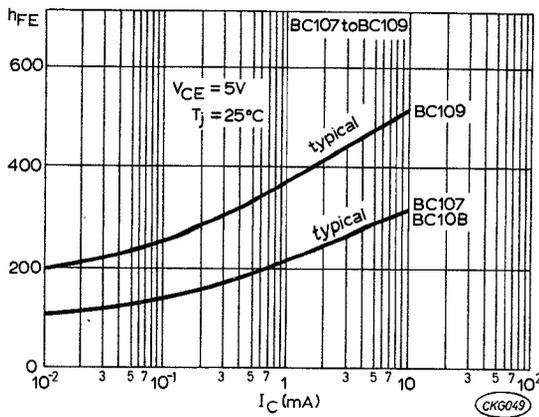


Fig. 28: Typical variations of forward current transfer ratio  $h_{FE}$  with collector current  $I_C$ . Note that curve is for specific collector voltage  $V_{CE}$ .

would have a very small a.c. current gain  $h_{fe}$  in these circumstances. Now do you see why I began with that upper-case and lower-case argument.

We must do something about this. Increasing the current in Tr1 is the obvious first thought, so we refer to the  $h_{FE}/I_C$  graph for the transistor in question.

Messrs Mullard, as ever, are immensely helpful, and can provide graphs that tell us practically everything except the Sign of the Zodiac when the transistor was born, so our Fig. 28. is a reproduction of their "typical variation of forward current transfer ratio with collector current". Please note, this is at a particular collector-emitter voltage, in this case  $V_{CE}=5V$ . But from this we can get some idea of what we want, and this is the sort of collector current it would be desirable to use. Here, we see the lowest usable value is down around  $10\mu A$ . We shall use a collector current of around  $50\mu A$ , and from the graph we can see that this will give us a d.c. current gain,  $h_{FE}$ , of somewhere around 260.

### Increasing $I_E$

We have  $2.6\mu A$  of emitter current so far, and we need  $50\mu A$ . Let's just revert to previous theory and stick in another resistor  $R_{e1}$  from the emitter of Tr1 to the negative line, as in Fig. 29. Now, this circuit is not for construction: it is deliberately

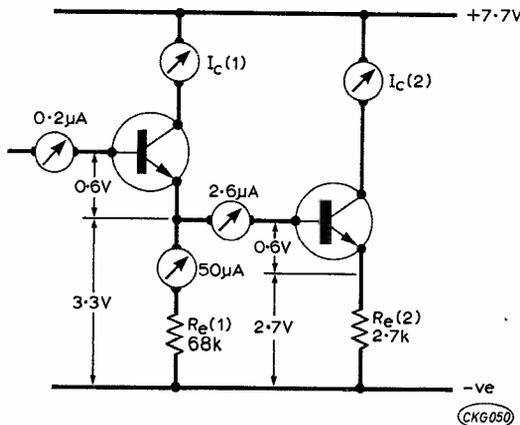


Fig. 29: The voltage and current plan of the simple circuit from which the final working model will evolve.

drawn to illustrate the design theory; please bear with me!

We have included the known voltages and currents, that is the collector current of Tr2, which is  $1mA$ , and the base current of Tr2, which is  $2.6\mu A$ . So the emitter current is effectively the same as the collector current, as the effect of the very small base current, which also flows through  $R_{e2}$ , can be ignored.  $1mA$  flowing through  $2.7k\Omega$  gives a voltage drop of  $2,700/1,000$  or  $2.7V$ . That's our emitter voltage of Tr2 fixed.

The base to emitter voltage of a silicon transistor is around  $0.6V$ , so we come up with a base voltage for Tr2 of  $2.7 + 0.6 = 3.3V$ . Take another look at Fig. 29. This is now the emitter voltage of Tr1, which was one of the missing factors. Again add  $0.6V$  and we get a figure for the base voltage of Tr1, i.e.,  $3.3 + 0.6 = 3.9V$ .

$R_{e1}$  is the mystery component. The emitter current of Tr1 will be the sum of that base current previously considered and the current flowing through  $R_{e1}$ . But we have already said that the required emitter current is to be  $50\mu A$ . So that leaves us with  $50 + 2.6$  or  $52.6\mu A$  as the actual emitter current.

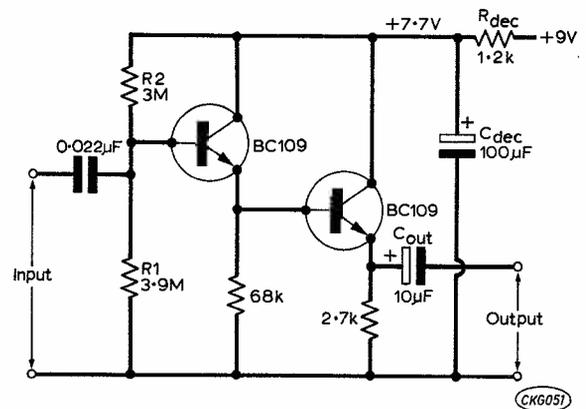


Fig. 30: The end result, a Darlington Pair input circuit with reasonably high impedance, good stability and the gain required.

The collector current  $I_C$  of Tr1 flows through  $R_{e1}$  and we know the emitter voltage. So  $R_{e1}$  the emitter resistor

$$= \frac{3.3V}{50\mu A} \quad \text{or} \quad \frac{3.3}{50 \times 10^{-6}} \quad \text{or} \quad \frac{3.3 \times 1,000,000}{50} = 66,000\Omega$$

Choosing components within a 5% tolerance range, we can settle for a preferred value of  $68k\Omega$ , and this is now marked in on Fig. 29.

### Base current Tr1

We now have the correct base current in Tr2 and the correct emitter current in Tr1 so can go on to calculate the values of bias resistor we shall need.

The base current of Tr1 will be its collector current (which we know) divided by  $h_{FE}$ , the d.c. current gain. But this base current is only a very small fraction of the emitter current, and can be ignored for the next calculation.

Taking the collector current  $I_C$  of Tr1 to be the same as its emitter current,  $52.6\mu A$ , we prove this point by saying:

$$I_{b(1)} = \frac{I_{c(1)}}{h_{FE(1)}} = \frac{52.6\mu A}{260}$$

somewhere near  $0.2\mu A$ .

Developing our final circuit, Fig. 30., and ignoring for the moment that I've already marked in the values of R1 and R2, let's calculate their ohmic values from what we already have. First, a proviso: for good stability, we want about five times as much current flowing in the bias chain as we have base current. So,  $0.2 \times 5 = 1\mu A$  as a guiding value.

We know the base voltage of Tr1 is 3.9V. The lower resistor, R1, has our desired figure of  $1\mu A$  through it, so the value is

$$R1 = \frac{3.9}{1 \times 10^{-6}} \text{ or } 3.9 \times 1,000,000 = 3.9M\Omega$$

This is a standard value, and a 5% tolerance component would be used.

R2 has a voltage dropped across it which is the difference between the collector voltage (in this case, the positive rail after decoupling) and the base voltage,  $= 7.7 - 3.9 = 3.8V$ . So

$$R2 = \frac{3.8}{1.2 \times 10^{-6}}$$

where the denominator in this case is the  $1\mu A$  flowing through R1 plus the  $0.2\mu A$  of base current.

$$R2 = \frac{38,000,000}{12} = 3,166k\Omega$$

A  $3M\Omega$  resistor, 5%, is near enough, and two  $1.5M\Omega$  resistors in series may be a more practical solution.

If you are in doubt about this tolerance business and having to make up values with series or parallel resistor combinations, bear in mind the simple rule: in series, variations in the biggest resistor have most effect—in parallel, variations in the smallest resistor have most effect.

## Input resistance

Looking into the base of Tr1, ignoring R1 and R2 for the moment, the input resistance is calculated from  $R_{in} = h_{fe(1)} \times h_{fe(2)} \times RE(2)$ . Approximately—because we now ignore those tricky hidden resistors,  $r_e$  of each transistor, which are now very small in comparison with the values of external  $R_e$  we have calculated.

Provided  $R_{e1}$  is many times larger than  $R_{e2}$ , its shunting effect on the input of Tr2 will be negligible. Make it between 5 and 30 times the value of  $R_{e2}$  and we shall not have many worries, so our  $R_{e1}$  is  $68k\Omega$ .

Harking back to the formula for  $R_{in}$ , we get the  $h_{fe}$  figures from the published data sheets ( $h_{fe}$  rising as collector current rises, remember), see Fig. 31.  $R_{in} = 240 \times 440 \times 2,700 = 285.12M\Omega$  to be exact.

The Stage Resistance is the parallel combination of this with R1 and R2, which is—work this one out from the formula

$$\frac{1}{R_{IN}} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R_{in}} = \frac{1}{3.9M\Omega} + \frac{1}{3M\Omega} + \frac{1}{285M\Omega}$$

approximately  $1.6M\Omega$

## Decoupling

Theory and practice never coincide, and the desired rail voltage may be quite a lot less than a convenient battery size. So we drop the residual voltage and decouple the line to prevent alternating signals modulating the battery resistance and causing the supply voltage to vary.

The components used are shown in Fig. 30. and are calculated from the voltage difference  $9V - 7.7V = 1.3V$  divided by the total current. This is the collector current of Tr1,  $0.05mA$ , of Tr2,  $1mA$  and in R2,  $0.0012mA$ , total  $1.0512mA$ .

We can take this as  $1mA$  through  $R_{dec}$ , giving  $1.3$

$1 \times 10^{-3}$  or  $1.3k\Omega$ . Again, using the nearest preferred value, within tolerance, we'll settle for  $1.2k\Omega$  at 5%.

The decoupling capacitor needs to be quite large, as we have already discussed, and a practical value is  $100\mu F$ . Similarly, a practical value of the output coupling capacitor,  $C_{out}$ , would be around  $10\mu F$ .

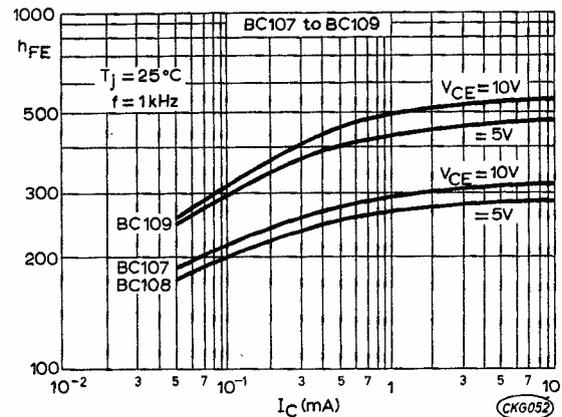


Fig. 31: Graph of variation of input impedance with collector current.

But  $C_{in}$  need not now be so large as we previously needed. The a.c. resistance (impedance) into which it is feeding is so much higher than before that a value such as  $0.022\mu F$  could be used. To check this, take the value that gives the same reactance to your desired lower frequency limit as does the input impedance of the circuit—i.e., the  $-6dB$  point (voltage). This works out to around  $4Hz$  for  $0.022\mu F$  which is plenty good enough for our purpose.

Before leaving the subject, I revert to that designation "Super Alpha". The term alpha, symbol  $\alpha$ , you will remember from previous notes is in our case the same as  $h_{fe}$ . As we obtained our  $R_{in}$  by multiplying the two  $h_{fe}$  figures, the effective  $h_{fe}$  of the Darlington Pair is called Super Alpha.

## Other uses

We have only been talking about input circuitry, and an impression may have been given that the Darlington pair is explicitly an input device. Not so, and just to prove it, but without any calculations, Fig. 32 shows four possible configurations of complementary push-pull output stages of audio amplifiers. These are stripped to their essentials, and have all been used in some form or another.

The use of the Darlington pair in power amplifiers

# THE Medium Wave Column

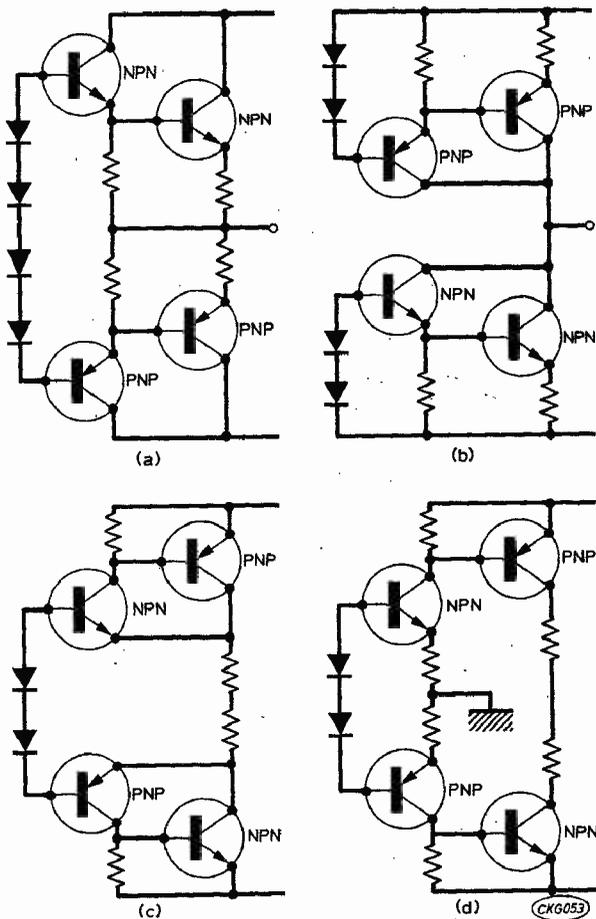


Fig. 32: Four variations of the Darlington Pair as used in push-pull output circuits of commercial power amplifiers.

overcomes (to some extent) a disadvantage of complementary symmetry, which is high current dissipation of a Class A driver transistor. Some other solutions exist, of course, such as quasi-complementary circuits, where the driving pair are "opposites" and the driven pair a matched and similar pair of transistors. This is not the place to talk about power amplifiers—a fascinating subject—but to illustrate the Darlington pair, so first to Fig. 32(a), where the two "halves" of the complementary circuit are formed from two pairs, much the same as we have already dealt with.

