

PRACTICAL WIRELESS

APRIL
1972

20p

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DIGITAL CLOCK



ALSO: TRANSISTOR TESTER: WIPER DELAY UNIT

RSC

HIGH-FIDELITY STEREO PACKAGE OFFERS

- Four fully wired units ready to 'plug in'.
 - ★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
 - ★ GARRARD SP25 MK III Turntable on Plinth with cover
 - ★ GOLDRING G850 Magnetic P.U. Cartridge with diamond stylus
 - ★ PAIR OF STANWAY II Speaker Units
- Special Total Price **£87.75**
Carr. £1.50

Terms: Deposit £13 and 9 monthly payments £9.35 (Total £97.15).

- ★ 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 **£99.75**
Carr. £1.50

Terms: Deposit £15 and 9 monthly payments £10.60 (Total £110.40).



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 **£59**
Or Deposit £9 and 9 monthly payments £6.25 (Total £65.25). Carr. £1.25
Trans. Plastic Cover £3.15 extra.

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

Special Total Price **£51.75**

Or Deposit £8 and 9 monthly payments £5.58 (Total £58.22)
Trans. Plastic cover £3.15 extra.

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

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

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

COMPLETE KIT **£23**
Carr. 65p

★ Performance comparable with units costing considerably more. Consists of (1) 12in. 15 watt Bass unit with east chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8 x 5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4.60 and 9 monthly payments £2.47 (Total £28.88).

DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUSPEAKER UNITS

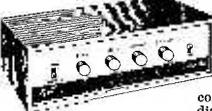
Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

DORCHESTER (Illustrated) Size 16 x 11 x 9in. appr. Range 45-15,000 c.p.s. Rating 10 watts. Fitted High Flux 13 x 8in. £9.45 Carr. 40p.
Dual Cone speaker. Imp. 3 or 15 ohms.

STANWAY II Size 20 x 10 1/2 x 9 1/2in. 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+6 WATT high quality STEREO AMPLIFIER

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



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

OR FACTORY BUILT IN TEAK VENEERED CABINET as illustrated **£14.99** or dep. £2.20 and 9 monthly payments £1.70 (Total £17.50).

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

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

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

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS **£15.50** Carr. 40p. Factory built with wiring diagrams & instructions **£19.50** Dep. £3 and 9 mthly pymts £2.15 (Total £22.65). Or in Teak veneer housing Dep. £3 and 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



£5.95 Carr. 30p
£6.95 Carr. 35p

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	£2.98	HF190D	12"	15W	£4.75
HF102D	10"	10W	£2.40	HF126	12"	15W	£5.50
HF120	12"	15W	£4.25	HF126D	12"	15W	£5.90

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 WHEN ORDERING **£3.85**



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. SES For optimum performance Gives pleasing results with any 8in. HI-FI speaker. Size 22 x 15 x 9in. Ported. **£5.35** with any 8in. HI-FI speaker. **£6.47**

SE10 For outstanding results with 10in. HI-FI spkr. **£6.74** SE12 For exlnt primene with 12in HI-FI speaker and Tweeter. **£7.87** Size 24 x 15 x 10in. P'd. Size 25 x 16 x 10 1/2in.



R.S.C. BATTERY/MAINS CONVERSION UNITS

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



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

200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. -2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9 1/2 x 2 1/2 x 5 1/2in. Attractive brushed silver finish facia plate, 10 x 3 1/2in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE **£9.75** **£7.50** Carr. 40p.

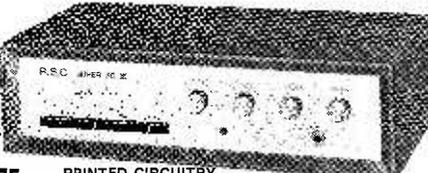


R.S.C. MkIII SUPER 30 HIGH FIDELITY STEREO AMPLIFIER

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. **£25** Carr. 65p

COMPLETE KIT OF PARTS OR FACTORY BUILT WITH 12 months guarantee. Dep. £5.75 and 9 monthly payments £3.50 (Total £37.25). OR FACTORY BUILT in cabinet as illustrated. Dep. £7 and 9 monthly payments £3.99 (Total £42.91)



PRINTED CIRCUITRY TWENTY SILICON TRANSISTORS. FOUR DIODES. FOUR RECTIFIERS

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

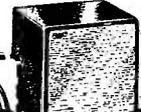
OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms. -2dB. Full Vol. HARMONIC DISTORTION

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: Disc Mag. 5 - 15mV 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.

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

RSC DISCO THEQUE EQUIPMENT

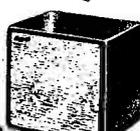
50 WATT SPEAKER



100 WATT AMPLIFIER



50 WATT SPEAKER



SAVINGS ON PACKAGE OFFER

All units available separately

- FAL FG1/8 Console
- 100W Power Amplifier
- Pair High Quality Headphones
- Matching Microphone fitted to Headphones
- Pair 50W Speakers black rexine covered Size approx. 18" x 18" x 8"

TOTAL COST OF ALL ILLUSTRATED UNITS Carr. £2-50

TERMS: Deposit £30 and 18 monthly payments of £139-75 (Total £1165)

FAL

F.G.1/2 DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Goldring CS90 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.

£69 Carr. £1-25

Terms: Deposit £15 and 9 monthly payments of £8-75 (Total £78-75)

SEND S.A.E. FOR DISCO LEAFLET

TWIN TURNTABLE WITH PRE-AMP

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

<p>TYPE C485 25-30 WATTS</p> <p>Fitted four 12" high flux 8 watt speakers</p> <p>Overall size approx. 48 x 10 x 6in. £17-75</p> <p>Terms: Dep. £8 and 9 monthly payments £2 (Total £21) Carr. 50p.</p>	<p>TYPE C4125 30 WATTS</p> <p>Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56 x 14 x 9in</p> <p>Terms: Dep. £4 and 9 monthly payments £3-37 (Total £34-38) Carr. 75p £31</p>
<p>TYPE C4100 100 WATTS inc. four 12" 60 watt speakers for conservative rating. Extra heavy construction. Size approx. 48 x 16 x 10" Acoustically filled and pressurised. Terms: Dep. £11 and 9 mthly. pmts. £6-75 (Total £71-75). Carr. £1 £65</p>	

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 6F86, 6F86, 6CC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes, 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with wiring diagram and instructions. Twin-handled perforated cover **£15-75** Carr. 65p

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

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

FULLY GUARANTEED. Impregnated and interleaved where necessary.

<p>Primarys 200-250v. 50c/s. Screened</p> <p>MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 in.</p> <p>250v., 60mA, 6-3v. 2s. 99p</p> <p>250-0-250v. 60mA 6-3v. 2s. £1-05</p> <p>FULLY SHROUDED UPRIGHT MOUNTING</p> <p>250-0-250v. 60mA, 6-3v. 2s., 0-5-6-3v. 2s. £1-40</p> <p>250-0-250v. 100mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-20</p> <p>300-0-300v. 100mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-20</p> <p>300-0-300v. 130mA, 6-3v. 4s., c.t. 6-3v. 1s. For Mullard 510 Amplifier £2-20</p> <p>350-0-350v. 100mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-65</p> <p>350-0-350v. 150mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-65</p> <p>425-0-425v. 200mA, 6-3v. 4s., c.t. 6v. 3s. £4-95</p> <p>425-0-425v. 200mA, 6-3v. 4s., 6-3v. 3s., 5v. 3s. £5-10</p> <p>450-0-450v. 250mA 6-3v. 4s., c.t. 6v. 3s. £5-50</p> <p>TOP SHROUDED DROP-THERO TYPE</p> <p>250-0-250v. 70mA, 6-3v. 2s., 0-5-6-3v. 2s. £1-85</p> <p>250-0-250v. 100mA, 6-3v. 3-sa. £1-55</p> <p>250-0-250v. 100mA, 6-3v. 2s., 6-3v. 1s. £1-80</p> <p>350-0-350v. 80mA, 6-3v. 2s., 0-5-6-3v. 2s. £1-65</p> <p>420-0-420v. 100mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-20</p> <p>300-0-300v. 100mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-20</p> <p>300-0-300v. 130mA 6-3v. 4s., c.t. 6-3v. 1s. Suitable for Mullard 510 Amplifier £2-60</p> <p>350-0-350v. 100mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-20</p> <p>350-0-350v. 150mA, 6-3v. 4s., 0-5-6-3v. 3s. £2-60</p>	<p>FILAMENT OR TRANSISTOR POWER PACK</p> <p>Types 6-3v. 1-5a. 49p; 6-3v. 3a. 54p; 6-3v. 3a. 76p; 6-3v. 6a. £1-30; 12v. 1a. 65p; 12v. 3a. or 24v. 1.5a. £1-35; 0-9-18v 1 1/2 50c; 0-12-25-42v £2-17-75</p> <p>CHARGER 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</p> <p>AUTO (STEP UP/STEP DOWN) TRANSFORMERS</p> <p>0-110/120v. 200-230-250v. 50-80 watts £1-10, 150 watts, £1-90; 250 watts £2-75; 500 watts £5-75</p> <p>OUTPUT TRANSFORMERS</p> <p>Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p</p> <p>Push-Pull 8 watts EL84 to 3 Ω or 15 Ω 83p</p> <p>Push-Pull 10 watts 6V6, 6CL8 to 3 Ω, 5 Ω or 15 Ω £1-37</p> <p>Push-Pull EL34 to 3 Ω or 15 Ω 10-12 watts £1-35</p> <p>Push-Pull Ultra Linear for Mullard 510, etc. £2-20</p> <p>Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 Ω or 15 Ω £1-99</p> <p>Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 Ω or 15 Ω £2-30</p> <p>SMOOTHING CHOKES 160mA, 7-10H, 250 Ω 70p; 100mA, 10H, 200 Ω 80p; 80mA, 10H, 300 Ω 90p; 60mA, 10H, 400 Ω 95p.</p> <p>SELENIUM RECTIFIERS F. W. (Bridged)</p> <p>1a. 85p. 2a. D.C. output. Max. A.C. input 18v. 1a. 85p. 2a. 85p. 3a. 50p. 4a. 65p. 6a. 80p.</p>
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LOW DEPOSIT CREDIT TERMS AVAILABLE ON PURCHASES over £8 (Kits of parts excepted)

INTEREST CHARGES REFUNDED 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** (Agents) O & C Electronics 227 Church Street
 - BIRMINGHAM** 30/31 Great Western Arcade, Tel. 021-236 1279 (Half-day Wed)
 - DERBY** 26 Osmonson Rd. The Spot (Half-day Wed.) Tel. 41361
 - DARLINGTON** 18 Priestgate (Half-day Wed.) Tel. 65043
 - 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. 25055
 - LEICESTER** 32 High Street (Half-day Thurs.) Tel. 56420
 - LEEDS** 5-7 County (Mecca) Arcade, Briggate (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. 47036
 - NEWCASTLE UPON TYNE** 41 Blackett 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 (09735) 77831.

TERMS C.W.O. or C.O.D. No C.O.D. under £1.
Postage 85p 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

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 YEARS' GUARANTEE

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

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

Dual Cone 15 Ω (for uses other than Base Guitar or Electronic Organ). **£6-75** Carr. or Dep. £1 and 9 monthly payments 75p (Total £7-75).

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

<p>F.A.L. PHASE 50 MK III AMPLIFIER £34-75</p> <p>PE. FANE POP 85/8 25W L/SPEAKERS £13-60</p> <p>Terms: Deposit £2-50 and 9 monthly payments of £4-72 (Total £48-96)</p>	<p>PACKAGE PRICE</p> <p>£45 Carr. £1</p>
<p>F.A.L. PHASE 50 MK III AMPLIFIER £34-75</p> <p>PE. FANE POP 85/8 L/SPEAKERS £21-00</p> <p>Terms: Deposit £10 and 9 monthly payments of £5-25 (Total £67-25)</p>	<p>PACKAGE PRICE</p> <p>£52 Carr. £1</p>
<p>F.A.L. PHASE 100 AMPLIFIER £81-95</p> <p>PE. L125 50W L/S in cabinets £87-00</p> <p>Terms: Deposit £23 and 9 monthly payments of £12-50 (Total £135-50)</p>	<p>PACKAGE PRICE</p> <p>£123 Carr. £2-50</p>
<p>F.A.L. PHASE 100 AMPLIFIER £81-95</p> <p>4 FANE POP 60 L/SPEAKERS £42-00</p> <p>Terms: Deposit £15-95 and 9 monthly payments of £10-50 (Total £110-45)</p>	<p>PACKAGE PRICE</p> <p>£99-95 Carr. £2</p>

HIGH QUALITY LOUDSPEAKER UNITS

TWO TONE REXINE AND VYNAIR FINISH

<p>L125 50 WATT</p> <p>12 1/2" 25 WATT</p> <p>10,000 lines 15 ohms. Also supplied Rexine covered Carr. 45p</p>	<p>£11-95</p>
<p>Or deposit £4-60 and 9 monthly payments of £3-82. Total £37-98</p>	<p>L13 13" x 8" 10 WATT</p> <p>10,000 lines 3 or 15 ohms. State impedance required. £5-25 Carr. 40p</p>

FAL PHASE 50 MKIII 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/ 3-30 ohms. Size 17" x 7" x 7 1/2"

200-250v. A.C. mains. Output 50 watts music rating. **£34-75** Carr. 75p.

Or deposit £7-25 & 9 monthly payments £3-50. Total £38-75.

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 £5-08 (Total £70-72)

£63 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. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers.

Send S.A.E. for leaflet. Terms: Deposit £4-20 and 9 monthly payments of £2-10 (Total £28-10).

£19-95 Carr. 65p

ORGAN KITS

Build your own Electronic Organ, if you want the best value for your money. Yes you really save over 50% and get the best and up-to-date designs. There are four models to choose from.

- ★ Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, at £103.00, P/P £1.50.
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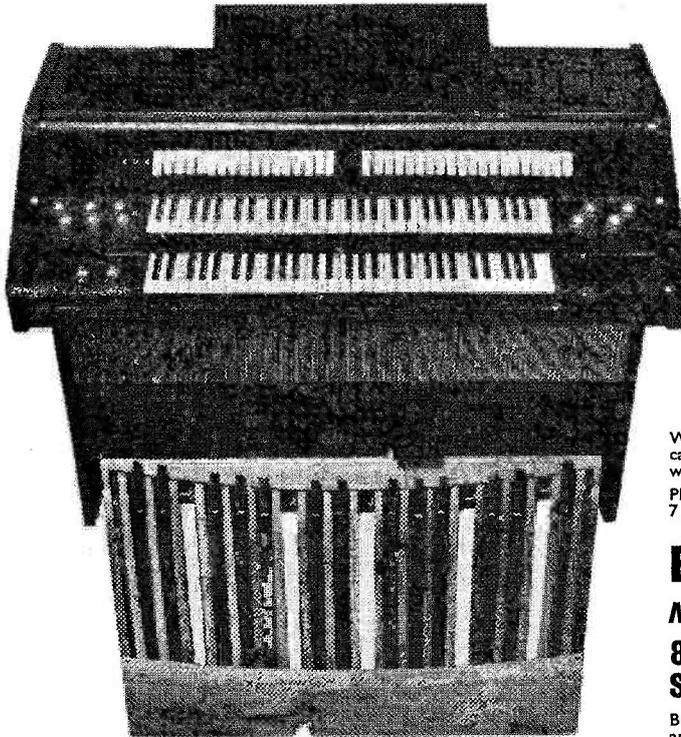
We regret H.P. facilities are not available, but components can be bought separately. Trade and overseas enquiries welcomed. Send 15p for latest catalogue.

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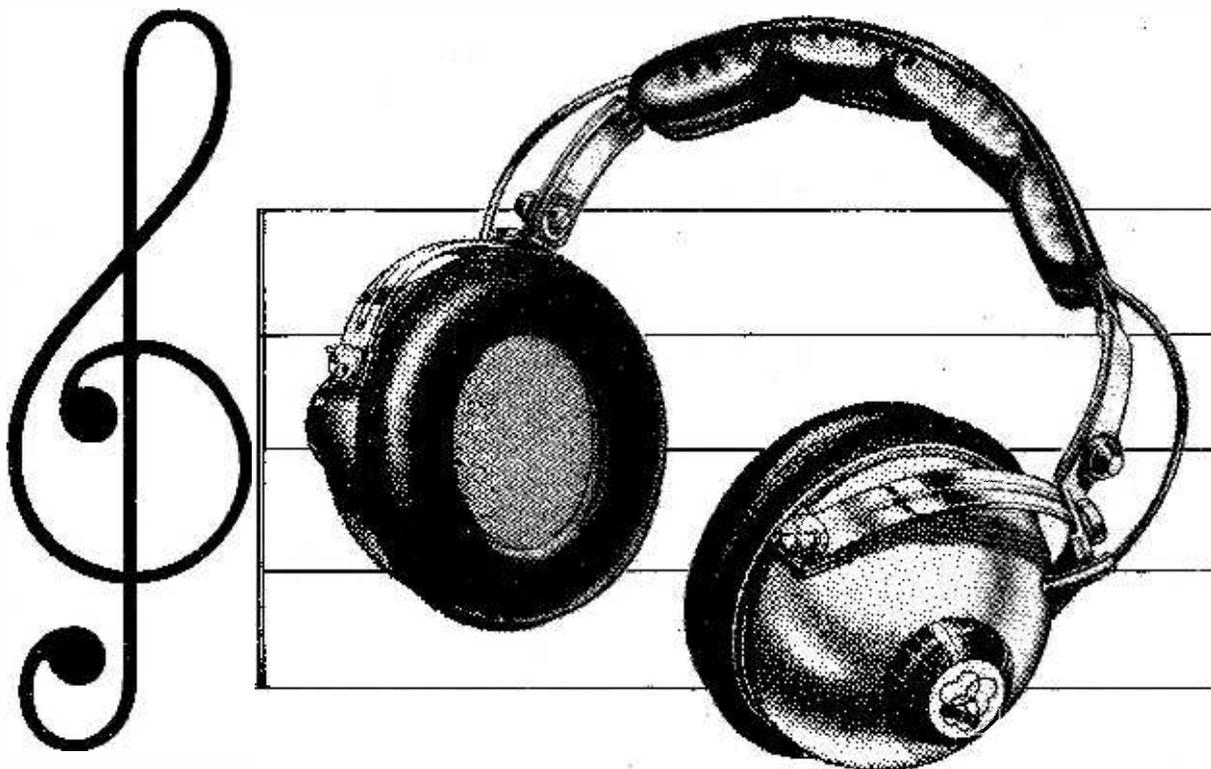
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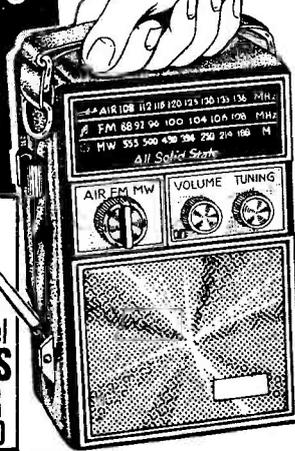
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AMSTRAD I.C. 2000	42.95	27.95
ARMSTRONG 521	59.00	42.95
DULCI 207	28.00	16.95
DULCI 207H FM	32.00	19.50
FERROGRAPH F307 Mk. II (cased)	54.00	48.95
FERROGRAPH F307 Mil (Metalcase)	60.00	42.95
GOODMANS Maxamp	54.00	34.95
LEAK Delta 30 (cased)	65.00	48.50
LEAK Delta 70 (cased)	79.50	58.95
METROSOUND ST20E	39.50	25.95
METROSOUND ST76	70.00	49.95
MICROSOUND Duplex 15	32.00	23.95
MICROSOUND Duplex 25	52.00	39.95
PHILIPS RH 591	79.00	56.95
PHILIPS RH 590	52.00	37.95
PHILIPS RH 580	29.00	19.95
PIONEER SA500A	53.62	39.95
PIONEER SA600	83.75	59.95
PIONEER SA700	97.97	66.95
PIONEER SA800	109.21	75.95
PIONEER SA900	133.83	93.95
PIONEER SA1000	137.56	95.95
PIONEER Reverberation 202W	46.35	30.95
RANK Rotel 210	54.90	24.95
RANK Rotel 310	47.50	31.50
RANK Rotel 610	74.50	48.95
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ROGERS Ravensbourne (cased)	64.00	46.95
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ROGERS Ravensbrook (cased) Mk. II	52.50	38.50
SINCLAIR 2000	35.00	23.50
SINCLAIR Project 60/2 x Z30/PZ5	23.90	15.95
SINCLAIR PROJECT 60/2 x Z50/PZ8/trans	34.86	23.25
SINCLAIR PROJECT 605	29.95	21.95
SINCLAIR AFU	5.95	4.45
SINCLAIR Noteric	62.95	42.95
SINCLAIR 3000	45.00	30.95
TELETON SAQ 206	32.50	18.25
TELETON 307	30.00	19.95
VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs.	185.00	139.00
WHARFEDALE Linton Amplifier	60.00	42.50

All take both ceramic and magnetic cartridges.

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*ARMSTRONG 524 FM	42.17	32.50
ARMSTRONG Mb Decoder	9.50	7.50
*DULCI FMT 7 FM	29.10	22.95
DULCI FMT 7S Stereo	33.79	24.95
GOODMANS Stereomax	80.07	47.95
LEAK Delta FM	75.00	58.50
LEAK Delta AM/FM	89.50	68.95
PHILIPS RH 690	45.30	34.95
PHILIPS RH 691	85.90	65.95
PHILIPS RH 692 AM/FM	62.99	48.95
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RANK Rotel 320	54.94	39.95
ROGERS Ravensbourne chassis	59.63	45.50
ROGERS Ravensbourne In teak case	64.45	48.95
ROGERS Ravensbrook chassis	43.37	34.95
ROGERS Ravensbrook (cased)	49.38	38.95
SINCLAIR 2000	45.00	34.95
SINCLAIR 3000	45.00	34.95
SINCLAIR Project 60 tuner (stereo)	25.00	19.25
TELETON GT 101	43.93	30.50

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

	Rec. Retail	Comet Price
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AKAI 6600	137.34	107.50
AKAI 6300	128.85	94.50
AKAI 6200	91.56	73.95
ARENA 2600	111.30	89.95
ARENA 19000	303.45	285.00
ARMSTRONG M8 Decoder	9.50	7.50
ARMSTRONG 525	92.77	69.95
ARMSTRONG 526	105.72	79.95
GOODMANS Module 80, 35w. RMS	91.59	68.50
GOODMANS Module 80 Compact	165.00	129.00
GOODMANS Module 110 FM/MW/LW/SW 100W RMS	135.00	108.00
LEAK Delta 75	165.00	128.95
MIDLAND 19/542	49.56	37.50
PHILIPS RH 790	134.00	77.95
PIONEER SX770 AM/FM	139.23	109.95
PIONEER SX900 AM/FM	167.83	125.95
PIONEER 440	104.16	82.95
ROGERS Ravensbrook Chassis	99.39	81.95
ROGERS Ravensbrook (cased)	108.43	87.95
ROTEL RX150	69.90	53.50
TANDBERG 1171	110.00	82.50
TANDBERG T1200	99.00	82.95
TELETON F2000	51.50	39.95
TELETON 10AT 150w. RMS	160.00	94.00
TELETON TFS50	79.65	53.95
TELETON TFS50 LA MW/LW/FM	86.64	61.95
TELETON CR55	125.26	61.95
WHARFEDALE 100-1	139.00	92.95



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GOLDRING G850	6.27	3.95
GOLDRING G800	12.55	5.95
GOLDRING G800E	18.16	10.45
GOLDRING G800 Super E	25.10	19.95
*GOLD RING CS90 Stereo	5.02	4.25
*GOLD RING CS91/E	7.53	6.35
EMPIRE 1000ZE/X	60.34	46.95
EMPIRE 999VE/X	43.00	33.95
EMPIRE 999TE/X	25.09	19.95
EMPIRE 999SE/X	20.31	15.95
EMPIRE 999E/X	15.89	12.30
EMPIRE 999Y	12.55	8.95
EMPIRE 900E/X	12.37	8.90
EMPIRE 900Y	9.26	7.25
EMPIRE 900E/X	9.56	7.50
ORBIT Magnetic NM 22	Special Price	2.90
ORTOFON SL15E	28.62	22.95
ORTOFON 2 X 25K Transformer	7.00	6.95
ORTOFON M15E	29.08	23.50
SHURE M3DM	7.16	4.49
SHURE M31E	11.63	8.69
SHURE M32E	10.73	8.00
SHURE M32-3	9.84	7.80
SHURE M44-5	10.73	7.25
SHURE M44-7	9.94	6.70
SHURE M-44C	9.84	6.70
SHURE M44E	11.63	7.95
SHURE M55E	12.52	8.95
SHURE M75G	16.99	11.95
SHURE M75-E	16.10	10.95
SHURE M75EJ	18.78	12.95
SHURE M75E	13.27	11.95
SHURE V15-11	39.35	27.50

Starred cartridges above are ceramic. All others are magnetic.

	Rec. Retail	Comet Price
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GOLDRING Lenco 75	13.98	9.50
GOLDRING Lenco L69	10.04	6.50
SME 3009 with S2 Shell	33.28	24.95
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The following Turntables are complete with base, plinth, perspex cover and cartridge. Fully wired and ready for use. All at special prices.		
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GARRARD SP25 Mk II with Shure M.55E	Special Price £22.95	
GARRARD AP76 with Goldring G800	Special Price £29.90	
GARRARD AP76 with Shure M55E	Special Price £33.95	
GARRARD AP76 with Shure M75EJ	Special Price £35.95	
GARRARD 2025 with Sonotone 9T AHC	Special Price £13.90	
GOLDRING 705/P with G850	Special Price £10.95	
GOLDRING GL75 with G800	Special Price £40.95	
THORENS 150 AB complete in TX11 cover Shure M55E cartridge	Special Price £49.95.	
GARRARD SP25 Mk III	15.85	9.95
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

	Rec. Retail	Comet Price
GARRARD Zero 100	56.25	42.95
GARRARD Zero 100S	51.75	41.95
GARRARD WB4 base Mk II Z to fit Zero 100 & Zero 100S.	6.40	4.95
Base and Cover to fit GARRARD SP25, SL55, SL65B	Special Price	3.60
GARRARD 40B	13.34	10.95
GARRARD AP76	27.85	18.95
GOLDRING GL89 Mk. II	27.60	18.95
GOLDRING GL75	36.21	26.95
GOLDRING GL75P	40.15	28.95
GOLDRING GL75P	48.78	35.95
GOLDRING Covers for 69P and 72P	4.48	3.75
Cover for 75P Deluxe	5.02	3.95
GOLDRING C99-plinth and cover for G99	11.05	9.75
GOLDRING G99	26.89	19.90
GOLDRING G101P	28.68	22.95
GOLDRING GL72 Chassis	28.68	22.95
GOLDRING GL72P	37.29	29.95
GOLDRING GL85	62.74	47.95
GOLDRING GL85P	72.78	55.95
GOODMANS 302S	37.74	19.95
LEAK Delta	69.50	59.95
MCDONALD MP 60	15.20	10.70
MCDONALD 610	19.28	14.50
MCDONALD HT 70	21.22	15.45
MCDONALD HT70 Inc. plinth & cov.	30.68	22.25
Base and Cover for MP 60 and 610	Special Price	4.25
PHILIPS 202 Electronic	66.50	52.95
PHILIPS 308 transcription unit complete with base and cover	37.60	28.95
PIONEER PL12A with base & cover	48.34	36.25
THORENS TX25 cover	8.52	6.60
THORENS TD12S	76.03	59.45
THORENS TD125AB	115.57	93.95
THORENS TD150 Mk. II	84.67	28.75
THORENS TD150A Mk. II	44.40	34.25
THORENS TD150AB Mk. II	48.05	38.95
THORENS TX11 Cover	4.26	3.75
WHARFEDALE Linton with base and cover and Shure M447 cartridge	35.00	27.95

	Rec. Retail	Comet Price
SPEAKERS		
ARENA HT 227 (pair)	42.00	26.95
AKAI SW 155	58.48	39.95
B & W Model 70	159.50	111.95
B & W Dm3	63.00	47.95
B & W DM1 (per pair)	76.94	60.95
CELESTION Ditton 120 (per pair)	57.70	43.95
CELESTION Ditton 15	38.47	27.25
CELESTION Ditton 25	65.00	44.50
CELESTION Ditton 44	54.00	39.50
GOODMANS Minister (per pair)	48.20	34.95
GOODMANS Havant (per pair)	56.00	43.95
GOODMANS Magister	62.50	39.50
GOODMANS Double Maxim	33.00	25.75
GOODMANS Mezzo 3	34.00	22.75
GOODMANS Magnum K2	44.00	29.75
GOODMANS Dimension 8	69.00	47.95
GOODMANS DIN 20NT kit	12.54	9.95
KELETON KN400 2-speaker System (pair)	16.10	12.75
KN600 3-speaker System (pair)	26.86	18.95
KN800 3-speaker System	15.90	10.95
KN1100 4-speaker System	20.40	14.95
KN1600 3-speaker System	25.20	18.95
KN2100 3-speaker System	30.70	23.95
LEAK 150 (per pair)	49.90	37.95
LEAK 250 (per pair)	65.00	47.50
LEAK 600	49.50	34.50
METROSOUND HFS 103 (pair)	30.05	23.95
PHILIPS RH 411 (pair)	21.20	16.95
PHILIPS RH 451 (pair)	21.20	16.95
PHILIPS RH 482 (per pair)	34.70	28.95
PHILIPS 300	38.00	30.95
SINCLAIR Q16	8.95	6.90
STE-MA 400	24.00	16.25
TANDBERG TAN 7	28.00	23.95
TANDBERG Tan 11 (per pair)	38.00	31.95
TANDBERG Tan 12 teak (pair)	52.00	44.95

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	Rec. Price	Retail Price	Comet Price
TANDBERG Tan 25 teak (pair)	68-00	58-95	58-95
TANDBERG Tan 50 teak	65-00	49-95	49-95
VOLTEX (Teak) pair	20-50	14-95	14-95
WHARFEDALE Speakers			
Denion Mark II (per pair)	39-90	29-95	29-95
Linton Mark II (per pair)	49-90	37-95	37-95
Melton Mark II	35-00	24-45	24-45
Doveda. 3 3 Mk II (new model)	45-00	30-50	30-50
Rosedale	65-00	44-95	44-95
Triton (pair)	72-16	37-95	37-95
Unit 3 Speaker Kit	12-53	9-45	9-45
Unit 4 Speaker Kit	18-00	12-25	12-25
Unit 5 Speaker Kit	26-00	17-95	17-95

	Rec. Price	Retail Price	Comet Price
CHASSIS SPEAKERS			
GOODMANS Twin-axlette 8	8-84	6-85	6-85
GOODMANS Axiom 201	14-45	10-95	10-95
GOODMANS Axiom 401	17-86	12-25	12-25
GOODMANS Twin Axiom 10	9-86	7-25	7-25
GOODMANS Audiom 8P	5-35	3-95	3-95
GOODMANS Audiom 10P	5-83	4-50	4-50
GOODMANS Audiom 12P	12-37	9-25	9-25
GOODMANS Audiom 15P	20-00	14-75	14-75
GOODMANS Audiom 18P	34-00	24-95	24-95
GOODMANS ARU 172	4-50	3-20	3-20
GOODMANS Trebak 100	8-60	5-25	5-25
GOODMANS Axiom 100	6-90	4-95	4-95
GOODMANS Midax 650	12-95	8-95	8-95
GOODMANS Attenuator	3-55	2-50	2-50
GOODMANS Crossover Networks			
XO950/5000	9-75	7-15	7-15
GOODMANS Crossover Networks XO950	7-40	4-95	4-95
GOODMANS Crossover Networks XO5000	2-65	1-85	1-85
WHARFEDALE Bin. Bronze/RS/DD	4-82	3-45	3-45
WHARFEDALE Super 8/RS/DD	8-19	6-70	6-70
WHARFEDALE Super 10/RS/DD	11-20	10-50	10-50
WHARFEDALE WMT1 Matching Transformer	0-84	0-70	0-70

	Rec. Price	Retail Price	Comet Price
HI-FI STEREO SYSTEMS COMPLETE			
ALBA UA552	45-86	35-50	35-50
AMSTRAD Stereo 1000	48-00	34-95	34-95
DANSETTE Concert Stereo	33-74	29-95	29-95
DECCA Sound 613	70-14	51-95	51-95
DECCA Sound 614	68-55	54-95	54-95
DECCA Sound 1204	89-44	72-95	72-95
DECCA Compact 3	119-56	103-95	103-95
DECCA 403	59-50	48-95	48-95
DECCA 613	70-14	57-95	57-95
ELIZABETHAN LZ101	59-95	42-95	42-95
FERGUSON 3450 with radio	72-40	61-95	61-95
FERGUSON 3451 with radio	99-50	79-95	79-95
FIDELITY UA2 Music Master	44-50	34-95	34-95
FIDELITY UA1 Music Master with radio	107-00	81-95	81-95
GOODMANS Module 80 Compact System FM/35W. R.M.S. (less L/S)			
H.M.V. 2404/516 with radio	165-00	129-00	129-00
HMV 2452	198-00	153-00	153-00
HMV 2450 with stereo radio	65-65	51-95	51-95
MARCONI 4452	134-20	107-95	107-95
PHILCO Ford M1500	78-00	57-95	57-95
PHILIPS 808	99-93	68-50	68-50
PHILIPS 580/481/105	96-05	75-95	75-95
PHILIPS GF 823	71-00	55-95	55-95
PHILIPS GF 824	47-80	35-95	35-95
PHILIPS RF 833	67-10	50-95	50-95
PHILIPS RF 834	67-10	51-95	51-95
PHILIPS GF 834	86-40	65-95	65-95
PYE Black Box Unit Stereo 1022	93-45	69-95	69-95
RIGANDA Party Time	27-50	21-95	21-95
STEEPLETON Stereo system	41-75	33-95	33-95
TELETON STP 8-track Stereo System			
System	54-75	47-00	47-00
ULTRA 6026	37-10	30-95	30-95

	Rec. Price	Retail Price	Comet Price
TAPE RECORDERS AND TAPE DECKS			
AKAI 1700 4-track stereo deck	93-00	59-95	59-95
AKAI 4000D 8-track stereo deck	89-95	61-95	61-95
AKAI CR80D 8-track stereo tape deck	79-95	55-95	55-95

	Rec. Price	Retail Price	Comet Price
AKAI CR80 8-track stereo recorder	99-95	69-95	69-95
AKAI X200D	145-95	103-00	103-00
AKAI 1800SD	153-00	105-00	105-00
AKAI 2000SD	289-00	216-00	216-00
AKAI GXC 40D Cassette Tape Deck	87-50	67-95	67-95
AKAI GXC 40 Cassette recorder	105-00	79-95	79-95
BUSH Discassette DC70	21-19	16-95	16-95
BUSH TP60 Cassette tape recorder	28-38	23-95	23-95
BUSH T.P. 66 Batt./Mains Cassette Recorder	28-95	22-75	22-75
BUSH TP70 Cassette, battery/mains tape recorder			
FERGUSON 3245 Twin track	28-91	23-50	23-50
FERGUSON 3246 4-track	36-70	26-95	26-95
FERGUSON 3247 4-track	42-55	31-95	31-95
FERGUSON 3248 4-track	47-95	35-95	35-95
FERGUSON 3249 4-track	53-75	40-95	40-95
FERGUSON 3252 4-track	100-52	79-95	79-95
FERGUSON 3253 1	43-55	33-50	33-50
FERGUSON 3258 4-track	72-40	55-95	55-95
FERROGRAPH 702 2-track tape deck	220-22	175-00	175-00
FERROGRAPH 704/W 4-track tape deck	220-22	175-00	175-00
FERROGRAPH 722	256-52	195-00	195-00
FERROGRAPH 724	256-52	195-00	195-00
GRUNDIG C200 De Luxe Cassette	38-45	28-95	28-95
GRUNDIG TK 121 twin track	57-90	40-95	40-95
GRUNDIG TK 141 4-track	63-90	46-95	46-95
GRUNDIG TK 146 4-track Auto	68-90	51-50	51-50
GRUNDIG TK 147 4-track Auto	95-75	73-95	73-95
GRUNDIG C410 Cassette recorder	43-70	33-95	33-95
PHILIPS 2202 cassette	26-90	18-95	18-95
PHILIPS 2204 cassette, battery/mains	32-30	23-50	23-50
PHILIPS R.R. 392 MW/UHF Radio Cassette Recorder	49-95	37-50	37-50
PHILIPS 3302 cassette	23-05	16-95	16-95
PHILIPS 4307 4-track	50-00	34-95	34-95
PHILIPS 4308 De Luxe 4-track	58-40	42-50	42-50
PHILIPS 4404 2-track stereo recorder	91-70	67-95	67-95
PHILIPS 4407 4-track stereo recorder	111-50	83-95	83-95
PHILIPS 4500 4-track stereo tape deck	127-70	93-95	93-95
PHILIPS 4408 4-track stereo	134-20	102-95	102-95
PHILIPS 2503 Cassette Stereo tape deck	52-05	45-95	45-95
PHILIPS 2400 stereo cassette less L/S	68-00	55-95	55-95
PYE 9109 cassette	20-95	18-95	18-95
PYE 9116 Stereo cassette	68-00	52-95	52-95
TANDBERG 1841 4-track stereo tape deck			
TANDBERG 3021X twin track stereo	107-00	82-95	82-95
TANDBERG 3041X 4-track stereo	107-00	82-95	82-95
TANDBERG 4021X twin track stereo	174-00	139-00	139-00
TANDBERG 4041X 4-track stereo	174-00	139-00	139-00
TANDBERG 6041X 4-track stereo	188-00	149-00	149-00
TANDBERG 6021X twin track stereo	188-00	149-00	149-00
TELETON TC110 cassette battery/mains	26-79	18-95	18-95
WHARFEDALE Dolby DC9 cassette stereo tape deck	110-00	89-95	89-95

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BASES AND COVERS			
GARRARD WB1 Base	3-71	3-25	3-25
GARRARD WB4 Base	5-49	4-75	4-75
GARRARD SPC1 Cover	3-60	2-95	2-95
GARRARD SPC4 Cover	4-27	2-75	2-75
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GOLDRING Plinth 75	8-60	7-00	7-00
GOLDRING Plinth 69	8-60	7-00	7-00
GOLDRING Covers for 69P and 72P	4-48	3-75	3-75
Cover for 75P	5-02	3-95	3-95
THORENS TX25 (for TD125AB)	8-52	6-95	6-95
THORENS TX10 Cover	4-26	3-75	3-75
Base and Cover for TD 125	15-04	12-45	12-45
SME Plinth System 2000	41-36	33-50	33-50
MOTORBOARDS only	5-22	3-25	3-25

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	Rec. Price	Retail Price	Comet Price			
THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Delta 70 Amplifier, 2 Wharfedale Dovedale 3 Speakers				234-33	175-95	175-95
TELETON STP 801 Stereo 8 track tape Audio system complete with speakers				54-75	47-00	47-00

	Rec. Price	Retail Price	Comet Price			
GARRARD AP76 with base and cover with Shure M55E cartridge. Arena 2600 AM/FM and SW Tuner/ Amp and 2 Goodmans Mezzo III speakers				229-43	148-00	148-00

	Rec. Price	Retail Price	Comet Price			
GOLDRING GL75 complete with base and cover, G800 Cartridge, Wharfedale 100-1 Tuner/Amp and 2 Wharfedale Dovedale III speakers				294-79	189-00	189-00

	Rec. Price	Retail Price	Comet Price			
GOODMANS Module 80 Tuner/ Amplifier, Garrard AP76 Turntable with Goldring G800 Cartridge and 2 Goodmans Minister Speakers				189-95	132-95	132-95

	Rec. Price	Retail Price	Comet Price			
GOLDRING 705P Turntable fully wired, complete with Goldring 850 Cartridge, Amstrad stereo 8000 amplifier and 2 MetroSound 103 speakers				81-00	49-95	49-95

	Rec. Price	Retail Price	Comet Price			
METROSOUND 448 8-track stereo play-back unit complete with 2 HFS 103 Speakers				83-56	70-95	70-95

	Rec. Price	Retail Price	Comet Price			
LINTON System with Wharfedale Linton Amplifier, Linton Turntable with Shure M47 Cartridge and pair of Linton MkII Speakers				144-90	107-95	107-95

	Rec. Price	Retail Price	Comet Price			
ALBA UA 700 Amplifier Garrard SP25 with G800 cartridge including base, plinth and cover and pair of Arena speakers				110-85	67-95	67-95

	Rec. Price	Retail Price	Comet Price			
AMSTRAD 8000 Mk. II Amplifier, Garrard SP25 with G800 cartridge including base, plinth and cover and pair of Voltex speakers				82-45	49-95	49-95

	Rec. Price	Retail Price	Comet Price			
PHILIPS 308 Transcription Turntable, complete with plinth, base and cover and fitted with Empire 909E/X cartridge, Rank Rotel 310 Amplifier and pair of Wharfedale Triton Speakers				169-63	106-95	106-95

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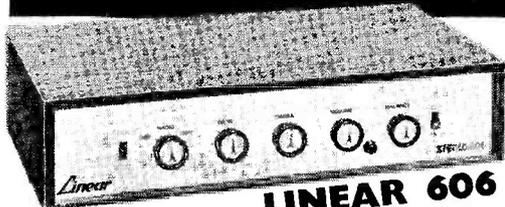
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0-200-230-250v. 50 Hz
A.C. mains operation.
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Bass Control ± 12 dB at 40 Hz.
Treble Control ± 12 dB at 14 KHz.
Sensitivities Mag. P.U. 3.5 m.v. into 47K ohm R.I.A.A. Ceramic P.U. 35 m.v. into 100K ohm. Tape Amp. 100 m.v. into 100K ohm. Radio Tuner 400 m.v. into 400K ohm.
Crosstalk 53 dB.
Hum and Noise -75 dB min. vol. -65 dB max. vol.
Total Harmonic Distortion 0.1% at 1 watt into 15 ohms.
Output (per channel) 6.5 watts I.H.F.M.