The drawback here is a biasing problem: base/emitter voltage at the point of conduction differs widely between driver and output transistor. Some bias adjustments are needed to supplement the work of the diodes.

Fig. 32(b) is an alternative, solving some problems, but really doing no more than turning the Darlington pairs upside down.

If we try, instead, the pair "inside out", we produce the cascaded complementary configuration of Fig. 32(c) where each set operates as an emitter follower. It is easier to provide bias because the diodes are more easily matched, but Fig. 32(d) shows the more usual solution, where we get the power gain of the two cascaded common emitters and a better bias system. But it has a drawback not always taken care of in eventual construction, and that is a more touchy thermal stability.

TO BE CONTINUED

F. E. WILDMAN of Southall, Middlesex has been busy with his Practical Wireless medium wave loop antenna. North American stations logged include WOR New York on 710kHz; CBM Montreal on 940kHz; WINS New York 1010kHz; CBA Moncton on 1070kHz; WBAL Baltimore 1090kHz; WNEW New York 1130kHz. He asks if medium wave DX is best during periods of anti-cyclonic weather. Although high pressure systems affect v.h.f. reception they appear to have no effect on the medium waves. Propagation on the lower frequencies is through the ionosphere which lies far above the thin shell of weather that surrounds the earth.

P. J. Kay who lives in Magull near Liverpool, reports reception of WNEW 1130kHz at 0030hrs on November 15th using a Perdio transistor portable. Very occasionally, high power North American medium wave stations such as WNEW, which is 50kW, are received in this country at considerable strength and can be heard from a favourable location on simple equipment. More reliable reception will be obtained by using a sensitive and selective receiver of communications standard along with an outdoor aerial or an indoor medium wave loop. Search before midnight for the following stations, all of which have been logged frequently during recent months. CBN St John's, Newfoundland on 640kHz; CJOX Grand Bank, Nfld and WOR New York, both on 710kHz; WDHN Boston on 850kHz; CJON St. John's 930kHz; CHER Sydney 950kHz; WINS New York 1010kHz; CBA Moncton 1070kHz; WNEW 1130kHz. These broadcasters are easy to identify as they use their callsigns frequently. After midnight look for Godhavn in Greenland on 650kHz. It can usually be heard with programmes in Danish or "Greenlandic", when reception from North America is favourable.

Harold Emblem of Mirfield, Yorkshire, reports reception of the new EAK5, Radio Popular Las Palmas in the Canary Islands on 836kHz. Michael Barraclough of Whitby mentions that this newcomer to the band is anxious for reception reports which should go to AP744, Las Palmas de Gran Canaria-1, Canary Islands. Harold has also logged the new outlet at Abu Dhabi in the Persian Gulf on 809kHz at 0230 hrs. Radio Pakistan has been heard testing on 1010kHz and has been logged by the writer at 2320hrs. This station is believed to be in West Pakistan.

Gordon Darling of South Harrow draws attention to a recent supplement to the Post Office Guide which says that Commonwealth Reply Coupons are no longer accepted in Canada, Australia, Ceylon, Trinidad and Tobago. In future, MW DXers sending reports to Canada will have to enclose an International Reply Coupon.

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

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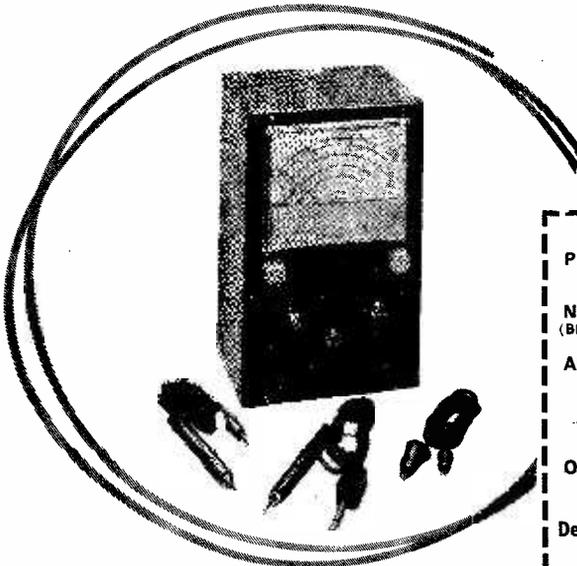
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# SHORT WAVES

## MONTHLY NEWS FOR DX LISTENERS

**N**OW that we have all recovered from the Festive Season we can get back to our shacks and start logging some DX. Many of you will have received new equipment as presents so how about putting it to good use and sending in a report.

### Logs

The first report this time comes from **Bryan Ewing** in Seven Kings, Ilford. Bryan's equipment consists of a Codar CR70A, an ATU and a 50 foot long-wire, his log included:—

6025 *Radio Portugal* at 2112.  
 6075 *R.A.I., Rome, Italy* at 0436.  
 6120 *S.B.C., Berne, Switzerland* at 0152.  
 6170 *Radio Sofia, Bulgaria* at 1900.  
 7105 *R.N.E., Spain* at 2030.  
 7230 *Radio Monte Carlo* at 1125.  
 7290 *Trans World Radio, Monaco* at 1525.  
 9460 *Radio Pakistan* at 2005.  
 9525 *All India Radio* at 2015.  
 9615 *H.C.J.B., Quito, Ecuador* at 0402.  
 9625 *Radio Sweden* at 1115.  
 9645 *Vatican Radio* at 2030.  
 9680 *Trans World Radio, Monaco* at 0925.  
 9710 *H.C.J.B., Quito, Ecuador* at 0146.  
 9912 *All India Radio* at 2015.  
 11710 *R.A.E., Argentina* at 2345.  
 11730 *R. Nederland, Bonaire* at 0200.  
 11750 *Finnish B.S.* at 1000.  
 11815 *Trans World Radio, Bonaire* at 0110.  
 11830 *Radio Havana, Cuba* at 0109.  
 11835 *R.T.V. Algerienne* in French at 2100.  
 11875 *R.S.A., South Africa* at 2347.  
 11895 *All India Radio* at 2330.  
 11955 *Voice of the Lebanon* at 0230.  
 15200 *Vatican Radio* at 1500.  
 15200 *Voice of Nigeria* at 0648.  
 15325 *Radio Canada* at 1520.  
 15410 *United Nations Radio* at 1700.  
 17820 *Radio Canada* at 0743.  
 17945 *Radio Pakistan* at 1345.  
 21545 *Radio Accra, Ghana* at 1445.  
 21590 *Radio Pakistan* at 0806.  
 (All these transmissions were in English except where otherwise stated.)

**Robin Yates** of Deganwy, Caernarvonshire heard the following stations on his Alba stereogram:—

5960 *H.C.J.B. Quito, Ecuador* at 0800.  
 5990 *Radio Canada* at 0715.  
 7310 *Radio Vilnius, Lithuania* at 2230.  
 9530 *All India Radio* at 1930.  
 9690 *WNYW, U.S.A.* at 2100.

## THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

9805 *Radio Cairo* at 2145.  
 11935 *FEBA, Seychelles* noted at 1730.  
 15130 *WNYW, U.S.A.* at 2000.  
 15155 *Radio Havana, Cuba* at 2010.  
 17720 *WINB, Red Lion* noted at 1930.  
 17855 *NHK, Japan* at 0800.

**Clive Jones** of Colliers Hatch near Epping describes his equipment as "a four valve domestic receiver with a looped, coiled and bent, untuned dipole!" This equipment enabled him to hear:—

6025 *Radio Portugal* in English at 2100.  
 9009 *Kol Israel* in English at 2120.  
 9480 *Radio Kiev, Ukraine* at 1950.  
 9545 *R. Accra, Ghana* in English at 2115.  
 9630 *R. Sweden, Saturday Show* at 1100.  
 9695 *R.S.A., South Africa* at 0040.  
 11720 *Radio Canada* in English at 2120.  
 11765 *Radio Australia* at 0900.  
 17880 *H.C.J.B., Quito, Ecuador* at 1915.

**Julian Moss** of Rayleigh has a Meridian 10 transistor superhet and a 60 foot long-wire enabling him to hear:—

5960 *H.C.J.B., Quito, Ecuador* at 0815.  
 6025 *R. Portugal, Voice of the West* at 2130.  
 7235 *R. Australia* in English at 1530.  
 9460 *R. Pakistan* with news at 2100.  
 9525 *R.S.A., South Africa, English* at 2245.  
 9530 *A.I.R., Delhi* in English at 1915.  
 9530 *V.O.A., Monrovia, sign-off* at 2230.  
 9545 *R. Accra, Ghana* in English at 2045.  
 9550 *Finnish B.S.* in English at 1830.  
 9570 *R. Australia* with DX News at 0735.  
 9575 *R.A.I., Rome* in Italian at 2130.  
 9620 *R. Belgrade, Yugoslavia* at 1550.  
 9625 *R. Sweden* in English at 1255.  
 9625 *Radio Canada* at 0720.  
 9670 *Damascus, Syria, news* in English at 2030.  
 9690 *WNYW, U.S.A.* at 2000.  
 9695 *R.S.A., South Africa* in English at 2215.  
 9745 *R. Baghdad, Iraq* in German at 2045.  
 11720 *Radio Canada* in English at 2120.  
 11765 *Radio Australia* in English at 0735.  
 11770 *A.F.R.T.S., football match* at 1950.  
 11790 *A.I.R., Delhi, news* in English at 2200.  
 11805 *VOA, Greenville, N. Carolina* at 1930.  
 11970 *R.S.A., South Africa news* in English at 2238.

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



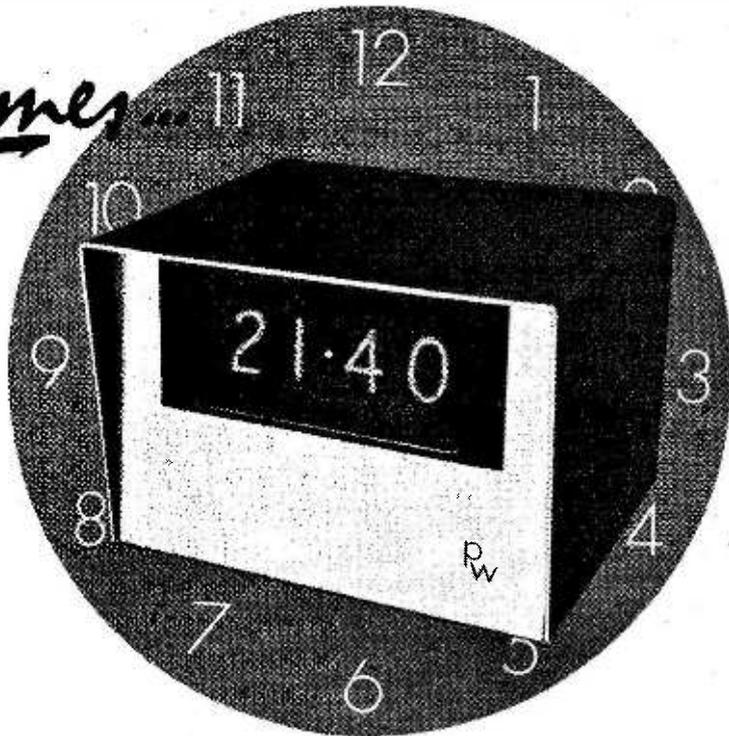
**IN NEXT MONTH'S**

**PRACTICAL  
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*Changing Times...*

# Digital Clock

Times certainly are changing. Eighteen months ago you would have been lucky to afford the components for a digital clock even if you could have found a supplier—but 1972 sees the dawning of a new age. While digital techniques become better known, prices continue to fall (about 50% last year). This digital clock is mains frequency operated and although it uses 12 i.c.'s (price at the time of writing 67p each) there is practically nothing else apart from the readout tubes. For the serious constructor now is the time to enter the digital field and how better than with a really practical project such as our digital clock.



## WIPER DELAY UNIT

"It never rains but it pours" is a saying that many car makers seem to take literally, forgetting that grizzle (not exactly an unknown phenomena in the British Isles!) causes poor visibility and is difficult to deal with using fixed speed wipers. This simple unit gives full speed control over the wipers using a few, inexpensive components.

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## TRANSISTOR TESTER

Although surplus transistors are excellent value, a small percentage are usually duds. The transistor tester to be described in the April issue has been specifically designed to sort these out. Both NPN and PNP devices can be tested and an unusual feature is that gain is directly read off, even though the meter used is of the cheapest type available. This is a thoroughly ingenious project for its simplicity—be sure not to miss it.



**ALL IN THE APRIL ISSUE  
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# SHORT WAVES

## THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz ● Times in GMT

**Q**UITE an easy month on the Amateur bands with not too many scribes sending in logs. I expect you're all still getting over the excitement of Christmas plus the novelty of the presents. Hands up all those who got a nice new receiver?

Some reporters have bemoaned the difficulties of learning to read c.w. signals and have asked if there is any "easy" way to pick up the morse code. If you own a tape recorder then you're half way there. All you need is some sort of morse key and buzzer (or better still an oscillator) and you can record your own morse. This will give you practice at sending and you can then play the tape back and practice reading also. Advantage is that you can send at just the right speed for your particular ability at receiving. Hint; use groups of mixed letters which don't make any sense, i.e., AMSZX, ATHQP, etc. This stops you anticipating the next character and makes sure that you really do "read" every symbol.

Another aid is the many slow morse transmissions which members of the R.S.G.B. put out specifically for those wishing to learn to read c.w. Topband is a favourite and since these stations are located all over the country there is almost certain to be a local station near you. In any case, you can see how many of the slow c.w. members you can log. There is some very good d.x. to be heard on c.w. On topband, for example, down very close to 1.8MHz you can often hear W stations. So get a copy of the code, learn it and start using your receiver to the full. Incidentally, you need a b.f.o. for c.w. reception and if you are one of the many who are just getting your feet wet on the amateur bands with a commercial broadcast-type receiver which happens to cover short waves but which doesn't have a b.f.o., then take a peep at the January 1972 issue of Practical Wireless. On page iii of the Experimenters Circuits Supplement you will find a very simple circuit for a b.f.o. which can be used in conjunction with most receivers. Check that your receiver has an i.f. of 465kHz or 1.6MHz otherwise you will need to change the i.f. transformer shown in the circuit. Incidentally, this external b.f.o. will also enable you resolve single sideband too.

If you kid yourself that you are already well proficient in the gentle art of reading c.w., try tuning in at 1900g.m.t. on the first Tuesday of each month. Listen on 3.520MHz for the G3BZU morse proficiency transmissions. These rattle merrily away at 20, 25, 30, 35, and 40 words per minute. If you get it all down 100 per cent correct and send it with 10p to the QRQ Manager, RNARS, H.M.S. Mercury, Leydene, Petersfield, Hants, you get a nice certificate which tells all and sundry what a super dot and dash sorter-outer you really are.

Another query which keeps cropping up in the mail is the one involving some poor s.w.l. who, while reading about beams and long wires, is stuck in a

room on the umpteenth floor of a "no aerials allowed" block of flats.

One idea is to build an a.t.u. (antenna tuning unit) and put a length of wire around the picture rail. Another sneaky (but effective) aerial is made by getting a length of enamelled copper wire, about 24 s.w.g., boring a hole in a small sorbo ball and pushing the end of the wire through and anchoring or tying it. You can now lower the ball out of the window and play out the wire. You've virtually got a vertical antenna and the good thing is that even with A1 vision, 24 s.w.g. enam. is invisible at more than a few feet. Idea of the rubber ball is to weight the wire and hold it down and also, if it's windy, the ball doesn't stove in someone's window 22 floors down. The idea of using some form of metal rod clipped to the window ledge will work but there is always the hazard that it will fall off and skewer some poor soul to the sidewalk—definitely not recommended!

Gibby's been chattering again and not getting on with the logs, but some questions in the mail come up again and again, so periodically it seems a good idea to answer these.

**Chris Kitchener** (Haverhill) has been swotting for O-levels and the R.A.E. (gd 1k OM). Time between "swots" brought signals from SV0WII, SM4DIT/MM, VK2YU, ZD3D, ZL3RB, 4X4SM, 8R1J, 9H1CU and 9J2JY all on a TR500SE receiver and PR30 pre-selector plus a tank whip at 36ft.

Interesting letter from **John Stevenson** (Woking) who has been playing with a solid state direct conversion receiver. This has two BC108's as a product detector fed from the aerial, BC108 b.f.o. and another three BC108's as an a.f. amplifier. Aerial is 50ft. end fed "wrapped round an oak tree." (Bet it brings in the signals a "Treet"). Preliminary peeps on 14MHz raised visions of CT1BT, IS1LID, IT9CLB, PY7EXY, UA3IQO, UB5AD, ZE1BP, 5Z4GK, 9H1GK.

**Howard Dearing** has dropped the s.w.l. prefix and now talks back signing G3XVX. Rig is a homebrew running 25W p.e.p. and 10W c.w. Receiver is a Hammerlund Super Pro with a homebrew topband converter using 3.1-3.3MHz as an i.f. Howard's log for 1.8MHz stations worked (I'm green already) reads: K2GNC, K8RNE, VE3EK, W1WQC, W2FD, W2IU, W2UEZ, W3GM, W4WFL/1, W4QCW, ZD8AY (Ascension Island) all on c.w. On s.s.b. the log reads: W1WQC, W1HGT, W2HCW. Antenna is an inverted L Marconi with 55ft. vertical section some 10ft. longer than an electrical quarter wave and tuned with a series capacitor. Earth system is a radial affair plus 12 buried copper pipes.

*Logs, in alphabetical order please, to arrive by the 15th of the month to:*

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AA130	10p	BD115	75p	OC16	50p	2N1803	18p
AA132	15p	BD123	85p	OC20	35p	2N1804	22p
AA213	10p	BD124	80p	OC22	50p	2N1805	22p
AA215	10p	BD131	75p	OC23	60p	2N1806	25p
AA217	10p	BD132	80p	OC24	60p	2N1807	25p
AC107	35p	BDY11	OC25	40p	2N1807	25p	
AC126	30p		OC26	25p	2N1808	25p	
AC127	25p	BDY17	OC28	60p	2N1809	25p	
AC128	20p		OC29	60p	2N1813	20p	
AC178	20p	BDY38	OC35	50p	2N2147	75p	
AC187	25p	BDY60	OC36	80p	2N2160	80p	
AC188	25p		OC42	40p	2N2217	25p	
AC188	25p		OC43	50p	2N2218	25p	
AC197	30p	BF116	OC44	15p	2N2218A		
AC198	25p	BF154	OC45	12p			
AC198	25p	BF158	OC70	12p	2N2219	20p	
AC199	20p	BF159	OC71	12p	2N2219A		
AC230	20p	BF180	OC72	20p			
AC232	10p	BF194	OC75	25p	2N2220	25p	
AC239	55p	BF195	OC76	25p	2N2221	20p	
AC240	55p	BF196	OC77	40p	2N2221A		
AF115	18p	BF197	OC81	20p			
AC244	25p	BFX13	OC81D	20p	2N2222	20p	
AD140	50p	BFX29	OC81Z	40p	2N2222A		
AD149	50p	BFX30	OC83	25p			
AD161	35p	BFX34	OC84	25p	2N2369	15p	
AD162	35p	BFX35	OC139	25p	2N2369A		
AF114	25p	BFX36	OC140	40p			
AF115	25p	BFX37	OC141	60p	2N2646	40p	
AF116	25p	BFX38	OC170	25p	2N2904	20p	
AF117	20p	BFY18	OC171	12p	2N2904A		
AF118	20p	BFY50	OC200	40p			
AF124	25p	BFY61	OC201	75p	2N2905	25p	
AF125	20p	BFY62	OC202	20p	2N2905A		
AF126	20p	BFY63	OC206	25p			
AF127	20p	BFY90	OC271	97p	2N2906	20p	
AF139	30p	B8X20	ORP12	50p	2N2906A		
AF180	50p	B8X21	ORP60	40p			
AF181	45p	B8Y27	ST140	15p	2N2907	25p	
AF186	50p	B8Y34	ST141	20p	2N2907A		
AF186	40p	B8Y35	TIP29A	50p			
AF239	40p	BU105	TIP30A	60p	2N2925	15p	
AS296	25p	BY100	TIP31A	60p	2N2920	10p	
AS297	30p	BY126	TIP32A	70p	2N3011	20p	
AS298	25p	BY124	TIP33A	20p	2N3053	20p	
AS299	30p	BY122	TIP33A	10p	2N3054	50p	
AS291	35p	BYZ10	TIP34A	10p	2N3055	75p	
BA100	15p	BYZ11		1.50			
BA102	30p	BYZ12	TS143	40p			
BA110	20p	BYZ13	TS160	12p	2N3614	55p	
BA115	7p	BZ778L	TS161	10p	2N3702	10p	
BA133	5p	GE1102	TS162	10p	2N3703	10p	
BA136	7p	GE1103	TS166	12p	2N3704	12p	
BA137	7p	GE1111	TS169	20p	2N3705	10p	
BA138	15p	GE1113	TS182	25p	2N3707	12p	
BC107	10p	GE1114	V405A	25p	2N3708	10p	
BC108	10p	GE1115	VR525	35p	2N3714		
BC109	10p	GE1116	W01	30p			
BC109C	12p	GE1117	W06	45p	2N3715	22p	
BC113	10p	GE1118	ZTX107	15p			
BC114	20p	GE1119	ZTX108	15p	2N3716	22-25	
BC115	20p	GM378A	ZTX109	15p			
BC116	20p	MAT101	ZTX300	12p	2N3771	22-25	
BC116A	25p	MAT101	ZTX301	15p			
BC117	20p	MAT121	ZTX302	20p	2N3772	22-25	
BC118	20p	MAT224	ZTX303	25p			
BC119	30p	MJ420	ZTX304	25p	2N3773	22-25	
BC134	20p	MJ421	ZTX500	15p			
BC135	15p	MJ2801	ZTX501	15p	2N3791	22-25	
BC136	20p		ZTX502	20p			
BC137	20p	MJ2901	ZTX503	17p	2N3818	35p	
BC138	20p		ZTX504	40p	2N3820	55p	
BC147	12p	MJE340	ZTX531	25p	2N3823	50p	
BC148	12p	MJE370	IN914	7p	2N3824	95p	
BC149	12p	MJE371	IN916	10p	2N3903	20p	
BC153	20p	MJE520	IN4148	7p	2N3906	25p	
BC154	20p	MJE521	IS44	7p	2N4088	12p	
BC167	15p	MJE525	IS221	7p	2N4081	12p	
BC169	12p		IS222	9p	2N4092	12p	
BC169C	15p	MJE3065	2G301	25p	2N4289	12p	
BC177	20p		2G302	30p	2N4280	12p	
BC178	20p		2G303	35p	2N4871	35p	
BC179	20p	MPSA56	2N404	20p	2N5457	30p	
BC1821	10p	MPSA101	2N696	15p	2N5458	35p	
BC1831	10p	MPSA106	2N697	15p	2N5459	40p	
BC1841	12p	MPSA107	2N698	30p	40250	50p	
BC212L	12p	NKT214	2N706	10p	40360	40p	
BC213L	12p	NKT216	2N708A	12p	40361	40p	
BC214L	15p	NKT403	2N708	15p	40362	50p	
BCY30	35p	NKT404	2N830	20p	40430	1.00	
BCY31	40p	OA15	2N987	40p	40543	65p	
BCY32	60p	OA10	2N1131	25p	40594	1.05	
BCY33	60p	OA47	2N1132	25p	40595	1.05	
BCY34	35p	OA70	2N1802	18p	40636	1.10	
BCY38	45p	OA79					
BCY39		OA81					
BCY40	1.00	OA90					
BCY40	1.00	OA91					
BCY70	15p	OA95					
BCY71	20p	OA200					
BCY72	15p	OA202					

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7401	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7402	Quad 2-input NOR gates	20p	18p	16p	14p	12p
7403	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7404	Hex inverter	20p	18p	16p	14p	12p
7405	Hex inverters with open collector outputs	20p	18p	16p	14p	12p
7410	Triple 3-input NAND gates	20p	18p	16p	14p	12p
7413	Dual 4-input Schmitt triggers	20p	18p	16p	14p	12p
7420	Dual 4-input NAND gates	20p	18p	16p	14p	12p
7430	Single 8-input NAND gates	20p	18p	16p	14p	12p
7440	Dual 4-input NAND buffer gates	20p	18p	16p	14p	12p
7441	BCD-Decimal decoder/Hex driver	75p	72p	70p	60p	55p
7442	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7443	Excess 3-Decimal decoder TTL outputs	1.00	95p	90p	80p	70p
7447	BCD-Decimal 7 seg. decoder/indicator driver	1.10	1.00	1.45	1.30	1.15
7448	BCD-Decimal 7 seg. decoder/indicator driver TTL O/P	1.10	1.00	1.45	1.30	1.15
7450	Expand dual 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7451	Dual 2-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7452	Quad 2-input expand AND-OR-INVERT gates	20p	18p	16p	14p	12p
7454	4-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7480	Dual 4-input expanders	20p	18p	16p	14p	12p
7470	Single J-K flip-flop (gated inputs)	30p	27p	25p	20p	18p
7472	Single J-K flip-flop (gated inputs)	30p	27p	25p	20p	18p
7473	Dual J-K flip-flop	40p	37p	35p	30p	28p
7474	Dual J-K flip-flop	40p	37p	35p	30p	28p
7475	Quadruple bistable latch	45p	42p	40p	35p	30p
7476	Dual J-K flip-flops with Preset and Clear	40p	37p	35p	30p	28p
7480	Gated Full Adder	80p	75p	70p	55p	50p
7481	16-bit read/write memory	1.25	1.15	1.10	1.00	90p
7482	2-bit binary Full Adder	1.00	90p	85p	80p	75p
7483	4-bit binary Full Adder	1.00	90p	85p	80p	75p
7484	16-bit RAM with gated write inputs	1.00	85p	80p	75p	71p
7486	Quadruple 2-input Exclusive OR gates	45p	41p	38p	35p	32p
7490	BCD decade counter	75p	70p	65p	60p	55p
7491	8-bit shift register	1.00	95p	90p	80p	75p
7492	Divide twelve counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	80p	75p	70p	65p	60p
7494	Dual entry 4-bit shift register	80p	75p	70p	65p	60p
7495	4-bit up-down shift register	80p	75p	70p	65p	60p
7496	5-bit parallel/serial in/out shift register	1.00	90p	85p	80p	75p
74100	8-bit bistable latch	2.00	1.80	1.75	1.50	1.40
74118	Hexuple Set-Reset latches	1.00	95p	90p	80p	75p
74121	Monostable multivibrators	80p	75p	70p	60p	55p
74141	BCD-Decimal decoder/Hex driver	1.00	95p	90p	80p	75p
74145	BCD-Decimal decoder (1-4-line) TTL O/P	1.00	95p	90p	80p	75p
74160	16-bit data selector/multiplexer	2.25	2.20	2.25	2.15	2.05
75151	8-bit data selector/multiplexer	1.10	95p	90p	80p	75p
74163	Dual 4-line to 1-line data selector/multiplexer	1.35	1.27	1.20	1.15	1.10
74154	16-bit decoder/demultiplexer	2.00	1.75	1.65	1.50	1.45
74155	Dual 2-line to 4-line decoder/demultiplexer	1.55	1.47	1.35	1.30	1.25
74156	Dual 2-line to 4-line decoder/demultiplexer	1.55	1.47	1.35	1.30	1.25
74190	Sync decade up-down counter, 1-line mode	1.95	1.85	1.75	1.60	1.50
74191	Sync 4-bit up-down counter, 1-line mode	1.95	1.85	1.75	1.60	1.50
74192	Sync decade up-down counter, 2-line mode	2.00	1.90	1.80	1.65	1.55
74193	Sync 4-bit up-down counter, 2-line mode	2.00	1.90	1.80	1.60	1.50
74196	Asynchronous presetable 4-bit binary counter	1.50	1.40	1.30	1.10	1.00
74197	Asynchronous presetable 4-bit binary counter	1.50	1.40	1.30	1.10	1.00

Complete data on the above in booklet 20 pages, Ref. 29, Issue 2 at 15p post paid.  
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BZY 88 series*	12p	10p	8p
14 watt			
ZL series	25p	25p	20p
3 watt			
3TZ series	30p	27p	25p
10 watt			
ZS series + 40p	37p	35p	30p

All types are 5%. Wire ended - these stand in voltages 3-300 volt in all standard voltages. \*3-33 volt.