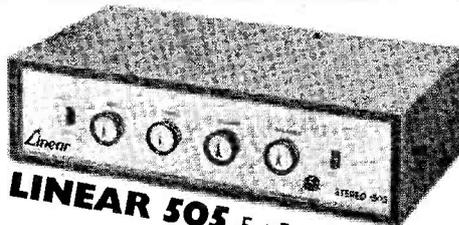
- ★ Individual Bass and Treble Controls.
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- ★ Attractive silver finished metal facia and matching control knobs.

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- ★ Suitable for crystal or ceramic Gram. Pick-up cartridges, and Radio input.
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Bass Control ± 12 dB at 60 Hz.
Treble Control ± 14 dB. at 14 KHz.

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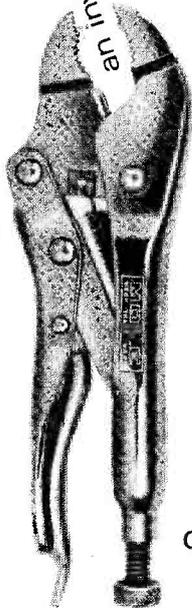
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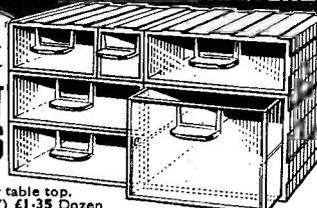
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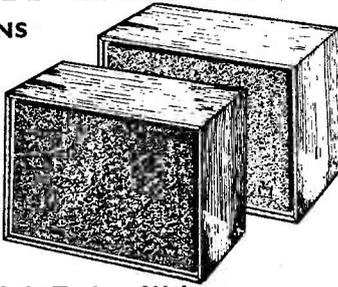
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List Price	Lasky's Price	C & P	List Price	Lasky's Price	C & P		
LINTON 2 Pair	£49.90	£39.95	£2	ROSEDALE ea.	£65.00	£50.00	£1
TRITON 3 Pair	£65.00	£53.50	£2	UNIT 3 each	£12.50	£9.70	50p
MELTON 2 each	£35.00	£25.50	£1	UNIT 4 each	£18.00	£12.50	50p
DOVEDALE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

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5in. RT.23 Double play, 1,200ft.	75p	7in. RT.10 Standard play, 1,200ft.	
5in. RT.18 Long play, 900ft.		Mylar	63p
Acetate	50p	7in. RT.12 Long play, 1,800ft.	
5in. RT.17 Standard play 600ft.	43p	Mylar	95p
5½in. RT.15 Double play, 1,800ft.	£1.13	7in. RT.13 Double play, 2,400ft.	
Mylar		Mylar	£1.25
5½in. RT.16 Long play 1,200ft.		7in. RT.11 Long play, 1,800ft.	
Acetate	75p	Acetate	75p
5½in. RT.24 Standard play 900ft.		7in. RT.19 Triple play, 3,600ft.	
P.V.C.	68p	Mylar	£2.50
5½in. RT.14 Long play 1,200ft.		3½in. RT.27 Quad play, 1,100ft.	£1.02
Mylar	75p		

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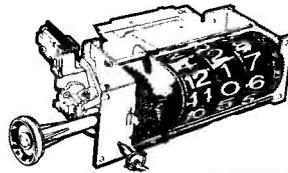
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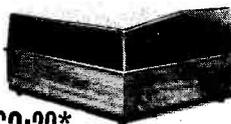
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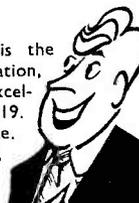
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AC126	0-13	OC171	0-23
AC127	0-17	OC200	0-25
AC128	0-13	OC201	0-25
AC176	0-25	2G301	0-13
ACY17	0-15	2G303	0-13
AF239	0-37	2N711	0-50
AF186	0-50	2N1302-3	0-20
AF139	0-37	2N1304-5	0-25
BC154	0-25	2N1306-7	0-30
BC107	0-13	2N1308-9	0-35
BC108	0-13	2N3819FET	0-45
BC109	0-14		
BF194	0-15	Power Transistors	
BF274	0-15	OC20	0-50
BFY50	0-20	OC23	0-30
BSY25	0-57	OC25	0-25
BSY26	0-13	OC26	0-25
BSY27	0-13	OC28	0-30
BSY28	0-13	OC35	0-25
BSY29	0-13	OC36	0-37
BSY95A	0-15	AD149	0-30
OC41	0-13	AUJ10	1-25
OC44	0-13	2S034	0-25
OC45	0-13	2N3055	0-50
OC71	0-13		
OC72	0-13	Diodes	
OC81	0-13	AA442	0-10
OC81D	0-13	OA95	0-19
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This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819. Data sheet supplied with device. 1-10 30p each, 10-50 25p each, 50+ 20p each.



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cartridge, plinth and cover
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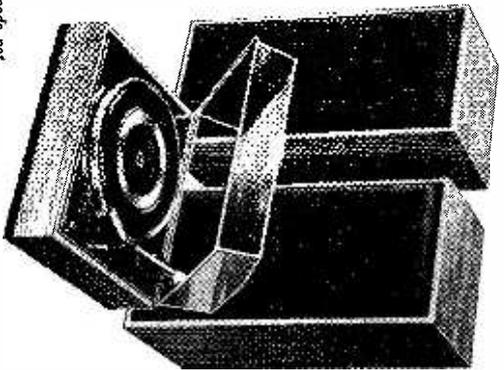
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Total
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£14 pair + £2 p&p.

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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 ±1dB R.L.A.A. Radio 150mV into 220K. (Sensitivity given at full power). Tape out facilities: headphone sockets, power out 250mW per channel. Tone controls and filter characteristics. Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15KHz. Treble filter: 12dB per octave. Signal to noise ratio: (all controls at max) 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 3/4" x 9" x 3 3/4".



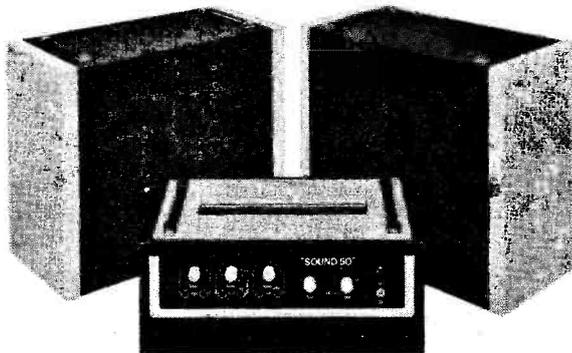
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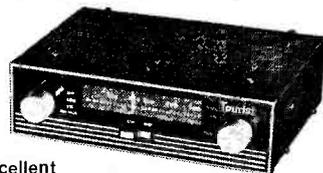
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CONTINENTAL 4 TRACK, 3 SPEED TAPE DECK



with high impedance heads

R.C. 74 tape deck. Three speeds—7½, 3½ and 1½ ips.

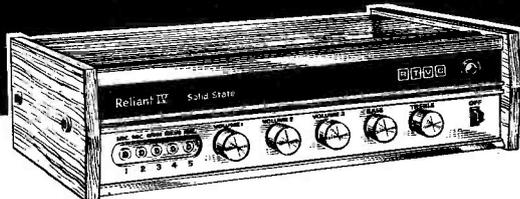
4-track record/playback head. Plus 4-track erase head. Positive pressure pad system. Takes any tape spool up to and including 7". The R.C. 74 is driven by a powerful 200/250V 50-cycle A.C. motor. A heavy, accurately balanced, flywheel brings wow and flutter levels down to approx. 0.3% total at 3½ and 7½ ips. Fast rewind in both directions.

Controls couldn't be simpler! Just five push buttons that interlock to cut out accidental tape damage. Efficient servo-action type braking. Easy drop-in tape loading.

The R.C. 74 comes with an attractive moulded deck cover, which has positions for tone and volume controls. The unit is built into a rigid die-cast frame, and overall size of the whole unit is 12½ × 11½ × 6 inches. Every single deck fully tested before dispatch. Spools not supplied.

Price complete £15.00. Plus 75p P. & P.

RELIANT mk. IV



Provides a high standard of sound reproduction, with full mixing facilities. Its versatility makes it suitable for: Discotheque, P.A., Home Entertainment Applications, etc.

- ★ Five Electronically Mixed Inputs
- ★ Three Individual Mixing Controls
- ★ Separate base and treble controls common to all five inputs
- ★ Mixer employing F.E.T. (Field Effect Transistor)
- ★ Solid State Circuitry ★ Attractive Styling

£9.50 plus P. & P. 60p.

INPUTS:—1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic or Guitar 8mV. Inputs 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.). All 250mV sensitivity.

CONTROLS:—3 Volume controls. Bass control range: 13db @ 60Hz. Treble control range ±12db @ 15KHz. Separate ON/OFF Switch. Neon Indicator.

POWER OUTPUT:—12 Watts R.M.S. into 3 to 4 ohms speaker

SIGNAL/NOISE:—Better than -60db on inputs 3, 4 and 5 & -50db on 1 & 2

SUPPLY:—220 - 250 AC Mains. **SIZE:**—12½" x 6" x 3½"

DUETTO mk. II I.C.

STEREO AMPLIFIER



Sophisticated styling combined with up-to-date electronics means Hi-Fi. This is what the Duetto Mk.II offers at a realistic price. Mullard built stereo pre-amplifier/tone control module and the highly efficient I.C. monolithic power chips ensure: reliability, very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum etc.

Inputs : P.U. 150mV. @ 2-2 Meg (for cer. cartridge)
Auxiliary 100mV. @ 1 Meg (for radio, tape etc.)

Outputs : 5 watts rms per channel into 8-15Ω speakers.
Switched stereo headphone socket with power correction.

Controls : Mono/stereo switch, selector switch, treble, bass, volume, balance and on/off switch. Neon indicator.

Tone Controls : Treble ±14db @ 15KHz
Bass ±14db @ 60Hz

Power Bandwidth : ±2db 20Hz-25KHz

£10.50

plus P. & P. 60p



See opposite page for addresses

FIND BURIED TREASURE!

Transistorised Treasure Locator

This fully portable transistorised metal locator detects and traces down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed.

HEATHROW, GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC. Extremely sensitive, will signal presence of certain objects buried several feet below ground. No knowledge of radio or electronics required. Can be built with ease in one short evening by anybody from nine years of age upwards, with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2-37** & 27p p. & p. (Sectional handle as illustrated 75p extra). Parts available separately. Made up looks worth £15!

Eavesdrop on the exciting world of Aircraft Communications

V.H.F. AIRCRAFT BAND ONLY CONVERTER £2-37

Listen in to AIR LINES, PRIVATE PLANES, JETPLANES. Eavesdrop on exciting cross talk between pilots, ground approach control, airport tower. Hear for yourself the disciplined voices hiding themselves on talk down. Be with them when they have to take nerve-ripping decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including HEATHROW, GATWICK, LUTON, KINGFISHER, etc. etc. CLEAR AS A BELL. This fantastic fully transistorised instrument can be built by anyone over nine in under two hours. No soldering necessary. Fully illustrated simple instructions take you step-by-step. Uses standard PP3 battery. All you do is extend rod aerial, place close to any ordinary medium wave radio (even portable). **NO CONNECTIONS WHATSOEVER NEEDED. SEND ONLY £2-37** & 27p p. & p. for kit including case, nuts, screws, wire, etc. (parts available separately).

SHORTWAVE TRANSISTOR RADIO

only **£2-25**

Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 76 stations tugged on rod aerial in 30 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4 1/2" x 1 1/2" **ONLY £2-25** + 17p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).

INGENUOUS ELECTRONIC SLEEP INDUCER

only **£2-75**

CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. It even stops by itself so you don't have to worry about it being on all night! The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, the effect it has on people is amazingly very similar to hypnosis. A complete kit is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions standard batteries, extremely economical. Size only 3" x 4 1/2" x 1 1/2"—take it anywhere. Kit includes case, nuts, wire, screws, etc. **SEND £2-75** + 25p p. & p. (parts available separately).

ELECTRONIC ORGAN

ONLY **£2-75**

Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. **SELF CONTAINED LOUDSPEAKER.** Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary. Simple as ABC to make. Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions. **ONLY £2-75** + 23p p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

Find buried treasure with this READY BUILT & TESTED TREASURE LOCATOR MODULE

ONLY **£4-95**

FULLY TRANSMITTER PRINTED CIRCUIT METAL DETECTOR MODULE. Ready built and tested—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A WORTH ABOVE £20!** Extremely sensitive—penetrates through earth, rock, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects. **No sensitive it will detect certain objects buried SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN! **£4-95** + 30p carr. etc. (High quality Danish Stethoscope head-phones £2-75 extra if required). **EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.**

BUILD 5 RADIO AND ELECTRONIC PROJECTS

only **£1-97**

Amazing Radio Construction set! Become a radio expert for **£1-97**. A complete Home Radio Course. No experience needed.

Parts including simple instructions for each design. Illustrated step-by-step plans, all transistors, loudspeaker, personal phone, knobs, screws, etc. all included. Presentation box **£7p** extra as illus. (if required) (parts available separately) no soldering necessary. **SEND £1-97** + 23p p. & p.

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON

CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. In a sense, many people find a relaxing, mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops—a well known type of pink noise. IF YOU WORRY IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—**TAKE IT ANYWHERE!** Uses standard PP3 batteries (current so small that battery life is almost shelf-life). **BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering. **£2-25** + 25p p. & p. Parts available separately.

CONCORD ELECTRONICS LTD. (PW11) 8 Westbourne Grove, London, W.2. Callers welcome 9 a.m.-6 p.m. inc. Saturday

MW/LW TRANSISTOR RADIO

Complete set of parts for this MW/LW Transistor Radio. Originally sold by world-famous company as a set for more than £17. Coverage 192-655m + 1070-1870m. 9 volt 6 transistor superhet using 3 AF117 in RF and IF stages powered by a two stage AF amplifier using 3 x AC128. Output approx. 500mW. Also works off car-aerial. Full instruction book 121p free with parts. Red only, ply case, rexine covered. Requires PP7 battery, price 23p extra. 3 1/2" high-quality speaker. Price **£6 plus 40p P. & P.** Size 8 1/2" x 6" x 3".

STEREO AMPLIFIER Type SHV—2 x 3 watts

Fully built. Separate vol., base and treble controls each channel; 12 x 4 1/2" x 6 1/2" high. E280, EOC38, 2 x ECI80 valves. O.P. trans. for 3-ohm speakers. Double wound mains trans. Suitable for crystal, magn. cartridge, tuner, etc. Fitted mono-stereo switch. 200-250V a.c. mains. **£7-25**, 50p P. & P.

MONO GRAM CHASSIS 3 WATT

3 Wave band long-med-short. Gram., 200-250V A.C. Ferrite aerial. Chassis 13 x 7 x 1 1/2". Dial 13 x 4 1/2". Double wound mains transformer 5 valves ECH81, E8F9, EBC81, EL84, EZ80. Price **£10-62!** (37sp p. & p.) Output trans. for 3-ohm speaker

MAINS TRANSFORMERS (240-250V input)

Postage in brackets
6-3V at 2 1/2A, 40p (15p).
25V at 50mA and 6-3V at 1 1/2A, 50p (20p).
25V at 1A, 6-3V at 2A and 250V at 30mA, 75p (25p).
90V at 20mA and 1-4V at 250mA, 50p (15p).
Deduct 10 per cent from total bill for more than one transformer.

Miniature A.M. transistor tuning gang, 250 + 250pf; 2 x 6b.a. fixings, size 1 1/2" x 1 1/2" x 1/2"; gearing 3:1 to 1/2" in dia. moulded bush. Plastic dust cover 1 Plessey.
25p post pd., less 10% for 6.

GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT. Hants
(2 mins. from Station and Buses). FULL GUARANTEE. Aldershot 22240
CLOSED WEDNESDAY. S.A.E. for enquiries please.

VALVES SAME DAY SERVICE

NETS! TESTED! GUARANTEED!

SETS 1R5, 1S5, 1T4, 8S4, 3V4, DAF91, DF91, DK91, DL92, DL94.
Set of 4 for £1-02. DAF96, DF96, DK96, DL96, 4 for £1-48.

1R5	-28	30C1	-28	DY802	-38	EL500	-69	PLC82	-85	UABC80	-82
1S5	-22	30C15	-58	DY802	-38	EL500	-69	PLC83	-87	UAC18	-85
1T4	-18	30C17	-78	EAB080	-62	EM81	-88	PLC84	-84	UBCA1	-62
3S4	-36	30C18	-61	EAF42	-50	EM84	-82	PLC85	-38	UBF80	-84
5U4G	-37	30F6	-84	EB91	-10	EM87	-34	PLC86	-38	UBF89	-82
6V4G	-85	30FL12	-89	EB041	-54	EY51	-38	PLC88	-65	UCC84	-32
5Y3GT	-86	30FL14	-68	EB090	-25	EZ40	-28	PLC89	-75	UCC85	-35
5Z4G	-35	30L1	-28	EBF80	-38	EZ41	-48	PEN36C	-70	UCD82	-58
6J80L2	-54	30L15	-57	EBF89	-29	EZ80	-28	PFL206	-59	UCH81	-82
6AL5	-11	30L17	-87	EBC81	-17	EZ81	-28	PL36	-49	UCI82	-32
6AM6	-18	30P4	-57	EBC82	-30	EZ80	-34	PL81	-44	UCI83	-55
6AQ5	-22	30P12	-73	EBC83	-34	EZ82	-34	PL81A	-47	UFI41	-56
6AT6	-20	30P19	-57	EBC85	-34	EZ84	-45	PL82	-33	UFI41	-56
6AU6	-20	30PL1	-60	EBC804	-54	KT41	-77	PL83	-33	UFI49	-80
6BA6	-20	30PL13	-89	EBCF80	-81	KT61	-55	PL84	-30	UL84	-30
6BE6	-21	30PL14	-66	EBCF82	-26	KT66	-78	PL600	-63	UM84	-22
6B6E	-41	35L6GT	-48	EBCH35	-55	LN319	-63	PL564	-63	UY41	-42
6BW7	-52	35V4	-25	ECH42	-58	LN329	-72	PM84	-38	UY85	-25
6FL4	-40	35ZAGT	-25	ECH81	-48	LN339	-63	PX26	-86	VP48	-77
6F23	-68	807	-45	ECH83	-40	N75	-87	PY32	-55	W77	-82
6F25	-58	AC/VP2	-77	ECH84	-38	PAB080	-34	PY33	-55	Z77	-82
6J7G	-24	B349	-66	ECL80	-30	PC86	-47	PY82	-25	Transistors	
6K7G	-18	B729	-82	ECL82	-31	PC88	-47	PY83	-28	AC107	-17
6K8G	-17	CC135	-87	ECL86	-36	PC96	-42	PY88	-38	AC127	-18
6Q7G	-35	CY31	-30	EB99	-38	PC97	-39	PY801	-34	AD146	-37
68N7GT	-30	DAF91	-82	EF41	-60	PC90	-31	PY860	-30	AF116	-20
6V8G	-28	DAF96	-86	EF80	-23	PC84	-29	R19	-80	AF117	-20
6V0GT	-28	DF33	-38	EF85	-28	PC85	-25	R20	-56	AF118	-20
6X4	-28	DF91	-16	EF96	-30	PC88	-40	U25	-64	AF118	-48
6X5GT	-28	DF96	-38	EF99	-26	PC89	-45	U26	-56	AF125	-17
10P13	-58	DH77	-20	EF91	-30	PC189	-48	U47	-68	AF127	-17
12AT7	-18	DK32	-38	EF92	-26	PC805	-56	U49	-26	OC34	-12
12AU7	-17	DK91	-28	EF98	-85	PCF80	-28	U50	-56	OC26	-95
12AX7	-20	DK92	-38	EF183	-28	PCF82	-38	U52	-31	OC45	-12
12BX7	-22	DK96	-38	EF184	-31	PCF86	-48	U78	-24	OC71	-12
19BG6G	-80	DL55	-40	EH90	-36	PCF800	-58	U91	-59	OC72	-12
20F2	-67	DL92	-26	EL33	-55	PCF801	-28	U93	-42	OC73	-12
20F3	-77	DL94	-37	EL41	-54	PCF802	-40	U95	-61	OC81	-12
20P4	-92	DL96	-38	EL84	-23	PCF805	-61	U301	-38	OC82	-12
26L6GT	-19	DY86	-24	EL90	-26	PCF806	-56	U329	-66	OC82D	-12
26U4GT	-57	DY87	-24	EL95	-33	PCF808	-68	U801	-80	OC170	-88



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

MAINS OPERATED CONTACTOR

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



NEED A SPECIAL SWITCH?

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



AUTO-ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12v positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £2.75 plus 25p post and ins.



MICRO SWITCH

5 amp. changeover contacts. 9p each. £1 doz. 15 amp. Model 10p each or £1.05 doz.



MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 20p each. £1-80 for ten, your assortment.



WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 50p post free.

BLANKET SWITCH

Double pole with neon lead into side so luminous in dark, ideal for dark room light or for use with waterproof element, new plastic case 20p each, 3 heat model 40p.



CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 38p each or 10 for £2.42.



TREASURE TRACER

Complete Kit (except wooden battery) to make the metal detector as the circuit in Practical Wireless August issue. £2.95 plus 20p post and insurance.



QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. £1.25, post and insurance 14p. 12v. car model also available same price. Jug heater £1.50 plus p. & 14p.



SNAP ACTION SLIDE SWITCH

Rated 5a, 240v. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. 6p each, 10 for 48p.



NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN. 3 Price 80p each, 10 for £8.

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



LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light. epoxy resin sealed. Size approx. 1in. dia. by 1/2in. thick. Rated at 500 MW, wire ended. 45p with circuit. Also OB12 light cell 45p.

SOLDER GUN

A must for every busy man, gives almost instant heat also illuminates job. Dual heat 100/140 watt £2.75 plus post and ins. 20p. BIG JOB 250 watt model £4.75 plus post and ins. 40p.



2 1/2 kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2 1/2 kW), switch down for half heat (1 1/2 kW), switch central blows cold for summer cooling, adjustable thermostat acts as auto control and safety cutout. Complete kit £3.75. Post and ins. 38p.

THE FULL-FI STEREO SIX

The amplifier

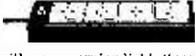


You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal chassis ready for mounting on plinth this amplifier uses solid state circuitry with an output of two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up.

UNREPEATABLE PRICE is £6.50 plus 38p post and insurance. Simulated teak cabinet ready to mount amplifier £1.95.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 5 feet of flex cable. Wired up ready to work. £2.20 plus 23p P. & I.



THIS MONTH'S SNIP MULLARD I.F. AMPLIFIER

3 transistors, 10 tuned circuits, Mullard Ref. No. LP L65289. Frequency not known but designed to be around 465. Mounted on printed circuit board size approx. 3" x 1 1/2". Enclosed and sealed in a metal case with tin copper connecting leads. 75p each. 10 for £2.75. 100 for £22.50p.



Smiths 24 hour 2 on/2 off Time Switch This is the popular model, as used in the Autosec and Morphy Richards time switches. Only needs a case and an output socket. 230v 50 cycle. Contacts switch up to 13 amps. Price £2.75p

TANGENTIAL HEATER UNITS

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. £3.50. 2kW Model as above except 2 kilowatts £2.50. Don't miss this. Control Switch 35p, P. & P. 40p.

COMPUTER TAPE

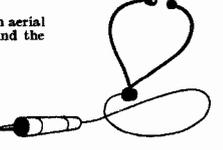
2,400ft. of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide £1.00 plus 33p post and insurance, with cassette. 1/2in. wide £1.00 plus 30p post and insurance with cassette. 1/4in. wide 85p plus 25p post and insurance with cassette. Spare spools and cassettes —1in. 75p, 1/2in. 75p each plus 20p post and insurance.

POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), 30p or 2 for 50p. Post paid.

RADIO STETHOSCOPE

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



TELEPHONE ANSWERING MACHINE

Simply have the G.P.O. change your telephone connection to plus in type—then this machine will plug in—in place of your telephone and will take messages whenever you wish it—briefly the machine comprises two tape recorders, the first one has a very short tape and it is started by the impulse which would normally ring the telephone—this speaks a message telling the caller it is a mechanical answer and asking him to speak his message—the end of this short tape pulls the lever which starts the main tape machine and holds it on while caller speaks. Normal manual switch permits play back of message and rewinds tape for the next session. These machines are normally rented and would cost at least £200 each to make—but we have a quantity believed to be working but definitely repairable. Price £17.50 each plus £1 carriage and insurance.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version. Price £5.25 plus 30p post. When ordering please state whether for positive or negative systems.

TYPE 25 RELAYS

These are miniature relays. Size approx. 1 3/16in. high x 1 1/2in. wide x 1/2in. deep. 4 changeover silver/gold contacts. Contact rating approx. 100v. D.C. Fitted with a plastic cover. Coil operates approx. 250MW D.C. Available with the following coils:
20ohms for 1.25v. 45ohm for 4-75v 52ohm for 4-9-6v
90ohm for 5-11-6v 130ohm for 10-16v 530ohm for 17-30v
1250ohm for 27-44v 2500ohm for 31-65v 5300ohm for 27-44v, 75p each, 10 for £2.75. Also one with 16,500ohm coil but this has only 2 heavy duty change over gold contacts. Price £1.45.



Veroboard. We are now stocking this in various sizes. Prices as follows: 0-1 0-15

2 1/2 x 3 1/2	22p	16p
2 1/2 x 5	24p	24p
3 1/2 x 5 1/2	24p	17p
3 1/2 x 5	27p	27p
17 x 2 1/2	75p	57p
17 x 3 1/2	100p	75p
17 x 5 (plain)	—	75p
17 x 3 1/2 (plain)	—	52p
17 x 2 1/2 (plain)	—	37p
2 1/2 x 5 (plain)	—	17p
2 1/2 x 3 1/2 (plain)	—	15p
Pin insertion tool	47p	47p
Spot face cutter	37p	37p
Pkt. 50 pins	20p	20p

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. Kit B—30-40 w. £1. Kit C—80 w. £1.20. Kit E—65 w. £1.90. Kit F for 8ft. 125 w. tube £1.75. Kit MF1 is for 6in., 9in. and 12in. miniature tubes £1. Kit MF2 for 21in. 13 w. miniature tube £1. Postage on Kits A and B 23p for one or two kits then 23p each for two kits ordered. Kits C, D and E 23p or first kit then 18p for each kit ordered. Kit F 33p than 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

O-8 AMMETER

2 in. square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price 45p each. 10 for £2.80.



Box Sign for Window Display. at home, office or shop, 2 ft. wide x 14 in. high x 1 1/2 in. deep. This is illuminated box sign made from sheet metal hammer finish enamel with a clear plastic window. You simply have your message printed or written on poster board or thick card. (Or use stick down letters available at most stations). You will then have a box sign normally costing anything between £10-£15. Illumination is by a 2 ft. fluorescent tube with control gear enclosed. Message card can be changed quite easily from hinged top back. Price £2 each, plus 65p post, etc.

Motivated Illuminated Box Sign. A previous item but with geared motor moving the message making it change eight times a minute. Very attention arresting. To use this for your own messages you would have to have each sign written on card then cut this up in strips which could be glued to the one supplied with the box sign. Price £4.50, plus 65p post and service.

Geared Motor with take off socket. The gear train is driven by normal type induction motor and gives a final speed of 6 r.p.m. The motor is mounted behind a chrome plate through which the take off drive protrudes and was originally intended to drive a spit for cooking, is also ideal for driving models or for driving a colour changing disc for the local dance hall, discotheque, etc. Really well made assembly. Price £1.75 plus 25p post, etc.

Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil cannot reach. Has a long life. We have purchased a large quantity of these from the Liquidator and are able to offer them to you at about half of the original list price. 30p per (8 oz.) can or 10 cans for £2 post paid. The lubricant is I.C.I. fluid L169.

REED SWITCHES

Glass encased, switches operated by external magnet: gold welded contacts. We can now offer 3 types:

Miniature. 1" long x approximately 1/2" diameter. Will make and break up to 1/2 A up to 300V. Price 15p each, £1.50 dozen.

Standard. 2" long x 1/2" diameter. This will break currents of up to 1A, voltage up to 250V. Price 10p each, 60p per dozen.

Flat. Flat type, 2" long, just over 1/2" thick flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed and covered square solenoid. Rating 1A 200V. Price 30p each, £2 per dozen.

Small ceramic magnets to operate these reed switches 9p each, 90p dozen.

Dry Reed Relays. Solenoids on moulded bobbins within magnetic shields—printer circuit or panel mounting.

Ref.	Coil Resistance	Reed Switches	Price
71005	2 K	1 normally open	25p
81916	5 K	1 normally open	—
05003	4 K	1 normally closed	75p
62040	1500 & 500 ohms	1 normally open	35p

Multiple Reed Relay, Ref. 53001. Contains 13 normally open reeds within a solenoid. Operates on 600 mW. Coil resistance 9K ohms. Price £1.95 each.

Multiple Reed Relay, Ref. 061. 2 normally open 1 normally closed coil resistance 30 ohms. Price 75p

J. BULL (ELECTRICAL) LTD.
(Dept. P.W.), 7 Park Street, Croydon CRO 1YD
Callers to: 162/3 Tamworth Road, Croydon.

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-66	TO-48	TO-48	TO-48
50	\$2	\$2	\$2	\$2	\$2	\$2
100	0-25	0-25	0-47	0-50	0-53	1-15
200	0-35	0-37	0-57	0-61	0-75	1-60
400	0-43	0-47	0-67	0-75	0-93	1-75
600	0-53	0-57	0-77	0-87	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	\$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	0-08	0-14	0-20	0-24	1-00
400	0-06	0-13	0-07	0-20	0-27	0-37	1-25
600	0-07	0-16	0-10	0-23	0-34	0-45	1-85
800	0-10	0-17	0-12	0-25	0-37	0-55	2-00
1000	0-11	0-25	0-15	0-30	0-46	0-63	2-50
1200	—	0-33	—	0-33	0-57	0-75	—

TRIACS

VBOM	2A	6A	10A
TO-1	TO-66	TO-66	TO-88
\$p	\$p	\$p	\$p
100	30	50	76
200	50	60	90
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

UNIFUNCTION

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

NPN SILICON PLANAR

BC107/8/8, 10p each; 50-99 8p; 100 up 8p each; 1,000 off 7p each. Fully-tested and coded TO-18 case.

FREE

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

AF239 PNP GERM. SIEMENS VHF TRANSISTORS. RF MIXER & OSC. UP TO 900 MHZ. USE AS REPLACEMENT FOR AF139-AF186 & 100's OF OTHER USES IN VHF. 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 20,000 TO CLEAR

CADMIUM CELLS

ORP12 45p ORP60, ORP61 40p each

PHOTO TRANS.

OC71 Type. 45p

SIL. G.P. DIODES 5p

300mW 30, 0-90 40 PIV (Min.) 100, 1-50 Sub-Min. 500, 5-00 Full Tested 1,000, 5-00 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.

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MIXED ELECTRONIC COMPONENTS Exceptionally good value

Resistors, capacitors, pots, electrolytics and coils plus many other useful items. Approximately 3lbs in weight. Price incl. P. & P. \$1.50 only.

Plus our satisfaction or money back guarantee.

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V. 400mW (DO-7 Case) 13p ea. 11W (Top-Hat) 18p ea. 10W (SO-10 Stud) 26p ea. All fully tested 99% tol. and marked. State voltage required.

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed Pak No. 8713 EQVT T2 8 D1374 OC75 T3 8 D1216 OC81D T4 8 D1381T OC81 T5 8 D1382T OC82 T6 8 D1344B OC44 T7 8 D1345B OC45 T8 8 D1387B OC78 T9 8 D1389A 2N1302 T10 8 D1387 AF117 All 50p each pak

2N2906 NPN SIL. DUAL TRANS. CODE D1899 TEXAS. Our price 25p each.

120 VC MIXIE DRIVER TRANSISTOR. Sim. BEX21 & 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 5p each. Any Qty.

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AF117 transistors. Large can 4 leads type. Leads cut short but still usable. Retail value at 15 for 60p.

KING OF THE PAKS Unequaled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak. or money back.

Pak No.	\$p
U1 120 Glass sub-min. general purpose germanium diodes	0-50
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. BSY96A, 2N706	0-50
U7 16 Silicon rectifiers Top-Hat 750mA up to 1,000V	0-50
U8 50 Sil. planar diodes 250mA, OA/200/202	0-50
U9 20 Mixed volt 1 watt Zener diodes	0-50
U11 30 PNP silicon planar transistors TO-5 sim. 2N1132	0-50
U13 30 PNP-NPN sil. transistors OC900 & 28104	0-50
U14 150 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 80 Germanium PNP AF transistors TO-5 like ACY 17-22	0-50
U18 8 8-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 Mact'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 2N706, BSY27	0-50
U26 30 Fast switching silicon diodes like IN914 micro-min	0-50
U29 10 1-Amp SCR's TO-5 can up to 600 PIV CRS1/25-600	1-00
U31 20 Sil. Planar NPN trans. low noise amp 8N3707	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 25 Sil. planar PNP trans. TO-5 BFY50/51/52	0-50
U37 30 Sil. alloy trans. 80-2 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 2N2906	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 3A 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
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Q3 4 OC77 type trans.	0-50
Q4 8 Matched trans. OC44/45/81/81D	0-50
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Q11 2 AF116 type trans.	0-50
Q12 3 AF117 type trans.	0-50
Q13 3 OC171 H.F. type trans.	0-50
Q14 5 2N2926 sil. epoxy trans.	0-50
Q15 2 GET950 low noise germ. trans.	0-50
Q16 3 NPN 1 ST141 & 2 ST140	0-50
Q17 4 Mact's 2 MAT 101 & 2 MAT 120	0-50
Q18 3 Mact's 2 MAT 101 & 1 MAT 121	0-50
Q19 4 OC44 germ. trans. A.F.	0-50
Q20 21 3 AC127 NPN germ. trans.	0-50
Q22 20 NKT trans. A.F. R.F. coded	0-50
Q23 10 202 sil. diodes sub-min.	0-50
Q24 8 OA81 diodes	0-50
Q25 6 IN914 sil. diodes 75 PIV 75mA	0-50
Q26 8 OA95 germ. diodes sub-min. IN69	0-50
Q27 2 10A 600 PIV sil. recta. 1845R	0-50
Q28 2 Sil. power recta. BY213	0-50
Q29 4 Sil. trans. 2 x 2N696, 1 x 2N697	0-50
Q30 7 Sil. switch trans. 2N708 PNP	0-50
Q31 6 Sil. switch trans. 2N708 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. 2N2369, 500MHZ	0-50
Q35 3 Sil. PNP TO-5 2 x 2N2904 & 1 x 2N905	0-50
Q36 7 2N3646 TO-18 plastic 300MHZ NPN	0-50
Q37 2 2N3053 NPN sil. trans	0-50
Q38 7 PNP trans. 4 x 2N3703, 3 x 2N3702	0-50
Q39 7 NPN trans. 4 x 2N3704, 3 x 2N3705	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 BC118 NPN TO-18 trans	0-50
Q46 8 BC119 NPN TO-18 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 BFY28 NPN switch TO-18	0-50
Q51 7 BFY85A NPN trans. 300MHZ	0-50
Q52 8 BY100 type sil. rect.	1-00
Q53 25 Sil. & germ. trans. mixed all marked new	1-50

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2N3820	50p
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OC71 Type. 45p

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TO-18 Lens end NPN Sim. to BP x 25 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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SILICON High Voltage 250V NPN TO-3 case. G.P. Switching & Amplifier Applications. Brand new Coded R 2400 VCBO 250V/CEO 100V/IC 6A/30 Watts. HFE type 20/IT 5MHZ. OUR PRICE EACH: 1-24 25-99 100 up 50p 45p 40p

EX-STOCK TYPE EACH AS PRICED
OC20 50p OC28 40p AD149 43p BD131 70p BD138 75p
OC22 30p OC29 40p AL102 85p BD135 80p BD140 85p
OC23 35p OC35 35p AL108 85p BD136 70p BD155 75p
OC24 45p OC36 40p BD121 60p BD136 80p BU105 65
OC25 25p AD140 40p BD123 75p BD137 70p 2N3054 45p
OC26 25p AD142 40p BD124 70p BD138 80p

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50	For	1-00	For	13-00

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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

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BP00 = SN7400	£p	£p	£p	BP86 = SN7486	£p	£p	£p
BP01 = SN7401	0.15	0.14	0.12	BP90 = SN7490	0.87	0.80	0.88
BP02 = SN7402	0.15	0.14	0.12	BP91 = SN7491AN	0.87	0.84	0.78
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	0.68
BP07 = SN7407	0.13	0.17	0.16	BP95 = SN7495	0.77	0.74	0.68
BP08 = SN7408	0.13	0.17	0.16	BP96 = SN7496	0.77	0.74	0.68
BP09 = SN7409	0.13	0.17	0.16	BP100 = SN74100	1.75	1.65	1.55
BP10 = SN7410	0.15	0.14	0.12	BP104 = SN74104	0.97	0.94	0.88
BP13 = SN7413	0.29	0.26	0.24	BP105 = SN74105	0.97	0.94	0.88
BP16 = SN7416	0.43	0.40	0.38	BP107 = SN74107	0.40	0.38	0.36
BP17 = SN7417	0.43	0.40	0.38	BP110 = SN74110	0.55	0.53	0.50
BP20 = SN7420	0.15	0.14	0.12	BP111 = SN74111	1.25	1.15	1.00
BP30 = SN7430	0.15	0.14	0.12	BP118 = 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	0.64	0.58	BP121 = SN74121	0.87	0.84	0.88
BP42 = SN7442	0.87	0.64	0.58	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	BP161 = SN74161	1.00	0.95	0.90
BP45 = SN7445	1.95	1.85	1.75	BP153 = SN74153	1.80	1.70	1.60
BP46 = SN7446	0.87	0.84	0.88	BP164 = SN74164	2.00	1.80	1.80
BP47 = SN7447	0.97	0.94	0.88	BP165 = SN74165	2.00	1.80	1.80
BP48 = SN7448	0.97	0.94	0.88	BP165 = SN74165	1.40	1.30	1.20
BP60 = SN7460	0.97	0.94	0.88	BP156 = SN74156	1.40	1.30	1.20
BP51 = SN7451	0.15	0.14	0.12	BP160 = SN74160	1.80	1.70	1.60
BP53 = SN7453	0.15	0.14	0.12	BP161 = SN74161	1.80	1.70	1.60
BP54 = SN7454	0.15	0.14	0.12	BP162 = SN74162	2.00	1.80	1.80
BP60 = SN7460	0.15	0.14	0.12	BP163 = SN74163	2.00	1.80	1.80
BP70 = SN7470	0.29	0.26	0.24	BP164 = SN74164	2.00	1.80	1.80
BP72 = SN7472	0.29	0.26	0.24	BP165 = SN74165	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	1.85	1.75
BP75 = SN7475	0.47	0.45	0.42	BP193 = SN74193	2.10	1.85	1.75
BP76 = SN7476	0.43	0.40	0.38	BP195 = SN74195	1.10	1.05	0.95
BP80 = SN7480	0.43	0.40	0.38	BP196 = SN74196	1.80	1.70	1.60
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 T.T.L. 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 mm 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 BP47 to drive this tube.

Full data available on request.

ACTUAL PRICE 1-5 £1.55. 6-25 £1.40 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.F. Amp	63p	53p	45p
BP 701C—SL701C	TO-5	8	OP Amp	63p	53p	45p
BP 702C—SL702C	TO-5	8	OP Amp Direct OP	63p	53p	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 709P—MA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP 710—72710	D.I.L.	14	Differential comparator	53p	45p	40p
BP 711—MA711	TO-5	10	Dual comparator	53p	50p	45p
BP 741—72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
MA 703C—MA703C	TO-5	6	R.F.—I.F. Amp	43p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	50p
TAA 293—	TO-74	10	G.P. Amp	90p	75p	70p
TAA 350	TO5	8	Wide band limiting amplifier	170p	158p	150p

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Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA1021 providing unlimited applications for the enthusiasts 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 73dB for some applications.
 - Signal to Noise Ratio 86dB.
 - Frequency response better than 50 Hz to 25 KHz for -3dB.
 - Overall Size 2" x 3" x 1".
 - Typical Total Harmonic distortion at 1 watt less than 1%.
 - Supply voltage (Vs) = 24V 150hm load. Module Tested and Guaranteed.
- Quantity 1-9 10-25
Price each 22.63 22.28
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!

Type No.	Function	I.C.'s		DTL 930 SERIES		LOGIC	
		1-24	25-99	100 up	1-24	25-99	100 up
BP930	Expandable dual 4-input NAND	..	..	13p	11p	10p	..
BP932	Expandable dual 4-input NAND buffer	..	..	13p	12p	11p	..
BP933	Dual 4-input expander	..	..	13p	12p	11p	..
BP935	Expandable Hex Inverter	..	..	13p	12p	11p	..
BP936	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	..
RP946	Quad, 2 input NAND	..	..	12p	11p	10p	..
BP948	Master-slave JK or RS	..	..	25p	24p	22p	..
BP951	Monostable	..	..	85p	80p	85p	..
BP952	Triple 3 input NAND	..	..	15p	11p	10p	..
BP9083	Dual Master-slave JK with separate clock	..	..	40p	38p	35p	..
BP9084	Dual Master-slave JK with separate clock	..	..	40p	38p	35p	..
BP9087	Dual Master-slave JK with Common Clock	..	..	40p	38p	35p	..
BP9089	Dual Master-slave JK Common Clock	..	..	40p	38p	35p	..