**TRIACS**

Stud with accessories

P.I. Current	1-11
Type volts	
SC35A	100 3 amps 80p
SC35B	200 3 amps 85p
SC35D	400 3 amps 90p
SC40A	100 6 amps 90p
SC40B	200 6 amps 1.05
SC40D	400 6 amps 1.00
SC45A	100 10 amps 1.05
SC45B	200 10 amps 1.15

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# LETTERS... The Editor does not necessarily endorse the views expressed by correspondents

## Bottled-up

With regard to Mr. D. Smith's letter (January 1972 issue), I would like to point out to him that he most certainly is not the last of a "dying breed." Speaking as an ardent valve lover, I personally believe that the transistor will never completely overcome the valve, as if it does it would bring about the downfall of amateur radio as we know it. As for integrated circuits, they are beneath contempt and unworthy of further comment. So Mr. Smith is definitely not alone and does most decidedly have "relatives somewhere" as far as valve lovers are concerned—807's in particular.—**P. I. Martin** (*Sussex*).

\* \* \*

Having worked on several transistor radios which almost fall to pieces when you try to service them I can appreciate D. H. O. Smith's preference for valves.

However I am wondering if valve enthusiasts can take hope, for I notice that quite a number of instruments are using a device which in effect is a miniature valve and called a nuvistor. Is this the valve making a comeback? Having unsuccessfully tried to obtain some literature on these nuvistors I am wishing some day the editor will commission an article on these to lighten our darkness.

Until the happy day when valves return may we not lift any printed circuits with soldering irons or blow up half a dozen transistors when searching for one faulty one.—**K. Freeby** (*Plymouth*).

\* \* \*

I too suffer from being one of that dying breed. Mr. Smith has my complete sympathy. 99.9% of my equipment is fully "bottleized," including a 50 watt r.m.s. (sine wave drive) amplifier which has given no trouble for about 3 years. Everything I build with valves works first time and goes on working. Few people realize how easy and cheap valve

equipment is to make, and in my opinion valves are best for starting people off on electronics, because, electrically, they are infinitely more robust than transistors. To any other valve enthusiasts—please, please write to this column and make your existence known. Incidentally the 50 watt amplifier can be made for £30 complete.—**T. Watton** (*Hull*).

\* \* \*

I agree with D. H. O. Smith (Herts) "Dying Breed"—January '72. He is not alone in his support for the radio valve.

I do a fair amount of servicing of valve sets and I would support the valve against the transistor for tone and quality (except for the larger transistor sets which have larger loudspeakers, etc.—**J. F. Wade**, (*Leyland, Lancs*)).

## Cassette deck

With the advent of the tape cassette isn't it about time some manufacturers put onto the market a cassette deck.

By this I don't mean a recorder with pre-amps and record amps to be used with an external amplifier such as a Hi-Fi system. But strictly speaking a tape transport. Where the individual can build his own tape recorder as he would with a reel to reel machine. It is pleasing to see in *Practical Wireless* the building of recorders but there is an increasing lack of tape transporters, only one being advertised at the present time in this magazine.

For a variation one has to go to the upper price brackets such as Brenell and TRD decks. So come on manufacturers how about a tape transport for cassette tape-recorders.—**V. C. Watts** (*Bath, Somerset*).

## Join the club

I should be most grateful if some publicity could be given to our club through the medium of *Practical Wireless*. The club was formed early in 1970 and today,

with over a hundred members, has its own club rooms at 81 Virginia Street, Glasgow, Cl.

Meetings are held each Friday at 8 p.m., at which slow morse is given by GM3HLQ. Lectures by club members and the occasional film form the main subject material of our meetings.

On the premises we have our own club station, with call sign GM4AGG, which is active on the HF bands with a KW2000, 70MHz with a Pye Ranger, and 144MHz with an IC2F.

On December 10th we held our first annual dinner at which GM3AEL (Zonal Rep.) presented our club with the Scottish N.F.D. Trophy for 1971.—**Victor T. Budas**, GM3VTB, (*Hon. Sec. 28 Kelvin-side Gardens, Glasgow, N.W.*)

## Transformed!

May I reply to Mr. R. Wibberley's letter in the December issue in which he condemns modern methods of transformer winding.

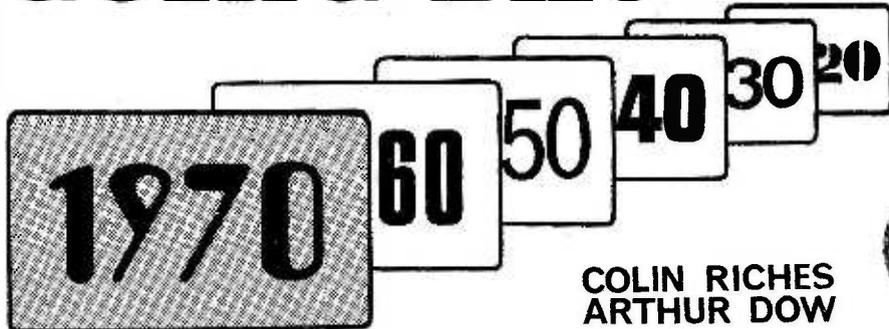
He states, "Enamelled wires are clearly inferior and unreliable. More so when wax impregnated." Correctly used, with the layers of wire separated with suitable insulation, enamelled windings are extremely hardy. Why else would they have become practically the standard material in low to medium power transformers? As a bonus, enamelled wire is cheaper and much less bulky than Mr. Wibberley's preferred silk-covered winding.

Mr. Wibberley also says, "Oil insulated windings are inferior, especially when mains voltages are used in primary windings." May I point out that National Grid transformers are completely immersed in oil for cooling purposes and these devices operate reliably at voltages between 11kV and 400kV.—**C. Wright** (*Northants*).

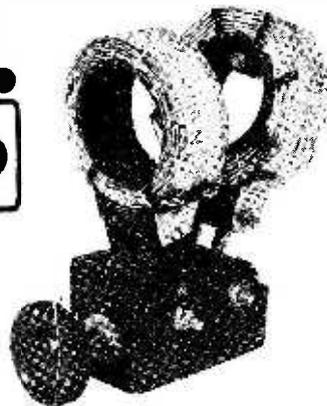
### DIARY DATE:

Paris Audio Festival  
March 9-14

# GOING BACK...



COLIN RICHES  
ARTHUR DOW



**V** P. MILLS, writing from 9 Fryars Bay, Beaumaris, Anglesey, Wales, says, "I possess a piece of ancient equipment owned by my father. It is a Sterling 2-valve upright cabinet receiver type BR2, instrument number 198 manufactured by Sterling Telephone and Electric Co. Ltd., London. Manufactured circa 1926 and using Marconi-Osram bright emitter valves types R5, red spot and green spot or alternatively type DER. The set is complete with Sterling headphones.

Unfortunately at some time the set was dismantled and whilst I have rescued the components concerned, I am devoid of the all important circuit diagram.

Recently I have been lucky enough to purchase another set found in an old workshop perched on a Welsh hillside. It is an exceptionally small receiver with valve holders and reaction coils located externally on top of the metal case. The set is titled "Polar Twin Receiving Set" (no Model No. or Serial No. given) and bearing a notice stating "Use with Mullard-Polar Valves".

Valves actually used are believed to be PM1 and PM1A. This set is also believed to date from 1925-6.

A very small S. G. Brown Hornspeaker was available, this has been restored and is now operational. There are a few loose ends within the receiver however which I think I can unravel.

I am particularly anxious to get these receivers

operational and Hamilton Radio who offer service sheets back to 1925 have not been able to help so I am writing in the hope that as a focal point of Veteran Radio you may be able to help or alternatively suggest a possible source of supply of relevant circuits.

I would also be very pleased to hear of any known source of supply of R5 or DER valves. Meanwhile keep the good work going, I hope to be able to join in shortly."

Mr. D. J. Lord, of 61 Empingham Road, Stamford, Lincs. tells us that although he was not around during the 20's and 30's, he has found the "Going Back" articles on the early days of radio most interesting.

On reading the article in last April's issue, he saw that Mr. F. C. Burgess has an old Marconiphone 2 valve set, which from his description must be very similar to the one that he has himself.

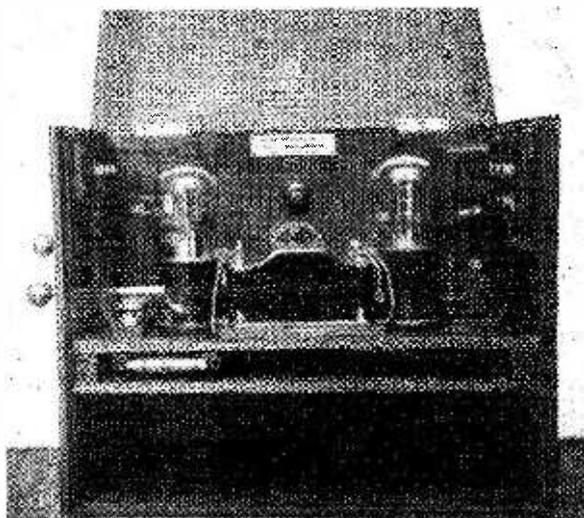
Mr. Lord enclosed a photograph of his set, the details of which are:—

Marconiphone V2A Long Range Model Type RB1B, Long Range Model M19, Inst. No. S/E 3926, G.P.O. Reg. No. 0175. Approved by the Postmaster Gen.

The set is still in working order, and is complete with a Marconi Distributor Unit for up to four pairs of headphones, and plug in coils and regenerator units covering the range 340-440m, 390-530m and 1300-1700m Long Wave.

The date of manufacture, or the original cost are not known, but he has always assumed that it was about 1923, and would be interested to learn the exact year if any reader can advise him. (We at P.W. would have said about 1924-1926)

He also has a copy of the BBC Hand Book for 1928, which contains an interesting selection of photographs and descriptions of the range of wireless sets available at that time, all of which appear to be of a considerably later design than his Marconiphone model.



Mr. D. J. Lord's receiver.

## Vintage CC

### BOOKS FOR DISPOSAL

...to sell: "More Practical Valve Circuits" by John Scott-Taggart, published in 1923. The first circuit is No. 68 and they go on to No. 151. Offers invited.—J. H. Greer, North Lodge, Great Ponton, Grantham, Lincolnshire.

...a three-volume copy of the Harmsworth's Wireless Encyclopedia and a bound copy of Wireless World for October 1923 to March 1924. I will sell to the highest bidder.—J. C. Porter, 15 Millais Gardens, Edgware, Middlesex.

...Harmsworth's Wireless Encyclopedia: three volumes with illustrations in good clean condition. Offers please.—C. Lesser, 7 Clippesby Close, Chessington, Surrey.

...a three-volume set of Harmsworth's Wireless Encyclopedia (1923).—Peter Thornhill, 5 Fourth Avenue, Scampton, Lincolnshire.

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

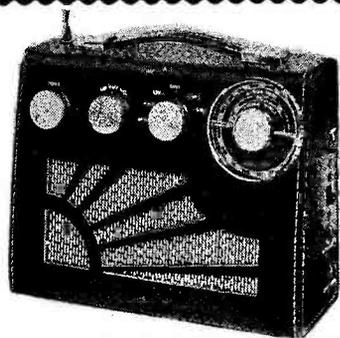
Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" x 2 1/2" Speaker. Air Spaced ganged Tuning Condenser with VLF 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 30p (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. 9 transistors plus 3 diodes. 8" x 2 1/2" 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).

Total building cost **£6-98** P. P. & Ins. 41p. (Overseas P. & P. £1)



## 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, including Micro-Alloy R.F. Transistors. 8" x 2 1/2" 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.