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

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UIC933 = 12 x μ A 933	.. 50p	UIC961 = 12 x μ A 961	.. 50p
UIC935 = 12 x μ A 935	.. 50p	UIC993 = 5 x μ A 993	.. 50p
UIC936 = 12 x μ A 936	.. 50p	UIC9094 = 5 x μ A 9094	.. 50p
UIC944 = 12 x μ A 944	.. 50p	UIC9097 = 5 x μ A 9097	.. 50p
UIC945 = 8 x μ A 945	.. 50p	UIC9099 = 5 x μ A 9099	.. 50p
UIC946 = 12 x μ A 946	.. 50p	UIC x 925 Assorted 930 Series	£15.50

Packs cannot be split but 25 Assorted Pieces (our mix) is available as Pack UICX9 Data Booklet available for the BP930 Series. PRICE 13p

UIC00 = 12 x 7400N	50p	UIC46 = 5 x 7446N	50p	UIC81 = 5 x 7481N	50p
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6CG7	0-50	20P1	0-50	ECC82	0-30	PC84	0-40	UCL82	0-85
6CH6	0-55	20P4	1-10	ECC83	0-30	PC85	0-40	UCL83	0-60
6CL5	0-50	20F6	1-20	ECC84	0-30	PC88	0-55	UF41	0-60
6CS4	0-35	20G5	0-50	ECC85	0-40	PC89	0-55	UF42	0-60
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6D3	0-45	25Z6GT	0-65	ECC91	0-20	PC806	0-80	UF85	0-40
6DC6	0-75	30A5	0-45	ECC189	0-60	PCF80	0-30	UF89	0-35
6DK6	0-43	30AE3	0-40	ECF80	0-35	PCF82	0-35	UL41	0-65
6DQ6B	0-58	30C1	0-30	ECF82	0-35	PCF84	0-50	UL84	0-30
6DS4	0-75	30C15	0-80	ECF86	0-65	PCF86	0-60	UM84	0-20
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6F2	0-50	30P14	0-75	ECL80	0-40	PCF805	0-75	W729	0-80
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6F11	0-38	30L15	0-85	ECL82	0-35	PCL81	0-50	Z808U	0-90
6F13	0-38	30L17	0-80	ECL83	0-65	PCL82	0-35		
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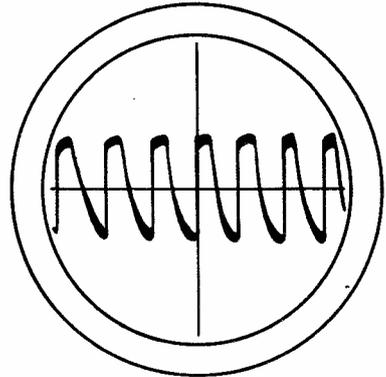
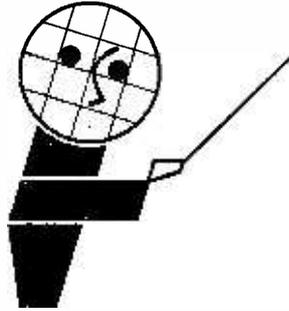
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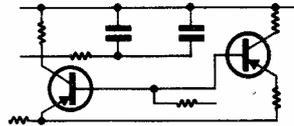
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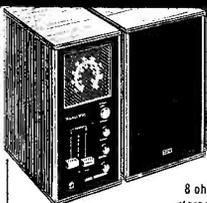
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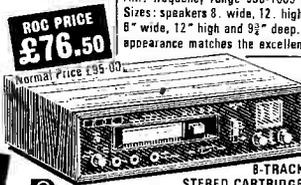
No hi-fi system is complete without one - hook it up to any ROC or other good quality amplifier, and the results are fantastic! The CS-20000 records and plays back. A big feature is its easy-to-use piano-key controls. Easy-to-get-at mic inputs are on top; line inputs and outputs at the rear. Dual-channel recording level meter. Pop-up cassette ejection. Stereo/Mono button. Tape counter. Pause control. Tape speed 1 1/2 ips (4-75 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.



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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 fronted by unique black glass. Figures light up behind it in green when the unit is on. Separate, easy-to-operate Left and Right volume controls. Microswitch for on/off. Programme selector. Separate bass and treble controls. Headphone socket on front panel for easy access. Single tuning knob for FM and AM. 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 µV, stereo separation 30dB, image rejection 40dB. AM: frequency range 530-1605 kHz, sensitivity 100 µV. Sizes: speakers 8" wide, 12" high and 9 1/2" deep; receiver 8" 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

The popular Lear-Jet type recording unit is the heart of the fantastic RP-1000ST, which has full record and play-back 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 9 1/2 ips (9.5 cms). Frequency response: playback 30-10,000 Hz; recording/playback 30-20,000 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
£27.25
Normal Price £39.95 each.

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 capability: 25 watts r.m.s. into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10 1/2" x 7 1/2" x 8 1/2". Exactly right for matching the most modern decor.



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 slide 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 ± 1 db at full power. 15 watts r.m.s. 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.



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£43.75
Normal Price £55.50

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. Its price and value, as well as its good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10.00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for 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 µV; AM, 250 µV. 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

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide x 3 1/2" high x 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 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

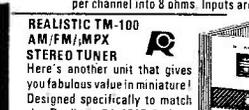
With this unit, you can play any standard 8-track cartridge! It gives you a total of 5 watts of power, to feed into two 8-ohm speakers. The frequency response is 50 to 10,000 Hz, giving you a fine tonal quality that can't be bettered at anything near this price. The EI has separate tone, balance and 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.



With this unit, you can play any standard 8-track cartridge! 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 EI 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.



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 ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4 1/2" high, 8" deep.



ROC PRICE
£14.50
Normal Price £21.00

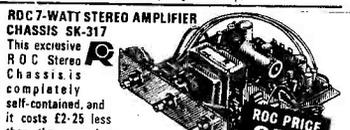
Here's another unit that gives you fabulous value in miniature! Designed specifically to match the Realistic SA-100B in both appearance, size and performance, the TM-100 is superb value-for-money. It gives you the full FM and AM ranges - FM, 88-108 MHz; AM, 535-1605 kHz. Sensitivities: FM 5 µV; AM 250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



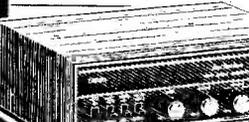
An ideal unit for your new stereo separate system. It is more than £10.00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got output for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3.0mV RIAA, crystal phono 100mV, tape 180mV, tuner 160mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well - sounds even better!



These will do justice to your amplifier - and to your pocket. At only £18.40 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts r.m.s (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.



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 tone control and separate volume controls for each channel. Specification: frequency response 40-17,000 Hz ± 3dB; output 3.5 watts music power per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45dB.



ROC PRICE
£29.00
Normal Price £39.60

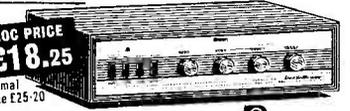
Here's a marvellous value for someone just starting to set themselves up in audio! At only £10.50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 20-20,000 Hz ± 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.



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: 20-20,000 Hz ± 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.



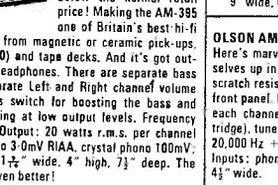
Here's a really good amplifier at a really down-to-earth price - nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you - reproduce signals from ceramic or crystal cartridge, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones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



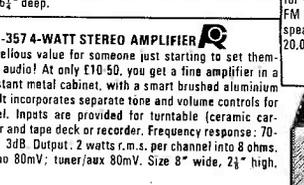
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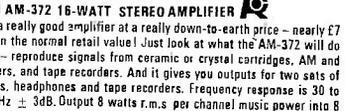
ROC PRICE
£10.50
Normal Price £14.70



ROC PRICE
£10.50
Normal Price £14.70



ROC PRICE
£10.50
Normal Price £14.70



ROC PRICE
£18.25
Normal Price £25.70



ROC PRICE
£10.50
Normal Price £14.70

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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 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**

THORENS TO150AB/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 1/4" x 3 1/2" x 1 1/2".
ROC PRICE £15-00



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.6 Cartridge Player or any other car stereo system. Fitted with over three yards of connecting cable. Dimensions: 6 1/4" x 5 1/2" x 3 1/2". Impedance: 8 ohms per speaker. Rating: 5 watts max. per speaker. **ROC PRICE £3-72**



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 1/4" x 5 1/2" x 3 1/2". Impedance: 8 ohms per speaker. Rating: 5 watts max. per speaker.
ROC PRICE £4-98



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 10-6 cm/dyne. **ROC PRICE £4-75**



EAGLE LC.07 STEREO MOVING-MAGNET CARTRIDGE

Here's your opportunity to own a transcription cartridge for the price of a ceramic! Is specially designed to match top quality tone arms, and to get the very best from your hi-fi amplifier. 0.7 mil diamond stylus. Output: 7mV per channel. Frequency range: 20-21,000 Hz. Channel balance: ±1dB. Channel separation: 28dB. Compliance: 12, 10-6 cm/dyne.
ROC PRICE £6-37



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: 8" high, 5 1/2" wide, 4 1/2" deep. Fitted with male plug and two female sockets. **ROC PRICE £9-50** per speaker.



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 1805 kHz medium wave band. Maximum output is 300 mW. Normal Price £9-45 **ROC PRICE £7-65**



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**

"WATTS" 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**

FLUX STEREO HEADPHONE "Y" ADAPTOR R.361

Enables you to use two sets of stereo headphones from a single socket. Fitted with male plug and two female sockets. **ROC PRICE £1-30**

EAGLE DL.67 HIGH COMPLIANCE 3-WAY TALK 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 6" 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 walnut. **ROC PRICE £18-80** each.

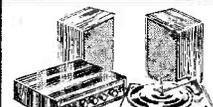


HERE'S A RANGE OF AUDIO SYSTEMS BUILT AROUND EXCLUSIVE ROC AMPLIFIERS AND TUNERS

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 £63-96 **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 £106-85 **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 Cryster 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 £48-45**

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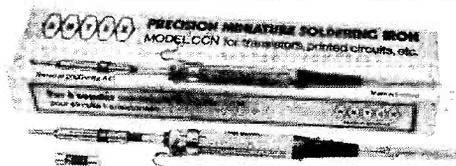




CN.240/2 Miniature soldering iron 15 watt 240 volts, fitted with nickel plated 3/32" bit and packed in transparent display box. Also available for 220 volts. **Price £1.70**

CN.240 Miniature soldering iron 15 watt 240 volts, fitted with iron coated 3/32" bit. Up to 18 interchangeable spare bits obtainable. This iron can also be supplied for 220, 110, 50 or 24 volts. **Price £1.70**

G.240 Miniature soldering iron 18 watt 240 volts usually used by H.M. Forces. Suitable for high speed soldering and fitted with iron coated 3/32" bit. Also available for 220 volts. Spare bits 1/8", 3/16" and 1/4" are obtainable. **Price £1.83.**



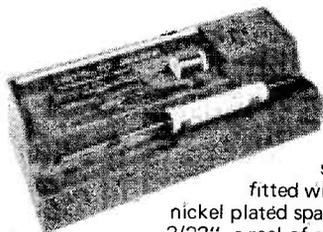
CCN.240 New model 15 watt 240 volts miniature soldering iron with ceramic shaft to ensure perfect insulation (4,000 v A.C.). Will solder live transistors in perfect safety; fitted with 3/32" iron coated bit. Spare bits 1/8", 3/16" and 1/4" available. Can also be supplied for 220 volts. **Price £1.80**

CCN.240/7 The same soldering iron fitted with our new 7-star high efficiency bit for very high speed soldering. The triple-coated bits are iron, nickel and chromium plated. **Price £1.95**



E.240 20 watt 240 volts soldering iron fitted with 1/4" iron coated bit. Spare bits 3/32", 1/8" and 3/16" available. Can also be supplied for 220 and 110 volts. **Price £1.80.**

ES.240 25 watt 240 volts soldering iron fitted with 1/8" iron coated bit. Spare bits 3/32", 3/16" and 1/2" available. Can also be supplied for 220 and 110 volts. **Price £1.83**



**SK.1
SOLDERING
KIT**

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

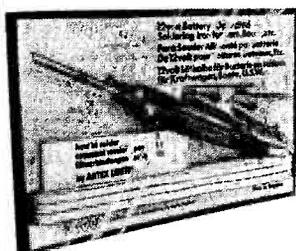
Price £2.75



**SK.2
SOLDERING KIT**

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

Price £2.40.



MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet. **Price £1.95.**

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PRACTICAL WIRELESS

VOL 47 NO 12

Issue 782

APRIL 1972

Something for everyone

FOR a long time now readers have been regaled with a monthly offering of information on the latest integrated circuits in the hope that they would find fun in playing around with our practical suggestions for employing these devices.

In last September's issue we started publishing a design for a Digital Frequency Counter/Timer that employed more than a dozen i.c.'s besides the usual discrete devices. Next month we shall be proudly introducing our "Texan" stereo amplifier to you. This also uses a number of i.c.'s in a highly developed circuit.

"All very clever" you say, "but what's all this about?" Just this—we don't want you to think that we have gone i.c. mad. If we could possibly ballot our younger readers they would no doubt plump for i.c.'s in every project, seeing that they have been brought up on the things. But we do have others who have been forking out the cover price of PW for a couple of decades or more, some even since our No. 1. We want to assure them that they are not forgotten. We shall continue of course to provide them with circuits and projects, even valve projects, suited to their taste.

But whether we like it or not it can be safely concluded that the transistor, and the avalanche of its derivatives, is here to stay, at least until someone pulls the same trick on the transistor as they did on the valve.

And the point of this homily? We don't want our supporters divided into opposing camps on the subject of i.c.'s. We want everyone, young and old, to understand them and what makes them tick (Digital Clock . . . makes them tick . . . ugh!) and to this end we shall be publishing a series of articles on the subject. We shall also be providing plenty of information on faultfinding around i.c.'s so that if the home constructor's version of a circuit fails to work he'll know where to start the Sherlock Holmes treatment.

After all, even if we turn our backs on them, all those millions of danged i.c.'s aren't going to disappear overnight into some bottomless pit, much as some of us would like. As Pat Hawker remarked recently in *Radio Communication* "people are at last beginning to weigh up the pros and cons of semiconductors a little more realistically than in the rush to solid state of the 'sixties. What we want to do is to encourage the use of semiconductor devices for those applications for which they are really most suitable—and in some other respects to thank goodness for the good old valve".

We aim to do just this in Practical Wireless.

W. N. STEVENS—*Editor*.

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**MAY ISSUE WILL BE
PUBLISHED ON APRIL 7th**

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

Sonex 72

Sonex '72 will feature the new products and trends. Exhibitors will introduce their new models at the Show—from all over the world.

A special daily programme of lectures and discussions by experts, technicians and personalities will be featured.

Sonex '72 will contain the latest equipment in specialist Hi-Fi, Tape Recorders, v.h.f. Radio and Stereo, to name but a few categories.

Accessories will also be featured.

The dates are March 22 and 23 (Trade only) and March 24, 25 and 26 (Trade and Public). Venue is Skyway Hotel, Bath Road, Hayes, Middlesex. Entrance tickets may be obtained from your local audio dealer.

Tuner and Amp.

Bryan Amplifiers inform us that their model 9000/50 amplifier and model 1500 f.e.t. tuner are now available.

Power output of the 9000/50 is 25W r.m.s. per channel into 8 Ω or 15 Ω at 1kHz and 10kHz. Signal to noise ratio for a magnetid P.U. is better than 70dB. Total harmonic distortion at 6W r.m.s. is 0.1%. Frequency response is ± 1 dB (40Hz to 20kHz).

Aerial input impedance of the 1500 tuner is 75 Ω and the tuning range is 87.5MHz to 108MHz. Sensitivity is 2.5 μ V for 30dB signal/noise ratio and 5 μ V for full limiting. I.F. rejection is 80dB and image rejection, 70dB. A.F.C. pull in range is 300kHz. Total harmonic distortion is 0.5% at 100% modulation at 1kHz and frequency response is ± 1 dB (40Hz to 14kHz).

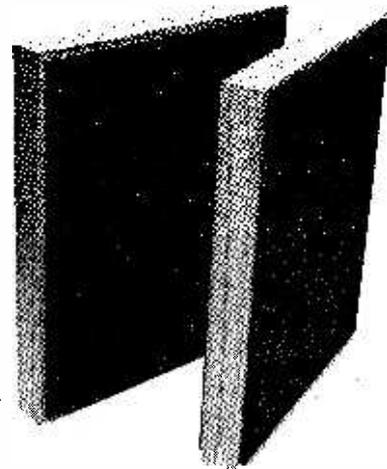
Cabinet sizes of both units are: 13 $\frac{3}{4}$ \times 5 $\frac{1}{4}$ \times 10 $\frac{3}{4}$ in. Each unit has a two-year guarantee and prices are £66 for the amplifier and £72.40 for the tuner. Chassis without cabinets are £61 and £67.57 respectively. *Bryan Amplifiers Limited, 18 Greenacres Road, Oldham, Lancashire.*

Poly Planar

Highgate Acoustics announce their poly planar range of speakers. There are three models in the range—P5B, P40 and RP8. Being very flat they can be mounted in a variety of positions i.e. into walls, flush doors, or in car doors. They can be obtained either in cabinets as shown or as basic units for mounting in the method the purchaser may choose.

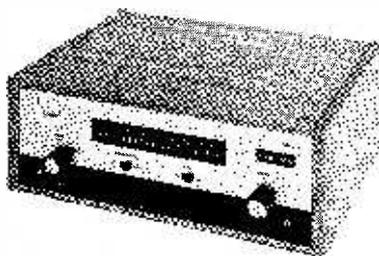
The Poly-Planar loudspeaker functions basically in a similar manner as that of the cone loudspeaker system. There is a magnetic structure which produces a radial field within a closely spaced gap. A voice coil is immersed in the gap and electrical signals applied to the coil produce motor action with resulting acoustical output. In place of the conventional paper cone, however, is a flat plastic panel which is only a fraction of the depth of the equivalent cone structure. This panel is made rigid by the choice of plastic materials in conjunction with a special surface skin treatment. The material used is expanded polystyrene in a compacted bead structure. Since the beads are largely air, the mass is extremely low.

To obtain the desired acoustic properties the panel incorporates a combination of circular grooves in conjunction with special acous-

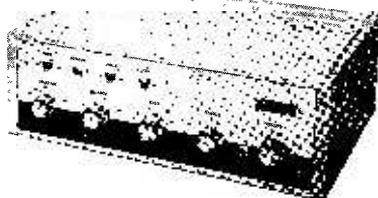


tic fill materials. This combination provides the proper balance of compliances and damping for wide response characteristics. With a flat rectangular panel a larger piston area is also available and hence the length and width dimensions can be made smaller than the cone speaker.

Model P40 (shown) has peak output of 40W (25W r.m.s.) Frequency range is 30Hz-20kHz. Input impedance is 8 Ω . Price of P40 speaker unit without cabinet is £5.75 and speakers in teak cabinets as shown in the picture cost £9.75 each. *Highgate Acoustics, 184 Great Portland Street, London, W.1. (01-636 2901).*



1500 tuner



9000/50

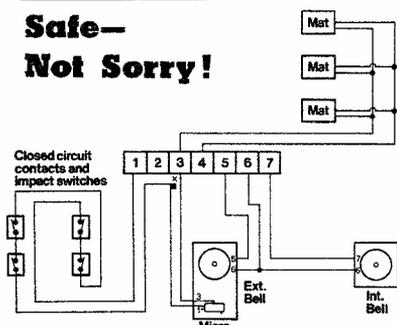
White Rose Rally

The above rally will be held at Lawnswood High School, Leeds on 2nd April, at the junction of the A660 Leeds-Otley and A6120 Leeds Ring Road. Ample car-parking space will be provided and refreshments will be available. There will be a raffle and trade stands with bring and buy stalls. The whole family will be catered for.

Talk-in will be on 160m and 2m with the callsign G3XEP/A. For further information contact R. Short, G3YEE (Tel Bradford 664220) or E. Lawley, G8EHV (QTHR).

This rally is organised by the White Rose Radio Society, G3XEP, 83 Armley Town Street, Leeds 12, Yorkshire.

Safe— Not Sorry!



Typical installation circuit.

L. Vale (Products) Limited inform us that they stock a complete range of anti-burglar devices from magnetic window catches to pressure mats that make an electrical contact when trodden on.

They manufacture and supply an efficient and reliable burglar alarm system which consists of an "open" and "closed" circuit control unit (Security Key Operated), a loud internal bell, and an external bell housed in an approved weather proof cover. The external bell unit is made of steel plate and has the wording "BURGLAR ALARM" imprinted thereon. The finish of the unit is in royal blue.

Working in conjunction with the above equipment are the main accessories, i.e. door and window contacts, pressure mats for concealing under lino or carpets, and vibrator switches for the protection of plate glass windows.

Door and window contacts operate on a closed circuit system—this means that when the alarm control unit is set, a minute amount of current flows through each of the contacts. The current is supplied by a heavy duty 12V battery housed in the control unit together with the "Electronic Transistorised Printed Circuit Panel."

The closed circuit contacts are so designed that the opening of a protected door or window will instantly cause the bell or bells to sound, and even if the door or window is immediately closed the alarm continues to sound.

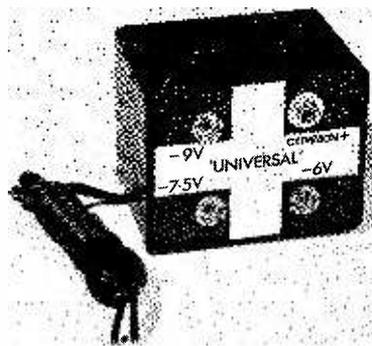
The cutting of wires on this circuit produces the same effect. L. Vale (Products) Ltd., 288 Bishopsgate, London, E.C.2. (01-247 8067 and 01-588 1341).

New from R.C.S.

RCS Products, (Radio) Limited announce their new "Universal" battery eliminator unit. It is a small power unit that is capable of supplying either 6V, 7.5V or 9V. There is a common positive on the unit with press stud "battery type" fixing with terminals for the three voltages (see photograph). Price is £2.50 plus 15p postage and packing.

The Company also announces the "Plus-3 Mk 2" power supply which is an up-to-date version of the earlier power unit that gives a switched output of 6V, 7.5V and 9V. A neon indicator is fitted to show when the unit is switched on. The price is £3.25 plus 15p.

Both of these units are ideal for operating cassette tape recorders where battery drain is quite high if they are used for any length of time, but the voltages they supply make them ideal for use with portable radios, slide viewers or any device normally working from batteries supplying the same voltages as the unit. RCS Products (Radio) Limited, 31 Oliver Road, Walthamstow, London, E.17.

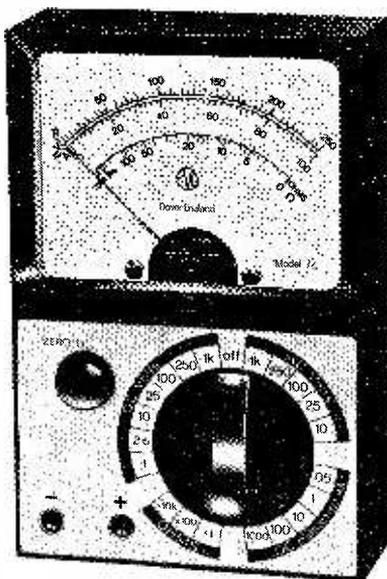


The "Universal"



The "Plus-3 Mk2"

Avo 1972



Avo (Thorn Group) announce a completely new Avometer, the Model 72. It is the company's first pocket-sized multimeter with a sensitivity of 20,000ΩV d.c., an accuracy of $\pm 2\%$ on all d.c. voltage, a.c. voltage and d.c. current ranges, a frequency response up to 30kHz and the ability to measure up to 20 megohms.

A single scale calibrated 0-100 and 0-250 covers all voltage and current readings. A further scale covers resistance measurements. Only two input sockets are required for all measurements, which cover d.c. voltage from 150mV to 1000V f.s.d., a.c. voltage from 10V to 1000V f.s.d., d.c. current from 50μA to 1A f.s.d. and resistance from 1Ω to 20MΩ.

The Avometer Model 72 is supplied complete with moulded test leads, interchangeable prods and clips and a comprehensive instruction book. Avo Limited Avocet House, Dover, Kent.

TRANSISTOR TESTER

M. WALLIS



OVER the years it is amazing how many semiconductors the average constructor accumulates. First there are those you buy in the ordinary way, then there are those salvaged from other equipment, from computer panels, etc., and finally there are the very cheap surplus types that have flooded the market in recent years.

For all these, apart from the those newly bought as guaranteed devices, a transistor tester is very useful. Even with new devices, the gain spreads of so many devices are wide and for certain circuits it is often necessary to select one with a particular gain. Transistors can also be matched using this circuit.

The Transistor Tester which is the subject of this article was designed to perform all the important tests and in addition the gain of the device can be directly read off. The unusual aspect of this particular circuit is that an inexpensive meter is used. This item is by far the largest cost in circuits of this type—it will often account for well over half the cost. If we are realistic, useful though a tester is when required, it hardly warrants large expenditure. The meter used in the prototype is of the cheapest type of moving coil meter available—the recording level meter. These come in various shapes and sizes, the majority are similar to the one illustrated but other miniature types are also available; the one used here has an edgewise scale.

The Transistor Tester gives an indication of the leakage of the transistor under test for both NPN and PNP transistors of all types as well as diodes. The gain of the transistor is measured at 1mA collector current. Nearly all these level meters have a sensitivity of around 150 μ A but they do vary, in any case it is not actually necessary to know the sensitivity of the meter or its d.c. resistance.

Meters of the type described are widely available at prices varying between 50p and £1, much less of course than any other types.

THE CIRCUIT

The circuit of the prototype is shown in Fig. 1. SW1 alters the polarity of the battery applied to the transistor to accommodate PNP and NPN types but the meter with its associated components is wired

permanently in the positive arm of the supply meaning that it does not have to be switched. SW2 simply applies the shunt resistor across the meter to alter it from its basic sensitivity to 1mA at the point marked on the meter. The choice of R2 must be made for the actual meter used and it may be considerably different from the value used in the prototype. It is of course necessary to switch only one side of this resistor and readers may be puzzled by switching both sides; this is only because constructing it in this way is easier and neater and has nothing to do with the electrical characteristics.

With the meter on its basic sensitivity with SW2 open and with a transistor connected up to the circuit it will be seen that the meter will read the current flowing through the device. If the base circuit is open, as it should be, this reading will indicate the leakage of the device. By definition the leakage of a device is that current passing through it with no bias applied.

With a good device only a small reading or none at all will be registered on the meter. With a transistor with heavy leakage the reading will be considerable.

SW3 and VR1 are a log potentiometer with switch wired in series. When SW3 is closed, base bias is applied and the current passed through the device should rise considerably (if it is a good transistor).

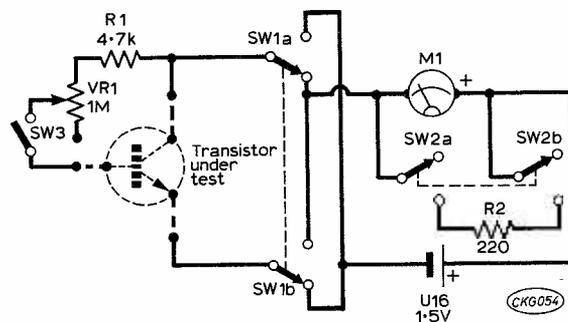


Fig. 1: The circuit of the transistor tester. SW1 alters the polarity for either NPN or PNP devices; SW2 changes the sensitivity from basic to 1mA; SW3 is combined with VR1 and applies bias to the base for gain readings.

TRANSISTOR GAIN MEASUREMENTS

Now the gain of a transistor is the collector current divided by the base current. We know what the collector current is if the meter reading is at a certain level, 1mA. Now the voltage at the collector will be very slightly less than that at the battery positive due to the d.c. resistance of the meter but as this resistance does not vary and since we are always going to take gain measurements at 1mA the voltage drop across the meter will be constant. In fact the voltage drop is only about 0.2V but this does represent about 15 per cent of the total supply (a 1.5V battery is used).

The voltage at the base will be about 0.3V for germanium types and 0.6V for silicon types, so for each type the voltage between the collector and the base will be constant: For silicon it will be $1.5V - 0.6V - 0.2V = 0.7V$ and for germanium a similar sum would show that there will be 1V. Since this voltage is always the same, the base current will depend on the value of resistor in the circuit.

What we do is to vary the base bias resistor until the correct level is shown on the meter. The setting of this will directly indicate the gain.

A $1M\Omega$ pot is used with a $4.7k\Omega$ safety resistor in series so that at the maximum resistance value for germanium types a 1mA reading on the meter would indicate a gain of 1,000 while for silicon this reading would indicate a gain of about 1,500. At minimum setting the gain would be about 5 for germanium and 7 for silicon. If there are transistors with gains outside this range the author has never heard of them.

It will mean that two scales for the gain will have to be marked, one for germanium and the other for silicon. An alternative would be to mark the gain scale for only one type (presumably silicon as these are far more common nowadays) and remember that a constant conversion factor is needed for germanium, that is divide the reading by 0.7.

Note that this tester is not really suitable for power transistors as the gain varies with the collector current and power transistors are designed for very much higher collector currents than the 1mA used here.

Another disadvantage is that a true gain reading is not possible if the leakage is high, though the circuit will at least show if the device is usable and in any case a transistor with high leakage is not likely to be of much use anyway.

TESTING DIODES

Diodes are tested by connecting between the emitter and collector sockets and changing over the PNP-NPN switch. In one position a small reading should be indicated (or none at all), the other way around the meter should be hard against the back stop. These meters are very hardy and will stand a considerable amount of overloading of this type.

CALIBRATION

The gain scale can be calibrated by doing a series of calculations by measuring the resistance of $R1$ plus $VR1$ in several places but in practice only three or four points need be marked. A gain of 20 is equivalent to a resistance reading 14k Ω ; for 50, 35k Ω ; for 100, 70k Ω and for 500, 350k Ω . These can be checked on a multimeter and the scale calibrated

accordingly. These readings are for silicon and the conversion factor should be applied to germanium.

In practice the scale is hardly needed as one gets a very good idea very quickly as to the sort of readings one should get to indicate a good device.

CONSTRUCTION

The prototype was built into a small aluminium case which is available from the suppliers mentioned in the components list. This is a very convenient housing for the Transistor Tester and is strongly recommended but of course any suitable case, either metal or plastic can be employed.

SW1 and SW2 are slide switches which are mounted either side at one end. Just a note of caution; even though slide switches are of simple construction, some cheap imported ones are very poorly made and will pack up quickly. This is mentioned through bitter experience; it is well worth while buying decent quality ones.

The drilling and cutting for the lid of the recommended case is shown in Fig. 2. The size of the cut out for the meter will depend on its actual dimensions and so no size is shown. The pot is mounted in the middle, leaving enough room around it to mark the scale.

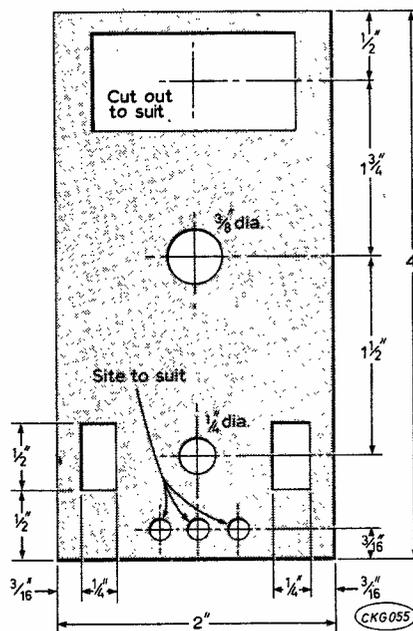


Fig. 2: The metalwork details. If the recommended case is used all drilling is done on the lid.

The transistor mounting sockets can take a variety of forms. Miniature sockets made by R.S. Components (the old Radiospares) are good and can be mounted along the bottom. These are small enough to take the leads of the transistors directly but they will also take small plugs (which match the sockets) which can be fitted with leads and croc clips to test transistors *in situ*. A conventional transistor mounting socket can be fitted between the

two slide switches; this can be wired either for the conventional e,b,c, arrangement as shown in the drawing but what may even be more useful is to wire it for those transistors which can only be tested by twisting the leads out of shape such as the 2N2926, etc., in this case wiring the socket e,c,b, may be preferred.

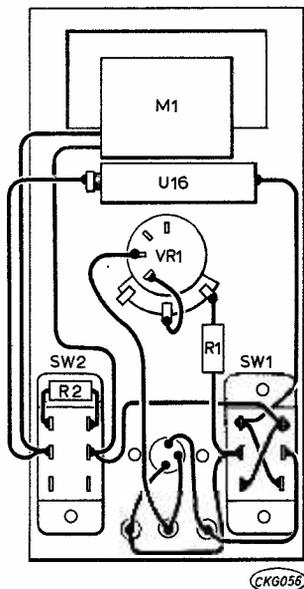


Fig. 3: The wiring details.

The battery can be small 1.5V, type U16, which can be held in place by gluing it to the lid.

METER SHUNTING

To obtain a meter reading of 1mA it will be necessary to shunt it. Sometimes d.c. resistances are marked on the meters themselves and if both the sensitivity and d.c. resistance are known, the resistance value can be calculated. However if this is done, check the final result as the author has sometimes found such data unreliable.

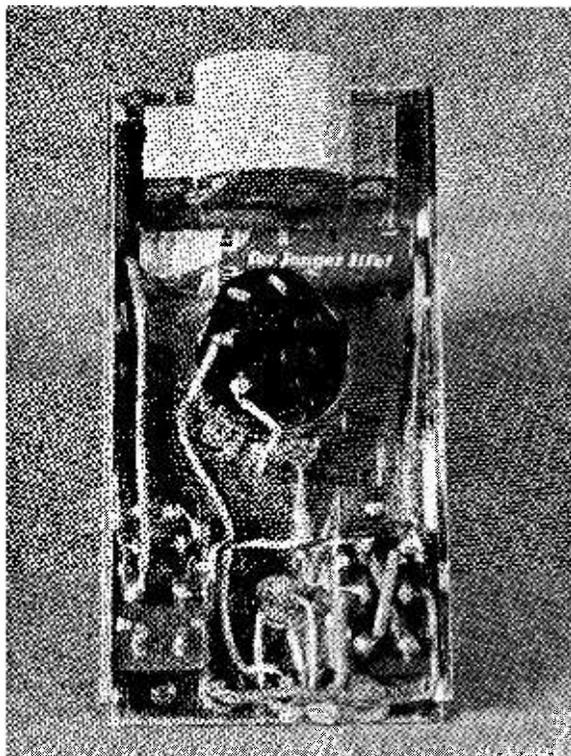
To find the correct shunt resistor temporarily wire a variable resistor (1kΩ should be sufficient) in parallel with the meter and wire this combination in series with a multimeter set to read 1mA, a 1.5V battery and a variable resistor of about 5kΩ. Before connecting up this arrangement ensure that both meters are connected with the right polarity and that the 1kΩ potentiometer is set to minimum

★ components list

R1 4.7kΩ $\frac{1}{4}$ W, 5%
 R2 220Ω—see text
 VR1 1MΩ log. pot with switch
 SW1, SW2 2 pole, 2 way slide switches
 M1 Recording level meter—see text
 U16 1.5V battery

Miscellaneous

Transistor socket; Miniature sockets (see text); Case available from H. L. Smith and Co. Ltd., 287/9 Edgware Road, London W2 1BE: Type K with PP base, size: 4 x 2½ x 1½in. Price 45p including postage.



An internal view of the prototype.

resistance. Now set the value of the 5kΩ resistor until the multimeter reads 1mA and then increase the value of the 1kΩ pot until the meter reads the correct level. A slight readjustment may be necessary to both controls but once the multimeter is reading 1mA and the meter is at the correct level it is only necessary to measure the value of the resistance track on the 1kΩ pot, select a resistor of that value and wire it into the circuit.

BATTERY TEST

With this circuit it is a simple matter to test the battery. With the meter in the "high sensitivity" position and a bridging wire between the e and b terminals, a setting will be found on the pot which will give the standard meter reading. If this is done with a new battery the position can be marked, as soon as such a test requires a lower resistance reading the battery should be changed. The battery should last a considerable time as it is drawing a maximum of 1mA when actually in use, for the rest of the time no current is drawn and the life of the battery will therefore approach the "shelf life" of at least a year.

Note that although transistors can sometimes be tested *in situ*, readings may be very unreliable due to other components in the circuit. A very convenient way to test these is to take two readings using the voltage range of a multimeter; (a) to see if there is a voltage drop across the load (usually a resistor but sometimes an inductor) and (b) see if there is a reading across the emitter and collector. If there are voltages across both the transistor and the load, however low, it's a pretty good bet that the device is O.K.

AUDIO distortion METER

DESIGN CONSIDERATIONS
F.C. Judd

TOTAL harmonic distortion in modern audio amplifiers is often as low as 0.1 per cent and in exceptional cases lower. Accurate measurement of THD down to even 0.1 per cent calls for a pretty expensive instrument and one with a built-in audio volt/millivolt meter and filters could cost over £200. The function of a THD meter is to remove all trace of the fundamental frequency of the test signal and leave only the harmonics produced by the amplifier under test, the amplitude of these being measured as an r.m.s. voltage which is then related to the r.m.s. voltage delivered by the amplifier to the input of the THD meter. It is very important therefore, that the audio signal generator used for THD measurement provides an almost distortion free signal otherwise any harmonics in the test signal will be added to those generated by the amplifier.

If reasonable accuracy is to be achieved then the audio signal generator must have a harmonic distortion factor of not greater than 0.05 per cent or preferably less, or must be coupled to the amplifier under test via a low pass filter so as to reduce harmonics from the test signal to 0.05 per cent or lower. Equally, 50Hz hum from either the audio signal generator, or the amplifier under test, can give false THD readings and it is usual to insert a high pass filter at the input to the THD bridge.

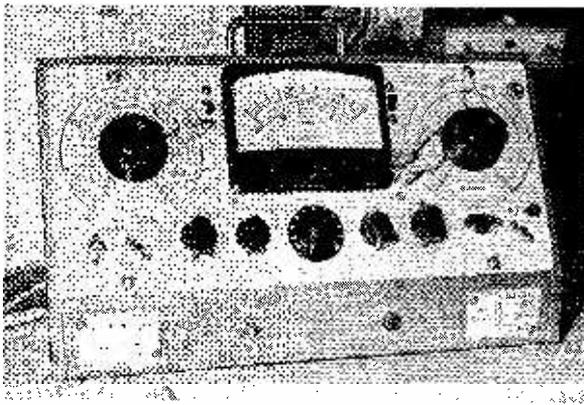
A typical set up for THD measurement would be

as shown in Fig. 1. The low pass filter at the generator output would not be necessary with a generator having less than about 0.05 per cent harmonic content.

THE THD BRIDGE

The basis of all THD meters is the bridge used to remove the fundamental of the test signal. The circuit given in Fig. 2 is a typical arrangement and covers the frequency range 15 to 30000Hz. The input attenuator may be an ordinary log carbon track potentiometer and is necessary to prevent overloading the bridge input Tr1 which is a combination emitter follower and amplifier. The input signal may well be quite large, e.g. that from a typical amplifier running at 20W r.m.s. output would be over 12V r.m.s. With an audio voltmeter connected at the output of the THD bridge, the input attenuator (VR1) must be used to reduce the input signal so as to obtain a reference reading of say 1V (1000mV) r.m.s. The overload point of the THD bridge input with VR1 at maximum is 5V r.m.s. and the absolute maximum reference signal should never be greater than 2V r.m.s.

If the bridge is carefully constructed its own hum



The THD meter constructed by the author and based upon the circuits in this article.

and noise level should not exceed 200µV. Distortion voltages down to approximately 0.5mV can be obtained from a 1V reference signal which represents 0.05 per cent. A distortion factor of 0.1 per cent would be represented by a reading of 1mV to a reference of 1V or 0.1 per cent which is 60dB below the reference

The signal from Tr1 is fed via S1A either to the bridge, from both the emitter and collector (via S1B), or directly (via S1A) to the base of the bridge amplifier Tr2. The input signal can therefore, be switched through for referencing or to the bridge for nulling. The bridge circuit may look a little complex but is simply a Wien bridge with fine control over frequency and balance, both of which are absolutely essential as the point of null at any fre-

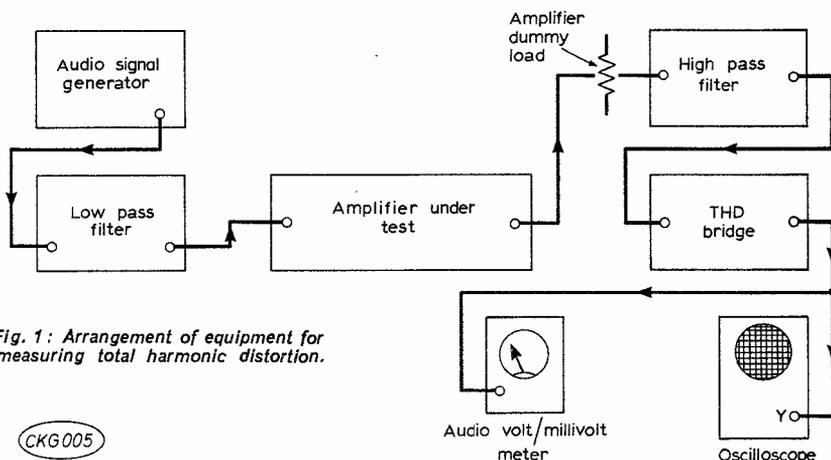


Fig. 1: Arrangement of equipment for measuring total harmonic distortion.