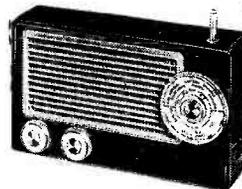
Total building costs **£5-98** P. P. & Ins. 41p. (Overseas P. & P. £1)



## 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 including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 6 1/2 x 2 1/2in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

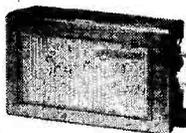
Total building costs **£3-98** P. P. & Ins. 26p. (Overseas P. & P. £1)



## 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 6 1/2 x 1 1/2 x 3 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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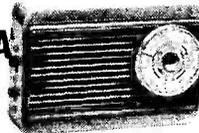


## TRANSONA FIVE

**NOW WITH 3in SPEAKER**

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stages—6 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone 3in. moving coil speaker. Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts Price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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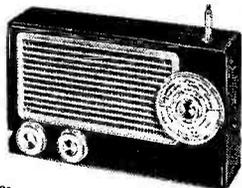


## TRANS EIGHT

**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 6 1/2 x 2 1/2in. 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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ROAMER EIGHT	<input type="checkbox"/>	TRANS EIGHT	<input type="checkbox"/>
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0A2	.30	6BZ6	.31	6SA7M	.35	12S77	.33	50L6GT	.45	EB34	.20	EL34	.44	KTW61	.33	PL38	.90	UCH42	.60	AC107	.15	BCY33	.30	OA390	.96	
0B2	.30	6CB6A	.38	6SC7GT	.33	12SK7	.24	85A2	.43	EB91	.10	EL35	1.00	KTW62	.33	PL81	.44	UCH81	.30	AC118	.25	BCY38	.23	OA292	.10	
0Z4	.25	6C4	.28	6SC7GT	.33	12SQ7GT		90C1	.59	EB41	.48	EL37	.74	KTW63	.50	PL81A	.48	UCH82	.33	AC127	.17	BCY39	.23	OA293	.10	
1A7GT	.33	6C9	.73	88H7	.33			50	150B2	.68	EB81	.29	EL41	.53	MHL66	.75	PL82	.30	UCH83	.43	AC128	.43	BF158	.29	OC23	.38
1B3GT	.35	6CD6G	1.06	68J7	.35	14H7	.48	807	.59	EB91	.28	EL42	.63	N78	2.05	PL83	.32	UF41	.50	AC154	.25	BF159	.25	OC24	.38	
1H5GT	.33	6CQ8A	.50	68K7GT	.23	14S7	.75	6702	.80	EBF80	.30	EL81	.50	N308	.95	PL84	.30	UF42	.60	AC156	.20	BF163	.20	OC25	.38	
1L4	.18	6CH6	.43	68Q7GT	.38	19A95	.24	3763	.50	EBF83	.38	EL83	.38	N329	.44	PL504/500		UF80	.35	AC157	.25	BF173	.38	OC26	.24	
1N5GT	.37	6CL6	.43	6V6G	.17	19B6G	.85	AC2/PEN		EBF89	.27	EL84	.22	P61	.44			UF85	.34	AC155	.25	BF181	.40	OC29	.68	
1R5	.26	6CM7	.50	6V6GT	.30	19G6	.50			EBL21	.60	EL85	.40	PAB60	.33	PL505	1.30	UF86	.65	AC166	.25	BF185	.40	OC35	.32	
1B4	.38	6CU6	.30	6X4	.50	20D4	1.05	AC2/PEN		EBL22	.60	EL86	.40	PAB60	.33	PL506	1.30	UF86	.65	AC168	.25	BF185	.40	OC35	.32	
1U4	.29	6CW4	.33	6X5GT	.25	20P2	.65	DD	.88	EB88	.59	EL91	.23	PC88	.47	PL509	1.30	UL41	.54	AC176	.55	BF194	.15	OC36	.43	
1U5	.48	6DE7	.50	7A7	.88	20L1	.98	AC6/PEN	.38	EC92	.34	EL93	.32	PC95	.53	PL802	.75	UL84	.31	AC177	.25	BFY50	.23	OC42	.63	
2D21	.85	6DT6A	.50	7B6	.68	20P1	.50	AC/PEN(7)		ECC32	1.50	EL96	.75	PC97	.36	PM84	.34	UM80	.38	AC177	.25	BFY51	.19	OC44	.10	
2CK5	.50	6EW6	.55	7B7	.32	20P3	.79			ECC33	1.50	EL96	.49	PC900	.32	PX4	1.16	UY41	.38	ACY18	.20	BFY52	.20	OC45	.11	
2A4	.25	6F1	.59	7C6	.30	20P4	.89	AC/TH1	.50	ECC40	.60	EM80	.38	PC984	.29	PX25	.96	UY85	.25	ACY19	.19	BY106	.18	OC70	.13	
3D6	.19	6F8	.68	7H7	.38	20P5	1.00	AC/TP	.98	ECC81	.18	EM81	.39	PC986	.26	PY33/2	.50	U10	.45	ACY20	.18	BY114	.18	OC71	.11	
3D4	.35	6F6G	.35	7R7	.45	25A9G	.29	AL80	.78	ECC82	.19	EM83	.75	PC988	.41	PY80	.33	U12/14	.38	ACY21	.19	BY126	.15	OC72	.11	
3Q5GT	.35	6F13	.38	7Z4	.50	25L6G	.20	ATP4	.13	ECC83	.22	EM84	.31	PC989	.45	PY81	.24	U13/20	.75	ACY22	.15	BY144	.18	OC73	.11	
3S4	.25	6F14	.42	9D7	.78	25Y3	.38	AZ1	.40	ECC84	.28	EM85	1.00	PC189	.48	PY82	.24	U19	1.73	ACY23	.18	BY127	.18	OC74	.23	
3V4	.32	6F18	.45	10C2	.49	25Y3G	.43	AZ31	.46	ECC85	.24	EM87	.35	PC189	.48	PY83	.26	U22	.39	AD140	.36	BYZ10	.25	OC75	.11	
4CB6	.50	6F23	.68	10D7	.50	25Z4G	.28	AZ41	.58	ECC86	.40	EY61	.38	PC182	.30	PY86	.32	U25	.64	AD149	.50	BYZ11	.25	OC76	.15	
5CG8	.50	6F24	.68	10F1	.75	25Z5	.40	CL38	.90	ECC88	.35	EY61	.35	PC184	.40	PY800	.95	U26	.56	AD161	.45	BYZ12	.25	OC77	.27	
5V4G	.84	6F25	.54	10F9	.45	25Z6G	.43	CV68	.53	ECC189	.49	EY63	.64	PC186	.44	PY806	.44	U32	.78	AD193	.45	BYZ13	.25	OC78	.15	
5Y3GT	.26	6F28	.60	10F13	.35	30A5	.44	CV1C	.53	ECC80A	.55	EY84	.50	PCF200	.67	PY801	.33	U47	.64	ADT140	.63	CG12E	.20	OC78D	.15	
5Z4G	.84	6F29	.15	10L11	.63	30C1	.28	CY31	.81	ECC8071	.70	EY87/6	.30	PCF801	.29	PZ30	.48	U191	.58	AF106	.50	FSY41A	.23	OC81	.11	
6/30L2	.55	6GH8A	.50	10P13	.64	30C15	.60	DAM91	.20	ECCF80	.27	EY88	.40	PCF802	.40	QV03/10		U251	.65	AF114	.25	FSY41A	.23	OC81D	.11	
6A8G	.33	6GK5	.50	10P14	1.08	30C17	.77	DAF96	.33	ECCF82	.26	EY91	.53	PCF805	.60			U281	.40	AF115	.15	GD9	.20	OC82	.11	
6AC7	.15	6GU7	.50	12A8	.63	30C18	.60	DF91	.14	ECCF86	.64	EZ40	.40	PCF806	.57	Q805/10	.49	U282	.40	AF117	.19	GET113	.20	OC82D	.11	
6AG9	.25	6H6GT	.15	12AC6	.49	30F5	.65	D986	.53	ECCF89	.42	EZ41	.43	PCF808	.63	QV04/7	.63	U301	.40	AF121	.30	GET116	.40	OC83	.20	
6AK9	.30	6I6	.19	12AD6	.40	30FL1	.60	DH76	.28	ECH21	.63	EZ80	.21	POH200	.62	R10	.75	U403	.33	AF124	.25	GET118	.20	OC84	.24	
6AM8A	.50	6J5GT	.29	12AE6	.48	30FL2	.60	DK40	.55	ECH42	.60	EZ81	.22	PC183	.32	R11	.98	U404	.33	AF126	.13	GET119	.20	OC123	.23	
6AN8	.49	6J6	.18	12AT6	.23	30FL12	.69	DK92	.35	ECH81	.27	EZ90	.20	PC183	.32	R16	1.75	U801	.98	AF129	.65	GET123	.38	OC139	.23	
6AQ5	.22	6J7G	.24	12AT7	.16	30FL14	.68	DK96	.36	ECH83	.39	FW4/900	.75	PC184	.34	R17	.88	U4020	.38	AF178	.68	GET187	.45	OC140	.25	
6AR5	.30	6J7GT	.28	12AU6	.21	30L1	.29	DL96	.35	ECH84	.34	FW4/900	.75	PC185/85		R19	.30	U28	.40	AF180	.48	GET187S	.15	OC169	.23	
6AT8	.19	6J9A	.50	12AU7	.19	30L15	.55	DH70	.30	ECL50	.30	GZ30	.34	GZ30	.34	SP42	.75	VP41	.33	AF186	.55	GET187	.25	OC172	.35	
6AV8	.28	6K7GT	.23	12AV6	.28	30L17	.67	DM71	.38	ECL82	.80	GZ32	.41	PC186	.38	SP61	.33	VT61A	.35	AF209	.38	GET189	.23	OC200	.22	
6AV6	.28	6K7GT	.23	12AV7	.22	30P4MR	.95	DY87/6	.24	ECL83	.92	GZ33	.70	PC188	.65	TH4B	.50	VU111	.44	BA123	.45	GET189S	.23	OC201	.33	
6AW8A	.54	6K8G	.18	12BA6	.30	30P12	.69	DY802	.35	ECL84	.54	GZ34	.48	PD500	1.44	TH233	.93	VU120	.60	BA115	.14	M1	.15	OC202	.43	
6AX4	.39	6L1	.98	12BE6	.30	30P19/		E80F	1.20	ECL85	.54	GZ37	.67	PEN4DD		TP2620	.98	VU120A	.60	BA116	.25	M2	.15	OC203	.30	
6B8G	.13	6L6GT	.39	12BH7	.27	30P4	.58	E833	1.20	ECL86	.35	GZ44	.48	HA8C80	.44			VU133	.35	BA129	.13	OA9	.13	OC205	.43	
6BA8	.20	6L7GT	.38	12BL1	.35	30P11	.59	E89CC	.80	EP23	.43	HL23D	.60	PEN36C	.75	UAF42	.49	W76	.34	BA129	.13	OA9	.13	OC205	.43	
6BC8	.50	6L15	.44	12C3GT	.39	30P13	.75	E92CC	.40	EF40	.49	HL41DD	.98	PEN48	.40	UBC41	.45	W107	.50	BA130	.10	OA10	.43	ORP12	.53	
6BE6	.21	6L19	1.38	12C7GT	.33	30P14	.65	E180F	.90	EF41	.58															
6BB6	.48	6LD20	.48	12K3	.50	30P15	.87	E182CC1	.00	EF42	.33															
6B36	.39	6N7GT	.40	12K7GT	.24	35A3	.48	E1148	.53	EF94	.98															
6BQ7A	.38	6O7	.43	12SA7GT		35L6GT	.42	E150	.18	EF73	.75															
6BR7	.79	6Q7G	.27		.40	35W4	.23	E176	.88	EF80	.22															
6BR8	.63	6R7	.55	12SC7	.33	35Z4GT	.24	E18C90	.30	EF83	.43															
6BW6	.79	6R7G	.45	12SG7	.23	35Z5GT	.30	E18C91	.38	EF85	.28															
6BW7	.54	6SA7GT	.35	12SH7	.15	50EH5	.55	E1AF42	.48	EF86	.29															

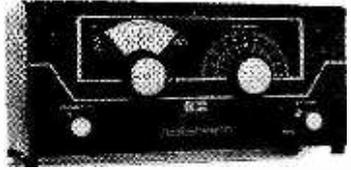
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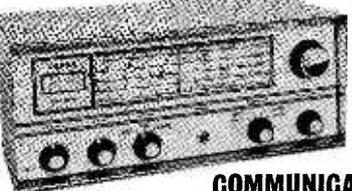


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**GR 70A**



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It tunes from 540 metres medium through to 10 metres with no gaps. Covers shipping, coastguard and distress frequencies, all six amateur bands 160-10 metres, International broadcast, Met. stations etc. etc. giving world-wide reception. Exclusive features include Air-spaced CODAR-COIL Hi-"Q" Aerial input, illuminated "S" Meter and Slide Rule Scale, Two speed vernier tuning, Switched B.F.O. for CW/SSB signals, 5 valves inc. two twin triodes giving 7 valve line-up, separate output for Tape recorder.

Ready to plug in to 200/240 volts A.C. it only needs your aerial and a 2/3 ohm loudspeaker to bring the world to your finger tips. 12 months full guarantee.

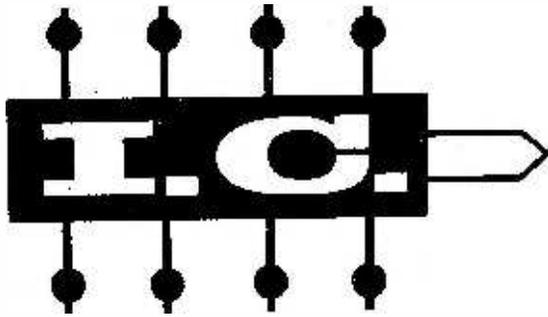
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Ask the chap who's got one, there's lots of them!

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# OF THE MONTH

L.A.J. IRELAND

Number 27 Toshiba TH9013P 20W Audio Amplifier

SOME time ago this column featured its first hybrid i.c., a 50 watt audio amplifier from Sanken of Japan. The hybrid approach, in which no attempt is made to fabricate the complete circuit of the unit on a single silicon chip (the "monolithic" approach), is particularly suited to high power or ultra high frequency applications.

Operation in these conditions poses requirements, such as component separation for minimum thermal or capacitive interaction, which are difficult to achieve within a single semiconductor slice. In audio circuits in particular it is advantageous to separate the output transistors, with their high current and thermal dissipation problems, from the driver stage which may usefully be monolithic.

Together with "chip" capacitors, which are also difficult to fabricate monolithically, these elements may be assembled into a single module or hybrid integrated circuit. This month's unit is an imported hybrid audio amplifier whose 20 watt rating fills the gap between the Sanken device already mentioned and the increasingly popular monolithics, whose power dissipation is of the order of 5 watts (G.E. type PA246, etc.).

The device is available from Erie Distribution Division, Erie Electronics Ltd., Gt. Yarmouth, Norfolk, and is quoted in the latest available price list at £4.31 for small numbers.

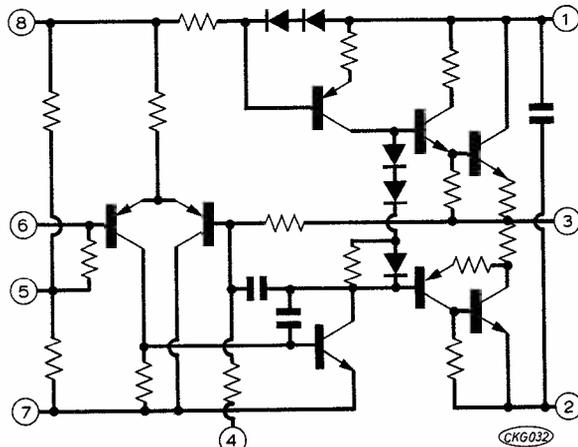


Fig. 1: Circuit of the hybrid audio amplifier.

## Circuit

Now for a detailed consideration of the capabilities of the unit. The high intercomponent leakage resistance possible with hybrid construction permits the use of supply voltages higher than is usual in i.c. work, with consequent lower currents for the same output, and the TH9013P therefore has a maximum supply rating of 50 volts at a current of 1.2 amps. The device should be attached to a heat sink of 300 sq.cms., giving a thermal resistance of 4°C/W or lower. This should retain the operating temperature of the device at 50°C or lower, but allowable case temperatures range from 0 to 90°C during operation, giving considerable latitude.

The circuit in Fig. 1 indicates that the device follows fairly conventional Class B lines, with identical n.p.n. silicon power transistors in push-pull, preceded by a complementary pair phase-splitter driving stage. A considerable advantage is the self-regulating character of the circuit, which does not require an external preset resistor to obtain symmetry of operation. Crossover distortion is therefore minimised, and ease of operation assured. In fact, the overall distortion figure quoted for the unit, at a signal frequency of 1kHz, is 0.3% at the full rated output of 20 watts, while the frequency response is flat to within 2dB from 10Hz to 40kHz. So it follows that if a pair of these devices is incorporated in a stereo outfit, departures from hi-fi standards should be sought in the record deck, the speakers or the preamps. Anywhere, in fact, except the power output stages!

## Power supplies

It is recommended that operation of the unit should be from twin power supplies rated at  $\pm 22.5$  volts. Such supplies are easily constructed using four silicon diodes of appropriate rating to make up a dual full wave rectifier set, working from a transformer with centre-tapped 45 volt secondary followed by suitable smoothing capacitors (at least 500 $\mu$ F, 50V).

Fig. 2 indicates the connections necessary for operation in a standard audio system, with the dual power supply mentioned; it also puts forward a method of operation from a single 45 volt supply should that prove necessary, using a 2000 $\mu$ F d.c.

blocking capacitor between the output of the amplifier and the 8ohm loudspeaker load. It is important to include the fuse link in the circuit; operation into an inadequate load can permanently damage the output transistors and some form of protection is vital. It should be noted that in the single supply case, the fuse link is in the power supply line, since otherwise the charging surge of the blocking capacitor could well blow the fuse.

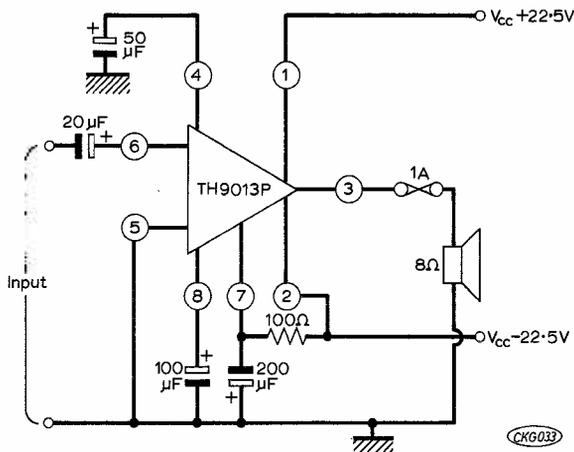


Fig. 2a: Connections to the TH9013P when using a dual power supply.

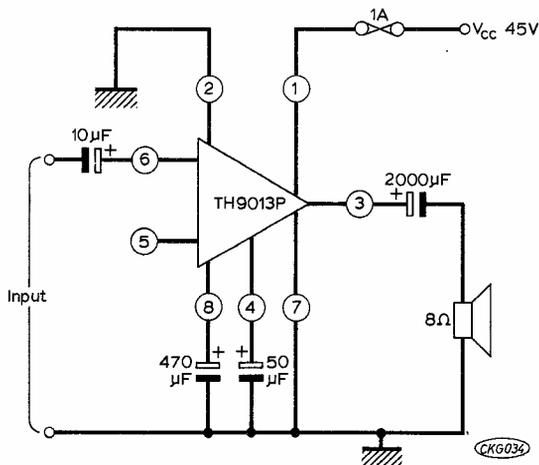


Fig. 2b: A single 45 volt power supply simplifies the external circuitry.

## Notes

Several i.c.'s suitable as preamps for the Toshiba unit have appeared from time to time in these columns, with associated tone and volume controls, so details of these accessories will not be pursued here.

The unit is presented in a sealed package 3×2×5/8in. with a machined face and mounting holes for heat sink attachment. Connections are via eight pins on the side of the package; the numbering in Fig. 1 is from left, when facing the pins with the heat sinking face downwards. For a convenient, economical and effective power amplifier for domestic applications, the TH9013P is certainly worth consideration. ■



## ISSUES WANTED

- ...Practical Electronics Feb. 1971.—P. Arden, Hallam Grange, Hallam Grange Rise, Fulwood, Sheffield, S10 4BE.
- ...Practical Wireless for June 1969 (final part of "Double 12" article).—W. Piddock, 128 Lodge Hill, Welling, Kent.
- ...Practical Wireless December 1963.—D. Hillman, 46 Spenser Street, Bootle, Lancashire, L20 4LW.
- ...Practical Wireless for May and June 1969. M. Jones, 44 Sturge Street, Sheffield, S2 3DP, Yorkshire.
- ...Practical Wireless December 1964, January 1969 to July 1970, September 1970, December 1970 and Practical Electronics for June and July 1970.—I. Moor, 6 Dykelands Road, Sunderland, Co. Durham, SR6 8EP.
- ...Practical Wireless Data Rule.—C. Jolliffe, 43 Holmea Road, Goring-on-Thames, Reading, Berkshire, RG8 9EX.
- ...blueprint for the P.W. 35W Guitar Amplifier (May 1964 issue).—R. Cross, 38 Priory Road, Fishtoft, Boston, Lincs.
- ...Feb. 1971 issue of P.W. and April, May and June 1971 issues of P.E. and any other issues of P.E.—B. Body, 27 Gimble Way, Penbury, Kent.
- ...May 1969 issue of P.W. and Jan to Feb. 1968 issues. T. McKernan, 55 Maryland, Hatfield, Herts.
- ...P.E. for Jan., Feb., Mar. and Oct. 1965, Feb., Apr., Aug. and Sept. 1966. "Television" for Oct. 1967, Apr., Jun. to Dec. 1968, Jan., Feb., Mar. and May 1969 and Feb., Dec. 1970. P. Mohan, 28 Hyde Park Terrace, Leeds, 6.
- ...P.W. for Jan. 1969 to Feb. 1969 and P.E. Jan. 1968 to Dec. 1970.—M. F. Green, 12A West Road, Weaverham, Northwich, Cheshire, CW8 3HQ.
- ...July 1960 P.W. with article on mods to the R1392 Rx.—G. W. Kilbee, 10 Woodlands Road, Ilford, Essex.
- ...Jan., Feb., Mar. and May P.W. for 1971.—C. Jennings, 13 Stonefield Street, Islington, London, N1 0HW.
- ...May and Jun. 1969 P.W.—G. A. Brooks, 227 St. Andrews Road, Coudson, Surrey.
- ...P.W. back numbers in exchange for Indian magazines.—N. Mohanty, M.Sc., Townhall Road, Cuttack-9, Orissa, India.
- ...P.W. for Apr. 1970 (General Coverage Receiver).—J. L. Littler, 61 Kent Road, Orpington, Kent, BR5 4AB.
- ...the issue of P.W. containing Mr. Cameron's decoder (May 1970).—G. R. Hunt, 53 Hand Lane, Leigh, Lancs.
- ...P.W. 1952-1955 and Radio Constructor 1952-1959.—Luxtun, 12 The Vale, Acton, London, W3 7SB.
- ...P.W. for Aug. 1967, Oct. 1969 and Jan. 1971. P.E. for Mar. 1971 and Radio Constructor for Feb. 1970.—A. D. Tuppen, "Greyholm" Geldeston, Beccles, Suffolk.
- ...Apr. 1965 issue of P.W. containing PC tuner article.—W. Pleass, 12 Farmadine Grove, Saffron Walden, Essex.
- ...P.W. for Jan. and June 1970 and P.E. for Jul 1967, Jan. 1968, May 1968, Sept. 1968, Oct. 1968, Feb. 1969, April 1969 and Mar. 1969.—C. Zammit Mangion, 59 St. Mary Street, Sliema, Malta.
- ...P.W. previous to Jan. 1969. Preferably complete sets. State details and price.—M. Tracey, 2 Maneway Way, Newquay, Cornwall.
- ...P.W. for June 1969.—M. J. Burrows, 7 Lyndhurst Road, Keynsham, Bristol.
- ...May 1971 issue of P.W.—A. Vermaak, 82 Kruger Avenue, Discovery, Transvaal, South Africa.

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C	1/2W	5%	4.7-10M	E24	1-2	1
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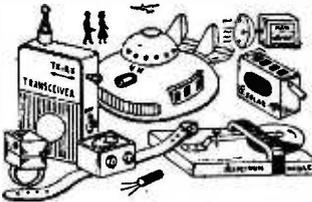
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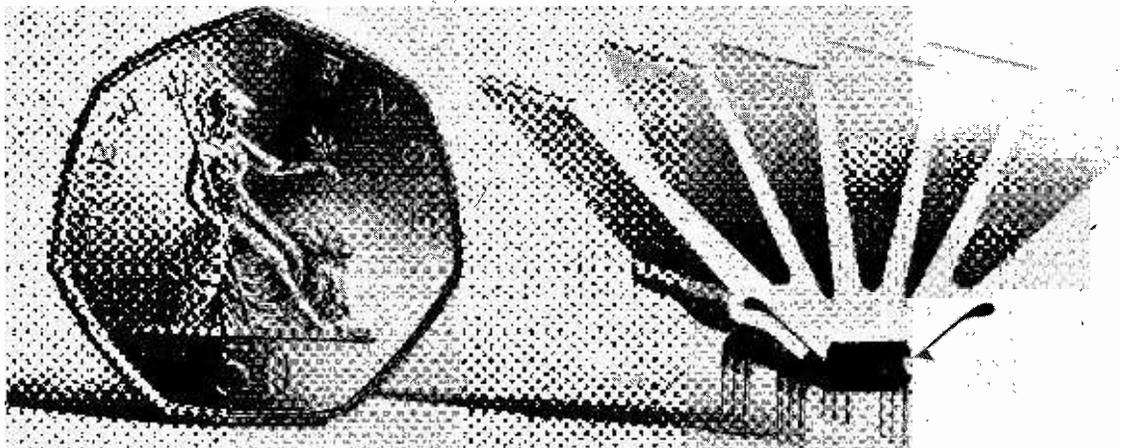
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## Super IC-12



### High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor, the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

**Output power** 6 watts RMS continuous (12 watts peak).

**Frequency Response** 5 Hz to 100KHz  $\pm$  1 dB.

**Total Harmonic Distortion** Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.

**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 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

**Quiescent current** 8mA at 28 volts; low enough to make the IC.12 ideal also for battery operation.

**Size** 22 x 45 x 28 mm including pins and heat sink.

With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project-60 range such as the Stereo 60 and A.F.U. may be added.



**FREE** 44 page instruction manual now included with all units. Available free on request to present IC.12 users. Gives full circuit and wiring diagrams for many applications including car-radios, oscillators, etc.