CKG005

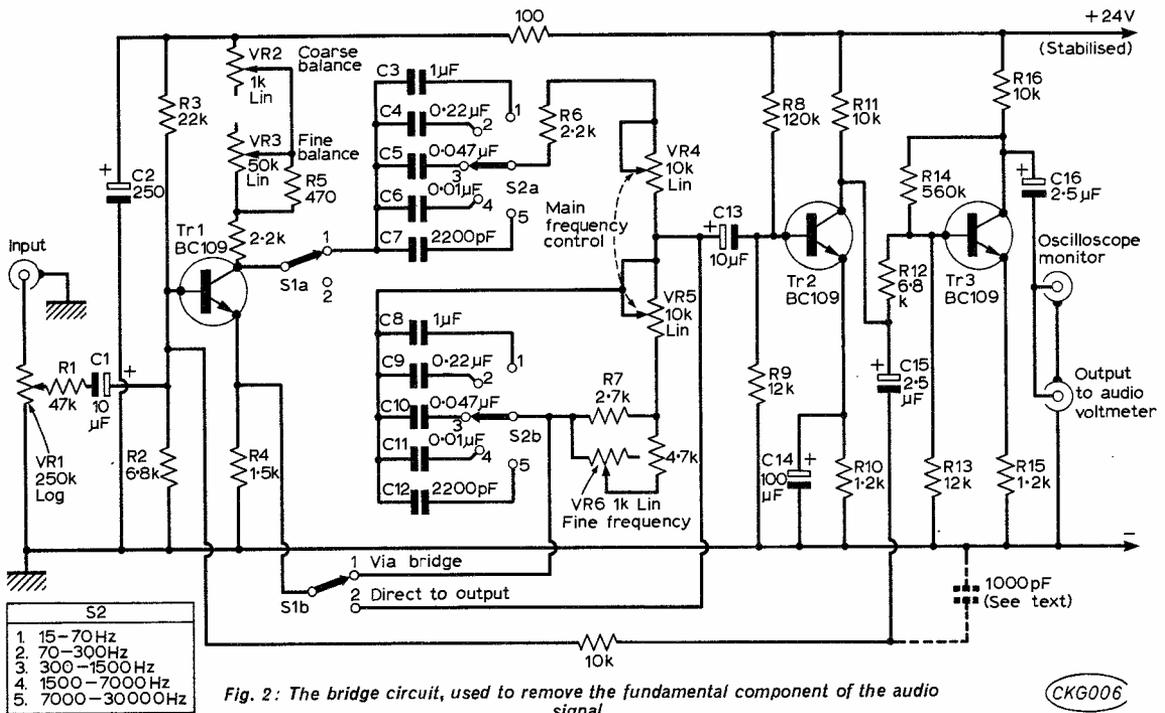


Fig. 2: The bridge circuit, used to remove the fundamental component of the audio signal.

CKG006

frequency is extremely sharp. Negative feedback is included between the output of Tr2 and the base of Tr1 to ensure appropriate gain and a linear frequency response. (The system frequency response straight through, should be within ± 1 dB from 10Hz to 100kHz.) The output to either an external audio voltmeter or a built-in meter is taken from the collector of the final amplifier Tr3.

accurate enough for obtaining distortion readings to less than 0.1 per cent. The lowest range should be adjusted for 1mV full scale deflection and the remainder of the ranges for either 3, 10, 30, 100, 300mV and 1V, 10V or 3, 5, 10, 50, 100mV and 1V, 10V. The highest, 10V range, is worth including as a check on input overload.

No values have been given for the attenuator network as these will depend on the selected millivolt and volt ranges. The basic attenuator impedance should be around 12k Ω to match the output from the bridge.

The impedance of the meter circuit input at Tr1 is

THE VOLT/MILLIVOLT METER

The circuit shown in Fig. 3 was used in the THD meter shown in the photograph and was found

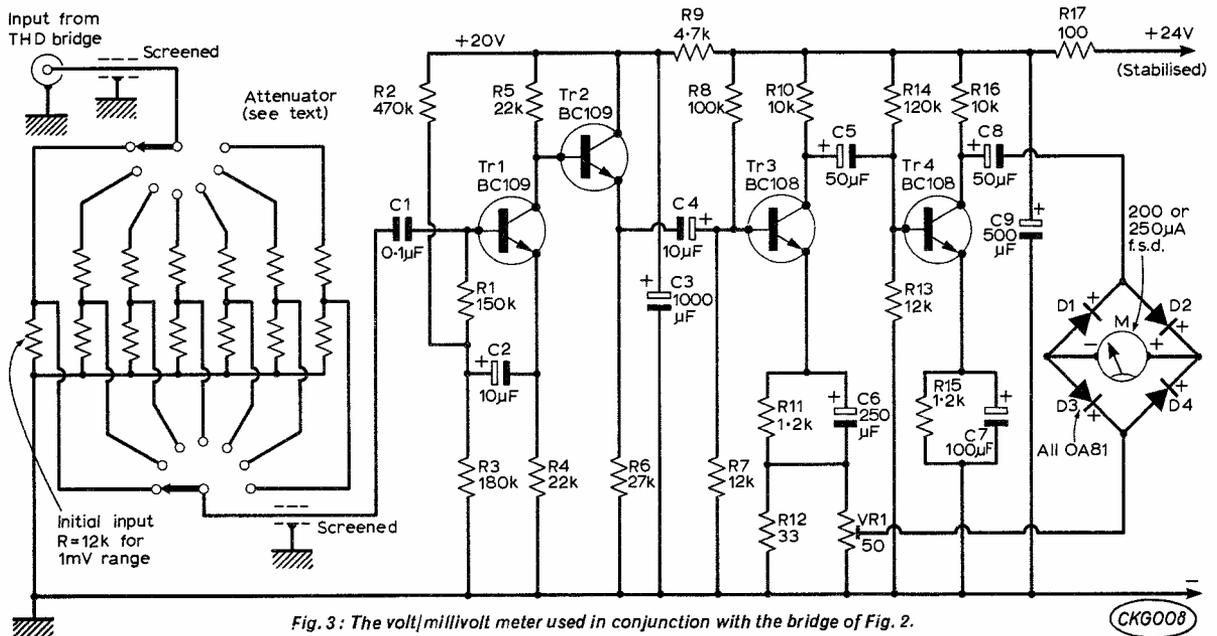


Fig. 3: The volt/millivolt meter used in conjunction with the bridge of Fig. 2.

CKG008

over $3M\Omega$ and the output from the emitter follower Tr2 about 250Ω . The overall frequency response from input to the meter itself is flat from 10Hz to 100kHz. The meter amplifier comprises Tr3 and Tr4 which feed a bridge rectifier employing silicon diodes. Feedback from the bridge to the emitter circuit of Tr3 ensures linearity.

Initial setting up can be carried out by injecting a 1mV sine wave signal to C1 at the input to Tr1 with a $12k\Omega$ resistor between C1 and earth. The feedback potentiometer VR1 should now be set to obtain full scale deflection on the meter. Other ranges are adjusted by the input attenuator networks accordingly. The meter used in the original was a $250\mu A$ f.s.d. large scale instrument but a $200\mu A$ movement could be used as there is sufficient range of control in the feedback potentiometer VR1.

POWER SUPPLY

The power supply must be stabilised but a simple zener diode control was found adequate. The supply rail must be adjusted to exactly 24V. The circuit for the power supply is shown in Fig. 4 and, in the original, employed a transformer and rectifier to deliver an initial supply of 30V. Any suitable zener for 24V at a current drain of approximately 12mA can be used.

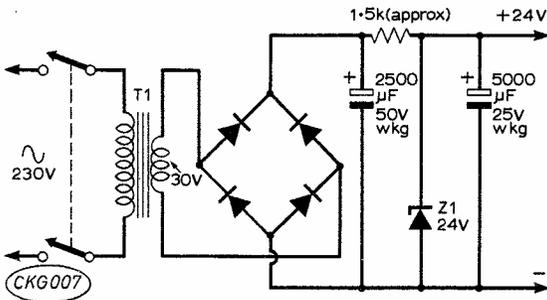


Fig. 4: Suggested power supply circuit for the THD meter.

It is most important that no hum is induced by the transformer into the circuit through mutual coupling, via connecting wires etc., and that hum is not introduced into the circuitry via hum loops.

OPERATION

As already mentioned the THD bridge can be used with an external audio volt/millivolt meter having a lowest range of 1mV f.s.d. If the built-in audio voltmeter is used this must be very accurately calibrated.

The normal procedure for THD measurement is to adjust the output of the amplifier under test to the power level at which distortion is to be measured, making sure that the input signal to the amplifier is within the specified limit. The signal from the amplifier is now fed to the bridge input and the attenuator adjusted to obtain a reference signal of say 1V r.m.s. The signal from the bridge should be displayed on an oscilloscope. The bridge circuit is now switched to "null" and the main frequency control set to the frequency of the test signal. Set the main balance control fully anti-clockwise and then turn slowly clockwise at the same time moving the frequency

control a little either way until a noticeable dip is obtained on the audio voltmeter and oscilloscope display. Adjust each control for the largest possible dip and then obtain the final nulling with the "fine" controls. Watch the 'scope to see that all trace of the fundamental is removed. Most of the "distortion" signal left will probably be second harmonic so the signal on the 'scope should have the appearance of double the original frequency like that shown in Fig. 5.

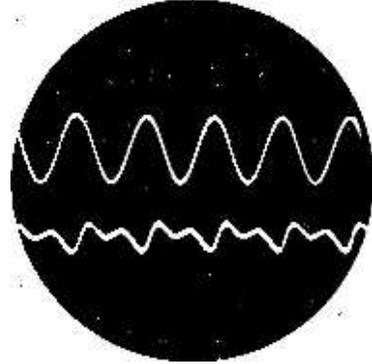
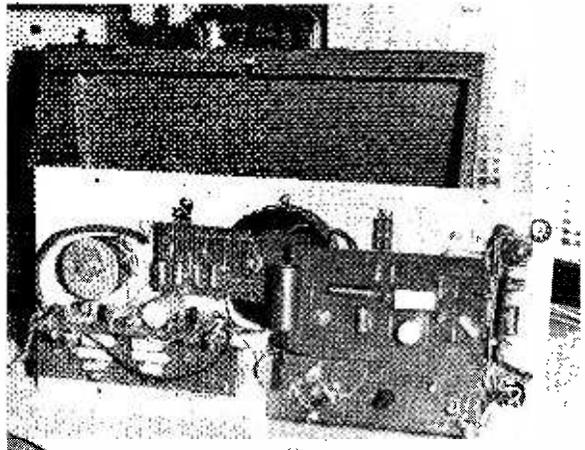


Fig. 5: The upper trace shows the 1000Hz output of an audio generator at 1V r.m.s. The lower trace shows the distortion, mainly second harmonic, at 18mV r.m.s. or 1.8%

The reading now remaining on the audio voltmeter will be the r.m.s. amplitude of all the harmonics and this is simply related to the reference signal as a percentage. Remember that a distortion level of 0.1 per cent is 60dB down or 1000 times lower than the reference signal level, hence the reason for ensuring an extremely low hum and noise level in the THD bridge amplifier. If the meter is carefully built it is possible to read to 0.05 per cent from a 2V reference but as the initial signal and hence the reference signal falls below 1V so the lowest percentage readable will increase.

For example, 0.1 per cent is just possible with a 500mV signal but at less than 500mV a THD of 0.1 per cent would be down to the noise level of the bridge amplifier. In practice THD readings of less than 0.1 per cent from a 1V reference are quite difficult to obtain. Remember that the amplifier noise level

—continued on page 1078



Internal view of the THD meter showing method of construction

THIS circuit provides intermittent operation of "self-parking" type windscreen wipers, without impairing their normal operation. The wipers can be made to operate at intervals up to 20 seconds for one sweep of the windscreen and it is suitable for cars with either positive or negative earth systems.

It is extremely useful in sleet or spotty rain conditions (typical British weather conditions!) as it stops the wipers simply smearing the windscreen, making vision virtually impossible.

THE CIRCUIT

The circuit is a simple two-transistor unit using the charging capacitor method of timing. The capacitor C1 charges at a rate determined by the value of R1 and VR1, consequently the base of Tr1 gradually becomes more negative with respect to its emitter. When C1 is fully charged Tr1 will then conduct, consuming current through R2. The potential difference across R3 will cause Tr2 to switch "on". C2 will charge and relay "A" will operate. When relay "A" is operated contacts 1a short out C1 causing it to immediately discharge, thus Tr1 and Tr2 cease to conduct.

C2 discharges holding the relay closed for about half a second after Tr2 ceases to conduct—it is in this half second that the wiper motor drives on to its "self-park" mechanism, which takes over operation of the windscreen wipers for one sweep of the windscreen. When C2 has discharged, the relay releases and thus C1 begins to charge once again.

With the component values given the sweep rate can be continuously adjusted between 2 and 20 seconds, however, this range can be adjusted

by the value of R1 which can lay between 33kΩ and 1MΩ.

There are no "specials" in the circuit thus all components should be readily available from any radio components store. A Post Office type relay was used in the prototype as it was readily available although any 3000Ω, 12V relay with two sets of make contacts can be employed. As most wiper motors are rated at approximately 5A it is important that the relay contacts operating the motor be the heavy-duty type.

CONSTRUCTION

The method of construction is by no means critical, literally any form of construction can be adopted which is convenient. As most cars offer very little space behind the dash-board for added extras, a method of mounting the completed circuit in the car should be considered in conjunction with the mode of construction.

However, the prototype was constructed on Vero-board and mounted behind the car's dashboard. If a Post Office type relay is used then it can be mounted as shown in the photograph. The circuit side of the choke is wired to positive or negative according to the car's earth system.

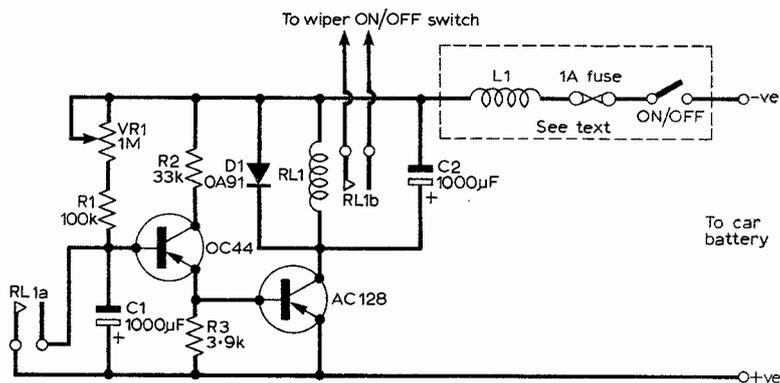
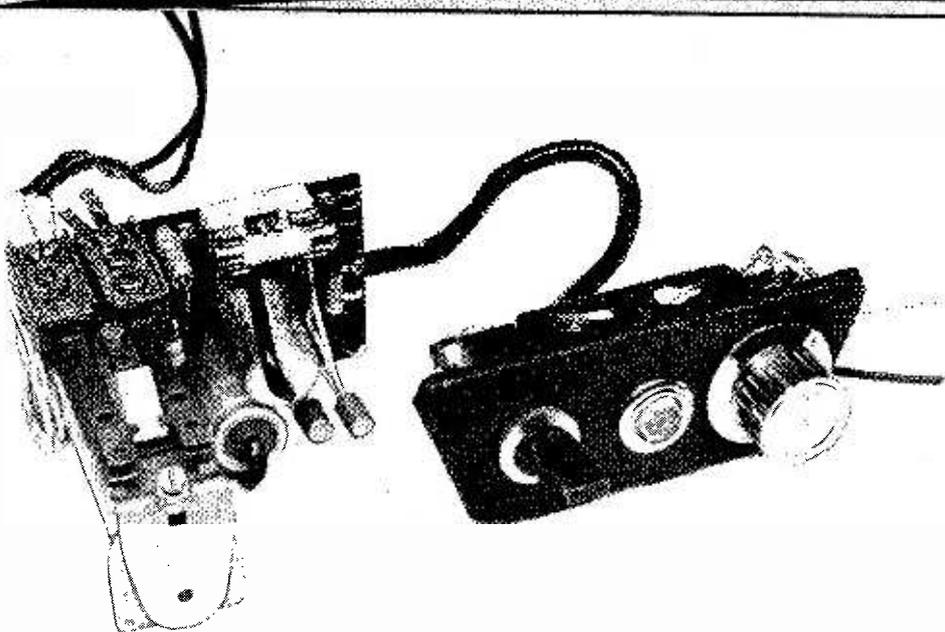


Fig. 1. The circuit of the wiper delay unit.

WIPER DELAY UNIT

H.R.STEPHENS



★ components list

Resistors

R1 100k Ω (see text)
 R2 33k Ω
 All $\frac{1}{2}$ W, 10% types

R3 3.9k Ω
 VR1 1M Ω lin. pot.

Capacitors

C1 1,000 μ F 12V

C2 1,000 μ F 12V

Semiconductors

Tr1 OC44
 Tr2 AC128

D1 OA91

Miscellaneous

RL1 Coil 300 Ω (approx.). 2 sets of make contacts (heavy duty). FS1 1 Amp fuse. Printed circuit type fuse holder to suit. Veroboard 80mm. x 50mm. Switch, wire etc. L1 2A Television supressor choke (Radiospares)

If the car has a positive earth system the wiring of the circuit to the car is similar to the circuit. For a negative earth system the fuse and choke (L1) should be wired in series with the positive circuit polarity.

The second set of relay contacts should be wired in parallel with the contacts on the wiper motor on/off switch. Thus the circuit will operate when switched on by an auxiliary dashboard switch. Whilst the circuit is in operation the wiper switch should be turned off. ■

**TRANSISTOR OSCILLOSCOPE.** February and March Issues

The 2N3906 transistors specified for the circuit are not suitable as they are PNP types. They should be 2N3706 types.

CAR REV COUNTER. February Issue

As many readers have pointed out, there are only two sparks per engine revolution and not four as stated. However, due to the waveshape of the spark some cars, including the author's, can be calibrated using the method given. A simpler method of calibration is by using the speedometer. The figures of m.p.h. per 1,000 revs in top gear for individual cars are available from Main Dealers. For the most popular cars these are:

Mini 850	14.8	Ford Zodiac Mk. IV	20.1
BLMC 1100	14.9	Hillman Imp	15.1
BLMC 1300	16.8	Hillman Avenger 1250	15.5
Austin A60	16.6	Hillman Hunter DL	17.5
Triumph Herald	15.7	Vauxhall Viva	15.8
Ford Escort	16.0	Vauxhall Victor FD	
Cortina Mk. III		2000	16.4
1300	14.6	Vauxhall Cresta PC	20.9

Thus for a Mini 850, when the car is doing 29.6 m.p.h., the Rev Counter should be calibrated at 2,000 r.p.m.

THE Medium Wave Column

THE new Radio Popular Las Palmas in the Canary Islands is now a strong signal on 836kHz. It can be heard from 2300hr up to 0100hr GMT mixed with Radio Peninsular de Huelva, Spain on the same channel. From nearby Santa Cruz de Tenerife, the government owned outlet on 620kHz is a powerful signal that is best heard after 0030hr when Batra, Egypt on the same frequency has left the air.

Mike Barraclough of Whitby reports a new Algerian on 155kHz on the long waves. This is the second North African to appear recently on this band. Azilal, Morocco on 209kHz is audible throughout the evening with some interference from Kiev. It can be found on the h.f. side of Droitwich 200kHz. Ain Beida, Algeria has moved from 529kHz to 533kHz. It is now clear of interference and is a conspicuous signal from sunset until sign-off at midnight.

Riyadh, Saudi Arabia has a second outlet on 1183kHz which appears as a weakish signal between Horby, Sweden 1178kHz and Hungary 1187kHz. It has been logged by **M. Snow** of Doncaster at 2144hr using his Eddystone 870A and 130ft longwire antenna. Baghdad, Iraq 760kHz is another in this area that can be heard in the space between European channels; tune between West Germany on 755kHz and Sottens, Switzerland on 764kHz. The Holy Koran station at Beni Suef, Egypt operates on 1155kHz until 2100hr GMT; it can be located between BBC R4 on 1151kHz and Strasbourg on 1160kHz.

Further information about Commonwealth Reply Coupons is now available. Canada, Trinidad, Lesotho, Ceylon and Australia no longer offer reduced rates for letters to the UK. DXers should send an International Reply Coupon, available from main post offices, to these countries to ensure that sufficient postage is obtained to cover the cost of a reply.

There are now two low power Greek stations operating out-of-band at the high frequency end of the medium waves. Radio Ierapetra, the weaker of the two, is on 1609kHz while Radio Fokis, Amphissa transmits on 1614kHz. Both are audible in the UK after dark; Amphissa signing-off at 2100hr and Ierapetra one hour later. Radio Ierapetra is particularly interesting as it is located on the island of Crete, which is generally regarded as a separate DX country. **Alan Thompson** of Neath, Glamorgan has received a verification in English from this 250watt local broadcaster in a rare DX country and he gives the address for reception reports as "The Eastern Crete Broadcasting Station, Ierapetra, Crete, Greece." The station identification is Radhiofonikos Stathmos Anatolikis Kritis.

Send logs and information about the Medium Waves to the writer at 132 Segars Lane, Southport, PR8 3JG.

All in the mind

In your letter (p. 918, Feb. 1972) the correspondent raises the interesting question of whether there is such a thing as "Telepathy", the use of radio equipment for this purpose, etc, etc. He also asks for authoritative statements.

The first statements I have been able to find in the literature are by Prof. Albert Einstein. The ones I know of (there may be others) are mentioned on p. 111 of the book *Einstein* by Antonina Vallentin. Here he was questioned by a theoretical physicist (I am not sure who it was) as to whether he believed in telepathy. He replied with some delicacy, saying only "This has probably more relation to physics than to psychology." One wants to read the words, here, really, to see exactly what happened.

Then, on p. 157 in the book *Albert Einstein* by Carl Seelig, Einstein is quoted again; he recounts experiences he had in Berlin during World War I. Again there is some delicacy, but I personally think the meaning is fairly clear. It is eight lines long.

In 1968 the Americans circulated a television film containing shots of Einstein, his room in Oxford (1932), the Curies, and Walter Zinn, who may have been the theoretical physicist referred to above—I don't know. I saw this on TV in Melbourne in 1968-69.

One should also read parts of Einstein's beautifully written autobiography—translated, it can be found in P. A. Schipp's book *Albert Einstein—Philosopher—Scientist*. This is in the series *The Library of Living Philosophers*.

The rest of this letter consists of my own direct experiences with telepathy. In April 1971 some people in Oxford came on the air with a powerful transmitter (range of the order of 5 miles) which enabled me, without any transmitter, as far as I know, to communicate with them by thought sequences. I was in a hired car, so I can't be quite certain of what was in it.

I personally think that the brain stores memories for pro-

duction on demand by our consciousness in the form of electro-chemical tensions, and that a graph(s) of voltage versus time could be made. This, in the case of sound sequences, would look like a d.c. oscilloscope trace containing multiple sine waves (of different frequencies) superimposed on each other. I assume that there is a "Tabula Rasa" or blank space—which may be three dimensional—in the nerve network which exists in the brain, and that e versus t graphs across it accompany our (sound) thought sequences.

It would be interesting to hear about the information and experience of others.—**J. N. Whiteley**, (*Oxford*).

* * *

With reference to V. D. Butler's letter in the February edition; I too have heard and read of people who were able to hear radio stations without any equipment.

One explanation of this, heard I think, on the Home Service programme "New Worlds", a year or so ago, is that occasionally, due to its physical construction and chemical reaction with the saliva a tooth filling may act like a crude diode. In areas of strong r.f. field the detected current somehow causes the tooth filling to vibrate like a miniature loudspeaker. The sound then travels up the jawbone into the ear.

I doubt that the signal is detected in the brain for two reasons (1) Thoughts consist more of on-off impulses than the more regular flow of electricity of sound. (2) If one part of the brain is affected by the radio-signal then other parts of the brain would be as well, causing such effects as flashing lights to be seen, strange tastes in the mouth etc.—**J. Rowley**, (*Bristol*).

* * *

Your correspondent V. D. Butler raises a very interesting topic. The human body has an ohmic resistance which can be readily measured by a person grasping, one in each hand, the prods of a sensitive test meter or galvanometer and it seems reasonable to suppose that a potential difference therefore

exists between the two points.

The human brain can be likened to a very intricate IC and it can be assumed that the human skull is no more a barrier to high frequency waves than the walls of a building. It may therefore be possible to discover how the mechanism of the brain may be utilised to rectify radio waves and make them audible in the human ear. Such a phenomenon would doubtless be the basis of telepathy whilst of course changing body resistance makes possible the lie detector.

No doubt once the technique was discovered it would not be long before mind over matter would enable a sensitive listener to concentrate his mind on a certain programme or station and all this without the antenna usually depicted on the cranium of the little green men from Mars.—**R. J. Hall**, (*Cornwall*).

Ban the transistor!

On page 830, of January 1972 edition of P.W., D. L. O. Smith wonders if he is a dying breed, using valves. I can tell him he is not. I am 22 years old, and certainly not an old hand at the game, but I do not use transistors for any serious project.

My main interest is Audio, and I have heard the best laboratory transistor and valve amplifiers, and although the technical specifications are often identical, my ears tell a different story! I cannot listen to a transistor amplifier without getting a headache! (I am of course assuming good speakers, pickup etc.) Another point is the reliability of valves. A valve generally dies slowly of old age, (I have some in good emissive working order from 1928 though). But transistors just appear to go, suddenly when they feel like it, and in some of the equipment I design, like 600W amplifiers, that could be disastrous! I have found that valve equipment can, if properly made, be 'thrown all over the place' without complaining and my mobile discotheque has never broken down in six years, and that's capable of 750W r.m.s. — **P. Rostgaard**, (*Herts*).

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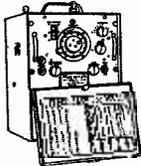
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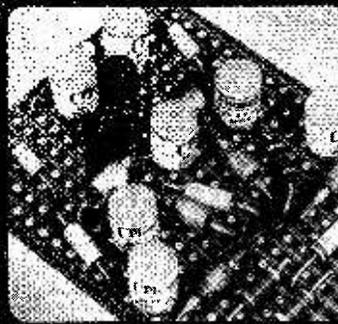
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The UBA is simple to construct, easy to install and cheap to run. The basic Detector Unit is carried in an ex-Army haversack slung high up on the back of the lady wearer. An interconnecting harness joins the haversack to the simple battery Power Unit carried in two Bren gun ammunition pouches on a waist belt. The all-important Alarm Unit is located in yet another piece of surplus equipment, namely a gasmask carrying pack which is also connected to the back pack by a cable harness.

All three units are carried on a standard set of Army webbing so that the complete UBA can be easily fitted in a moment.

Ladies may well prefer some form of fancy buckle on the belt rather than the standard Army buckle which is meant to be practical rather than ornamental but this is a matter of discussion between the constructor and his lady friend.

Principle of Operation

The Sensing Unit comprises two gold plated electrodes, each six inches in diameter, one mounted on each hip, thus constituting a simple capacitor with

the body as the dielectric. Each electrode has a thin screened wire which is plugged into the back pack.

It is a well known medical fact that when a lady becomes with child she immediately undergoes certain body changes and thus the dielectric constant of the body also changes thus altering the effective value of the capacitor.

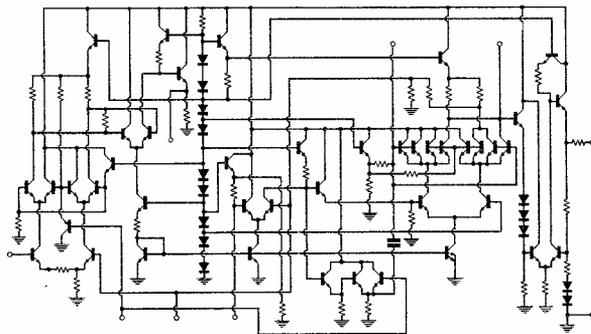
Circuit

The Detector Unit contains a crystal controlled oscillator on about 100kMc plus a second oscillator using the popular Whottle circuit also operating close to 100kMc. It is into the second oscillator circuit that the Sensing electrodes are plugged. The only control on the Detector Unit consists of a small balancing variable capacitor of $10\mu\text{F}$ which is combined with the on-off-on-off switch.

The Power Unit in the two pouches on the belt is formed from approximately four thousand type BA71 \times 67 \times 89 rechargeable cells wired in series. Since the capacity of these cells is limited, about $2\mu\text{F}$, the design incorporates an arrangement for recharging the cells from the mains supply. NOTE:—The cells must not be recharged while the UBA is being worn. An undetected leakage in the system could have disastrous results.

Construction

The two oscillators are contained within a single integrated circuit, type K9P no discrete components being needed outside the i.c. The i.c. is mounted on a wooden frame made to fit inside the haversack. The mounting, consisting of nine helical springs, also



Abridged circuit of the Universal Baby Alarm.

joins the nine leads of the i.c. to terminal tags on the wooden frame thereby protecting the i.c. from shock as it is presumed that the lady will don the UBA in the privacy of her bedroom. Two five-ampere sockets are fitted to accommodate the electrode leads.

The Alarm Unit mainly consists of an alarm bell of the type fitted above pawnbroker's premises and generally painted red. If the normal gasmask carrying case proves too small get a bigger one or sew two together. The assembly of the Power Supply is perhaps the most time consuming. The wiring in series of the four thousand cells is best done on a production line system. Con some friends home for a drink and get them to assist. Twenty friends will only need to wire two hundred cells each but if two hundred friends can be accommodated the whole job

can be disposed of in a tenth of the time.

The string of cells is fed into a plastic tube which is then coiled into the two pouches.

The interconnecting harness can be made up of any odd lengths of wire preferably 36 s.w.g. bare enamel for lightness.

Adjustment

After switching on the UBA a few days must be allowed for the oscillators to settle down after which time an audible signal will be heard from the Alarm Unit mounted on the chest. A slight adjustment to the balancing control will reduce the tone to zero kMc. Needless to say the electrodes must be attached and the webbing carrying the three units also properly fitted for maximum comfort before the balancing operation can be carried out.

From that point onwards any changes in the body's dielectric constant, for reasons previously mentioned, will upset the balance between the two oscillators and a piercing, shrieking, strident signal will be emitted from the Alarm Unit thus acquainting the lady with her new condition.

Notes

Details of the preliminary adjustments have already been given. Should the alarm ever ring it may be switched off by the lady operating the on-off switch high up on the back of the back pack, if she can reach it. If this should happen in a crowded street it will have the most salutary effect upon the wearer of the UBA. ■

could be higher than its distortion factor.

The THD bridge shown in the photograph, which uses the circuits given in this article, works to a limit of about 0.08 per cent for a 1V reference when used in conjunction with an audio generator and filter delivering a signal with less than 0.01 per cent distortion.

HUM FILTER

A circuit for a suitable high pass (hum) filter is given in Fig. 6A. This can be built in and switched in or out at the bridge input as shown. Its response

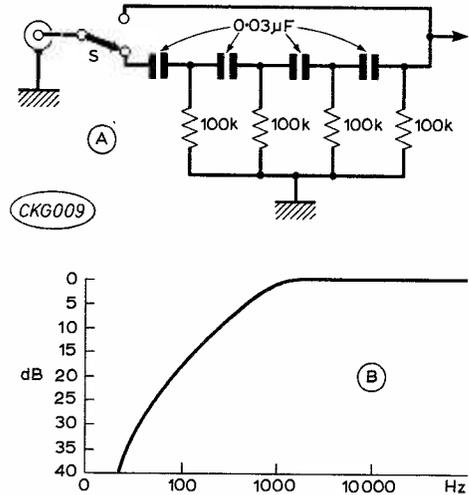


Fig. 6A: Hum filter for the THD bridge input and, Fig. 6B, the filter response curve.

should be checked of course and should be approximately 30dB down at 50Hz reference to 0dB at 1000Hz (see Fig. 6B). The insertion loss is about 2dB at 1000Hz.

CONSTRUCTION

The THD meter constructed by the writer is shown in the accompanying photographs. It was built into a case 17in. wide and 9in. high with a sloping front panel. The case depth at the base is 6in. and 2in. at the top. The circuit boards for the bridge and audio voltmeter etc., were assembled on s.r.b.p. boards, these being mounted on stand-off brackets on the rear of the front panel.

The coarse frequency and balance controls may be wirewound potentiometers but the fine frequency and balance controls must be good quality carbon track potentiometers.

Whilst not wishing to put readers off building an instrument of this nature it must be stressed that other accurate test equipment such as an audio volt/millivolt meter, oscilloscope and audio signal generator are essential for testing and calibrating and that the utmost care must be taken to ensure that the instrument has a uniform frequency response and a hum and noise level of 200µV or less. Accurate calibration of the audio volt/millivolt meter is also vital and the meter scale should preferably be as large as possible. ■

CO! CO! CO! CO! CO! CO! CO! CO!

INFORMATION WANTED

- ...instruction manual and/or any gen regarding Air Ministry surplus receiver R3673.—R. Winson, 62 Stephen's Firs, Mortimer, Reading, RG7 3UY.
- ...typical circuitry for making demonstration model of laser using English Electric laser Tube XL607 or XL609.—Simco Meters Limited, Meter Factory Road, Post Box No. 46, Tiruchirappalli 1, India.
- ...servicing data on Seltophone tape recorder 2084/HSW/3103/274/0104 4-track 2-speed.—T. Brook, 16 Dakin Avenue, Fairfield, Euxton, Derbyshire.
- ...any information on my old set. Built 1930-1940, long medium and short waves and valves ECH81, EF41, EBC41, EL84 and EZ40.—R. Cox, 127 Bermuda Mansions, Yew Tree Estate, Walsall.
- ...where can I get a replacement speaker for Pilot Radio Limited, "Little Maestro"—H. W. Hudson, Rosemary Cottage, Darlington Road, Basingstoke, Hants.
- ...information on the ex-W.D. No. 19 set. I am studying for the R.A.E. and would like to know some of this set's details and limitations, as I would like to use it when I obtain my license.—P. Herbert, 5 Castlecombe Drive, Princes Way, Wimbledon, S.W.19.
- ...any gen on the Omron Subminy Timer. Type STP 240V a.c. It says "do not remove case" on the exterior.—Peter Neal, 65a The Ridgeway, Enfield, Middlesex.
- ...supply of power unit for CR150/2 and cable socket for the seven connecting pins at the rear of the set. Also at the rear is a four leg socket, could anyone please say what this is for and where I could obtain a P/P socket—Charles Mumford, "The Hurst" 124 Headwood Road, Hastings, Sussex.
- ...handbook wanted on loan for Aiwa TP1012 stereo tape recorder.—R. McGowan, 32 Hilbert Road, North Cheam, Sutton.
- ...info. please on the following: Rx R1082 ref. 10D8415, Controller Electric type 4 ref 10J/22. Training sets W.T. Mk. III, H.E.C.L. Cat. No. ZA21137, Receiver type R3003 ref. 10Db/2, Wireless Remote Control Unit "P"—No. 1 ZA12642—John Hutcheon, The Manse, Bourque, Kirkudbright, Kirkudbrightshire.
- ...manual for w.s. 22.—S. Glen, Bennetts Cottage, Puxey, Sturminster Newton, Dorset
- ...manual or handbook on Mutual Conductance Tube Tester 1-777 (U.S.A.)—R. A. Garnham, 22 Somers Close, Ipswich, Suffolk.
- ...any information on radio direction finder working on 200/400kHz using marine radio beacons.—L. Griffiths, 37 Moore Road, Upper Norwood, London, S.E.19.
- ...conversion details or manual for PCR 2 Rx.—I. Browne, School House, Monkton Combe School, Nr. Bath, Somerset.
- ...modes to the 3673 Rx also buy or loan P.W. July 1960 for mods to the 1392 Rx.—W. J. Waldron, 14 Forthmanor Road, Cwmbran, Mon.
- ...any data on the XE-post, double-tuned type VT118 (832)—R. Knight, Lincoln's Imp, Roedowns Road, Medstead, Alton, Hants.
- ...handbook on the Rx (Admiralty pattern) No. 100339 made by Rees and Picking in 1953. This is badly needed by several elderly DXers in this district.—W. Packer, B.E.M., 43 Seaview Drive, Great Wakering, Southend, Essex.
- ...circuit and instructions for Mullard tape recorder amplifier using Marrott heads x/RP5/18 and erase X/ES/11.—V. Hammond, 46 Cresswell Road, NE28 8QE.
- ...circuit diagram and/or handbook for Zenith Transoceanic s.w. Rx. model 8G005 YTZ.—J. H. Lloyd, 70 Heath Drive, Ware, Herts.
- ...any info on a.m. receiver R1224A especially valves (these are missing).—L. Moyses, 1683 Pershore Road, Kings Norton, B'Ham, B30 3DT.
- ...the Strand amplifier blueprint issued with P.W. October 1962.—84 Lansbury Drive, Hayes, Middlesex.
- ...manual and/or circuit of Honor Corporation TE-20 signal generator believed same as Lafayette TE20. Also issues wanted Jan, Mar, Apl, May and July 1968 P.W. for the Clubman series. Will buy or borrow.—P. J. Brent, 4 Cochrane Place, Helensburgh, Dunbartonshire, Scotland.

Page 79
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Page 80
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deluxe^{9/12} receiver

for the SWL PART 1
R. H. LONGDEN

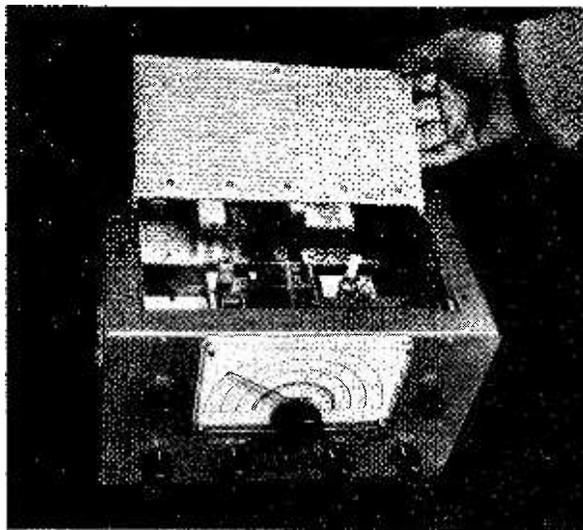
MANY receivers used on the short wave bands suffer from two particular limitations; lack of sufficient adjacent channel selectivity and the appearance of second-channel interference on the higher frequencies. These defects have completely different causes so it is helpful to note briefly how they arise.

Second-Channel Interference. Because of the way in which a superhet operates, the i.f. stages can pass and amplify signals which are twice the i.f. from the wanted signal. With an intermediate frequency of 470kHz, the second channel is 940kHz from the wanted signal. On low frequencies the aerial and mixer tuned circuits prevent such signals reaching the mixer. But on the higher frequency bands the aerial and mixer circuits become less effective so that second channel interference becomes troublesome. Even with an r.f. stage, such interference can be serious on frequencies from about 14-30MHz.

To avoid the complication of more r.f. stages, a higher intermediate frequency may be adopted. With the receiver described here the i.f. is 1.6MHz, so that second channel signals are 3.2MHz from the wanted transmission and are thus much more adequately discriminated against by the aerial and mixer tuned circuits.

Adjacent Channel Selectivity. This is the ability of a receiver to select the wanted signal and reject signals which are near to it. A 1.6MHz i.f. amplifier has much less adjacent channel selectivity than a 470kHz amplifier. So a 1.6MHz i.f. may reduce second channel interference, but only at the cost of troublesome adjacent channel interference on congested bands.

In this receiver, this is overcome by using three double-tuned and one single-tuned i.f.t., providing seven tuned circuits in this section. In addition a



1.6MHz crystal filter can be switched in giving a high degree of selectivity.

When constructed for general short wave reception of a.m. signals, the receiver has nine transistors, built in four sub-assemblies, as in Fig. 1:— (1) RF and mixer, (2) Crystal filter with i.f. amplifier, (3) 2-stage i.f. amplifier with diode demodulator, (4) AF, driver and push-pull output. After completion, these units are fitted to the common chassis.

When reception of e.w. and s.s.b. signals is required, section (5) is added, making twelve transistors in all. One transistor operates as a beat frequency/carrier oscillator and the other two as product detector.

RF AND MIXER CIRCUIT

This is shown in Fig. 2. L1, L2 and L3 are the aerial, mixer and oscillator coils, tuned by the 3-gang capacitor VC1, VC2 and VC3. To obtain optimum efficiency throughout each range, with any aerial,

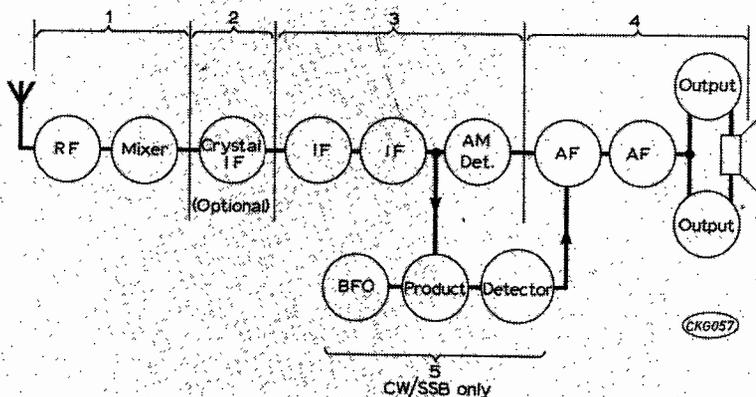


Fig. 1. Diagram of stages comprising receiver. The crystal filter and b.f.o./product detector are optional.

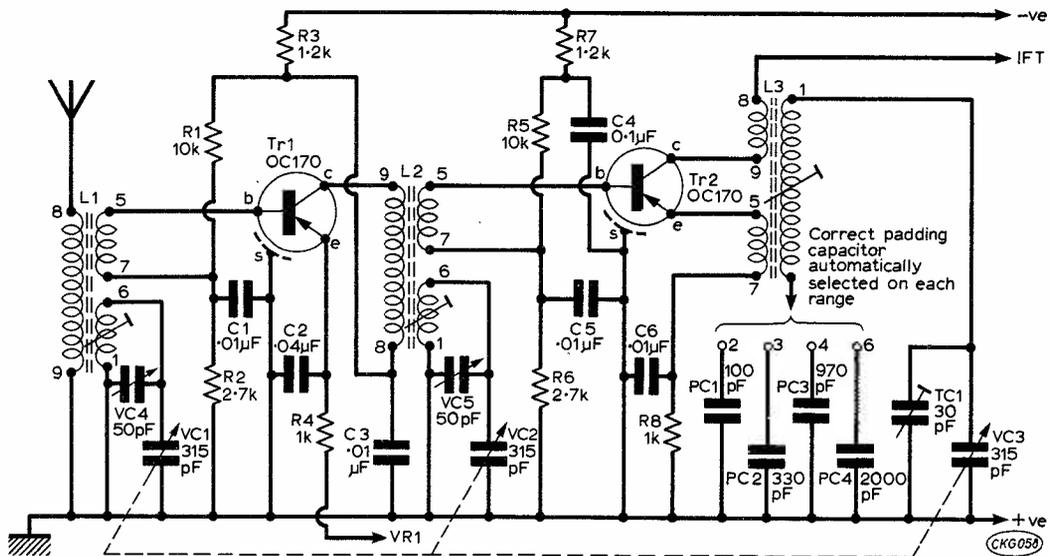


Fig. 2. Circuit of the r.f. and mixer stages, the output feeding the crystal filter or i.f. amplifier.

small panel trimmers VC4 and VC5 are provided for L1 and L2. The oscillator trimmer TC1 is set at about half capacitance and will probably need no adjustment.

To avoid bandswitching, while allowing full coverage, miniature plug-in coils are used. A set of three coils is required for each band. They are coded "Blue" for L1, "Yellow" for L2, and "White" for L3. Coverage, with the maker's range numbers, is approximately as follows:

Range 3	1.7-5.3MHz
Range 4	5-15MHz
Range 5	10-30MHz.

Though the receiver is not particularly intended for medium wave reception, Range 2 coils may be used for this band.

Each oscillator coil L3 requires a different value of padder capacitor. The coils use a different pin for each range, so the padder is automatically correct for any coil plugged in.

The emitter bias circuit of Tr1 is brought out so that it can be connected to the r.f./i.f. gain control VR1.

Construction. This assembly consists of an open flanged box, carrying the coil holders at a convenient height, with a plain Veroboard (or paxolin) panel for resistors and capacitors.

The box is readily made from a "universal chassis" member 8×2in. The member has flanges both sides and at the ends. The side flanges are both cut away by snipping out a 90° section 1½in. from the end. The 8×2in. member is then bent to form a box 5×2×1½in. high. After drilling and punching holes for the coil holders, the 5×1½in. panel is attached to the flanges with bolts.

Wiring is shown in Fig. 3. All connections should be quite short and direct. Resistors and capacitors are on the outside of the panel, and wiring inside. The transistors, C3, and the padders are wired directly to the coil holder pins, as shown.

Run R3 and R7 to a pin or black lead, which is later used as the negative circuit. Take R4 to a pin or coloured lead, for VR1.

Take a coloured lead from pin 8 to L1. This runs through the chassis to the aerial socket. A coloured lead is provided from pin 8 of the holder for L3, to go to the i.f. amplifier.

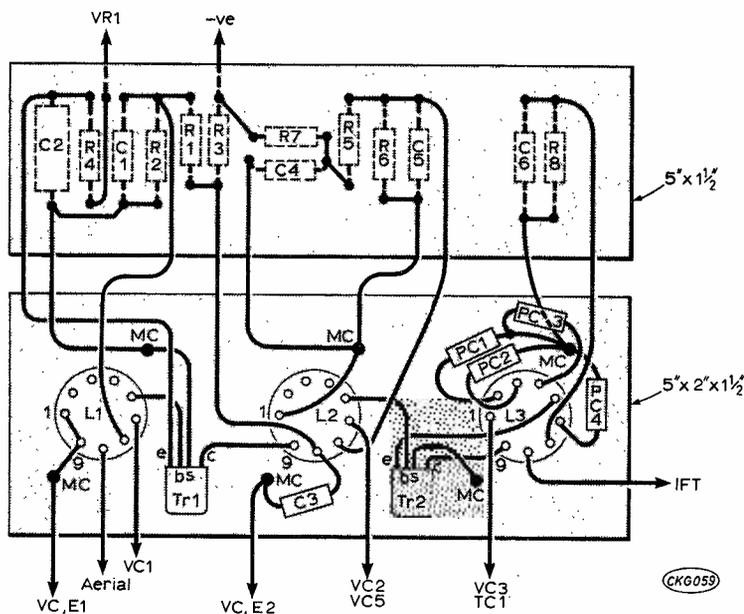


Fig. 3. Wiring details of the r.f. and mixer stages with the circuit board (top) separated from the metal chassis (below) for clarity.

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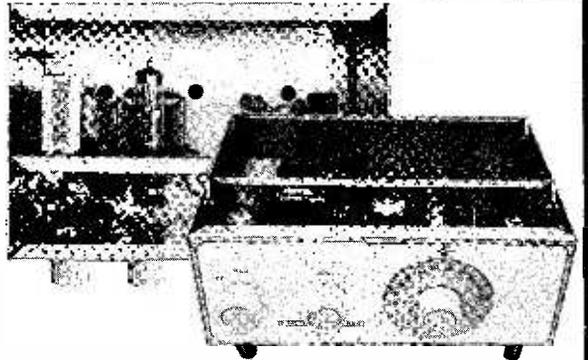
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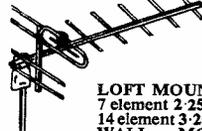
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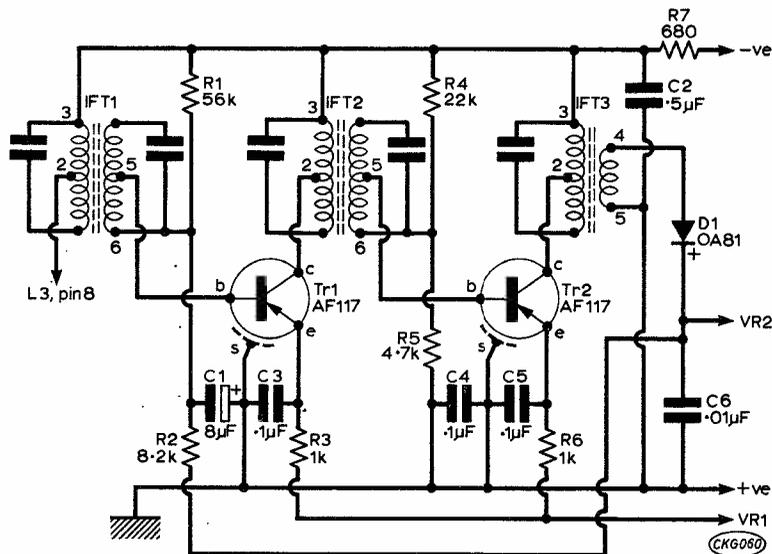


Fig. 4. Circuit of the two-stage 1.6MHz i.f. amplifier. Gain control VR1 for the r.f. and i.f. stages is mounted on the front panel.

out the band. If VC4 or VC5 is fully open, screw down TC1 a little. Lock L3 core with a nut, and if necessary re-adjust L1 and L2 cores so that least movement of VC4 and VC5 is required throughout the band. Repeat for the other ranges.

If "squegging" arises, causing oscillation and whistles towards the h.f. end of a band, L3 core may be too far in, or a resistor of about 100Ω may be placed between Tr2 collector and pin 9, or the winding to pin 9 can be unsoldered, and one turn removed. Place the coil in a holder while soldering.

Solder on three insulated leads, to run to the front, middle and back sections, VC1, VC2 and VC3, of the ganged capacitor. Also take from the chassis tags the lead marked VC, E1 and that marked VC, E2.

The assembled unit is fixed about 1/2 in. from the ganged capacitor by bolts through its flanges and the chassis. Lead VC, E1 is taken under the capacitor, cut to length, and soldered to the front rotor (moving plates) tag. Lead VC, E2 is similarly taken to the rotor tag which is towards the rear of the capacitor. These leads provide direct earth-returns between the coils and capacitor.

Cut and solder leads VC1, VC2 and VC3 to the sections of the capacitor. At the same time solder a lead to VC3 to bring up to TC1, which is fixed to a small bracket bolted to the back plate of the capacitor.

The capacitor can now be screwed to the chassis, with a washer under each foot (to clear VC, E1 and E2 leads). If necessary, the r.f. and mixer assembly can be unbolted and put on its side without disconnecting any of the leads to the ganged capacitor, to trace wiring or other faults.

Alignment. Coil cores are unscrewed and TC1 is half closed with VC4 and VC5 about one-quarter closed. With the ganged capacitor closed, adjust the core of L3 for a suitable band-end frequency (say 1700kHz, for Range 3). Tune a little away from the extreme end of the band, and adjust the cores of L1 and L2 for best volume. VC4 and VC5 should now peak for best volume through-

THE IF AMPLIFIER

The circuit of this is shown in Fig. 4. It is a fixed tuned amplifier operating at 1.6MHz having five tuned circuits. There are two adjustable cores in i.f.t.1, two in i.f.t.2, and a single core in i.f.t.3.

Emitter bias circuit resistors R3 and R6 are brought out to a lead which is later connected to the gain control VR1. This allows manual control of gain, to avoid overloading on strong signals.

The detector diode D1 provides an audio output for the a.f. gain control VR2, and also a.g.c. bias for Tr1.

Construction. Resistors and capacitors are mounted on a plain Veroboard panel 5 × 1 1/2 in., Fig. 5. This also takes pins or flying leads for VR1, VR2 and the negative supply line. The positive or chassis return is completed through the tags MC and receiver chassis.

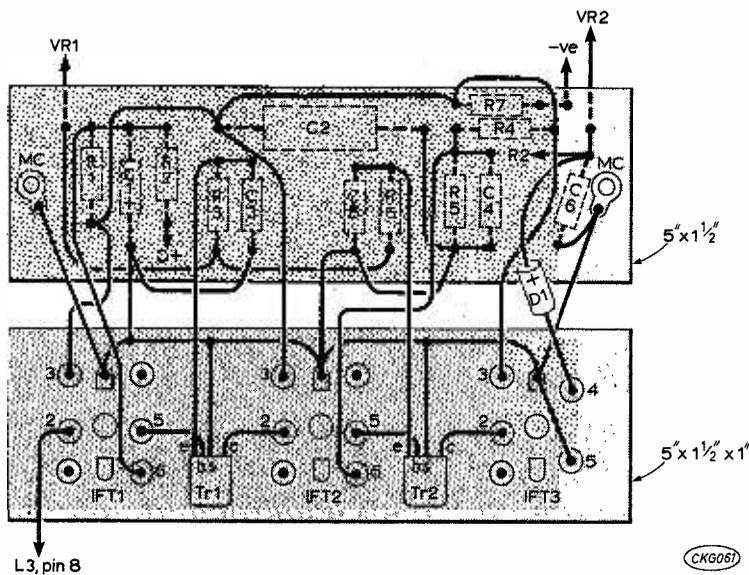
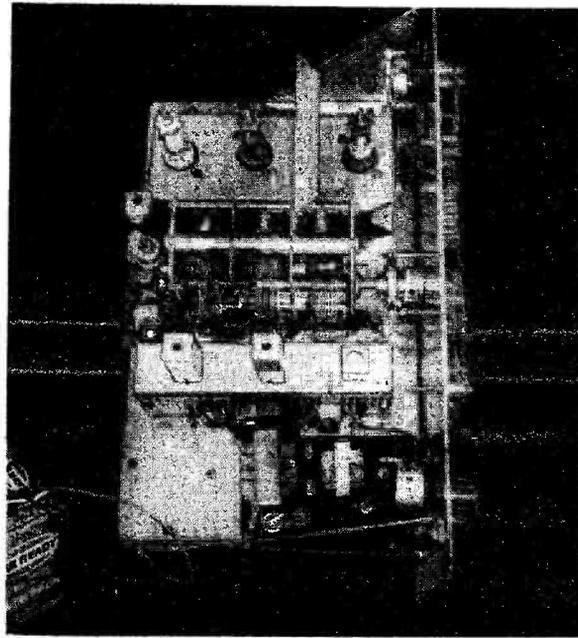


Fig. 5. Component layout for the i.f. amplifier. Again the board is shown separated from the chassis.

The 8×1in. flanged "universal chassis" member is first drilled for the i.f.t.s. Drilling positions can be found by pressing the pins on paper, placing the paper on the metal, and marking through with a sharply pointed tool. Remember to include holes for a trimming tool, so that the lower cores can be reached.

A 90° section is snipped or sawn from each runner, 1½in. from the end. The member is then given two right-angled bends, forming a flanged part 5in. long, 1in. wide, and 1½in. high. The Veroboard is fixed to the flanges with bolts which also secure the MC tags.

Insulated sleeving is put on the transistor leads, and the transistors are soldered on, the wires being cut shorter as necessary. A lead is soldered to pin 2



General view of completed receiver with the r.f./mixer unit at the top and the i.f. unit immediately below the ganged tuning capacitor.

★ components list

RF/MIXER UNIT		
Resistors:		
R1 10kΩ	R4 1kΩ	R7 1.2kΩ
R2 2.7kΩ	R5 10kΩ	R8 1kΩ
R3 1.2kΩ	R6 2.7kΩ	
All ±W 10%		
Capacitors:		
C1 0.012F	C3 0.01μF	C5 0.01μF
C2 0.04μF	C4 0.1μF	C6 0.01μF
All 12V minimum working voltage		
VC1, 2, 3	3 gang 315pF per section (Jackson)	
VC4	50pF panel trimmer (Jackson C804)	
VC5	50pF panel trimmer (Jackson C804)	
TC1	30pF beehive trimmer or similar	
Semiconductors:		
Tr1 OC170	Tr2 OC170	
Inductors:		
L1	Miniature coils (transistor) Blue range (Denco)	
L2	Miniature coils (transistor) Yellow range (Denco)	
L3	Miniature coils (transistor) White range (Denco)	
Miscellaneous:		
Veroboard 5 x 1½in. 0.15in. matrix. "Universal chassis" flanged member 8 x 2in. (Home Radio).		
B9A valveholders (without skirt) 3.		
IF AMPLIFIER		
Resistors:		
R1 56kΩ	R4 22kΩ	R7 680Ω
R2 8.2kΩ	R5 4.7kΩ	
R3 1kΩ	R6 1kΩ	
Capacitors:		
C1 8μF	C3 0.1μF	C5 0.1μF
C2 0.5μF	C4 0.1μF	C6 0.01μF
All 12V minimum working voltage		
Semiconductors:		
Tr1 AF117	Tr2 AF117	D1 OA81
Miscellaneous:		
IFT1, 2 (Denco IFT18/1-6). IFT3 (Denco IFT17/1-6).		
"Universal chassis" flanged member 8 x 1½in. (Home Radio). Veroboard 5 x 1½in.		
Additional materials:		
Chassis 10 x 6 x 2in., cabinet 12 x 7 x 7in. (Type W. H. L. Smith). Pair brackets 4 x 4in. (Type C. H. L. Smith). Tuning drive mechanism (Type DL6 Home Radio). RF gain control, VR1 2kΩ linear potentiometer. Audio gain control, VR2 5kΩ log. potentiometer with switch. Sockets for: aerial, earth, speaker. Knobs, PP9 battery.		

of i.f.t.1 which will later run either to pin 8 on L3, or to the crystal unit collector.

Alignment. The i.f. amplifier can be checked before fitting it in place. Temporarily join the VR1 lead to MC. Connect a 4.7kΩ resistor or the 5kΩ volume control from VR2 to MC, and take the a.f. output to phones or an audio amplifier as convenient. Connect the battery positive to MC, and negative to negative.

The modulated signal from a generator tuned to 1.6MHz can be loosely coupled to the lead from pin 2 of i.f.t.1. The tone should be heard and all the i.f.t. cores rotated for best volume.

The signal from the generator should be kept low, so that adjustment of the cores is not masked by the a.g.c. action. A correctly shaped tool, such as the Denco TT5, should be used since a wedge-shaped blade may easily break the cores.

Should cores have been moved far from their pre-aligned settings, no signal may be heard. If so, inject the signal at Tr2 base, and adjust the core of i.f.t.3. Then inject at Tr1 base, and adjust both cores of i.f.t.2. Finally, adjust i.f.t.1 with the signal at pin 2.

If no signal generator is available, tune in any station and adjust all the i.f.t. cores for best results.

Two bolts through the end flanges mount the assembly a little clear of the variable capacitor, with i.f.t.3 at the front. Holes are required in the chassis of the receiver, so that the lower i.f.t. cores can be readjusted if necessary.

A lead is run from the pin forming the connecting point for R3 and R6, through the receiver chassis to the r.f. gain control. VR2 and negative are similarly connected to the appropriate points.

It will be observed that these sections of the receiver can be tested before adding the crystal filter stage, the lead from pin 2, i.f.t.1 in Fig. 4, running directly to pin 8 of the oscillator coil L3.

Next month we shall give full details of the crystal filter, audio stages and the optional BFO/product detector unit.



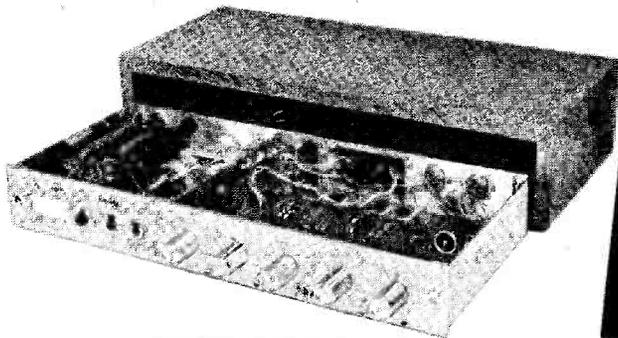
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PART 1



THE idea of using numerical indicator tubes to give a digital time display is not new; indeed several designs exist already to provide such a display using TTL elements for the logic circuitry.

This article sets out to simplify the construction of a twenty-four hour digital clock in order to make it a practical proposition for the home constructor. The main simplification in construction results from the use of readily available printed circuit boards (the 'Decade PCB' supplied by RS Components Ltd).*

The mains frequency is used as the prime timing source, thus reducing the circuit complexity while maintaining sufficient accuracy for most needs.

Only two types of integrated circuits are used throughout; the 7490 TTL Decade Counter and the 7441 TTL B.C.D. to Decimal Decoder/Driver.

Although a zero reset facility is not included a simple method is shown for setting the clock initially using two push buttons.

Either a light-emitting diode (l.e.d.) or a small filament lamp may be used to provide a combined decimal point and flashing seconds display.

The power supply is much simplified by the use of a monolithic voltage regulator for the 5V regulated supply needed for the integrated circuits.

For simplicity the design is separated into three distinct units, the power supply, the countdown board (which also includes initial setting) and the seconds flasher. The circuit diagrams for these units are shown in the article.

CHOICE OF COMPONENTS

The use of TTL modules for the counting and display decoding functions is decided on grounds of cost. TTL families such as the 7400 series are so popular and have sold in such volume that the current prices are ridiculously low. In fact the modules used have operational capabilities far in excess of those needed for this particular application, using

* Reference to the components list indicates that a number of items are manufactured by RS Components Ltd. These items may be ordered through radio and electronic component dealers. RS Components *will not* supply these items direct to the general public.

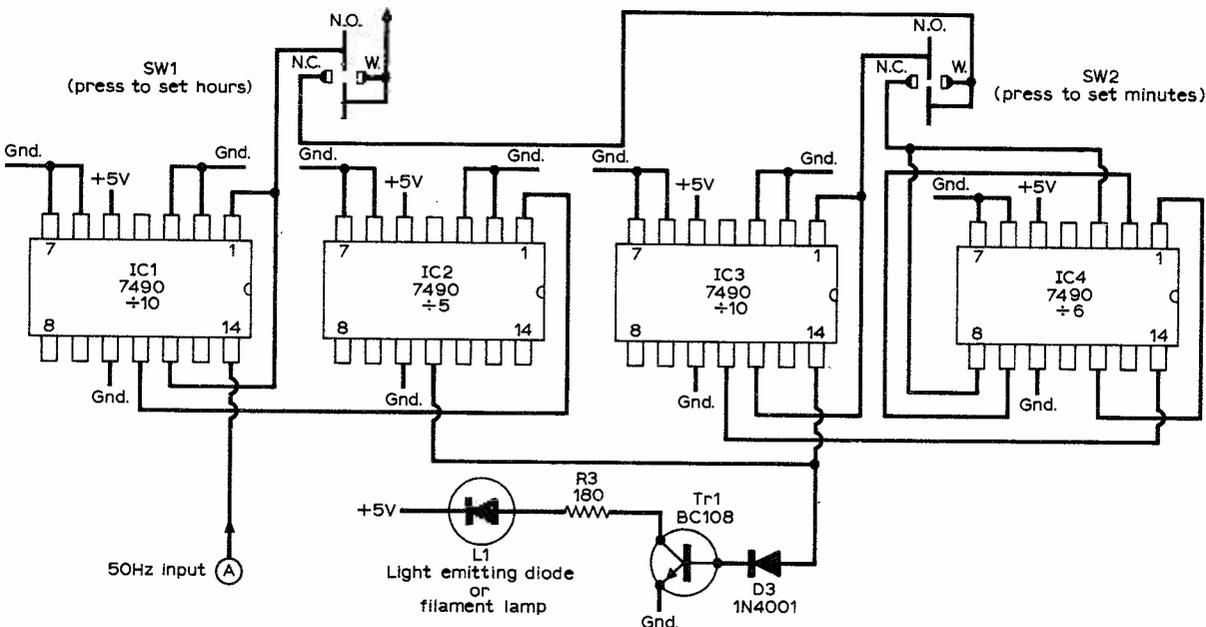
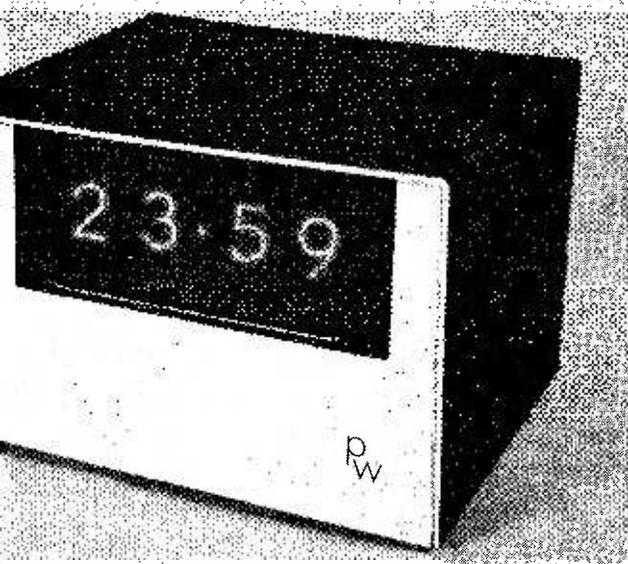


Fig. 1: Details of the "countdown module" including the setting switches and the decimal point circuitry. Output to the display module is taken from the arrowed connection (top left).



clock

J.G. MERCER

circuitry 'just good enough' would be prohibitively expensive.

Several different types of numerical indicator tubes may be used in place of those specified in the components list. Since the tube connections are clearly annotated on the printed circuit board almost any cold cathode tube with or without decimal points may be used provided that the wire leads are at least 1½ in. in length. Tubes with a red lacquer coating are preferable from the point of view of contrast and clarity, but clear tubes may be used behind a red screen. The red filter is necessary to block the blue portion of the spectrum contained in the tube discharge to give sharply defined numerals.

The use of a monolithic voltage regulator for the 5V power supply gives good performance together with considerable circuit simplification. The regulator used has high noise immunity, internal overload and short circuit protection.

For the decimal point and seconds indicator a light emitting diode was used in the prototype to provide a clear light source with a low current consumption but since a driving transistor is used a small 5V or 6V 40mA filament indicator may be used.

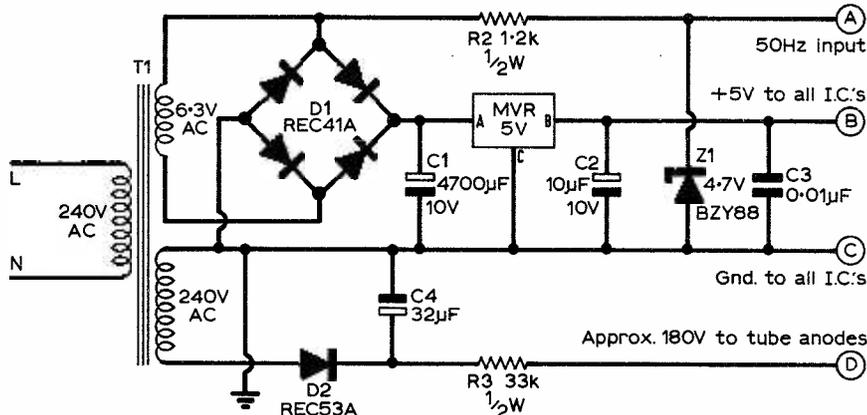


Fig. 2: Complete P.S.U. including the 5V rail, earth to all ICs and 180V numicator tube supply.

★ components list

Resistors

- R1 16kΩ (on each PC board)
 - R2 1.2kΩ
 - R3 33kΩ
 - R4 180Ω
- All 10% ½W

Capacitors

- C1 4700µF 10V electrolytic
- C2 10µF 10V electrolytic
- C3 0.01µF 250V polyester
- C4 32µF 450V electrolytic

Semiconductors

- D1 'Bridge Rectifier Rec 41A' (RS Components)
- D2 'Rectifier Rec 53A' (RS Components)
- D3 1N4001
- MVR 'Monolithic Voltage Regulator MRV5V' (RS Components)
- Z1 BZY88 Zener
- Tr1 BC108

Switches

- SW1 } Push to changeover switch. Min. Push co
- SW2 } (RS Components)

Integrated Circuits

- IC1-IC8 7490 TTL (RS Components) or Texas SN7490N
- IC9-IC12 7441 TTL (RS Components) or Texas SN74141

Miscellaneous

- T1 'Midget mains transformer 250V' 0-250V at 25mA 6.3V at 1.2A (RS Components)
 - L1 Light emitting diode (or filament lamp without 180Ω resistor)
 - DC1-DC4 Printed Circuit Board 'Decade PCB' (RS Components)
 - N1-N4 Numicator tube 'RS Num Tube' (RS Components) or Hivac XN series (see text)
- Escutcheon plate (for front panel—optional) 'Flush meter kit' (RS Components)
- Complete metalwork in 16s.w.g. aluminium alloy, undrilled, but with front panel punched for read-out is available from H. L. Smith & Co., 289 Edgware Rd., London, W.2, at £1.20+24p on orders by post.

NOTE

RS Components, mentioned in this list used to be known by the name "Radiospares".

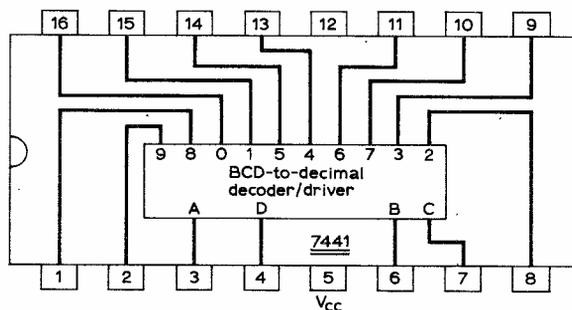
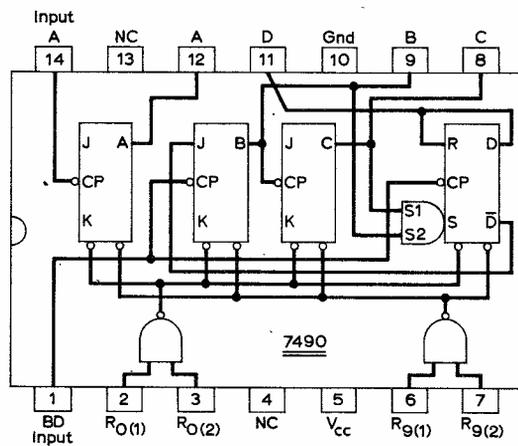
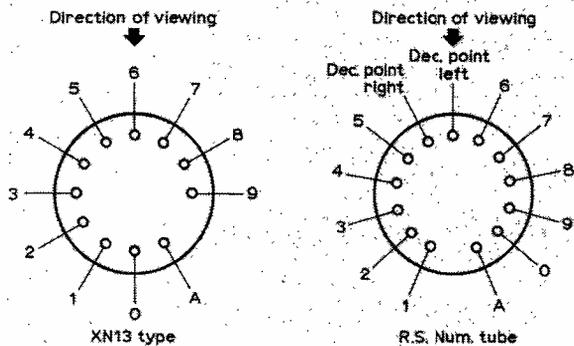
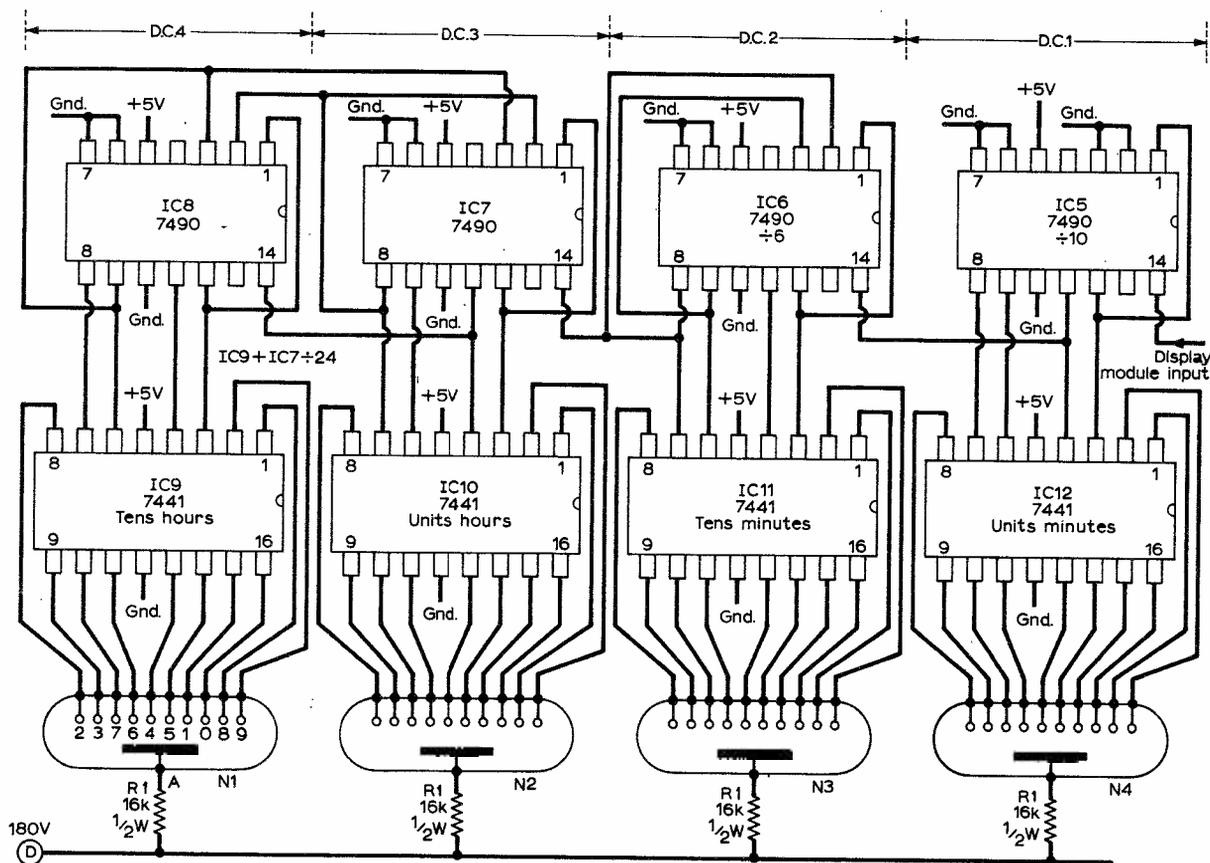
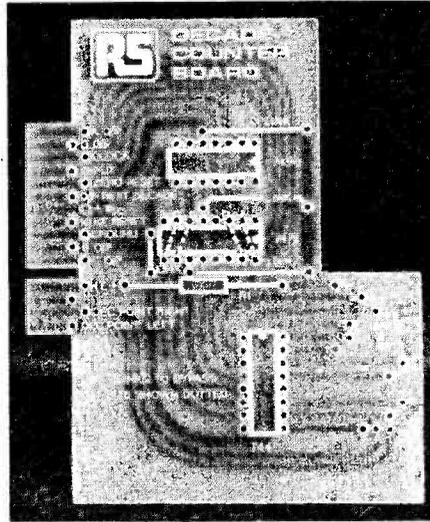
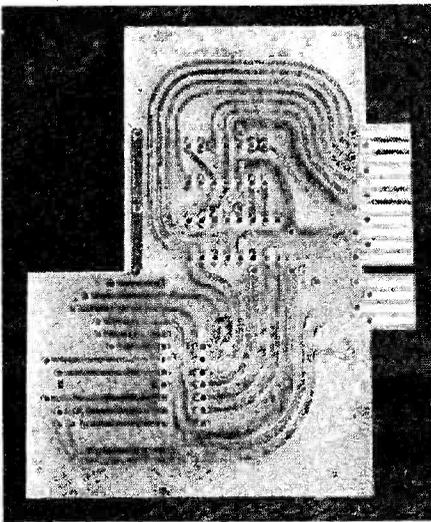


Fig. 3: (above) Base connections for the numicator tubes.

Fig. 4: (right) The pin connections for the integrated circuits. The top view of the dual in-line package is shown.

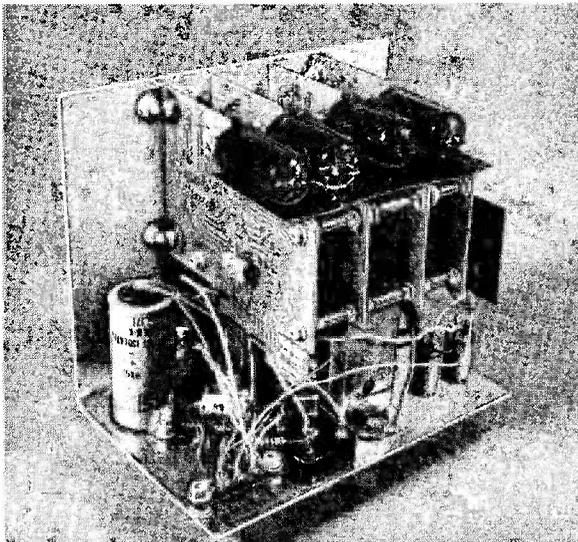
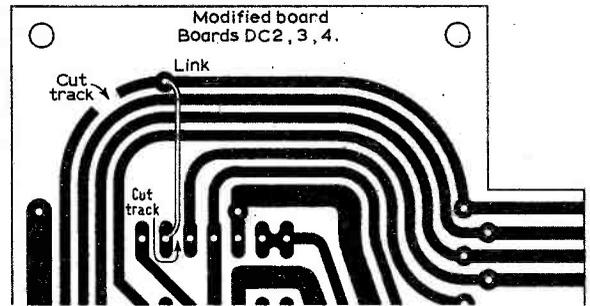
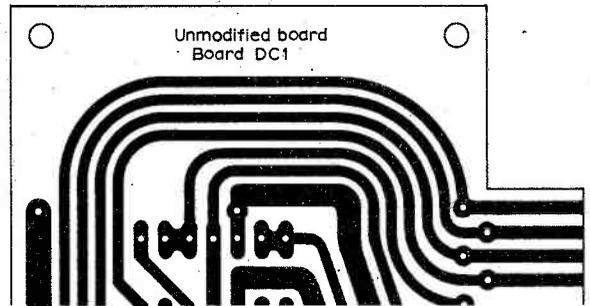
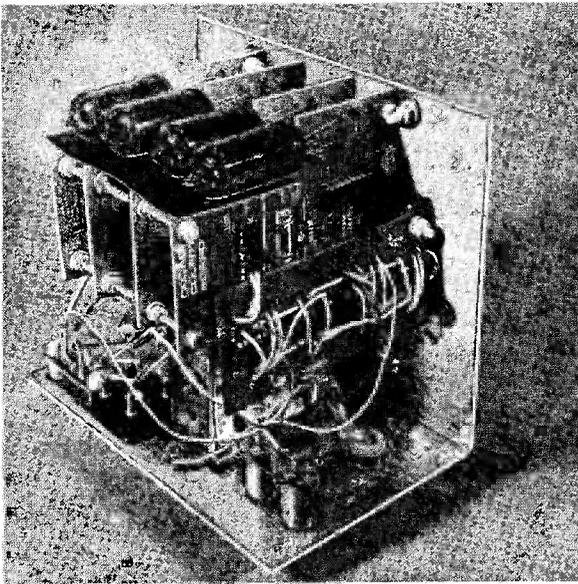
Fig. 5: (below) The circuit diagram of the display module. This consists of four assembled decade counter boards—marked DC1, DC2, DC3 and DC4.





The decoder counter board shown from the front and rear. Below left: two views of the completed digital clock.

Fig. 6 (below) Details of the modification that has to be made to the decade boards.



The 250V a.c. secondary of the transformer is used in conjunction with a single capacitor and rectifier to supply the tubes with the necessary voltage via a current limiting series resistor.

The 6.3V secondary provides both the timing source and the 5V power supply as will be seen from reference to Fig. 2. The 50Hz timing signal is simply half wave rectified 6.3V which is clipped with a 4.7V zener diode to provide an input signal which approximates to a square wave.

The 6.3V secondary is also connected to a bridge rectifier and a smoothing capacitor which forms the supply for the monolithic voltage regulator the output of the regulator is fed to the integrated circuits via a 10 μ F electrolytic and a 0.01 μ F polyester capacitor to cope with any spikes generated on the integrated circuits d.c. supply line.

—continued on page 1114



New Books

Books reviewed on this page are normally obtainable through any retail bookshop. In this instance, the information printed in **heavy** type should be quoted.

F.M. RADIO SERVICING HANDBOOK

By Gordon J. King

Published by Newnes-Butterworth

206 pages, 9½ x 6 inches. Hard covers

Price £3

SINCE the first edition of this handbook came out in 1957 it has been reprinted four times so it is fair to assume that it has proved very popular. What I do not understand is why it is called a "servicing" handbook! The first eight chapters provide a wonderful discourse ranging from a discussion of the basic f.m. signal through detailed description of the various stages of an f.m. receiver to aerials for f.m. and v.h.f. propagation.

While all this knowledge may be highly interesting it is not until Chapter 9 that we reach "F.M. receiver alignment", a measly twelve and a half pages. The meat, such as it is, is in the following chapter "Servicing the F.M. Receiver", just thirteen pages which include three full page circuit diagrams. Chapter 11 gives the desirable specifications for f.m. receivers and systems and quotes extracts from the DIN 45-500 standards. And that is that.

I thoroughly enjoyed reading the book but then I don't service f.m. receivers for a living. If I was a serviceman seeking *practical* information I'd have to look elsewhere for guidance.—AED.

PICKUPS AND LOUDSPEAKERS

By John Earl

Published by Fountain Press Ltd.,

46, Chancery Lane, London WC2.

240pp. 8 x 5 in. Price: £3.00.

IN the technical bibliography, there are handbooks and viewbooks. The first category is a large one: books from which one seeks a reference. In the latter category we find those whose facts are as impeccable, whose sources as well-researched, whose theses are as convincingly marshalled, but whose roughage of information is flavoured by the spice of a well-informed personal opinion.

Such are the series of 'Choose and Use' books from Fountain, companion volumes: **Tuners and Amplifiers**, by the same author and **Tape Recorders** by H. W. Hellyer. Their excellent presentation makes them easy reading, and a proud addition to the bookshelf. Between the three volumes, the whole domestic audio scene is covered.

John Earl as a regular equipment reviewer, trenchant and perceptive, is peculiarly qualified to be able to take a broad, yet penetrating, view of his subject. The main approach in **Pickups and Loudspeakers** is essentially practical, with sufficient theory to underline the facts one needs in order to compare and evaluate. At the prices one can nowadays buy pickup arms, cartridges and loudspeakers, such guidance is vitally necessary.

His introductory chapter is a brief run-through of basic principles, but manages to include an interesting exposition on disc manufacture. Chapter 2 digs more deeply into the mechanical construction and operation, and the electrical properties of pickups. That is—cartridges and arm. I am very happy to note that this author at least regards the two items as a combined factor in hi-fi.

Progressing, Chapter 3 advises on matching and loading, the next on choice. Between them, these two chapters answer many of the questions a prospective buyer may want (and be too shy?) to ask.

Three more chapters deal in the same way with the loudspeaker. Here there is an area of controversy, and not all authorities will agree with the author's conclusions and some of the information must be assimilated in conjunction with **Tuners and Amplifiers**. I was very glad to see, in this section, some sensible notes on efficiency and power. Too many misconceptions exist and Mr. Earl's gift of lucid exposition is refreshing. A chapter on turntable units and another on headphones complete the book.

This is a helpful and entertaining addition to the audio bookshelves. Even at a relatively high price of three pounds **Pickups and Loudspeakers** is good value and heartily recommended. **H.W.H.**

1972 WORLD RADIO-TV HANDBOOK

Published by Billboard Publications Inc. and

available from Fountain Press.

384 pages, 9 x 6 in. Price £2.80.

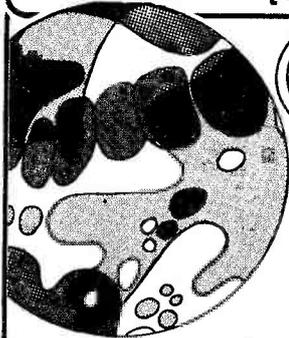
IF you're interested in DX and don't have a copy of the World Radio-TV Handbook, you don't know what you are missing. This is the "Bible" which can be consulted for all kinds of information. Take an obscure country such as the Ivory Coast; we can find a list of all the radio stations, seven of them, their frequencies, their hours of operation, the network that they belong to, where to find out programme details, the languages used, the announcements used, the interval signal used and so much more.

Turning to the TV section we can see that the service is Government owned but is also commercial, how many stations there are, their channels and powers, the hours of operation and the number of TV sets. Even the names and addresses of the chief personalities are given.