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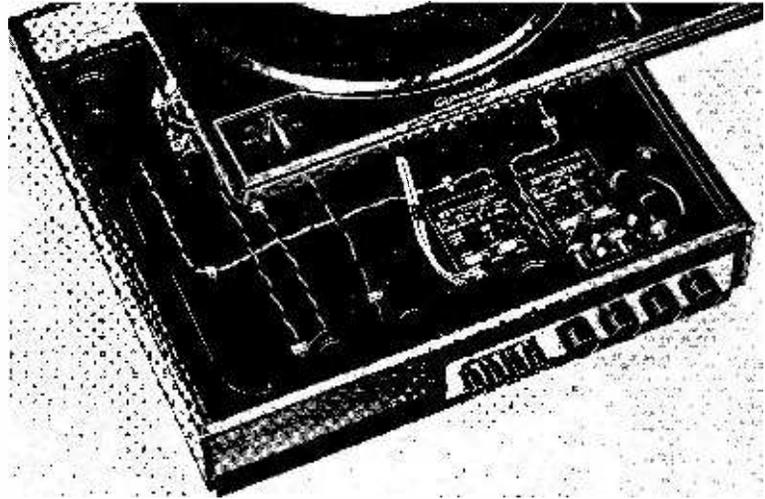
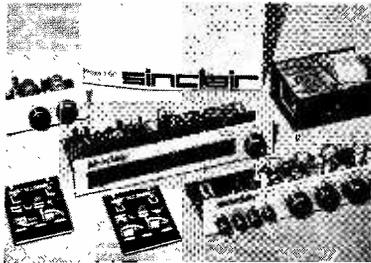
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# sinclair

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The easy way to buy and build Project 60



Project 605 is one pack containing: one PZ.5, two Z.30'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.

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Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world. Performance characteristics are so good they hold their own with any other available system irrespective of price or size.

Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

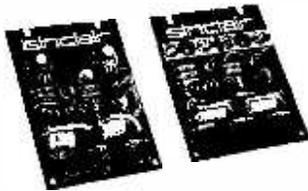
#### Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control	<b>£4.48</b>
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control etc.	<b>£9.45</b>
20 + 20 W. stereo amplifier for most needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	<b>£23.90</b>
20 + 20 W. stereo amplifier with high performance spkrs.	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	<b>£26.90</b>
40 + 40 W. R.M.S. de-luxe stereo amplifier	2 x Z.50s, Stereo 60 PZ.8, mains transformer	As above	<b>£34.88</b>
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	<b>£19.43</b>

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

# from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules

## Z.30 & Z.50 power amplifiers



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output 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 may be used with other units in the Project 60 range equally well.

**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  $\pm 1$  dB.

**Distortion:** 0.02% into 8 ohms.

**Signal to noise ratio:** better than 70dB unweighted.

**Input sensitivity:** 250mV into 100 Kohms.

For speakers from 3 to 15 ohms impedance.

**Size:** 14 x 80 x 57 mm.

### Z.30

Built, tested and guaranteed with circuits and instructions manual. **£4.48**

### Z.50

Built, tested and guaranteed with circuits and instructions manual. **£5.48**

## Power Supply Units

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 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**



## Project 60 Stereo F.M. Tuner



*First in the world to use the phase lock loop principle*

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

**SPECIFICATIONS—Number of transistors:** 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 2 $\mu$ V for 30dB quieting; 7 $\mu$ V for lock-in over full deviation. **Squelch level:** 20 $\mu$ V. **A.F.C. range:**  $\pm 200$  KHz. **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10 Hz – 15 KHz ( $\pm 1$ dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2 $\mu$ V. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC. **Indicators:** Power on/tuning/stereo. **Size:** 93 x 40 x 207 mm.

Built and tested. Post free.

**£25**

## Stereo 60 Pre-amp/control unit



Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

**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 + 15 to -15dB at 10 KHz; BASS + 15 to -15dB at 100Hz.

**Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm. **£9.98**

Built tested and guaranteed.

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



For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and 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. Two filter stages—rumble (high pass) and scratch (low pass). Supply voltage—15 to 35V. Current—3mA. 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. **Size:** 66 x 40 x 90 mm. **£5.98**

Built tested and guaranteed.

## The Sinclair Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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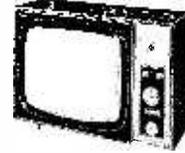
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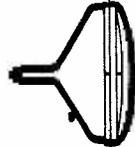
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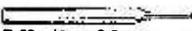
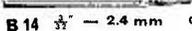
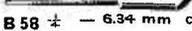
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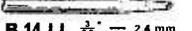
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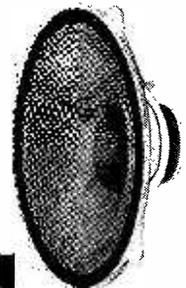
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COAXIAL PLUG 6p. PANEL SOCKETS 6p. LINE 18p. OUTLET BOXES, SURFACE OR FLUSH 25p. BALANCED TWIN FEEDERS 5p. 9d. 80 ohms or 300 ohms. JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p; Phone Plugs 5p; Phone Socket 5p. JACK PLUGS Std. Chrome 15p; 5 mm Chrome 14p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 25p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS, 6p; CERAMIC 6p; CANS 5p.

E.M.I. TAPE MOTORS Post 15p. 120v. or 240v. A.C. 1,200 r.p.m. 4 pole 135mA. Spindle 0.187 x 0.75in. £1.25 Size 3 1/2 x 2 1/2 x 2 1/2 in. (illustrated). BALFOUR GRAM MOTORS 120v. or 240v. A.C. 1,200 r.p.m. 4 pole 50mA. Spindle 1/2 x 3/20. Size 2 1/2 x 2 1/2 x 1 1/2 in. Post 15p 85p

CUSTOMERS FREE CAR PARK CALLERS WELCOME 337 WHITEHORSE ROAD, CROYDON Open 9-6 p.m. (Wednesdays 9-1 p.m., Saturdays 9-5 p.m.) Buses 50, 68, 159 pass door. Rail Selhurst Tel. 01-684-1665

# The largest selection

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

PIV	1A	3A	7A	10A	16A	30A
	TO-5	TO-66	TO-66	TO-48	TO-48	TO-48
50	0.23	0.25	0.47	0.50	0.53	1.15
100	0.25	0.33	0.53	0.58	0.68	1.40
200	0.35	0.47	0.87	0.81	0.75	1.60
400	0.43	0.47	0.87	0.75	0.83	1.75
600	0.53	0.57	0.77	0.97	1.25	
800	0.63	0.70	0.90	1.20	1.50	4.00

## SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1.5A	3A	10A	30A
	\$p	\$p	\$p	\$p	\$p	\$p	\$p
50	0.40	0.05	0.05	0.07	0.14	0.21	0.47
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	0.27	1.25
600	0.07	0.16	0.10	0.22	0.34	0.45	1.35
800	0.10	0.17	0.13	0.25	0.37	0.55	2.00
1000	0.11	0.25	0.15	0.30	0.46	0.83	2.50
1200		0.33		0.38	0.57	0.75	

## TRIACS

VBOM	2A	6A	10A
	TO-1	TO-66	TO-88
	\$p	\$p	\$p
100	30	50	76
200	50	60	80
400	70	75	1-10

## LUCAS SILICON RECTIFIERS

35 amp, 400 p.i.v. stud type. **\$1.10p** each.

**DIACS**  
FOR USE WITH TRIACS  
BR100 (D32) 37p each

## 2A POTTED BRIDGE RECTIFIERS 200V 50p

**UNIJUNCTION**  
UT46. Eqt. 2N2646, Eqt. T1843, BEN3000 27p each, 25-99 25p 100UP 20p.

**NPN SILICON PLANAR**  
BC107/8/8, 100p each; BC-99 \$p; 100 up. \$p each; Fully tested and coded TO-18 case.

**FREE**  
One 50p Pak of your own choice free with orders valued \$4 or over.

AP239 PNP GERM. SIEMENS VHF TRANSISTORS, RF MIXER & OSC. UP TO 900 MHZ. USE AS REPLACEMENT FOR AF139-AF186 & 100's OF OTHER TYPES IN VHE. OUR SPECIAL LOW PRICE:—1-24 37p each, 25-99 34p each 100+ 30p each.

**SPECIAL OFFER**  
2N2926 (Y) (O) 10 for 50p, 25 for \$1 20.00 TO CLEAR

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

**PHOTO TRANS.**  
OCP71 Type. 43p

**SIL. G.P. DIODES \$p**  
300mW 30. .50  
40PIV(Min.) 100. 1.50  
Sub-Min. 500. .50  
Full Tested 1,000. 9.00  
Ideal for Organ Builders.

**D13D1 Silicon Unilateral switch 50p each.**  
A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

**JUMBO COMPONENT PAKS**  
MIXED ELECTRONIC COMPONENTS  
Especially good value

Resistors, capacitors, pots, electrolytics and coils plus many other useful items. Approximately 38bs in weight. Price incl. P. & P. \$1.50 only  
Plus our satisfaction or money back guarantee.

**FULL RANGE OF ZENER DIODES**  
2-33V 400mV (D0-7 Case) 18p ea. 1W (Top-Hat) 18p ea. 10W (SO-10 Stud) 25p ea. All fully tested 5% tol. and marked. State voltage required.

**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 2G389A 2N1302  
T10 8 2G417 AF117  
All 50p each pak

**2N2060 NPN SIL. DUAL TRANS. CODE D1699**  
TEXAS. Our price 25p each.

**100 VCB MIXIE DRIVER TRANSISTOR.** Sim. BX21 & C407, 2N1893 FULLY TESTED AND CODED ND 120. 1-24 17p each. TO-5 N.P.N. 25 up 15p each.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqt. ZTX300 \$p each. Any Qty.

**EX-EQUIPMENT MULLARD**  
AF117 transistors. Large can 4 leads type. Leads cut short but still usable, real value at 15 for 50p.

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### SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED In Every Pak, or money back.

Pak No.	Description	\$p
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U2	60 Mixed germanium transistors AF/RF	0.50
U3	75 Germanium gold bonded diodes sim. OA5, OA47	0.50
U4	40 Germanium transistors like OC81, AC128	0.50
U5	60 200mA sub-min. Sil. diodes	0.50
U6	30 Silicon planar transistors NPN sim. BSY95A, 2N706	0.50
U7	16 Silicon rectifiers Top-Hat 750mA up to 1,000V	0.50
U8	50 Sil. planar diodes 250mA, OA200/202	0.50
U9	20 Mixed volts 1 watt Zener diodes	0.50
U11	30 PNP silicon planar transistors TO-5 sim. 2N1132	0.50
U13	30 PNP-NPN sil. transistors OC200 & 28104	0.50
U14	180 Mixed silicon and germanium diodes	0.50
U15	25 NPN silicon planar transistors TO-5 sim. 2N697	0.50
U16	10 3-Amp silicon rectifiers stud type up to 1000 PIV	0.50
U17	30 Germanium PNP AF transistors TO-5 like ACY 17-22	0.50
U18	8 6-Amp silicon rectifiers BY213 type up to 600 PIV	0.50
U19	25 Silicon NPN transistors like BC108	0.50
U20	12 1-5 Amp silicon rectifiers Top-Hat up to 1,000 PIV	0.50
U21	39 A.F. germanium alloy transistors 2G300 series & OC71	0.50
U23	30 Madu's like MAT series PNP transistors	0.50
U24	20 Germanium 1-Amp rectifiers GJM up to 300 PIV	0.50
U25	25 300 Mc/s NPN silicon transistors 2N705, BSY27	0.50
U26	30 Fast switching silicon diodes like 1N914 micro-min	0.50
U29	10 1-Amp SCR's TO-5 can up to 600 PIV C8B1/25-600	1.00
U31	20 Sil. Planar NPN trans. low noise amp SN3707	0.50
U32	25 Zener diodes 400mW D07 case mixed volts, 3-18	0.50
U33	51 Plastic case 1 amp silicon rectifiers IN4000 series	0.50
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 28302/4	0.50
U35	25 Sil. planar trans. PNP TO-18 2N2906	0.50
U36	35 Sil. planar PNP trans. TO-5 BFY50/51/52	0.50
U37	30 Sil. alloy trans. SO-2 PNP, OC200 28322	0.50
U38	20 Fast switching sil. trans. NPN, 400Mc/s 2N3011	0.50
U39	30 RF germ. PNP trans. 2N1303 5 TO-5	0.50
U40	10 Dual trans. 6 lead TO-5 2N2060	0.50
U41	25 RF germ. trans. TO-1 OC45 NKT72	0.50
U42	10 VHF germ. PNP trans. TO-1 NKT667, AF117	0.50
U43	25 Sil. trans. plastic TO-18 A.F. BC113/114	0.50
U44	20 Sil. trans. plastic TO-5 BC115/116	0.50
U45	7 SA SCR's TO-66 up to 600 Piv.	1.00