Comprehensive? I should say it is. The above information is for a small country—imagine what it's like for a large one! The formula of presentation has not changed over the years but each edition is different, largely because of the continued growth of broadcasting. The complete anarchy on the Short Waves (and Medium Waves if that is your "thing") has made life more and more difficult for the DXer but the WRTH will enable you to do the best you can—without it you are lost. **H.W.M.**

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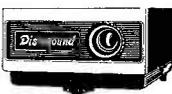
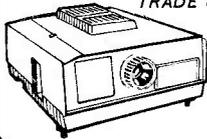
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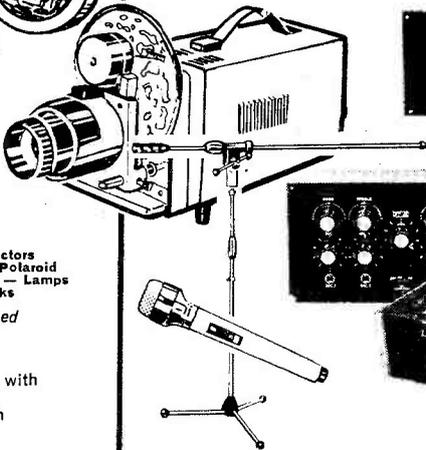
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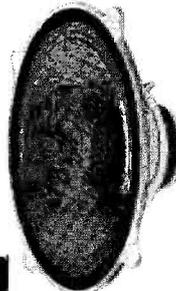
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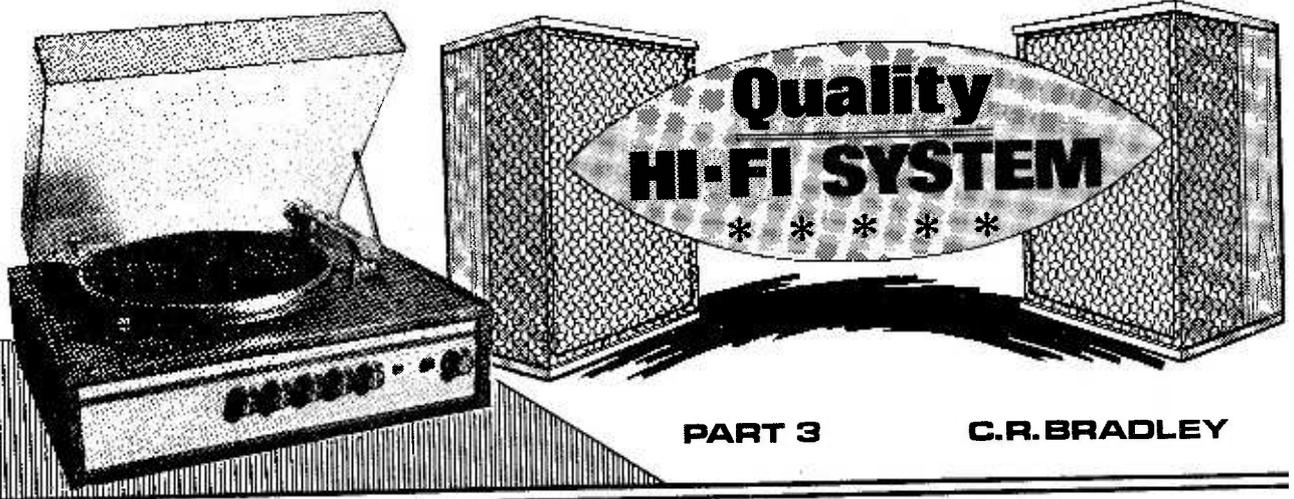
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Continued from the March issue

Layout and wiring

The component layout of each preamplifier is shown in Fig. 14. A standard 5in. (along tracks) \times 3 $\frac{3}{4}$ in. piece of 0.15in. matrix Veroboard is used for each, with the rear 2in. approx. of the boards left unused to provide a handgrip. The numbers along the top of the board in Fig. 14 correspond with the edge connector pin numbers in the circuit, Fig. 6; the lettering of horizontal rows of holes is just arbitrary.

Before fitting the components, make the 38 breaks in the tracks, preferably with the proper Vero tool. Then check the fit of the board in an edge connector—it will probably be necessary to file away the sides slightly. Then solder in the components and links taking special care with the lead identification of electrolytic capacitors and transistors. A miniature soldering iron is essential. Note that the unused portions of all the tracks are strapped together and are connected to earth via pin 1. Make a final check that no tracks have been shorted together by stray blobs of solder and that the bare metal transistor cases do not touch other wiring as they are not isolated but connected to the transistor collectors.

The wiring of the front panel and edge connectors is shown in Fig. 15. Keep all wiring between the connectors and the controls close to the panel and as short as possible, using screened cable where indicated. Note that *all* earth connections and cable screen connections are made to one point—the body of the volume control. A good hot soldering iron is needed to flow solder on to the back of the control's case and prolonged heating should be avoided. Some components are carried by S1, S2 and the headphone socket. Those on S1 are anchored at one end only and should have the shortest possible leads. A cylindrical screen (cut from a tin can) surrounds the whole of S1 and its components and this can easily be bent into a shape that will clip into position, or can be soldered in place.

A warning about soldering to the edge connector pins: the plastic connector body softens readily with heat and an almost imperceptible resulting movement of a pin can give contact trouble later. The rule there-

fore is to solder to the edge connectors only with a board plugged in (to keep the pins located) and with quick application of a hot iron.

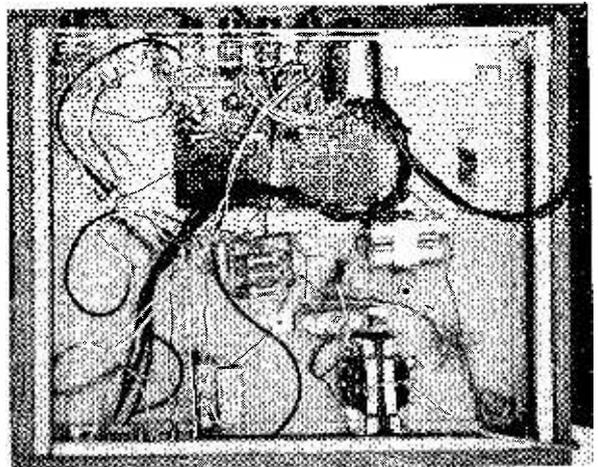
The general arrangement of the plinth electronics is shown in Fig. 16. The power supply components are positioned in this case to give clearance for the turntable motor at rear left; for a different arrangement the only requirement is to keep them as far as possible from the preamplifier boards and signal wiring. A piece of paxolin supported by two scrap aluminium brackets carries the bridge diodes D1-4 and a tagstrip carries some other components. A metal strap secures C17 and C18.

Plinth completion

With the preamplifiers plugged in but FS1 and FS2 not present, connect the mains supply and switch on. Check that the panel neon lights and that the following voltages (within 10%) are present:

C17/C18 positive	45V
C16 positive	30V

If the latter reading is incorrect investigate why



Underside view of plinth showing wiring details.

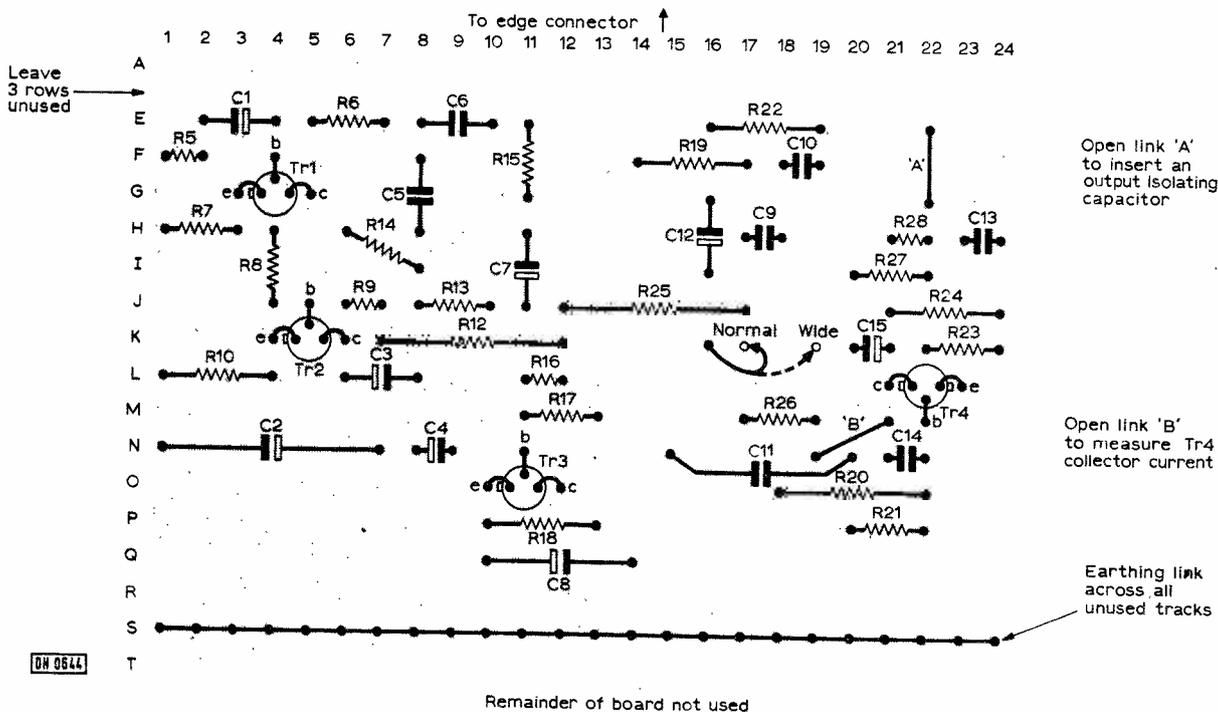
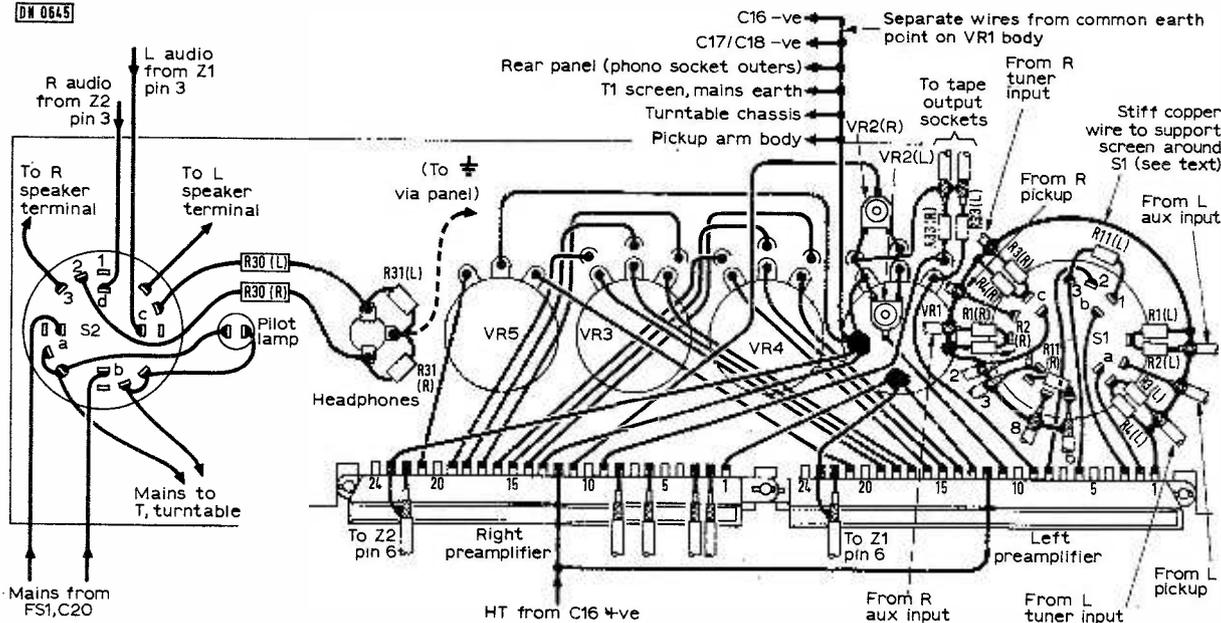


Fig. 14 (above): Component layout of identical left and right pre-amplifier boards, wired from track side of Veroboard.

Fig. 15 (below): Wiring of front panel and preamplifier edge connectors. Note the volume control earthing points.

DW 0645



the preamplifiers are not drawing correct current, using the typical voltages and currents given as a guide in Fig. 6. The transistor collector voltages are easiest to measure as they are present on the transistor cases.

If this much is satisfactory switch off, wait a minute, connect a pair of *inexpensive* loudspeakers to the output terminals, switch to DISC and switch to SPEAKERS. With VOLUME fully clockwise and both VR2s midway, play a record or tap the pickup

shell to see if the system is working. If either channel is dead, the signal chain can quickly be checked by touching the following points in order, which should produce hum from one speaker:

- VOLUME control (VR1) slider: Z1 or Z2 pin 6:
- Tr2 case (collector): Tr4 case (collector):
- S1a or S1c wiper: TREBLE control (VR4) slider:

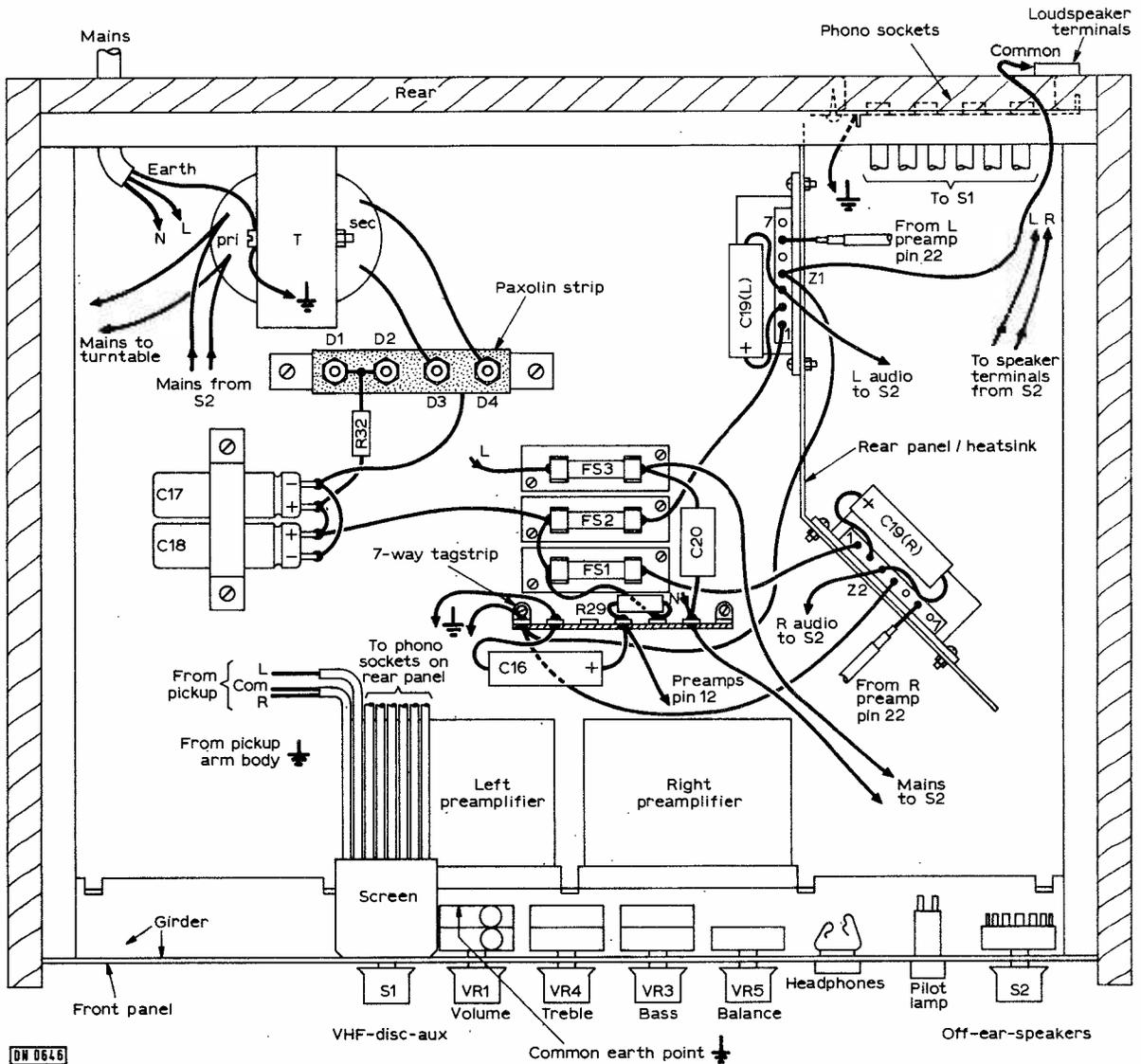


Fig. 16: Plinth layout with turntable board lifted clear—check diodes D1–D4 for polarity before fitting.

Assuming a record can now be played connect the proper loudspeakers. The system should always be switched off when changing speaker connections because of the possibility of inadvertently shorting the terminals. If the speaker cables have to be more than a few feet long, use heavy gauge mains flex to minimise power loss in the cable resistance.

Set the VR2s so the maximum volume likely to be required is obtained with VOLUME fully clockwise, and the balance is correct with BALANCE midway. Experiment with BASS, TREBLE and BRILLIANCE and with enclosure positioning until good stereo is obtained. If sounds are not well located the speaker phasing is wrong; cure this by interchanging the connections at the back of one enclosure only.

The author covered the control panel with Contact plastic film in a grey grained pattern to contrast with the teak veneer. The control knobs are Eagle type PK2 (pointer) and NK2 (numbered 0-10). Their functions are shown in abbreviated form (thus: VHF-

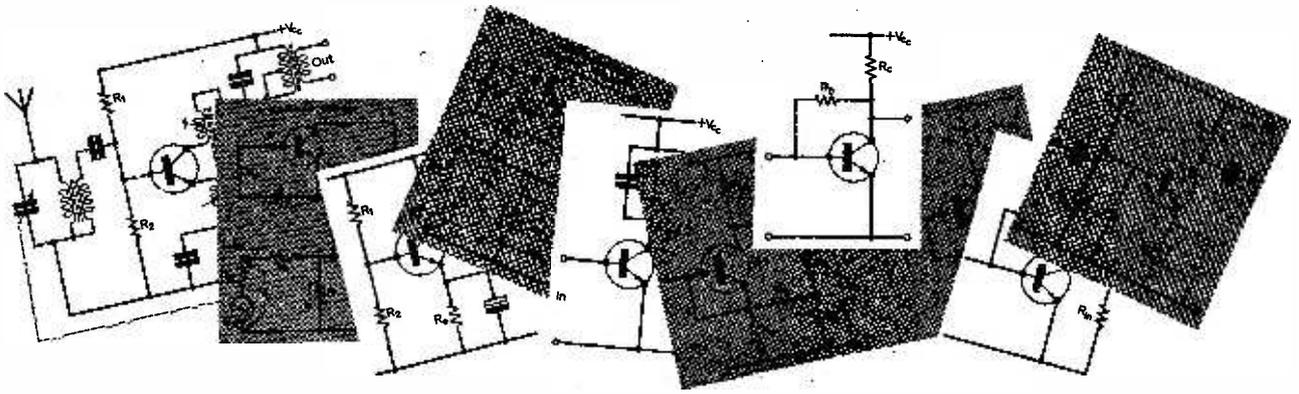
DISC-AUX V T B BAL EAR OFF-EAR-SPKS) by Letraset characters on a thin strip of aluminium above, held to the panel by Araldite.

The veneer used on the enclosures and plinth may benefit from wax polishing. If the large area of fret used on the enclosures tends to sag, it can be tightened up by *very carefully* bringing an electric bar heater to bear, applying the absolute minimum heat.

The perspex lid must be treated carefully or it will gather scratches. Dust is best stroked off with a barely damp sponge or cloth. A "Dust Bug" is a useful accessory for keeping records and stylus clean.

Fuses

Standard 500mA fuses are adequate for FS1 and FS2 instead of the 1A specified for all normal listening volumes, and give worthwhile extra protection to the power amplifiers. ■



TRANSISTOR CIRCUITRY for beginners

PART 7

H.W. HELLYER & MICHAEL HOLLIER

h_{FE} again

Last month's circuit suffered from one defect that was mentioned at the time, but this is not so bothersome that it seriously affects circuit building—although, to read some of the letters on Page 1017, evoked by Mr. Smith's 'Dying Breed' letter in the January issue, any use of transistors is "so bothersome" . . . etc.

Using two separate transistors in a Darlington circuit, as we did, has the drawback that there can be variations in h_{FE} , d.c. current gain. These variations can be from 200 to 800, a ratio of 4:1.

We noted that the d.c. gain of the complete circuit is the product of the h_{FE} of **both** transistors. Taking the most extreme cases, this can lead to a variation of far too great a magnitude for us to be able to build small circuits confidently, unless, of course, we have recourse to the appropriate measuring gear to check every result as we go along. Even though we are not in mass production, where variations have to be limited to the utmost minimum, it is reassuring to know that our small circuit, when built, will perform reasonably near expectations. . . .

Take, for example, the case when both transistors have a typical h_{FE} of 400. The overall gain then is $400 \times 400 = 160,000$ times. If the h_{FE} of each transistor in the discrete Darlington pair was at our previously stated typical lower limit, then $200 \times 200 = 40,000$ would be our expected d.c. current gain. On the other hand, if both were blessed with an h_{FE} of 800, then the gain would shoot up to 640,000. In other words, the h_{FE} variation of 4:1 has become a d.c. current gain possible variation of 16:1.

How does this come about? Referring back to Part 6, we can see that the change from the 'level pegging' case, of 160,000 in a downward direction (to 40,000) will cause a change in the emitter current of the second transistor, altering the emitter voltage. So the maximum a.c. voltage swing available from the emitter, that is the output signal, is altered. Downwards in this case, upwards in the case of our 800 \times 800 pair.

Of course, things are not as bad as the foregoing examples have depicted. Budding transistor enthusiasts, be reassured. It may be as well to remind

our pro-valve friends at this point that for similar gain figures valves bought across the counter would have provided us not only with even wilder variations but also with a few other possible discrepancies to make to constructor's life more interesting.

Not that we are entirely anti-'bottleising' as Mr. Watton of Hull has so beautifully coined it; merely that, having transistors, we are interested in doing something useful with them, just for fun!

In practice

One way of making sure these tremendous swings in gain do not occur in practice is to choose one's transistors carefully. I do not necessarily mean vetting each one with a home-made tester, although that's not bad practice either. The manufacturer very kindly does a lot of work for us by 'gain-grouping' his transistors. So, if you buy a BC109B, you know, or you should if you have taken the trouble to look it up, that this semiconductor in gain group B will have an h_{FE} 'spread' of around 2:1.

We have mentioned 'spread' before and this little exercise in d.c. gain differences underlines the fact that transistors, made in their millions, are grouped so that differences fall between usable close limits. Nevertheless, there are variations, and we must always take them into account.

The a.c. changes matter too. Here, the most important factor may be the change in input resistance of the first transistor of the pair. But, as we saw last month, this can be modified by alteration of the base bias transistors. In fact, to repeat our rule: stage input resistance is primarily controlled by the base bias transistors.

Darlington Pair Transistor

An even better way of overcoming the problem of spread, as any middle-aged man will tell you (and he speaks with feeling!—Mike), is strict control from the outset. So if a manufacturer can not only choose the pairs of transistors for us, but also put them into one package, we are halfway towards building reliable circuitry.

This is precisely what transistor makers have done

with the 'Darlington' transistors. This is a relatively new device to us, although it has been available to industry for some while. Nowadays, the price makes a Darlington Pair Device comparable with discrete and similar components.

I realise that the Darlington Pair Transistor, or the Darlington Transistor as it is beginning to be called, quite wrongly, for it might give future Riches and Dow historian types wrong ideas about its evolution, is leading us along the dangerous path decried by some correspondents, to whom an integrated circuit is the ultimate in effete indulgence. But here we are struggling for efficiency. I beg leave to introduce the Darlington Transistor at this point, using a Motorola device purchased from Jermyn Industries Ltd., Vestry Estate, Sevenoaks, Kent.

It is, in effect, a very simple type of integrated circuit, as our Fig. 33 shows. Two transistors are contained within the one package, the internal connections being as shown, and is, in fact, the Darlington Pair with which we should already have become familiar. Three lead-out wires are provided. These are, as shown, named Base, Collector and Emitter, even though we are fully aware that the base is that of the first transistor, the collector is a common electrode and the emitter is that of the second transistor.

In manufacture, the first transistor is so made that it can operate at a low collector current without serious loss of gain. Remember, last month we were forced to increase, quite deliberately, the emitter current? This was done with the aid of an external resistor R_{E1} , and the object was to get a reasonable gain in the first transistor.

Symbolism

If we simply showed Fig. 33 in the complete circuit, there would be no telling if we had chosen transistors at random from the spares box or ordered them with fine limits from their makers. One way out would be to circle the pair around, as in Fig. 34, but as drawing offices love simplifying, an alternative to depict the composite device is needed.

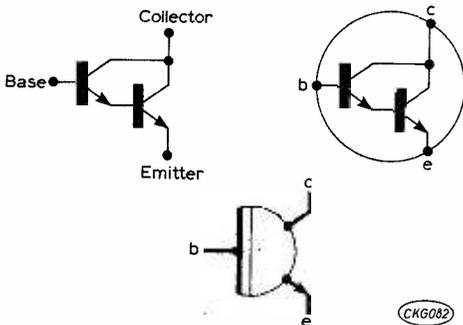


Fig. 33 (Top left): The basic configuration of two transistors in the Darlington circuit.

Fig. 34 (Top right): The conventional method of containing the actual circuit within a circle.

Fig. 35 (bottom): The recommended method of depicting a Darlington transistor.

One such method has been described by J. L. Linsley Hood in an article in the September 1971 *Wireless World*, in which he depicts the Darlington transistor as a glorified 'D', with its appropriate three-wire connection. This way, it is easy to remember, and as John was the first to bring this device to our attention and trigger off some experimentation

on our part, we shall honour him by continuing to depict the Darlington transistor by the overblown 'D' with double line at the straight side, as in Fig. 35.

Similarly, as this is the component we used for initial experiments, we are concerned here with the Darlington transistor that J.L.L.H. recommended, the Motorola MPS-A14. There are others, and this is no place to do a Babani. Any reader who has followed us thus far can dig out his own alternatives, we feel sure.

The MPS-A14 is a composite pair, and all data is given for the 'complete' high-gain transistor. We shall treat it, in other words, as if it were indeed a single device.

Single-double stage

Over to Fig. 36, where we see the Darlington transistor as the heart of an amplifying stage. This innocent 'D' is, as we know, a 'double-device', and we must ask readers to remember that the aim of this series of articles is to lead beginners gently (*by the nose? Ed.*) into the subject. So we will revert to the same line voltage, a 9-volt battery, similar decoupling, R_{dec} and C_{dec} , and allow C_{in} and C_{out} to perform their usual functions. No sophistication, at this point. My hand do not leave my arms, ladies and gentlemen, watch closely!

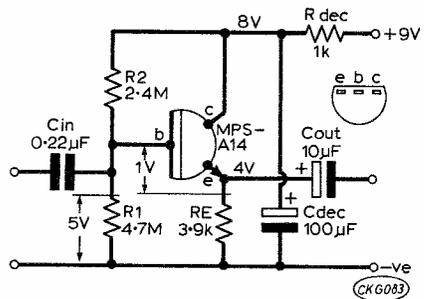


Fig. 36: Basic circuit of the 'high-to-low' preamplifier. See text for details.

We assume the collector volts to be 8, giving us a 1-volt drop across R_{dec} , with C_{dec} performing its usual function. To obtain maximum output voltage, the emitter voltage should be about half the supply, i.e. around 4 volts. This lets the a.c. signal swing the emitter close up to 8V on its positive-going half-cycle, and down near 0V on its negative-going half-cycle.

This swing of nearly 8 volts peak-to-peak works out to 4 volts peak, which is 4×0.707 or 2.828 volts r.m.s.

We have already determined our emitter voltage as 4 volts. Collector current we can make 1mA, and this then gives us a value for emitter resistance:

$$R_E = \frac{4 \text{ (volts)}}{1 \text{ (mA)}} = 4,000 \text{ (4k}\Omega\text{)}$$

If we use a 3.9k Ω resistor of 5% tolerance, that should do us nicely.

Base current is calculated from the formula:

$$I_b = \frac{I_c}{h_{FE}}$$

and from the manufacturers' data sheets, the h_{FE}

is around 4,800. So we can say:

$$I_b = \frac{1 \text{ (mA)}}{4,800}$$

or approximately 2 micro-amperes.

The foregoing may have underlined one important point that needs mentioning here. When relating formulae, always get your units to the common value. In the first of the above two formulae, we were dividing volts by milliamps, so had to multiply the top line by 1,000 to keep things right: in the second, we were dividing milliamps by a figure, not a measured quantity, so needed no such normalisation. Watch that word, we shall be referring later to normalising!

Reverting to our base current, we can see that, from manufacturer's published data again, we get around a volt between base and emitter. If we add this to the emitter voltage we get 5 volts.

Remember what we said last month about stability? We shall aim for a current through the potential divider of about five times the base current. This now allows us to calculate the value of R_1 .

$$R_1 = \frac{5 \text{ (volts)}}{5 \times I_b} = \frac{5 \times 10^6}{5 \times 0.02(\mu\text{A})} = 5 \text{ megohms (5M}\Omega\text{)}$$

Again, we shall be quite near enough with a 4.7M Ω component at 5% tolerance.

Resistor R_2 has the $5 \times I_b$ current of R_1 plus the current of the transistor flowing in it, making a total of 1.2 μ A. The voltage across R_2 is the supply voltage (8V at this point) minus the base voltage (5V), which gives us 3V.

$$R_2 = \frac{3}{1.2 (\mu\text{A})} = \frac{3 \times 10^6}{1.2} = 2.5\text{M}\Omega$$

The nearest 5% component is 2.4M Ω but if this component is not to hand, a pair of 1.2M Ω resistors in series should not be too difficult to acquire.

Stage Input Resistance

Since no figure is given in the manufacturer's data sheets for transistor input resistance, nor for h_{ie} , our calculation of input resistance has to be approximate. As stage input resistance depends so much on the shunting effect of R_1 and R_2 , as we showed earlier, the degree of inaccuracy should not be great. Stage input resistance R_{in} , (to an approximation), can be calculated from:

$$R_{in} = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{4.7\text{M}\Omega \times 2.4\text{M}\Omega}{4.7\text{M}\Omega + 2.4\text{M}\Omega}$$

or, around 1.58M Ω . This is quite high enough for all normal purposes, as we have seen before.

Decoupling

We must not forget the decoupling components, and here R_{dec} drops 1 volt. The collector current of the transistor flows through it. But also, the current of six times I_b flows through this. Nevertheless:

$$I_{total} = I_c + (6 \times I_b) = 1\text{mA} + 1.2\mu\text{A}$$

and this is not significantly different from 1mA, so

$$R_{dec} \text{ can be effectively, } \frac{1\text{V}}{1\text{mA}} \text{ or } 1\text{k}\Omega.$$

This is a standard 5% component, so no problem of choice is raised. The capacitors for decoupling and

input and output coupling can be the same as in last month's exercise, and for the same reasons. Values: 100 μ F, 0.22 μ F, 10 μ F.

Output Impedance

As we do not have a specified h_{fo} (a.c. current gain), we cannot easily calculate the output resistance R_{out} of this stage. But of one thing we can be certain, again with reference to previous notes, it cannot be greater than the emitter resistor, R_E .

If we make up a prototype with the values already determined, as we have, we can take some measurements and make calculations.

Using a definite 9 volts supply, we find that there are some very small discrepancies between nominal and actual values, as follows:

	Calculated	Measured
V_E	4V	4.1V
$V_{out(RMS)}$	2.82	2.9
R_{in}	1.58M Ω	1.6M Ω
R_{out}	—	60 ohms (approx.)

This very low output impedance means that a very long line can be used. A very long cable (a couple of miles of microphone lead, for example!) can be employed if we use such a buffer stage. Seriously, even though Vivian Capel may not have recommended such extreme measures in his recent Public Address Handbook, such a device as this simple buffer can usefully extend one's microphone lines by several hundred yards. A very large value of cable capacity will be needed before there is any serious loss in h.f. response.

Normalising

One more point must be made. As Mike pointed out to me, many of the things we take for granted, working with transistors every day, are unfathomable mysteries to the beginner.

Taking an example from the work done in this article we publish, Fig. 37, a replica of the d.c. current gain curve published by Motorola, relating to the transistor we have recommended—that is, the MPS-A14. But this is a 'normalised' curve, and we see that the vertical axis is scaled in fractions of one, with the unity line about seven-eighths of the way up.

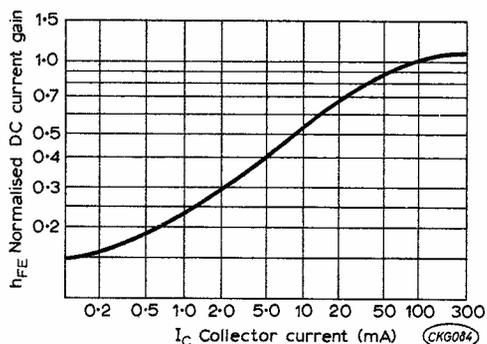


Fig. 37: Normalised d.c. current gain graph (Motorola).

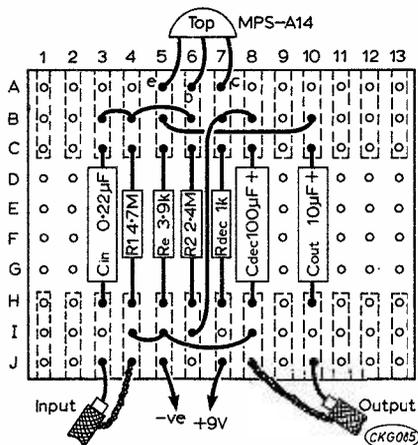


Fig. 38: Practical layout on Veroboard of the circuit shown in Fig. 36. Components on top, foil strips underneath.

Now, we know that this vertical axis, representing h_{FE} , should be in hundreds, not just fractions of one. So what's to do?

The idea is that one can use the same curve for several transistors, by relating to the unity line as a datum. For example, if we relate the given curve to the transistor we are using, we note first that the $h_{FE} = 1$ line, relates to an I_c of around 100mA.

If we take our actual I_c to the intersection of the curve, then carry it across, we find the factor by which the quoted h_{FE} can be multiplied.

For example, our I_c is 1mA, which gives us around 0.24, so we multiply the quoted minimum h_{FE} at 100mA I_c , 20,000, by 0.25, getting 5,000. Accurately plotting the graph gives us the 4,800 previously quoted.

Construction

The amplifier was constructed (again in the ubiquitous 2-oz. tobacco tin) from Veroboard, Fig. 38. This has the outer three lines joined, so that there are a number of foil strips linking three holes, with insulated board between. Cutting and drilling details are exactly as we showed in Part 5. Links, output, input and battery connections are similar, too.

It is important that the board is housed in a screened box, that there is a really short length of wire from the negative to the metal box, and it is preferable that the battery be contained within the box. This limits battery size, but considerably cuts down hum pick up. An input and output selector and an on/off switch are refinements that can be added quite easily.

The important thing to remember is that the buffer circuit is the link between microphone and input. Normally, a crystal microphone is supplied with a couple of yards, no more, of cable. Keep this as short as possible and you can lengthen the lead between buffer and recorder across a field if you like. But mind that bull!

TO BE CONTINUED

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From the
Donkey's
Mouth

IF you have never been invited to deliver a lecture on "The Mystery of Radio" to the Ladies Sewing Circle of the Lesser Sodbury Women's Institute, believe me you haven't lived.

Slave away at invention and development in the tin huts of Malvern or the turrets of Cavendish, publish learned papers in the journals of esoteric societies, submit pages of démonstration, bedecked with graphs and adorned with hieroglyphics, to those glossy monthlies devoted to your subject and your neighbours only know you as "that chap down the road with the birdcage on his roof."

But only let the gossip columnist of your local rag insert a para about your paper on "Hi-Fi parameters" and every gramophone society, tape coven, music association, women's guild or gardening club for miles around beats a path to your door.

Radio lectures, like icebergs, are mainly below the surface. One spends weeks mugging up the details, buried in tomes like a don at the Bodleian, compressing an encyclopaedic assortment of facts into the visible tip of a narrative.

One button-holes colleagues and bores them with one's best lines. The ear is attuned to the apposite joke. Its facets polished, it can be judiciously inserted like a salted nugget in a vein of Fool's Gold.



One buttonholes colleagues with one's best lines

Foolish or not, the discourse is gilded, the timing rehearsed, slides sorted, numbered and cued, notes impeccably annotated. . . .

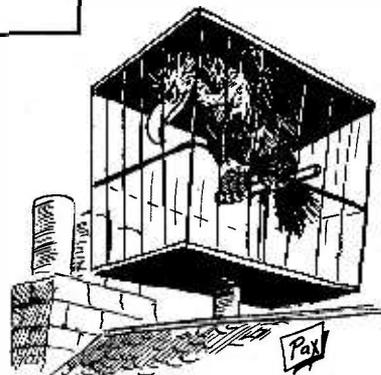
On the night of the junket, having overcome the drawbacks of wrong-sized power points, lack of chalk and the obtrusive committee member who simply wants to talk we reach the point when the middle rows of chairs are occupied and the Chairman is clearing his throat.

In his introduction he will always get our name or our title wrong and our carefully proposed introduction will be lost in a clatter of latecomers. We grow flustered, mix our cues, flash up the cliff-edge at Poldhu when we meant to talk about Goonhilly.

If you get launched into your subject with enthusiasm, Question Time can sometimes be curtailed. But when it comes the worst few moments are the first. Jocular, then quizzical, then plainly anxious, the Chairman appeals for questions. The Hall is as silent as when Lady Uptight committed an indecent Spoonerism.

Mind you, lectures to the learned societies are not so easily handled. Always, inevitably, there sits that eagle-eyed invigilator in the front row. He has mugged up the details of your subject. He has read, especially the controversial correspondence in the intellectual monthlies. He knows the several sides of every technically unresolvable argument. His question, inserted quietly, like the stiletto to impale the lecturer on the horns of a dilemma. It always, every time, carries a supplementary. Whichever way the poor fish on the platform flounders he is going to be gaffed by the subsequent: "Ah, but —"

Henry has learned to recognise this menace. He now counters by a challenge. "Our friend has obviously read up Professor Oblonksky's Theory. Perhaps he would care to refresh our memories before we continue. . . ."



The chap with the birdcage on his roof.

Never, never try to crush him. After all, he has done you the honour of some preliminary study. Unlike the menace who has only come in out of the cold, yawns and nods while you explain the principle of the superhet, and rivets the eye as you try to remember whether transfilters are an advantage or not.

Transport is one problem, security another, as your scribe found when turning up mid-morning at Olympia during the last Audio Fair. In the boot, on the back seats, in glove-pockets and map-shelves, even hanging on the seat straps of Jemima, I had around a thousand quid's worth of filchable equipment. I dared not leave the car unattended.

But if bribing gatekeepers and tipping lift attendants to get gear in was a problem, how much more a trying effect was the exercise of getting it out!

You would have thought the great Audio Fair Robbery was being planned to see the way poor Rex (Baldock not Hassan) was chivvied by blue uniforms. By the soothing urbanity of Donald Aldous we eventually got loaded, with one policeman standing guard on the theatre door, another at the lift and the security chief himself ushering us out of the car-park. . . .

Ah, they order things very differently at the Lesser Sodbury Ladies' Sewing Circle.

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29308	30p	2N3416	37p	40320	47p	BCY33	25p	B8X77	27p	NKT404	62p
29309	30p	2N3417	37p	40323	32p	BCY34	32p	B8X78	27p	NKT405	62p
29371	15p	2N3570	41p	40324	45p	BCY35	40p	B8Y10	27p	NKT406	65p
29374	20p	2N3572	97p	40326	37p	BCY39	30p	BSY11	27p	NKT451	68p
29381	22p	2N3805	27p	40329	30p	BCY40	50p	BSY24	15p	NKT452	62p
2N404	22p	2N3806	27p	40344	27p	BCY42	15p	BSY25	15p	NKT453	47p
2N696	20p	2N3607	22p	40347	27p	BCY43	15p	B8Y26	17p	NKT603P	82p
2N697	17p	2N3702	11p	40348	62p	BCY54	22p	B8Y27	17p	NKT603P	82p
2N698	25p	2N3703	10p	40360	42p	BCY55	22p	B8Y28	22p	NKT674S	30p
2N706	12p	2N3704	11p	40361	47p	BCY59	22p	B8Y29	17p	NKT877V	30p
2N705A	12p	2N3705	10p	40362	27p	BCY60	97p	B8Y32	25p	NKT713	25p
2N708	15p	2N3706	09p	40370	37p	BCY70	20p	B8Y36	25p	NKT781	30p
2N709	62p	2N3707	11p	40406	57p	BCY71	25p	B8Y37	25p	NKT10419	90p
2N718	25p	2N3708	07p	40407	40p	BCY72	17p	B8Y38	22p	NKT10433	87p
2N736	25p	2N3709	10p	40408	57p	BCZ10	27p	B8Y39	22p	NKT10519	38p
2N757	30p	2N3710	08p	40410	62p	BCZ11	45p	B8Y40	38p	NKT20329	47p
2N914	17p	2N3711	12p	40467A	57p	BD116	41.12p	B8Y61	38p	NKT20339	47p
2N916	17p	2N3715	11.25p	40468A	35p	BD121	65p	B8Y62	32p	NKT20339	47p
2N918	30p	2N3716	21.80p	40600	50p	BD123	82p	B8Y63	37p	NKT20339	47p
2N929	22p	2N3791	22.00p	AC107	30p	BD124	60p	B8Y64	40p	NKT20339	47p
2N930	27p	2N3801	22.00p	AC106	30p	BD131	75p	B8Y65	40p	NKT80111	77p
2N1090	25p	2N3823	97p	AC127	25p	BD132	85p	B8Y66	47p	NKT80112	77p
2N1091	25p	2N3854	27p	AC128	20p	BDY10	41.37p	B8Y79	57p	NKT80113	81p
2N1131	25p	2N3854A	27p	AC154	22p	BDY11	41.62p	B8Y82	52p	NKT80211	81p
2N1132	25p	2N3856	27p	AC176	25p	RDY17	41.50p	B8Y90	57p	NKT80212	81p
2N1302	17p	2N3855A	30p	AC187	62p	BDY18	41.75p	B8Y96A	12p	NKT80213	81p
2N1303	17p	2N3856	30p	AC158	25p	BDY19	41.97p	B8W41	42p	NKT80214	81p
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2N1306	25p	2N3858A	30p	ACY19	25p	BDY60	41.25p	C424	27p	NKT80216	81p
2N1307	25p	2N3859	27p	ACY20	25p	BDY61	41.25p	C425	25p	NKT80213	82p
2N1308	30p	2N3859A	32p	ACY21	25p	BDY62	41.00p	C426	30p	NKT80213	82p
2N1309	30p	2N3860	20p	ACY22	20p	BF115	25p	C428	37p	NKT80215	82p
2N1307	14p	2N3866	40p	ACY23	20p	BF117	27p	C744	42p	NKT80215	82p
2N1613	25p	2N3877	40p	ACY40	20p	BF163	37p	D16P1	37p	NKT80215	82p
2N1681	35p	2N3877A	40p	ACY41	25p	BF167	18p	D16P2	40p	NKT80216	82p
2N1682	30p	2N3900	37p	ACY44	40p	BF173	19p	D16P3	37p	NKT80216	82p
2N1683	27p	2N3900A	40p	AD140	52p	BF177	30p	D16P4	40p	NKT80216	82p
2N1683	27p	2N3901	47p	AD149	57p	BF178	30p	GET102	30p	O209	92p
2N1684	40p	2N3901A	47p	AD150	57p	BF179	30p	GET113	30p	O220	50p
2N1711	25p	2N3904	35p	AD161	37p	BF180	35p	GET114	20p	O221	50p
2N1889	32p	2N3905	37p	AD162	37p	BF181	32p	GET118	20p	O223	60p
2N1893	37p	2N3906	37p	AF106	42p	BF184	25p	GET119	20p	O224	60p
2N2147	82p	2N4058	17p	AF114	25p	BF188	42p	GET120	52p	O225	27p
2N2148	82p	2N4059	10p	AF115	25p	BF194	17p	GET121	52p	O226	27p
2N2150	57p	2N4061	15p	AF116	25p	BF195	15p	GET122	52p	O227	27p
2N2189	37p	2N4061	12p	AF117	25p	BF196	42p	GET123	52p	O228	62p
2N2193A	42p	2N4062	12p	AF118	62p	BF197	42p	GET124	52p	O229	62p
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2N2297	30p	2N4292	12p	AF180	52p	BFX12	22p	MF440	90p	O238	20p
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2N2369	17p	2N5027	30p	AF229	42p	BFX29	20p	MF481	87p	O240	20p
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2N2483	27p	2N5030	42p	AF211	32p	BFX44	37p	MI800	20.17p	O243	20p
2N2484	32p	2N5172	12p	ASV26	25p	BFX68	67p	MJE840	62p	OR1D	22p
2N2509	25p	2N5174	52p	ASV27	37p	BFX84	25p	ME820	60p	OC83	25p
2N2540	25p	2N5175	52p	ASV28	37p	BFX85	32p	ME821	32p	OC84	25p
2N2613	35p	2N5176	45p	ASV29	27p	BFX88	25p	MPF101	37p	OC139	32p
2N2614	30p	2N5232A	80p	ASV86	25p	BFX87	27p	MPF102	37p	OC140	32p
2N2646	52p	2N5245	45p	ASV90	25p	BFX88	25p	MPF104	37p	OC170	30p
2N2696	32p	2N5246	42p	ASV91	32p	BFX89	62p	MPF105	37p	OC171	30p
2N2711	25p	2N5249	67p	ASV94	25p	BFX93A	70p	MPS3638	37p	OC200	40p
2N2712	25p	2N5248	22.25p	ASV96	22p	BFY10	22p	NKT0018	42p	OC201	60p
2N2713	27p	2N5246	22.75p	AT108	42p	BW111	42p	NKT012	42p	OC202	75p
2N2714	30p	2N5267	22.02p	ASZ21	42p	BFY17	22p	NKT125	27p	OC203	42p
2N2865	62p	2N5305	37p	BC107	10p	BFY18	32p	NKT126	27p	OC204	42p
2N2904	30p	2N5306	40p	BC108	10p	BFY19	32p	NKT128	27p	OC205	90p
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2N2905	37p	2N5308	37p	BC113	15p	BFY21	42p	NKT137	32p	OC211	42p
2N2905A	40p	2N5309	62p	BC115	15p	BFY24	45p	NKT210	30p	ORF12	50p
2N2906	25p	2N5310	42p	BC116A	15p	BFY25	25p	NKT211	30p	ORF81	50p
2N2806A	27p	2N5354	27p	BC118	10p	BFY26	20p	NKT212	30p	P346A	22p
2N2907	30p	2N5355	27p	BC121	20p	BFY29	50p	NKT213	30p	TIS84	27p
2N2923	15p	2N5356	32p	BC122	20p	BFY90	50p	NKT214	22p	TIS84	27p
2N2924	15p	2N5365	47p	BC125	20p	BFY41	50p	NKT215	22p	TIS84	27p
2N2925	15p	2N5366	32p	BC126	20p	BFY48	62p	NKT216	37p	TIS84	27p
2N2926	15p	2N5387	87p	BC140	37p	BFY50	20p	NKT217	37p	TIS84	27p
Green	14p	2N5457	37p	BC147	10p	BFY51	20p	NKT219	30p	TIS84	27p
Yellow	12p	2E005	75p	BC148	10p	BFY52	22p	NKT223	27p	TIS84	27p
Orange	12p	2E020	22.00p	BC149	12p	BFY53	17p	NKT224	25p	TIS84	27p
2N3011	30p	2E102	50p	BC125	17p	RFY66A	57p	NKT225	22p	TIS80	22p
2N3014	32p	2E105	25p	BC157	20p	BFY75	80p	NKT229	30p	TIS51	12p
2N3083	35p	2E106	17p	BC158	12p	BFY76	80p	NKT234	17p	TIS51	12p
2N3054	46p	2E101	32p	BC159	12p	BFY77	57p	NKT238	25p	TIS63	22p
2N3055	62p	2E102	35p	BC160	62p	BFY90	67p	NKT240	27p	TIS60	22p
2N3138	30p	2E103	27p	BC167	11p	BFW53	27p	NKT241	27p	TIS61	22p
2N3134	30p	2E108	40p	BC168B	10p	BFW59	25p	NKT242	20p	TIS62	22p
2N3135	25p	2E128	70p	BC183C	11p	BFW60	25p	NKT243	62p	TIP29A	50p
2N3136	40p	2E130	77p	BC183D	12p	BFW61	25p	NKT244	17p	TIP29A	50p
2N3890	25p	2E141	72p	BC199C	12p	BFX29	41.80p	NKT245	17p	TIP31A	62p
2N3891	20p	2E142	55p	BC170	12p	BFY10	41.45p	NKT261	20p	TIP32A	75p
2N3891A	30p	2E143	67p	BC171	15p	BRV39	37p	NKT262	30p	TIP38A	75p
2N3892	17p	2E152	87p	BC172	15p	B8X19	17p	NKT264	20p	TIP34A	22.05p
2N3893	17p	R.C.A.	52p	BC175	22p	B8X20	17p	NKT271	20p		

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card

A. BIRDS



operated safe

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The Theory

Basically it consists of five transistors, each acting as a switch and placed in series with the others. The operation is as follows. Five light-dependent resistors (LDR's) are strategically placed in recesses on a metal plate, opposite which is a bright light. A card is then inserted which closes a micro-switch and activates the light. The light shines through three holes punched in the card. You may ask, "Why only three holes, when there are five LDR's?" The answer is that three holes will allow current to flow through three transistors when light falls on them, and the other two when in darkness. The reason for this is that if they all respond to light, all that would be needed to open the safe would be a rod to operate the micro-switch, hence lighting the bulb and opening the safe. If two switch only in the dark, then current will only flow if the predetermined light conditions are present. Only then will the current flow allowing the relay to close which in turn activates the solenoid, opening the safe.

The Circuit

As can be seen from Fig. 1, the circuit consists of five transistors, each acting as a switch. The transistors used were all type AC126. They will 'handle' about 500mW which is well over the power drain of this circuit and meets our requirements admirably.

Tr1, Tr2 and Tr3 obtain their base bias voltage through LDR1, 2 and 3. When these are in the dark their resistance is high thus there is virtually no bias on these transistors and they will not conduct. In the light the resistance is low so the transistors are biased and allow current to flow.

The other two transistors and LDR's do almost exactly the opposite. They are biased through resistors R1 and R2. When LDR4 and 5 are in the dark

their resistance is high and Tr4 and Tr5 receive their bias via R1 and R2 but when light falls on these their resistance drops and so a voltage is applied to the base of the transistors. This is of opposite polarity to that of the bias voltage required, therefore it cancels it and transistors four and five no longer conduct.

All the transistors are connected in series so that any break in this circuit, i.e. any transistors not

★ components list

R1-2	10kΩ ½W, 10%
LDR1-5	ORP12
Tr1-5	AC126
D1	OA91
C1	50µF, 50V
SW1	2-pole, on/off toggle switch
SW2	On/off microswitch, suitable for 250V a.c.
RL1	Low voltage relay, Henry's Radio N915748B (3·5V, 32Ω)
Solenoid	Miniature type with actuator, 18V, 55Ω (Henry's Radio)
Transformer	250V primary, 18V secondary 0·5A (or 9·0-9V secondary)
Rectifier	Bridge type, silicon, BY164 or similar

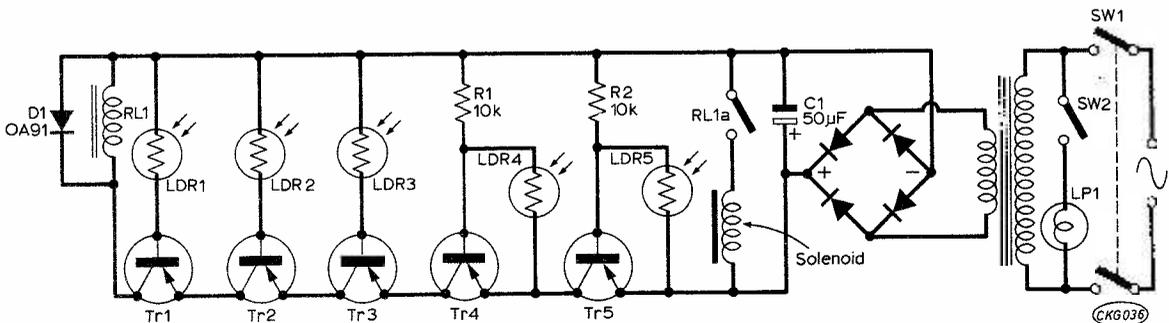


Fig. 1: The circuit of the card operated safe. For further details see the components list above.

switched on, will not allow the relay to be activated. Such a break would obviously be caused by light falling on LDR4 or 5 or darkness on LDR1, 2 or 3. When the light falls on the correct LDR's, the relay activates and closes the circuit to activate the solenoid so unlocking the door.

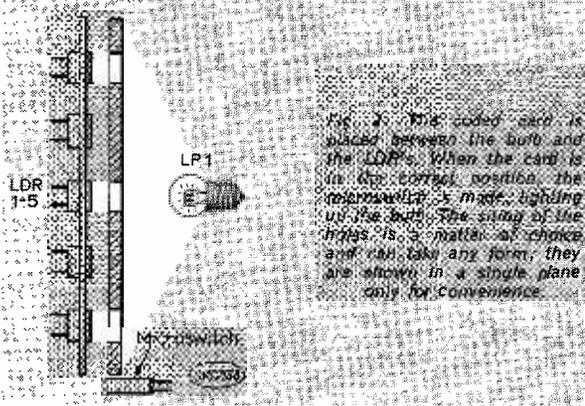


Fig. 2: The coded card is placed between the bulb and the LDR's. When the card is in the correct position, the microswitch is made, lighting up the bulb. The shape of the holes is a matter of choice and can take any form; they are shown in a single plane only for convenience.

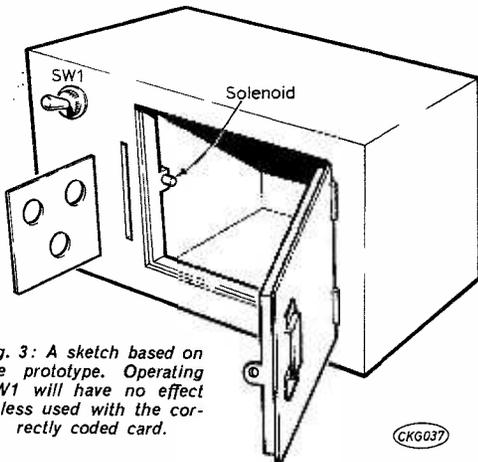


Fig. 3: A sketch based on the prototype. Operating SW1 will have no effect unless used with the correctly coded card.

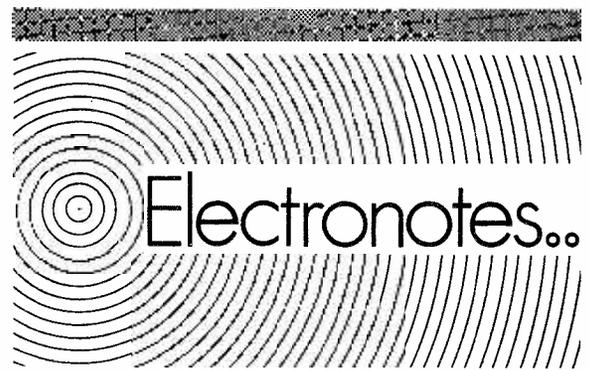
Power Supply

The power supply is straightforward enough, and consists of a miniature transformer and a small silicon bridge rectifier. The current is smoothed by a capacitor across the output from the rectifier. This then is the supply for the electronics and the solenoid.

Operation

The mechanical operation is as follows. The code plate, that is one which fits between the light source and the LDR's, has three holes cut out to line up with those LDR's which require light for switching on. This arrangement is shown in Fig. 2. When the card is inserted in the cut out shown in Fig. 3, the back edge of the card touches against a microswitch (SW2) which activates the light source, LP1.

The mechanical construction of the safe is largely up to the reader but it is clear that siting of the solenoid should be chosen with care. ■



S. GINSBERG

It seems strange that some people should appear to be born with so many talents. Take William Herschel for example, who began adult life as a professional musician. Many would have been happy to spend their days amongst the semiquavers but not Herschel. In 1781 he discovered the planet Uranus which brought him great fame in the realms of astronomy—truly he was a star. George III was so impressed that he endowed Herschel with a civil list pension. Enough for any man, surely. But not so for our William who immediately turned his attention to solar spectroscopy. It was he who discovered that, if a thermometer was held just beyond the end of the spectrum visible to the eye, an increase in temperature was apparent. Because this end of the spectrum was past the visible red, Herschel named it the infra-red and thus a new name was born.

The apparatus used was crude by modern standards, and the liquid thermometers slow to respond, but Herschel showed that the effect was there and that the radiation, just like that of visible light, could be refracted and reflected.

These first, simple experiments early in the nineteenth century have passed from the realms of novelty into an exacting science.

Infra-red cameras can give an indication of certain forms of cancer which are virtually undetectable by other means and thus these instruments are now employed in many hospitals.

Special infra-red cameras are also employed in aircraft. In military applications they can detect a whole army even though there is no visible light and no moon either since all bodies (and especially vehicles, such as tanks) give off radiation. Aerial surveys are useful to show, for example, exactly where the waste (and warmer) water travels to when it is pumped into the sea from nuclear power stations. It can also be used to plot infra-red "maps" of the terrain below.

Trouble with the cameras was that the sensing element had to be kept very, very cold, and it was common to enclose it in liquid gas. This in turn spelt bulky refrigeration equipment plus a rotating/revolving mirror system to form the scan.

Then someone found that a crystal-like material called triglycine sulphate (referred to as TGS) responded to changes in temperature but with an important advantage; it could be used at room temperatures and thus did not require liquid air cooling.

Tiny integrated circuit arrays are now manufactured which can be strobed electronically (thus getting rid of the rotating mirrors) and thus an infra-red television camera of very small proportions becomes a reality.

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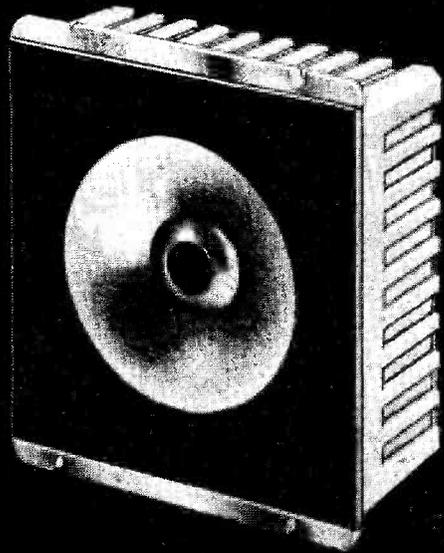
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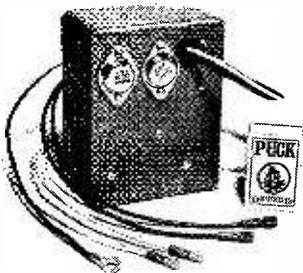
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0Z4	.25	6CB8A	.28	6SG7GT	.33	12SK7	.24	86A2	.43	EB91	.10	EL35	1.00	KTW82	.83	PL38	.50	UCF82	.60	AC107	.15	BCY38	.28	OC23	.38	
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1H5GT	.33	6CD6G	1.06	6SK7GT	.23	14H7	.48	807	.59	EB91	.28	EL42	.53	N78	2.05	PL2	.30	UCF83	.48	AC128	.30	BF159	.25	OC26	.24	
1L4	.13	6CQ8A	.60	6RQ7GT	.38	14S7	.75	5702	.80	EBF80	.30	EL43	.50	N308	.95	PL33	.32	UF41	.50	AC154	.25	BF163	.20	OC28	.60	
1N5GT	.37	6H6	.58	6U4GT	.60	15A05	.24	5763	.50	EBF83	.38	EL45	.38	N339	.44	PL34	.30	UF42	.60	AC156	.20	BF173	.38	OC29	.63	
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184	.22	6CM7	.50	6V6GT	.30	19G6	.50		.99	EL121	.60	EL85	.40	PAB30	.33			UF85	.84	AC165	.25	BF181	.40	OC36	.43	
1U4	.29	6CU5	.30	6X4	.20	20D4	1.05	AC2/PEN		EC86	.59	EL86	.38	PC86	.47	PL505	1.30	UF86	.63	AC166	.25	BF185	.40	OC42	.83	
1U5	.48	6CW4	.63	6X5GT	.25	20P2	.65	DD	.98	EC88	.59	EL91	.23	PC88	.47	PL508	.90	UF89	.27	AC168	.38	BFY50	.23	OC44	.10	
2D21	.35	6DE7	.60	7A7	.88	20L1	.98	AC6PEN	.38	EC92	.34	EL95	.32	PC95	.53	PL509	1.30	UL41	.54	AC176	.55	BFY51	.19	OC45	.11	
2CK5	.50	6D76A	.50	7B6	.58	20P4	.50	AC/PEN(7)		EC93	1.50	EL360	.49	PC97	.38	PL502	.75	UL84	.31	AC177	.28	BFY52	.20	OC46	.15	
3A4	.25	6EW6	.55	7B7	.32	20P3	.79		.98	EC93	1.50	EL350	.75	PC900	.32	PM84	.34	UL91	.39	AD140	.30	BY106	.18	OC71	.11	
3D6	.19	6F1	.59	70C	.30	20P4	.89	AC/THL	.50	EC40	.60	EM30	.38	PCCS4	.39	PX4	1.18	UY41	.38	AD149	.50	BY213	.25	OC78	.15	
3Q4	.38	6F6	.63	7H7	.28	20P5	1.00	AC/TP	.98	EC81	.16	EM31	.39	PCCS5	.26	PX25	.98	UY85	.25	ACY19	.19	BY114	.18	OC72	.11	
3Q5GT	.35	6F8G	.65	7R7	.65	25A6G	.29	AL60	.78	EC82	.19	EM33	.75	PCCS8	.41	PY33/2	.50	UY10	.45	ACY20	.18	BY126	.15	OC74	.23	
384	.25	6F13	.33	7Y4	.60	25L6G	.20	ATP4	.12	EC83	.22	EM34	.31	PCCS9	.45	PY80	.33	UY12/14	.38	ACY21	.19	BY127	.18	OC75	.11	
3V4	.32	6F14	.42	7Z4	.50	25Y6	.38	AZ1	.40	EC84	.26	EM35	1.00	PCU189	.48	PY81	.34	UY18/20	.75	ACY22	.15	BY210	.25	OC76	.15	
4CB8	.50	6F18	.45	8D7	.73	25Y6G	.45	AZ31	.60	EC85	.24	EM37	.35	PCF80	.28	PY82	.24	UY21	.39	AD140	.30	BY212	.25	OC77	.27	
5CG8	.50	6F23	.68	10C2	.49	25Z4G	.28	AZ41	.53	EC86	.40	EY31	.33	PCF82	.32	PY83	.24	UY24	.39	AD140	.30	BY213	.25	OC78	.15	
5V4G	.34	6F24	.68	10DE7	.50	25Z5	.40	CL33	.90	EC88	.35	EY31	.35	PCF84	.40	PY88	.32	UY25	.66	AD149	.50	BY213	.25	OC78	.15	
5Y3GT	.26	6F25	.54	10F1	.75	25Z6G	.48	CV63	.53	EC189	.48	EY33	.54	PCF86	.44	PY600	.95	UY26	.56	AD161	.45	CG126	.20	OC81	.11	
5Z4G	.34	6F28	.60	10F9	.45	30A5	.44	CY10	.53	EC804	.55	EY34	.50	PCF200	.67	PY800	.33	UY45	.78	AD162	.45	FSY11A	.23	OC81D	.11	
9/30L2	.55	6F28	.15	10F15	.35	30C1	.28	CY31	.31	EC807/10		EY37/6	.30	PCF801	.29	PY801	.33	UY47	.64	AD170	.63	FSY41A	.23	OC82	.11	
6A8G	.33	6G8A	.60	10LD11	.53	30L5	.60	DAF91	.20	ECF80	.27	EY38	.40	PCF802	.40	PZ90	.48	UY91	.55	AD106	.50	GD9	.20	OC82D	.11	
6AC7	.15	6GK5	.50	10P13	.54	30C17	.77	DAF96	.33	ECF82	.28	EY91	.53	PCF805	.60	QV03/10		UY91	.65	AD114	.25	GE113	.20	OC83	.20	
6A65	.25	6GU7	.50	10P14	1.08	30C18	.60	DF91	.14	ECF86	.64	EZ40	.40	PCF806	.57	1.20	UY81	.40	UY91	.65	AD115	.15	GE118	.20	OC84	.24
6AG6	.30	6H6GT	.15	12A6	.63	30F5	.65	DF96	.34	ECF8042	.10	EZ41	.42	PCF808	.68	Q895/10	.49	UY82	.40	AD117	.19	GET119	.20	OC133	.23	
6AM8A	.50	6J8G	.19	12AC6	.40	30F11	.60	DH76	.28	ECH21	.63	EZ80	.21	PCH200	.82	QV04/7	.63	UY81	.40	AD121	.30	GET153	.38	OC139	.23	
6AN8	.49	6J8GT	.29	12AD6	.40	30F12	.60	DK40	.55	ECH42	.60	EZ81	.22	PL82	.32	R10	.75	UY403	.33	AD124	.25	FEY587	.43	OC140	.95	
6AQ5	.22	6J6	.13	12AE3	.43	30F13	.69	DK92	.25	ECH81	.27	EZ90	.60	PL83	.58	R11	.98	UY404	.38	AD126	.18	GEY873	.15	OC169	.23	
6AR5	.30	6J7G	.24	12AT8	.23	30F114	.68	DK96	.35	ECH83	.39	FW4/500.75		PL84	.94	R15	1.75	UY401	.98	AD139	.65	GEY887	.23	OC172	.35	
6AT6	.18	6J7GT	.38	12AT7	.16	30L1	.29	DL96	.35	ECH84	.34	FW4/800.75		PCL805/85		R17	.88	UY402	.88	AD178	.63	GEY897	.23	OC200	.22	
6AV6	.20	6J8A	.60	12AUG	.21	30L15	.58	DM70	.30	EC180	.30	GZ30	.34		.40	R19	.30	UY23	.40	AD180	.48	GET898	.23	OC201	.38	
6AV6	.28	6K7G	.10	12AU7	.19	30L17	.67	DM71	.33	ECL82	.30	GZ32	.41	PCL86	.38	SP42	.75	VP41	.38	AD186	.55	M1	.15	OC202	.43	
6AW8A	.54	6K7GT	.23	12AV6	.28	30P4MR	.95	EY87/6	.24	ECL83	.52	GZ33	.70	PL88	.85	SP61	.33	VT61A	.35	AD189	.38	M3	.25	OC203	.30	
6AX4	.39	6K8G	.16	12AX7	.22	30P12	.69	DY807	.35	ECL84	.54	GZ34	.48	PD500	1.44	TH45	.50	UY111	.44	BA102	.45	OA5	.28	OC204	.30	
6B8G	.13	6L6	.98	12BA6	.30	30P19	.89	EB0F	1.20	ECL85	.54	GZ37	.48	PEN4DD		TH233	.88	UY120	.60	BA116	.25	OA10	.43	ORP12	.53	
6B8A	.20	6L6GT	.39	12BE6	.30	30P4	.58	EB3F	1.20	ECL86	.35	HABC80.44			1.38	TP2820	.30	UY120A	.60	BA116	.25	OA10	.43	ORP12	.53	
6BC8	.50	6L7GT	.38	12BH7	.27	30P11	.59	EB8CC	.60	EP23	.63	HL23DD.44														
6BE6	.21	6L18	.44	12J5GT	.30	30P113	.75	E92CC	.60	EP40	.49															
6B8G6	1.05	6L19	1.38	12J7GT	.33	30P114	.85	E180F	.90	EP41	.58															
6BH6	.43	6L20	.46	12K5	.69	30P115	.87	E183CCL	.09	EP43	.35															
6BJ6	.39	6N7GT	.48	12K7GT	.34	35A2	.48	E1148	.53	EP54	.98															
6BQ7A	.38	6Q7	.48	12SA7GT	.35	35LGT	.42	EA50	.18	EP73	.75															
6BR7	.78	6Q7G	.27		.40	35W4	.23	EA76	.38	EP80	.22															
6BR8	.63	6R7	.55	12SC7	.35	35Z4GT	.24	EACB30	.30	EP83	.28															
6B96	.72	6R7G	.35	12SG7	.23	35Z5GT	.30	EAC91	.38	EP85	.26															

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PW JUNE 1971

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SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

A RECORD number of reports have been received this month so I will start straight away with one from **John Adams** of Stocksbridge who has an Eddystone EC10 and a Joystick antenna:

- 6540 R. *Pyongyang*, Korea, news at 1910.
- 9545 R. *Ghana*, English news at 2130.
- 9570 R. *Australia*, Sports news at 0835.
- 9695 RSA, *South Africa*, French at 2000.
- 9745 R. *Baghdad*, Iraq, English at 1940.
- 11765 R. *Australia*, News in English at 0900.
- 11920 *Ivory Coast Radio*, English at 1835.
- 11940 R. *Kuwait*, News at 1835.
- 15155 R. *Havana*, Cuba, English at 2012.
- 15175 RSA, *South Africa*, English at 1900.
- 17720 WINB, *Red Lion*, English at 1945.
- 21545 R. *Ghana* in English at 1515.

James Haigh of Huddersfield used his R209 receiver and Joystick antenna to log the following:

- 7120 R. *Kiev*, Ukraine in English at 1930.
- 7310 R. *Vilnius*, Lithuania, English at 2230.
- 9530 VOA, *Liberia* sign-off at 2230.
- 9600 *Radio Tashkent* in English at 1400.
- 11710 RAE, *Argentina* in English at 2300.
- 11795 WINB, *Red Lion* in English at 2000.
- 11820 BBC, *Ascension Island* relay at 2115.
- 11970 *Windward Is. B.S.*, English at 2000.

Albert Gavin of Wallasey has a Marconi CR100/5 receiver and a 100 foot long-wire antenna enabling him to hear:

- 11780 HCJB, *Quito*, Ecuador, English at 0405.
- 11850 TWR, *Bonaire* in French at 2200.
- 11950 FEBA, *Seychelles* in English at 1745.
- 15170 ELWA, *Liberia* in Arabic at 2255.
- 17835 XERMX, *Mexico* in Spanish at 1830.
- 17840 R. *Nac. Venezuela*, Portuguese at 2145.
- 25790 R.S.A., *South Africa* in English at 1430.

Ian Howes of Lowestoft has a Teleton TF181 receiver and his log included:

- 4835 R. *Mali* in French at 2215.
- 9515 R. *Ankara*, English news at 2200.
- 9525 AIR, *Delhi*, sign-on at 2215.
- 9720 R. *Ceylon*, relay of BBC news 0200.
- 9745 R. *Baghdad*, English news at 1930.
- 11745 HCJB, *Quito*, Ecuador, English at 0000.
- 11900 R. *Tunisia* in Arabic at 2000.
- 11950 FEBA, Arabic at 1800.
- 11920 *Abidjan*, local music at 2330.
- 15280 4VEH, *Haiti* in English at 0015.
- 21545 R. *Ghana* in English at 1515.

Julian Moss of Rayleigh has used his Meridian 10 transistor receiver and 60 foot long-wire to log the following stations:

- 6235 R. *Pakistan* in English at 2005.
- 7120 R. *Kiev*, Ukraine in English at 1955.
- 9545 R. *Ghana*, Accra in English at 2150.
- 9605 R. *Athens*, Greece, news in English at 1945.
- 9745 R. *Baghdad*, Iraq in English at 1945.

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

- 11705 R. *Lebanon*, Beirut in English at 1900.
- 11795 ETLF, Addis Ababa in French at 0530.
- 11820 BBC, *Ascension Is.* relay in English at 2015.
- 11835 R. *Omdurman*, Sudan in Arabic at 0515.
- 11875 R. *Pakistan*, news in English at 1910.
- 11910 ETLF, Addis Ababa in English at 1930.
- 11950 FEBA, *Seychelles* in English at 1730.

Jeff W. Jones of Huyton, Liverpool used his PCR receiver and 150 foot loft antenna to log:

- 7160 R. *Kiev*, Ukraine at 0100.
- 7240 R. *Pakistan* at 2145.
- 9460 R. *Hanoi* in Vietnamese at 1459.
- 9615 HCJB, *Quito*, Ecuador at 0230.
- 9630 R. *Nacional de Columbia* at 0034.

Hugh Cocks of Mayfield, Sussex sent in a report which included the following stations:

- 6055 R. *Australia*, Darwin at 1500.
- 9515 R. *Ankara*, Turkey in English at 2200.
- 9545 R. *Ghana* in English at 2200.
- 9560 NHK, Japan noted at 1200.
- 9715 *La Voix de la Revolution Congolaise* in French at 1930.

- 11735 R. *Morocco* in English at 1700.
- 11850 R. *Ghana* in English at 2030.
- 11920 *Ivory Coast* in French at 2200.
- 11950 FEBA, *Seychelles* at 1700.
- 21570 NHK, Japan in English at 0830.

The **Radio Club of Bredinghurst School, London S.E.15**, sent in the following log which they compiled using a French 18 valve, double conversion superhet:

- 6070 *Radio Sofia*, Bulgaria at 1930.
- 7270 *Radio Warsaw*, Poland at 1945.
- 11755 *Finnish B.C.* at 1815.
- 11925 *Kuwait Broadcasting Service* at 1845.
- 15130 WNYW, Radio New York Worldwide at 1945.
- 25790 R.S.A., *South Africa* at 1100.

Austin M. Guest of Cannock sent in the following report:

- 6010 RAI, Rome with news in English at 0100.
- 7120 R. *Kiev*, Ukraine, news in English at 0030.
- 9525 R.S.A., *South Africa* in English at 0030.
- 9670 R. *Baghdad*, Iraq, in English at 1945.
- 11720 CBC, *Canada* in French at 2045.

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

HELP US TO HELP YOU

IT would help us to help you, if when sending in your "CQ" for inclusion in the "CQ Column", you could follow the style we use and write it on a post card. In this way, we can speed things up and present readers with a more efficient service.

SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

WELL bless my soul (no one ever does, but that's life) what ever happened to all those h.f. lovers? This past month has seen a deluge of logs all extolling the virtues of either eighty metres or, surprise surprise, the dreaded forty. One letter even bore the slogan, "Help stamp out twenty metre d.x." now there's a thought.

Here is another. The Wolverhampton Amateur Radio Society is celebrating its 50th anniversary in March. Great plans are afoot which include a 40-page history of the club. If you live around that area, why not drop the chairman a line at 4 Grafton Place, Bilston, Staffs WV14 6LH. Name is **W. Moorwood, G3CAQ**. Scalp hunters will be pleased to hear that this Society is also issuing a "Worked all Black Country Award". All gen from G3CAQ.

An excellent scheme for the Radio Amateur Invalid Bedfast Club is in operation. Idea is to create a valve store for the benefit of members and supporters. If you are a converted solid state type, or if you have any valves in that junk box, how about a donation of some bottles? Go on, you'll never use them, will you? Action to take is to drop a line, with a list of bottles, to **John Moxham**, 40 Roman Way, Glastonbury, Somerset.

John was in bed for a month and this, plus a Drake 2B receiver and a half-wave inverted "V" brought in some fantastic goodies on 3.5MHz. The log includes: DU1FH, EA8EX, FL8MM, JY1, JY1B, K8HD, KP4DLW, PY7BLV, TA1SK/4X, TF5TP, VA2UN, VB1MSA, VE1FO, VE2WM, VE3BCB, VO2GD, VP2AA, VP2VAM, VP9BK, VS6DO, WA4YBV, WA6KRA, WB0FFG/TF, W6LWH, XE1KB, ZC4BJ, ZL1AGO, ZL2BT, ZL3LE, ZL4KE, 5A1GM, 5Z4MO, 7P8AZ, 9Y4T—all of which makes '3JDG very unhappy and determined to put up a better antenna.

D. Lawley (Kent), CR7OA, 101ft end fed plus a quarter wave wire for an earth, bagged these on 1.8MHz; EI9J, GM3YCB, GW3UPK, HB9CM, HB9NL, OK1ADO, OK1ATP, OK2PDN, OLI1AOH, OL5ANJ, PA0RTR, all c.w. except the GW (s.s.b.).

R. Kell (Northumberland), modified R109, 33ft vertical is learning to read c.w. Best s.s.b. on 3.5MHz; CT1JH, CT1LT. EA9BK, PJ2M, PJ5KB, TI2CBK.

Best from the eighty metre log of **W. Hamilton** (Hereford) were: CT1SQ, EA3JE, EA110, K2BT, K2ETB, VE3ON, VE3PT. All on a Heathkit GC-1U with a television v.h.f./u.h.f. antenna.

"How about some SSTV (slow scan television) logs?" asks **J. Iredale** (Llandudno) who has logged IICAM and I5CG who use a.m. for sound. Anyone got any gear for receiving the video? Frequency quoted is 14.255MHz with other calls to QRX for—G5ZT and PAOCAM.

Letter with pretty stamps on from **Karl Muller** in the land of 3D6 which is Swaziland for those who haven't yet got a countries list (shame on you, it's only 9p from the R.S.G.B.). Receivers are a Philips

domestic BC type and a newly-acquired Barlow-Wadley XCR-30 which appears to be a multiple conversion beast of rare ability.

Karl finds 3.5MHz pretty useless but enthuses about 7MHz. His log for this band reads: CX1RY, F8EX, JA1NLX, JA1OHV, JA7JRC, JA9CNI, K3JH, JH6AQ, LU6JAK, VK2KM, 4S7AB, 5H3LV, 7Q7RF, 9J2XZ, 9U5AC, all on c.w. Just shows what's about on forty or are we all missing something in the U.K.?

D. Storrs (Yorkshire) claims: "I can only read about two w.p.m. c.w.". Never mind, great trees from little acorns etc. (OK, OK, so who's heard of an oak tree reading c.w.?). Gear includes an AR88D and a 132ft end fed. The all band log includes things heard on 3.5MHz like: CT, FL8, JA1, JY, MP4, OD, OH0, PY7, VE, VO, VP2 VS6, ZC4, ZD3, ZL1, 4X4, 5X5 and 9H1.

Up on 14MHz Dave's log reads: FR7ZG, HRIRS, KS1, JA1ARM, K6ONI, KH6BB, KV4AD, PY2XU, VE3UP, VE4BW, VE5BW, VE6AYU, VE7IC, VK2ID, VK3WM, VK4IW, VK6GF, VQ9R, W6RTZ, W7KT, W7GKF, ZL2MCX, ZS1JP, ZS5JG, 5H3LC, 5Z4AB, 6Y5PB/P, 9M2DK (presume these all s.s.b.).

Another s.w.l. with success on 7MHz is **D. Parkin** (Yorkshire). Receivers are a 52 set and a BC342; antenna, 60ft end fed. A sniff around this 100kHz brought in: AC4BBF, AP4KJ, BV1SHM, CM5AQ, CN6PL, CN7HP, CR6MX, CX2CQ, EA6DU, EA8CL, EL6AD, AP3ZU/A, ET3UZ/A, FY7AE, JY6AM, KP4WA, KZ5MB, MP4BNC, OA2LS, OX1BLQ, OX3BN, PY0LG, PY2ERS, PY4AEN, SV0IA, FT2GJ, TI2ABN, TU2AZ, VE3KE, VK2LT, VK3LY, VK9AC, VP2KLC, VP8MA, VQ1MC, VR1CV, VU2AE, XE1IJJ, YI8YIK, ZL2XZ, 3V8BJ, 4X4DK, 4Z4JZ, 5B4LK, 9K2YP, 9X5AA.

Contests for March include: 4-5, 2 metre and 70cm open contest; 11-12, BERU; April 9, 3.5MHz low power contest (well worth a listen); April 9, 4 metre contest.

Eric Dowdeswell G4AR (Ex-ST2AR) of PW's technical staff is highly delighted at working W1BB/1 on Top Band c.w. for his "first time across". Ten watts to a 5763 and a half wave inverted Vee at 50 feet did the trick. Eric wonders how many of the G's who seem to regularly work into the U.S. can put their hand on their heart and swear that they don't exceed the legal limit of ten watts?

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

12 Cross Way, Harpenden, Herts.

MOBILE RALLIES

APRIL 16—North Midlands, Drayton Manor Park, Near Tamworth, Staffordshire.

MAY 7—Spalding "Tulip Time", Lincolnshire.

JUNE 25—Bristol City and County RSGB Group, Longleat, Warminster, Wiltshire.

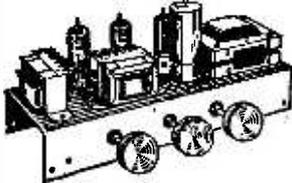
JULY 2—South Shields and District Amateur Radio Club.

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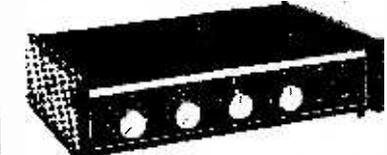
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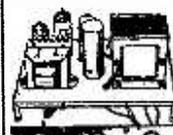
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EF80	12½p	PC183	12½p	6U4	8p
EBF89	12½p	PCF82	20p	6F23	20p
ECC81	10p	PL36	20p	20P1	20p
ECC82	12½p	PL81	17½p	20P3	10p
ECL80	7½p	PY31	7½p	20D1	10p
EF80	7½p	PY33	17½p	30P4	20p
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2N 2219	35p	AF 117	20p	BC 183L	9p	ME 4102	12p	1N 4006	12p
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2N 2926	5p	BC 114	15p	BC 212L	10p	ME 6101	14p	W01	82p
2N 3053	20p	BC 115	15p	BC 213L	10p	ME 6102	15p	W02	4p
2N 4036	40p	BC 116	15p	BC 214L	10p	C 407	90p	1N 4148	5p
AC 107	15p	BC 117	10p	BC 267	9p	C 426	30p	OA 90	7p
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TAKE 20

JULIAN ANDERSON

No. 35

GUNSHOT SIMULATOR

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

THIS month's circuit is possibly the most complex that has yet appeared in this series but it is one that should be popular with those who have interest in amateur theatricals. Even if never intended for a serious use, it is an interesting circuit that has plenty of room for experimenting.

We are inside our £1 budget but if the switches are included we are actually using 23 components but it would be a pity to exclude this circuit from this series for that reason.

The Circuit

The circuit of the gunshot simulator is shown in Fig. 1. It needs to be fed to an amplifier but the output is high and will drive pretty well any transistor or valved amplifier.

There are three distinct parts to the circuit: the noise generator, the amplifier and the pulsing circuit. To understand these circuits it is necessary to examine what comprises the crack of a gun firing as far as waveshape is concerned. Basically it is white noise—that is noise of random amplitude and frequency. This is the *ssshh* heard from a transistor amplifier when turned fully up with no input applied. But this of course, by itself, bears little relationship to the sound of a gun and it is necessary to control the length of time that this noise appears and also the amplitude during this period. In fact the waveshape envelope appears something like a sawtooth. When the sound starts it should be instantly high and drop off more slowly. If you impersonate a gun firing with your mouth you will see what is meant by this. It is not of course necessary to understand this explanation (waveforms and envelopes are not widely understood) but it will help in experimenting with the circuit to obtain your own interpretation of what a gunshot sounds like.

It is necessary to provide a source of white noise and here a little experimenting is needed by the constructor. Tr1 is a germanium transistor with R1 and R2 applying a voltage across it. This will be conducting a small current limited by R1 and R2. Now all semiconductor devices create noise and it is only necessary to select a particular one which is particularly noisy. The author has a very large number of transistors and so was able to have a quick run through to see what proportion would work in this circuit. All devices created some noise but by far the best (or worst for normal operation) were surplus germanium types, though the OC71/

OC44/OC45 types were also generally good for this. Normal diodes can be used (we are after all using the transistor as a diode) but it was found by experiment that these did not generally give a great enough output.