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

## NEW QUALITY TESTED PAKS

Pak Description	Price \$p
Q1 20 Red spot trans. PNP AF	0.50
Q2 16 White spot R.F. trans. PNP	0.50
Q3 4 OC77 type trans.	0.50
Q4 8 Matched trans. OC44/45/81/81D	0.50
Q5 4 OC73 transistors	0.50
Q6 4 OC72 transistors	0.50
Q7 4 AC128 trans. PNP high gain	0.50
Q8 4 AC126 trans. PNP	0.50
Q9 7 OC81 type trans.	0.50
Q10 7 OC71 type trans.	0.50
Q11 2 AC127/128 comp. pair PNP/NPN	0.50
Q12 3 AF116 type trans.	0.50
Q13 3 AF117 type trans.	0.50
Q14 3 OC171 H.F. type trans.	0.50
Q15 5 2N2926 sil. epoxy trans.	0.50
Q16 2 GET880 low noise germ. trans.	0.50
Q17 3 NPN 1 SET41 & 2 SET40	0.50
Q18 4 Madu's 2 MAT 100 & 2 MAT 120	0.50
Q19 3 Madu's 2 MAT 101 & 1 MAT 121	0.50
Q20 4 OC44 germ. trans. A.F.	0.50
Q21 3 AC127 NPN germ. trans.	0.50
Q22 20 NKT trans. A.F. R.F. coded	0.50
Q23 10 OA205 sil. diodes sub-min.	0.50
Q24 8 OA81 diodes	0.50
Q25 6 1N914 sil. diodes 76PIV 75mA	0.50
Q26 8 OA85 germ. diodes sub-min. 1N69	0.50
Q27 2 10A 600PIV sil. rect. 1845E	0.50
Q28 8 Sil. power rect. BY213	0.50
Q29 4 Sil. trans. 2 x 2N696, 1 x 2N697, 1 x 2N698	0.50
Q30 7 Sil. switch trans. 2N705 PNP	0.50
Q31 6 Sil. switch trans. 2N706 NPN	0.50
Q32 3 PNP sil. trans. 2 x 2N1131, 1 x 2N1132	0.50
Q33 3 Sil. NPN trans. 2N1711	0.50
Q34 7 Sil. NPN trans. 2N2060, 500MHZ	0.50
Q35 3 Sil. PNP TO-5 2 x 2N2904 & 1 x 2905	0.50
Q36 7 2N3646 TO-18 plastic 300MHZ NPN	0.50
Q37 5 2N3053 NPN sil. trans.	0.50
Q38 7 PNP trans. 4 x 2N3703, 3 x 2N3702	0.50
Q40 7 NPN amp. 4 x 2N3707, 3 x 2N3708	0.50
Q41 3 Plastic NPN TO-18 2N3904	0.50
Q42 6 NPN trans. 2N5172	0.50
Q43 7 BC107 NPN trans.	0.50
Q44 7 NPN trans. 4 x BC108, 3 x BC109	0.50
Q45 3 BC113 NPN TO-18 trans.	0.50
Q46 3 BC115 NPN TO-5 trans.	0.50
Q47 6 NPN high gain 3 x BC167, 3 x BC168	0.50
Q48 4 BCY70 NPN trans. TO-18	0.50
Q49 4 NPN trans. 2 x BFY51, 2 x BFY52	0.50
Q50 7 BSY28 NPN switch TO-18	0.50
Q51 7 BSY35A NPN trans. 300MHZ	1.00
Q52 8 BY104 type sil. rect.	0.50
Q53 25 Sil. & germ. trans. mixed all marked new	1.50

## PRINTED CIRCUITS—EX-COMPUTER

Packed with semiconductors and components. 10 boards give a guaranteed 30 trans and 30 diodes. Our price 10 boards, 50p Plus 10p P. & P. 100 Boards \$23. P. & P. 30p.

**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.

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

2N3819	35p
2N3820	50p
2N3821	35p
2N3823	30p
2N3848	30p
2N3459	40p
BFW 10	40p
MPP105	40p

**PHOTO TRANS.**  
OCP71 Type. 43p

**SILICON PHOTO TRANSISTOR.** TO-18 Lens and 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

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14 and 16 Lead Sockets for use with Dual-in-Line Integrated Circuits

Order No.	Price each
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TSO 14 pin type	30p 27p 25p
TSO 16 pin type	35p 32p 30p

## POWER TRANSISTOR BONANZA!

**GENERAL PURPOSE GERM. PNP**  
Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACE.—OC25-29-30-35-36. NKT 401-403-404-405-406-430-451-452-453. T13027-3028, 2N250A. 2N456A-457A-458A. 2N611 A & B. 2G220-222, ETC. VCBO 80V VCEO 50V IC 10A PT. 30 WATTS Hie

**AD161** PNP  
**AD162** PNP  
M/P COMP GERM TRANS. OUR LOWEST PRICE OF 68p PER PAIR

**2N3055**  
115 WATT SIL POWER NPN 63p EACH

**SILICON 50 WATTS MATCHED NPN/PPN**  
Plastic. BIP 20 PNP. Brand new. VCBO 100V VCEO 50V IC 10A. HFE type 100/14 3mHZ. OUR PRICE PER PAIR: 1-24 26-99 100 prs. prs. prs. 60p 55p 50p

**EX-STOCK TYPE EACH AS PRICED**  
OC20 50p OC28 40p AD149 48p BD131 70p BD139 75p OC22 30p OC29 40p AL102 85p BD139 80p BD140 85p OC23 33p OC26 38p AL103 85p BD138 70p BD155 75p OC24 45p OC36 40p BD121 60p BD136 80p BU105 23 OC25 25p AD140 40p BD123 75p BD137 70p 2N3054 45p OC28 25p AD142 40p BD124 70p BD138 80p

**GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/S.** BSY27/28/29A. 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	\$p	100	For	1.75
50	For	500	For	7.50
50	For	1000	For	13.00

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	Price each
Epoxy TO-5 case	1-24 26-99 100 up
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Date and Circuits Booklet for IC's Price 7p.

# -the lowest prices!

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Check our 74 Series List before you buy any I.C's. Our prices are the lowest possible. All devices ex-stock. Full spec. guaranteed

BI-PAK Order No.	Price and qty. prices			BI-PAK Order No.	Price and qty. prices		
	1-24	25-99	100 up		1-24	25-99	100 up
BP00=SN7400	0.15	0.14	0.12	BP86=SN7486	0.82	0.30	0.88
BP01=SN7401	0.15	0.14	0.12	BP90=SN7490	0.87	0.84	0.88
BP02=SN7402	0.15	0.14	0.12	BP91=SN7491AN	0.87	0.84	0.88
BP03=SN7403	0.15	0.14	0.12	BP92=SN7492	0.87	0.84	0.88
BP04=SN7404	0.15	0.14	0.12	BP93=SN7493	0.87	0.84	0.88
BP05=SN7405	0.15	0.14	0.12	BP94=SN7494	0.77	0.74	0.88
BP07=SN7407	0.18	0.17	0.16	BP95=SN7495	0.77	0.74	0.88
BP08=SN7408	0.18	0.17	0.16	BP96=SN7496	0.77	0.74	0.88
BP09=SN7409	0.18	0.17	0.16	BP100=SN74100	1.75	1.85	1.55
BP10=SN7410	0.15	0.14	0.12	BP104=SN74104	0.97	0.94	0.88
BP13=SN7413	0.28	0.26	0.24	BP105=SN74105	0.97	0.94	0.88
BP16=SN7416	0.43	0.40	0.38	BP107=SN74107	1.40	0.93	0.98
BP17=SN7417	0.43	0.40	0.38	BP110=SN74110	0.85	0.88	0.80
BP20=SN7420	0.15	0.14	0.12	BP111=SN74111	1.25	1.15	1.00
BP30=SN7430	0.15	0.14	0.12	BP115=SN74118	1.00	0.95	0.90
BP40=SN7440	0.15	0.14	0.12	BP119=SN74119	1.35	1.25	1.10
BP41=SN7441	0.87	0.84	0.88	BP121=SN74121	0.87	0.84	0.88
BP42=SN7442	0.87	0.84	0.88	BP145=SN74145	1.50	1.40	1.30
BP43=SN7443	1.95	1.85	1.75	BP150=SN74150	1.80	1.70	1.60
BP44=SN7444	1.95	1.85	1.75	BP151=SN74151	1.00	0.95	0.90
BP45=SN7445	1.95	1.85	1.75	BP153=SN74153	1.20	1.10	0.95
BP46=SN7446	0.97	0.94	0.88	BP154=SN74154	1.80	1.70	1.60
BP47=SN7447	0.97	0.94	0.88	BP155=SN74155	1.40	1.30	1.20
BP48=SN7448	0.97	0.94	0.88	BP157=SN74157	1.40	1.30	1.20
BP49=SN7449	0.15	0.14	0.12	BP160=SN74160	1.80	1.70	1.60
BP51=SN7451	0.15	0.14	0.12	BP161=SN74161	1.80	1.70	1.60
BP53=SN7453	0.15	0.14	0.12	BP164=SN74164	2.00	1.90	1.80
BP54=SN7454	0.15	0.14	0.12	BP165=SN74165	2.00	1.90	1.80
BP60=SN7460	0.15	0.14	0.12	BP181=SN74181	2.75	2.60	2.40
BP70=SN7470	0.28	0.26	0.24	BP182=SN74182	0.97	0.94	0.88
BP72=SN7472	1.95	1.85	1.75	BP190=SN74190	3.50	3.25	3.00
BP73=SN7473	0.37	0.35	0.32	BP191=SN74191	3.50	3.25	3.00
BP74=SN7474	0.37	0.35	0.32	BP192=SN74192	2.10	1.95	1.75
BP75=SN7475	0.47	0.45	0.42	BP193=SN74193	2.10	1.95	1.75
BP76=SN7476	0.43	0.40	0.38	BP195=SN74195	1.10	1.05	0.95
BP80=SN7480	0.87	0.84	0.88	BP196=SN74196	1.50	1.40	1.30
BP81=SN7481	0.97	0.94	0.88	BP197=SN74197	1.80	1.70	1.60
BP82=SN7482	0.97	0.94	0.88	BP198=SN74198	5.50	5.00	4.00
BP83=SN7483	1.10	1.05	0.95	BP199=SN74199	5.50	5.00	4.00

PRICE-MIX. Devices may be mixed to qualify for quantity prices. PRICES for quantities in excess of 500 pieces mixed, on application. Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock. WARE 3442.

## NUMERICAL INDICATOR TUBE Type MG-17G

Cold Cathode gas-filled side-viewing numerals (0-9) and Decimal Point.

COLOUR: Neon Red.

DATA: Anode supply voltage 180 min Vdc.  
Cathode current: 0.35 Nom mA dc.

Ideal for use in constructing Digital Clocks, Desk Calculators etc., and many products described in this magazine. We recommend use of BP41 or BP141 to drive this tube.

Full data available on request.

PRICE 1-5 £1.55. 6-25 £1.40

ACTUAL SIZE

### BRAND NEW LINEAR I.C'S-FULL SPEC.

Type No.	Case	Leads	Description	Price
				1-24 25-99 100 up
BP 201C-SL201C	TO-5	8	G.P. Amp	83p 53p 45p
BP 701C-SL701C	TO-5	8	OP Amp	83p 50p 45p
BP 709C-SL709C	TO-5	8	OP Amp Direct OP	83p 50p 45p
BP 702-72702	D.I.L.	14	(G.P. OP Amp Wide Band)	53p 45p 40p
BP 709-72709	D.I.L.	14	High OP Amp	53p 45p 40p
BP 709F-7A709C	TO-5	8	High Gain OP Amp	53p 45p 40p
BP 710-72710	D.I.L.	14	Differential comparator	53p 45p 40p
BP 711-7A711	TO-5	10	Dual comparator	53p 50p 45p
BP 741-72741	D.I.L.	14	High Gain OP Amp (Protected)	75p 60p 50p
7A 709C-7A709C	TO-5	6	R.F.-I.F. Amp	43p 35p 27p
TAA 263-	TO-72	4	A.F. Amp	70p 60p 55p
TAA 293-	TO-74	10	G.P. Amp	90p 75p 70p
TAA 360	TO5	8	Wide Band limiting amplifier	170p 158p 150p

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A wide range of all types of electronic components and equipment available at competitive prices. Expert technical advice freely given.

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OPEN 9.15-6 TUES. to SATS. FRIDAYS UNTIL 8 p.m.

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THE NEW S.G.S. EA 1000 AUDIO AMPLIFIER MODULE \*GUARANTEED NOT LESS THAN 3 WATTS RMS



Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA/621 providing unrivalled applications for the enthusiast in the construction of radios, record players, Audio and Stereo units. Also ideal for intercom systems, monitoring applications and phone answering machines.

OTHER USES: portable applications where supply rails as low as 9V are of prime importance.

- Sensitivity 40 mV for 1 watt. VOLTAGE GAIN 40dB but can be varied up to 78dB for some applications.
- Signal to Noise Ratio 86dB.
- Frequency response better than 50 Hz to 25 KHz for -8dB.
- Normal supply Voltage 9-24V.
- Suitable for 3-16 OHM Loads.
- Overall Size 2" x 3" x 1".
- Typical Total Harmonic distortion at 1 watt less than 1%.
- Supply voltage (V<sub>s</sub>) = 24V 15ohm load. Module Tested and Guaranteed.

Quantity Price each 1-9 10-85 22-83 42-28  
Larger quantities quoted on request.

Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

### NOTE THESE PRICES!

#### I.C's DTL 930 SERIES LOGIC

Type No.	Function	Price
		1-24 25-99 100 up
BP830	Expandable dual 4-input NAND	13p 11p 10p
BP832	Expandable dual 4-input NAND buffer	13p 12p 11p
BP833	Dual 4-input expander	13p 12p 11p
BP835	Expandable Hex Inverter	13p 12p 11p
BP836	Hex Inverter	13p 12p 11p
BP944	Dual 4-input NAND expandable buffer without pull-up	13p 12p 11p
BP945	Master-slave JK or RS	25p 24p 22p
BP946	Quad, 2 input NAND	12p 11p 10p
BP948	Master-slave JK or RS	25p 24p 22p
BP991	Monostable	85p 60p 55p
BP982	Triple 3 input NAND	12p 11p 10p
BP9093	Dual Master-slave JK with separate clock	40p 38p 35p
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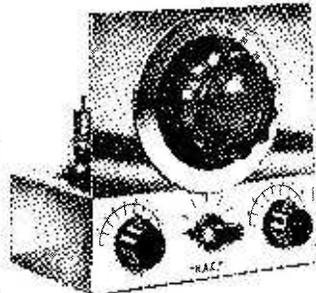
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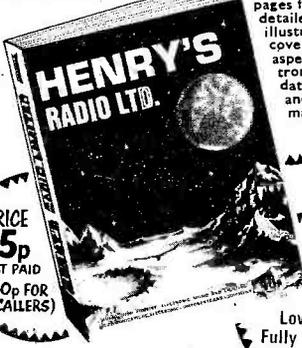
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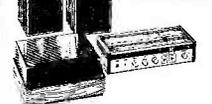
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