The output from the noise generator is coupled via C1 to the base of the straightforward amplifier Tr2 which is coupled in the common emitter mode. C2 is an optional capacitor which can be switched between the collector and base of Tr2. This has the effect of cutting off the higher frequencies of the noise making the gunshot appear as though it was made some distance away.

The output of this amplifier is applied to a further stage of amplification, Tr3, but here the positive supply voltage is fed from the emitter of Tr4, the shaping circuit. The output is taken from the collector of Tr3 via the d.c. blocking capacitor C4 to the external amplifier. It will be seen that there is absolutely no output from Tr3 unless Tr4 is in a conducting state thus causing the voltage at the emitter of Tr4 to rise.

The circuit is triggered by making SW2, a push-

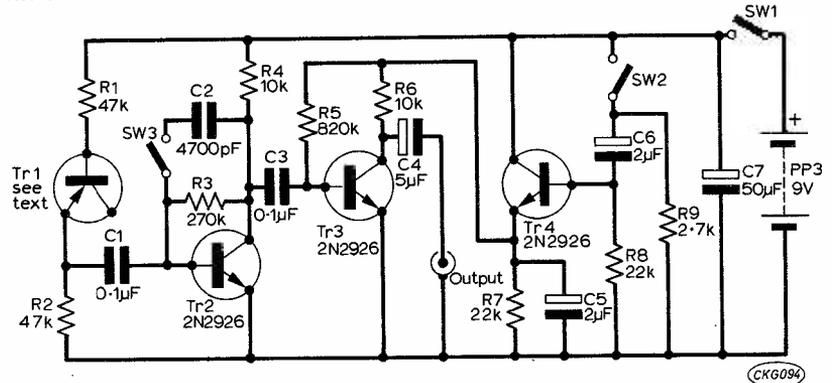


Fig. 1: The circuit of the Gunshot Simulator.

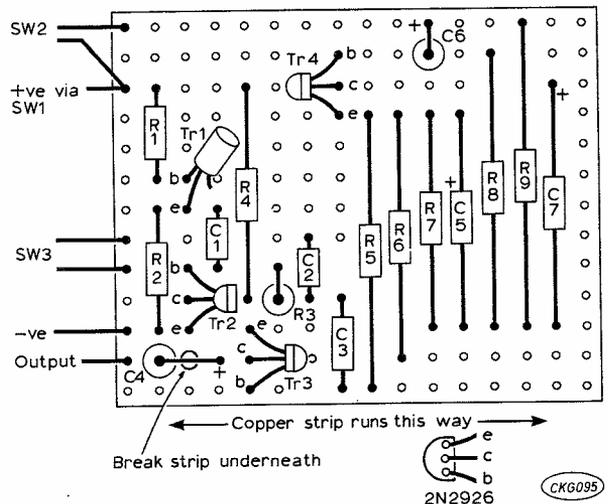


Fig. 1: Suggested component layout on Veroboard.

to-make switch. C6 rapidly charges through R8 and while it is charging Tr4 has its base voltage raised almost to the positive potential and is fully switched on. However as C6 becomes fully charged, the voltage at the base of Tr4 falls until the transistor is no longer conducting.

When Tr4 is conducting, the potential across R7 approaches that of the supply voltage and this enables Tr3 to operate. C5 holds this voltage for a short period. R9 is included so that as soon as SW2 is opened again it discharges C6 and so resets the circuit for a further "firing"; with the values used here it is possible to make SW2 rapidly and the effect is still realistic.

It will be seen that there is considerable room for experimenting. The circuit will work with almost any values for R7, R8 R9, C5 and C6 but this will affect the rise time and the decay time and possibly

★ components list

R1	47kΩ 5% 1W	1p
R2	47kΩ	1p
R3	270kΩ	1p
R4	10kΩ	1p
R5	220kΩ	1p
R6	10kΩ	1p
R7	22kΩ	1p
R8	22kΩ	1p
R9	27kΩ	1p
C1	0.1μF Disc ceramic	2p
C2	4.700pF (or 5.000pF)	2p
C3	0.1μF Disc ceramic	2p
C4	5.0μF 10V minimum	4p
C5	2μF 10V	5p
C6	2μF 10V	5p
C7	50μF 10V	4p
Tr1	See text	—
Tr2	2N2226G	11p
Tr3	2N2226G	11p
Tr4	2N2226G	11p
SW1	S.P. Push on, push off	9p
SW2	S.P. Push to make	9p
SW3	S.P. Push on, push off	9p
		90p

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 and these should be checked carefully before ordering.

the potential level across R7. The values shown were considered by the author to be those which most closely simulated a gun firing, but this is largely a matter of personal choice.

Changes to the amplifier section should not be necessary and will not affect the sound to any extent but C1, C2 and C3 can be experimented with, C1 and C3 favour the higher "noise" frequencies at the expense of the lower ones.

The output of the circuit is something over 1V and it has been found that it helps to overload the amplifier slightly with the output from this unit. The current is small and a PP3 battery is quite sufficient to power the circuit.

The whole unit can be built into a small plastic box with the push button switches on top. The price shown in the components list is for the Castelco types of plastic switches. A Veroboard layout is shown in Fig. 2 though of course layout is far from critical.

DIGITAL CLOCK—continued from page 1091

The 50Hz input signal is fed into the countdown board input and divided by 10 by IC1. The divide-by-two output of IC1 is used for the fast (hours) setting when it is linked to the display module input.

IC2 is connected to divide-by-five and its output (one pulse per second) is fed both to IC3 and the seconds display circuit. The seconds circuit consists of an isolating diode together with a driver transistor and a current limiting resistor.

IC3 is connected to divide-by-10 and its output divided by six by IC4. The method of connecting a 7490 to divide by numbers other than 10 and five is described below.

Using the gated zero reset lines it is possible to inhibit count inputs and return all outputs to logical zero after any required count. At a count of six the b.c.d. outputs A B C D will be at 0 1 1 0 respectively. Therefore the B and C outputs are directly connected to the two zero reset inputs to automatically re-cycle the counter after a count of six. The C output of IC4 is fed to the A input of IC5. This counter is connected to divide-by-10 (as IC's 1 and 3), its b.c.d. output being decoded by IC12 which drives the minutes display tube. The D output of IC5 gives a pulse every 10 minutes which is applied to the input of IC6. IC6 is connected to divide-by-six, its b.c.d. output being decoded by IC11 to give the tens minutes display. The C output of IC6 is fed to the input of IC7 to give an equivalent of one pulse per hour. The connections of IC7 and IC8 are combined to give a two stage counter which automatically recycles ever 24 hours. If the outputs of the two counters at a count of 24 are examined, we find:

UNITS				TENS			
A ₁	B ₁	C ₁	D ₁	A ₂	B ₂	C ₂	D ₂
0	0	1	0	0	1	0	0

Therefore the two sets of reset terminals are commoned and connected individually to C₁ and B₂ to reset both counters to zero when a count of 24 is reached. Both 9 resets are taken to chassis, and the D output of IC7 is connected to input A of IC8. The b.c.d. outputs of the two i.c. are decoded by IC10 and IC9 which display units hours and tens of hours.

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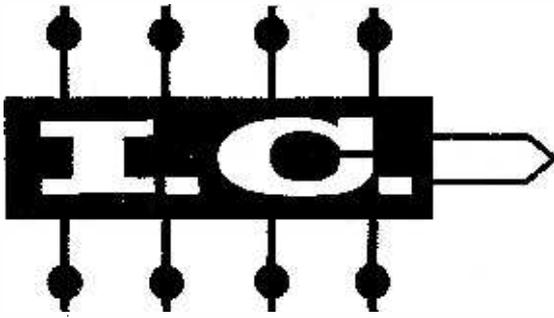
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5U4G	6F1	60 10C2	65 25F6GT
5V4G	6F5G	60 10C2	65 25G6GT
5Y3GT	6F6G	60 10C2	65 25H6GT
5Z4G	6F8G	60 10C2	65 25I6GT
6J30L2	6F11	60 10C2	65 25J6GT
6A7	6F14	60 10C2	65 25K6GT
6A8G	6F14	60 10C2	65 25L6GT
6AK5	6F23	60 10C2	65 25M6GT
6AM5	6F25	60 10C2	65 25N6GT
6AM6	6F25	60 10C2	65 25O6GT
6AQ5	6F32	60 10C2	65 25P6GT
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6AT6	6H6	60 10C2	65 25R6GT
6AU6	6J5M	60 10C2	65 25S6GT
6B4G	£1.00	60 10C2	65 25T6GT
6B8G	6J5GT	60 10C2	65 25U6GT
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OF THE MONTH

L.A.J. IRELAND

Number 28 RCA CA3088E Receiver Module

ANY i.c. specifically designed for a.m. receivers is bound to arouse considerable interest in the average radio enthusiast. So far, a number of such i.c.'s have been reviewed in the present series but none so sophisticated as the RCA type CA3088E which has recently been released on the market. This i.c. reflects the advances currently being made in i.c. design and the inroads such devices are making in the consumer market. Many manufacturers are adopting i.c.'s as standard components in their designs and no doubt this trend is bound to continue.

The CA3088E incorporates all the necessary active components for a typical a.m. front end and in addition includes a number of facilities found normally only in expensive radio sets, such as a buffer stage to drive a tuning meter, zener controlled voltage regulation allowing the device to operate from 6 to 18 volts, and i.f. and r.f./a.g.c. stages. A detector and audio preamp is also featured on the same monolithic chip and although it is now

technically feasible to include the complete audio power stage as is evidenced by the TBA 631 this feature was omitted in the present design.

The complete circuit diagram of the CA3088E is shown in Fig. 1. It features four independent transistor amplifiers each with its own zener regulated biasing control and as each component is fabricated on the same silicon chip, it results in good overall stability and temperature tracking. Transistor Q1 acts as a typical low noise converter stage and as the emitter is already connected through R2 to earth it is suitable for operation with only a 5 pin oscillator coil. The i.f. produced is applied through a standard i.f.t. to Q5, the first i.f. amplifier. Accurate biasing voltages for both of these stages is obtained from the transistor array Q2, Q3 and Q4 whose current is controlled by the D1-D4 diode network.

The second i.f. amplifier stage consisting of Q7, Q9 and Q10, has its output directly coupled to Q12 acting as a type of 'anode bend' detector with the emitter voltage on Q10 ensuring the Q12 is biased

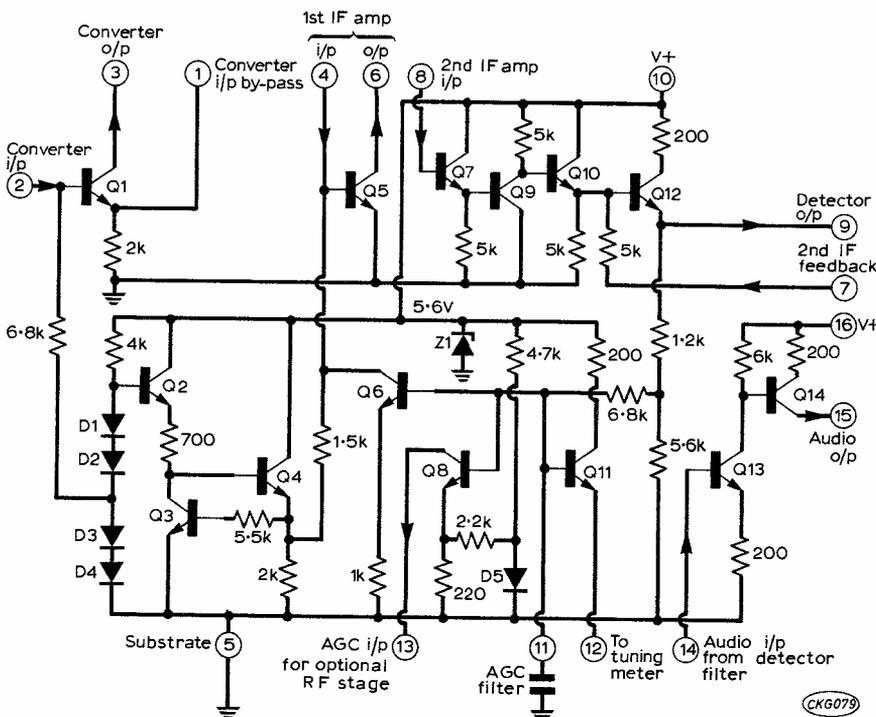


Fig. 1: Complete diagram of the CA3088E integrated circuit. Such circuits are not usually very informative but this is an exception.

CKG079

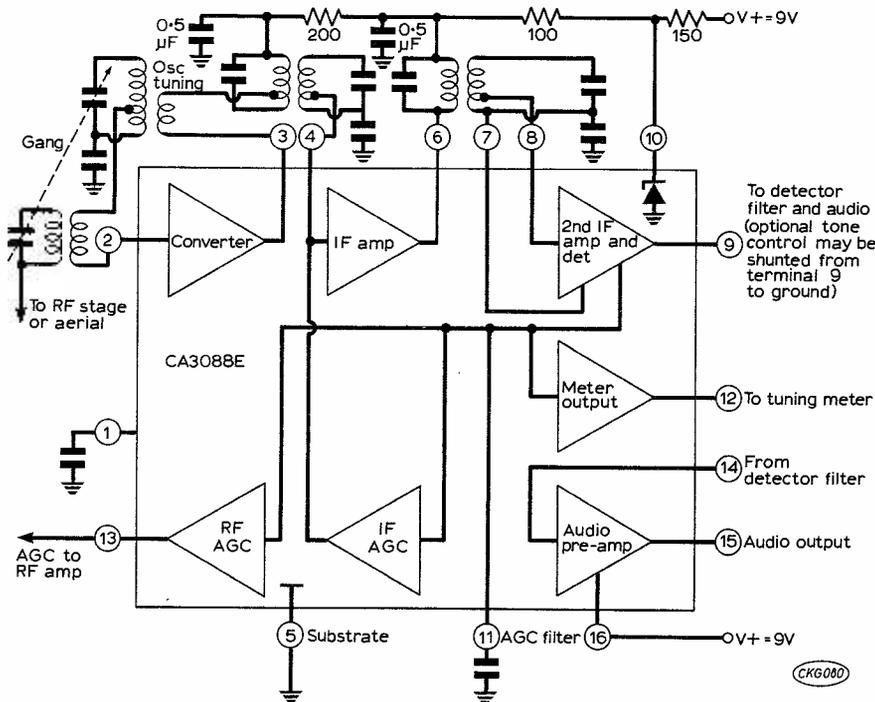


Fig. 2: Typical a.m. broadcast band receiver using the CA3088E with suggested values for the discrete components.

off almost completely. The detected audio output developed across R20 and R21 is used to drive the audio preamp Q13 and Q14 in addition to the tuning meter amplifier stage Q11.

A typical functional circuit utilising the CA3088E in an a.m. broadcast receiver is shown in Fig. 2. A tone control circuit may be inserted between terminal 9 of the i.c. and the input to the preamp stage at pin 14. A block diagram is used to indicate the various stages and as the pin numberings are

given their transistor equivalent circuits may be easily ascertained by referring to Fig. 1. If an external r.f. amplifier is needed to increase sensitivity, a delayed a.g.c. output voltage is provided at pin 13 to control the gate biasing of a f.e.t. Fig. 3 shows the interconnections and component values needed for such a design. The CA3088E (£1.08) and 40841 (32p) are available from: Roberts Electronics Ltd., 17 Hermitage Road, Hitchin, Herts. ■

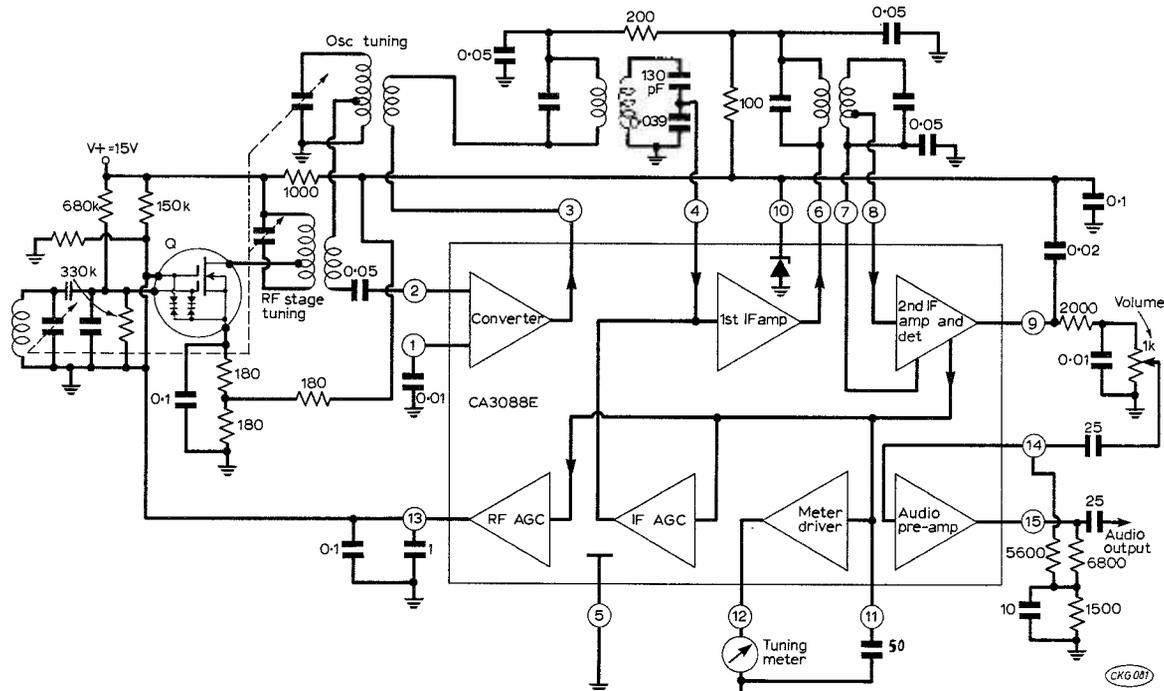
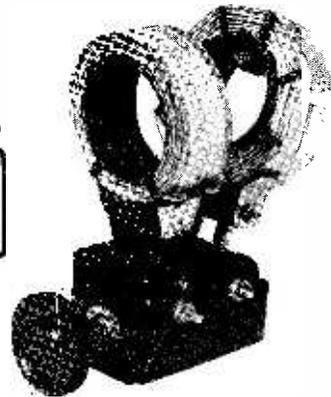
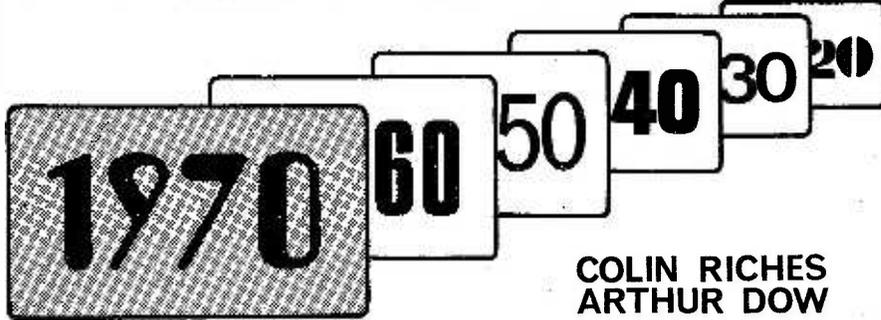


Fig. 3: Another a.m. receiver circuit built around the CA3088E. This time an r.f. amplifier stage has been added, a 40841 f.e.t.

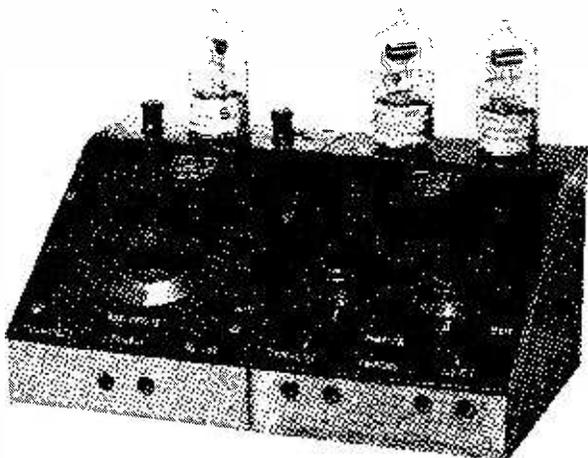
GOING BACK...



COLIN RICHES
ARTHUR DOW

OUR fame is spreading! One of our regular correspondents, Keith Lancaster of Hornchurch, Essex, has forwarded to us details of the German receiver shown in the accompanying photograph, the owner being Mr. C. Petsikopoulos of Athens, Greece.

The set was retrieved from a pile of scrap electronic equipment that was being thrown away by the local Post Office! After a little renovation the set is now in good working order and apparently performs quite well on the medium wave band. The circuit is simplicity itself comprising a regenerative detector followed by two stages of audio amplification, the valves used being Telefunken Type REII.



This 3-valve German radio receiver was rescued from destruction by a Greek reader of 'Going Back'.

The maker of this "little wonder" was the UNDA company of Munich and the date of manufacture was 1924.

It is to be hoped that Mr. P will make other finds since vintage equipment of other countries is likely to be of a design quite different from that which we are accustomed to see in this country.

Pen Friends Wanted

Mr. Lancaster also seeks pen friends for another of his "Going Back" friends, this time in Australia.

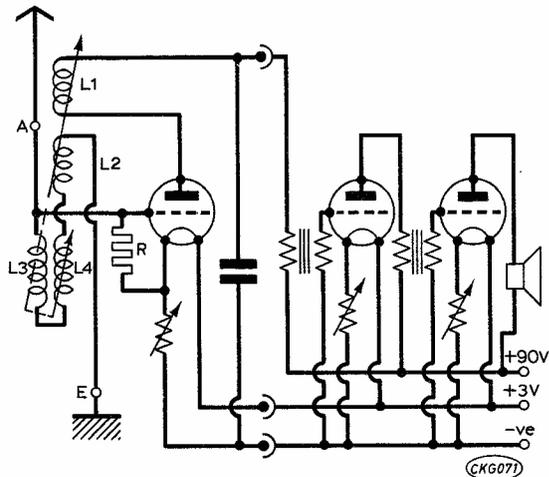
Mr. F. Stewart of 673 Great Western Highway, Falconbridge, N.S.W. 2776, has a larger-than-average collection of some 35 receivers and over 900 valves from the early days of wireless and he would be glad to correspond with one or two readers of "Going Back" with a view to exchanging vintage valves.

Craftsmanship

As we rapidly enter the "throw-away-rather-than-repair" era it becomes increasingly interesting to come across old fashioned solidly constructed equipment and to admire the workmanship that went into its making. A typical example is shown here, a wavemeter Type A by the Marconi Wireless Telegraph Co. made in 1928 and covering 125 to 500 metres in two ranges.

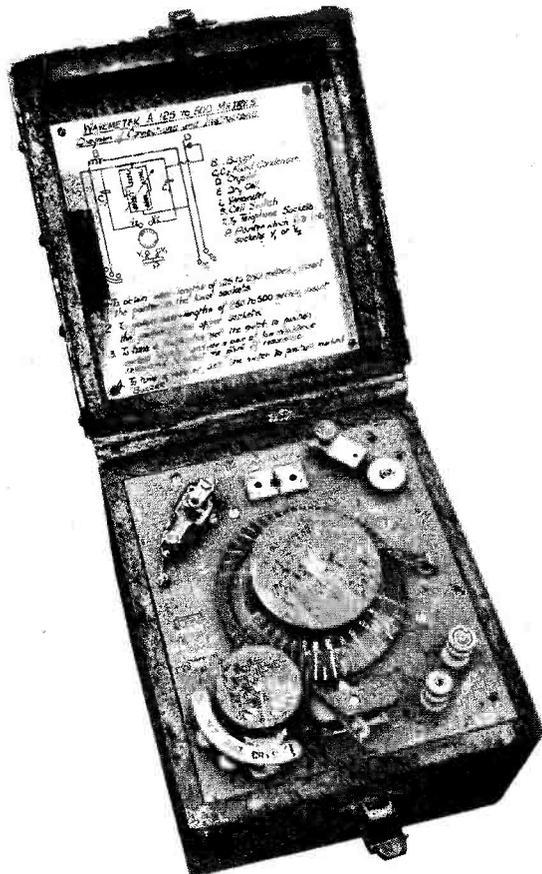
The usual buzzer was connected to the tuned circuit in the "transmit" mode while a crystal detector was switched in on "receive". However it was the construction that most intrigued us since every part is hand made, the panel and all insulating material being cut or turned from solid "Keramot", a red version of the better known black ebonite. This material could be buffed and polished to produce a beautiful lustrous finish, especially on panels which were then engraved and filled white. No sticky transfers that rub off in no time at all!

The fixed condenser (we refuse to say capacitor!)

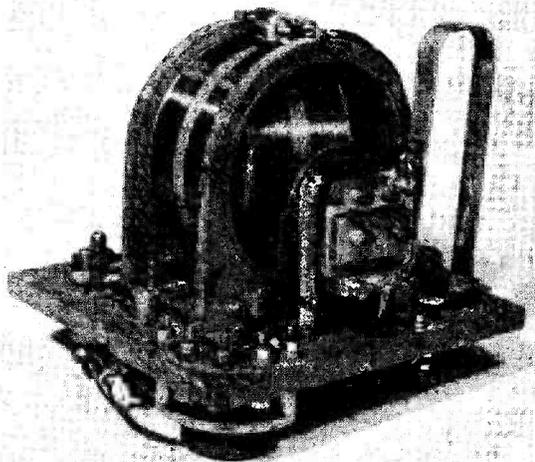


A copy of the original circuit of the set shown on the left.

is made from copper and mica sheets clamped between two heavy brass plates. Internally the brass brackets and terminals and other metalwork are varnished and still look like new. Even the circuit diagram inside the lid is engraved on a polished brass plate. The outside of the case is covered with canvas which is now black with the dirt and grime of many years service.



The stout cabinet has done a good job in protecting the works of this 1928 wavemeter. The excellent craftsmanship and solid construction is illustrated below.



The wavemeter was sent to us by Mr. A. Linden of St. Helens, Lancs to whom we are greatly indebted. He found it in a job lot of ex-WD equipment bought just after the last war, which was a sad come-down for such an elegant instrument!

We recall that the Army's No. 1 set in use in 1939 was built with similar materials, in the same way, by hand! Its successor the No. 11 set was poles apart, using mass produced parts and mass production methods of assembly.

V R S

Readers may remember that Mr. Lancaster was all agog with enthusiasm at one time over the possibilities of forming a Vintage Radio Society and he undertook to organise the anticipated shoals of readers anxious to get on the bandwagon.

In spite of our efforts in this column the apathy towards the venture was appalling, a mere handful of people expressing interest, among which were several whose motives were obviously to make a bit on the buying and selling of vintage equipment. Mr. Lancaster has now washed his hands of the whole idea, a woeful and disappointed man. Many thanks indeed Keith, at least you tried!

TELEVISION

APRIL ISSUE

COLOUR RECEIVER

Starting this month, full constructional details of a modern single-standard full PAL specification colour receiver. Arrangements have been made to ensure easy supply of all the components required.

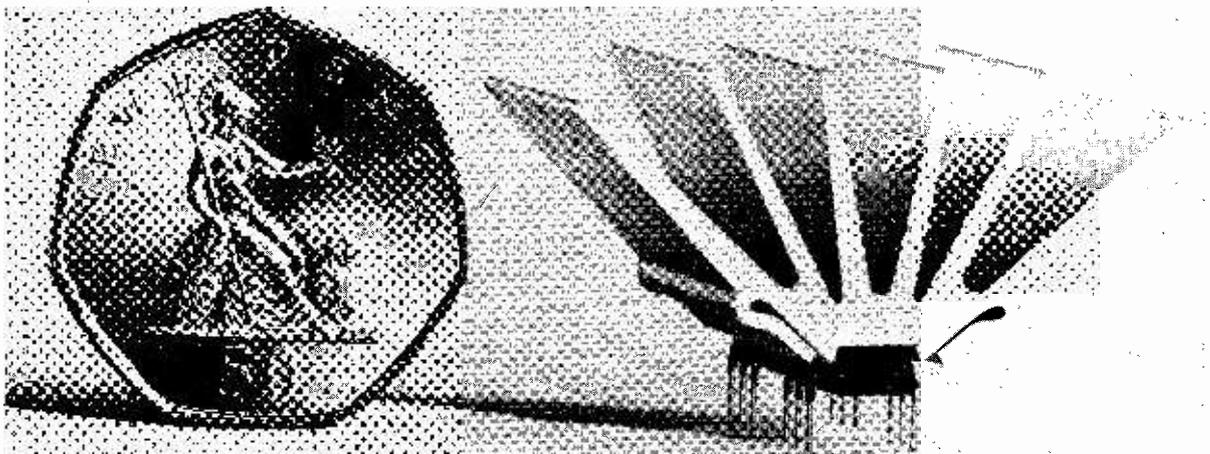
- Strong, simply made cabinet.
- Printed circuit board construction.
- Front pull-out draw containing all convergence controls for easy adjustment.
- Optional built-in crosshatch generator.
- A conventional, surplus or varactor tuner may be used.
- Automatic frequency control.
- Latest 22 in. Mazda flat-face square-corner tube.
- Delay-line PAL decoder.
- Fully integrated sound channel (using two i.c.'s).

Make sure you don't miss this important project!

ON SALE MARCH 22

new

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.



Price, inc. **FREE** printed circuit board for mounting and manual.

£2.98 Post free

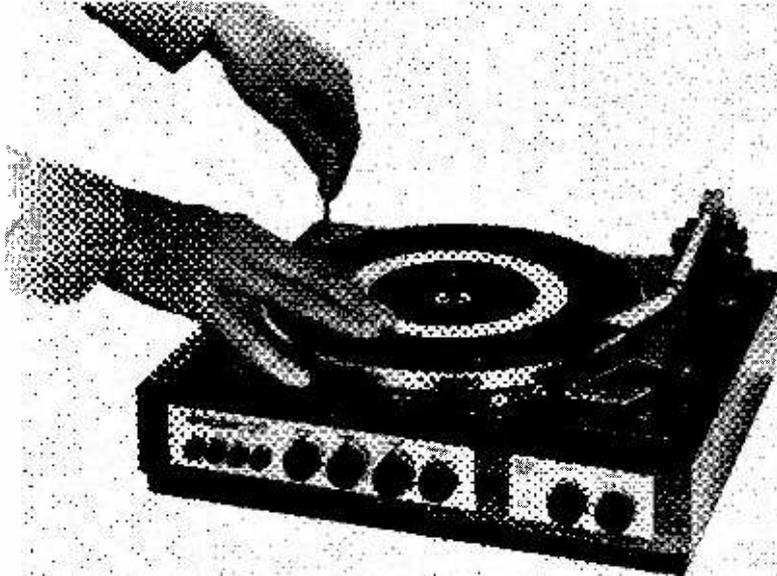
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Sinclair Project 60



Project 605

The easy way
to buy and
build
Project 60



Project 605 is one pack containing a PZ.5 and Z.30, and Stereo 60 and a Master Unit. The kit includes everything you need to build a complete hi-fi system. It includes everything you need to build a complete hi-fi system. It includes everything you need to build a complete hi-fi system. It includes everything you need to build a complete hi-fi system.

Complete Project 605 kit with components and instructions **£29.95**

All you need for a superb 30 watt high fidelity stereo amplifier.

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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 audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with 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	Units cost
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control, etc.	£4.48
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control etc.	£9.45
12 W. RMS continuous sine wave stereo amp. for average needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	£23.90
25 W. RMS continuous sine wave stereo amp. using low efficiency (high performance) speakers	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	£26.90
80 W. (3 ohms) RMS continuous sine wave de luxe stereo amplifier. (60 W. RMS into 8 ohms)	2 x Z.50s, Stereo 60 PZ.8, mains transformer	As above	£34.88
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£19.43

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

Project 60 Stereo F.M. Tuner

Built and tested. Post free. **£25**



The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other 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. 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 most other high fidelity systems.

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

Stereo 60 Pre-amp/control unit

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

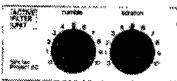


Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation 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 $\pm 1\text{dB}$: 20 to 25,000 Hz. Ceramic p.u. – up to 3mV: Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE + 12 to – 12dB at 10 KHz: BASS + 12 to – 12dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207mm.

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

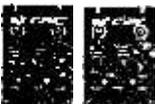
Built tested and guaranteed. **£5.98**



For use between Stereo 60 unit and two Z.30s or Z.50s, 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.

Z.30 & Z.50 power amplifiers

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



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at 15w (8Ω) and all lower outputs. Whether you

use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and 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 $\pm 1\text{dB}$.

Distortion: 0.02% into 8 ohms.

Signal to noise ratio: better than 70dB unweighted.
Input sensitivity: 250mV into 100 Kohms (for 15w into 8Ω)

For speakers from 3 to 15 ohms impedance.

Size: 14 x 80 x 57 mm.

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.5 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

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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Price £17 plus £1 carr.

METER UNITS

These are a 270° meter with a F.S.D. of 1 Ma, scale marked 0, 2, 4, 6 & 8 x Deg Cent. White letters on black, size 2" OSD 3¼" long high grade Aircraft meter. Supplied new boxed.

Price £1.25 plus 15p post

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RADIAC SURVEY METERS—Portable unit as 3 ranges 3, 30 & 300 Rongt per hour with carrying case and inst. battery operated gen on batteries, supplied new cond. £3.00. **VALVES** 6SN7 5 for 50p. OB2 stab new, 2 for 50p. 85A2 stab new, 2 for 50p. **UNISELECTORS** Coil 600 ohm contacts 1p 11w 3b small type 80p. **TRANS** Pri a 230v Secs 6.3v 1.7a & 6.3v .3a both ct small C core 50p., also 6.3 x 3 times at 8, 2 & 1a 80p. **AIRCRAFT UNIT** contains 4 type V60/20p power transis, 2 24v relays, 3 toroid trans, height det unit with magnetic pick-off all in useful case, size 8 x 8 x 4" £1.80. **MORSE KEYS** fully enclosed key on base 2 x 5" adjustable with Send/Rx swt cord & plug. American surplus £1.10. **SPEAKER UNITS** P.A. type by Truvox in sloping front case size 9 x 9 x 8" 8 ohm spk with 600 ohm line trans. New boxed £2.75. **BATTERIES** lead acid type 6v 40 A/Hr in metal case with carrying handle and lid. New boxed with inst. £2.75. **CONTROL BOX** contains small 500 Ua meter 1½" dia scale 0 to 5 plus swts pots etc. £1.25. **TEST SKS** small coloured 12 for 25p. **SCOPE TROLLIES** by Cossor £5.25. **O/P & T.U** contain 2 x LA2503 Vinkors, 4x transis 4x Min relays etc. New 85p. **FILTER UNIT** contains 10 type LA.2 pot cores, 10x1% conds & 10 wire ended neons £1.15. **METER UNITS** radio altimeters F.S.D. 6.5 Ma size 3½ sq. 270° 95p. **WAVEFORM GEN** contains 24 B7g valves 24v blower etc. all on chassis with cover £2.00. **RECT.** 7 multi-purpose unit 200/250 50c/s 1/P 12v DC O/P 1a or 12v DC 1/P & mains out at approx. 40 watts in wooden box with circuit, note complete but soiled condition £1.25. **DYNAMOTOR UNITS** two types both 12v D.C. 1/P fully enclosed. American surplus type A O/P 220v D.C. at 100 Ma £1.25, type B O/P 440v DC at 200 Ma £1.75, both new spares for T.C.S. Tx/Rx. **DIODES** 800 P.I.V. at 1a new 12 for £1.00. **TRANSISTORS** type OC42 P.N.P. swt type long leads on boards 12 for 50p. **RELAYS** 12v 180 ohm 4p c/o contacts m.b.b. 50p. **AMP Unit** small amp 115v 50 c/s 1/P valves 6X4, 12AX7, 6AK6 500 ohm o/p with circ & mods fully enclosed. American surplus £1.80. **AIRCRAFT Rx** xtal controlled 2.8 to 18 Mc/s in 3 bands 24v 1/P 3 ohm spk O/P £7.00. **U.H.F.** Rx covers 330 to 335 Mc/s 24v 1/P requires ext. L.O part of landing aid £3.00. **FILTER UNIT** contains 20 type LA.2 pot cores & 20 1% conds, all in screened box £1.45. **CONTROL BOX** contains 4x tog swts, yax swt pots etc. 55p. **CONTROL UNIT** contains valves 6BA6, 12AU7, 6AS6 large pot cores size 1½ x ¾", luf 1% cond, 2x relays 2 x 8uf 350v PTFE v/h & screens. New boxed 95p. **CABLE** 6ft length, of 5 core cable, 3 for 50p. **RADIO MAGS** American, 73 mag new back issues 8 for £1.15. **CONTROL UNIT** with 2x 120v 5a P.N.P. transis, 2x 50 ohm relays, 3x 6.8v 1w zeners etc. £1.00. **PLUG & SK** Plessey type 6 way with cable clamp ex new equip 30p per pair. **H.F. DRIVE Unit** with 5763 & 4xEF91 6 trimmers, 8 coils, Yax swt etc £1.30. **INVERTORS** 28v to 115v 400 c/s 180 Va new by Cossor £12.50. **E.H.T. COND** 1x. 5uf 2 kv wk size 4 x 2 x 2" inc term 50p. **TAG STRIPS** solder type 24 way. New boxed 10 for 25p. **CIRCUIT DIAGRAMS** Rx's 1155B & N.1475, 1392 all 30p. **SCOPES** CD518 (CT316), 13A, 1035Mk1/2/3, 1049 Mk 3 all 50p. CD513.2 £1.50. CT38 50p. W.M. Class D No. 2 30p. **SIG GEN** TF801a 75p.

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

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TYPE S-80
80 mm. square fronts

50μA	...	23-20	50V. D.C.	...	23-60
50-0-50μA	...	23-10	300V. D.C.	...	23-60
100μA	...	23-75	1 amp. D.C.	...	23-60
100-0-100μA	...	23-10	5 amp. D.C.	...	23-60
500μA	...	23-00	5 amp. D.C.	...	23-60
1mA	...	23-60	300V. A.C.	...	23-60
20V. D.C.	...	23-20	VU Meter	...	23-87

"SEW" CLEAR PLASTIC METERS

Type MR.35P. 4 1/2 in. x 4 1/2 in. fronts.

50μA	...	23-60	10V. D.C.	...	23-20
50-0-50μA	...	23-10	20V. D.C.	...	23-20
100μA	...	23-60	50V. D.C.	...	23-20
100-0-100μA	...	23-60	300V. D.C.	...	23-20
500μA	...	23-60	15V. A.C.	...	23-80
100-0-100μA	...	23-00	300V. A.C.	...	23-80
200μA	...	23-00	S Meter 1mA	...	23-87
500μA	...	23-90	VU Meter	...	23-60
500-0-500μA	...	23-90	1 amp. A.C.	...	23-80
1mA	...	23-90	5 amp. A.C.	...	23-80
1-0-1mA	...	23-90	10 amp. A.C.	...	23-80
5mA	...	23-90	20 amp. A.C.	...	23-80
10mA	...	23-90	30 amp. A.C.	...	23-80

Type MR.35P. 2 1/2 in. square fronts.

50μA	...	23-10	10V. D.C.	...	23-20
50-0-50μA	...	23-60	20V. D.C.	...	23-20
100μA	...	23-60	50V. D.C.	...	23-20
100-0-100μA	...	23-60	300V. D.C.	...	23-20
500μA	...	23-60	15V. A.C.	...	23-10
1mA	...	23-00	300V. A.C.	...	23-10
5mA	...	23-00	S Meter 1mA	...	23-10
10mA	...	23-00	VU Meter	...	23-20
50mA	...	23-06	1 amp. A.C.	...	23-60
100mA	...	23-00	5 amp. A.C.	...	23-06
500μA	...	23-00	10 amp. A.C.	...	23-00
1 amp.	...	23-00	20 amp. A.C.	...	23-00
5 amp.	...	23-00	30 amp. A.C.	...	23-00

Type MR.35P. 3 1/2 in. x 3 1/2 in. fronts.

50μA	...	23-37	10V. D.C.	...	23-20
50-0-50μA	...	23-75	20V. D.C.	...	23-20
100μA	...	23-75	50V. D.C.	...	23-20
100-0-100μA	...	23-95	150V. D.C.	...	23-20
200μA	...	23-95	300V. D.C.	...	23-20
500μA	...	23-40	15V. A.C.	...	23-30
500-0-500μA	...	23-20	50V. A.C.	...	23-30
1mA	...	23-20	300V. A.C.	...	23-30
5mA	...	23-20	500V. A.C.	...	23-30
10mA	...	23-20	S Meter 1mA	...	23-87
50mA	...	23-20	VU Meter	...	23-20
500μA	...	23-20	50mA A.C.*	...	23-20
1 amp.	...	23-20	100mA A.C.*	...	23-20
5 amp.	...	23-20	200mA A.C.*	...	23-20
10 amp.	...	23-20	500mA A.C.*	...	23-20
15 amp.	...	23-20	1 amp. A.C.*	...	23-20
20 amp.	...	23-20	5 amp. A.C.*	...	23-20
30 amp.	...	23-20	10 amp. A.C.*	...	23-20
50 amp.	...	23-20	20 amp. A.C.*	...	23-20
5V. D.C.	...	23-20	30 amp. A.C.*	...	23-20

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1mA	...	24-40	300V d.c.	...	24-40
50-0-50μA	...	24-65			
1-0-1mA	...	24-40	Dual range		
1A d.c.	...	24-40	500mA/5A d.c.	...	24-55
5A d.c.	...	24-40	5V/50V d.c.	...	24-65
10V. d.c.	...	24-40			

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Type MR.65. 3 1/2 in. square fronts.

1 amp.	...	21-95	25μA	...	23-50
2 amp.	...	21-95	50μA	...	23-75
5 amp.	...	21-95	50-0-50μA	...	23-35
15 amp.	...	21-95	100μA	...	23-35
30 amp.	...	21-95	100-0-100μA	...	23-25
50 amp.	...	21-95	500μA	...	23-20
5V. D.C.	...	21-95	1mA	...	21-95
10V. D.C.	...	21-95	1-0-1mA	...	21-95
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5 amp. A.C.*	...	21-95	50 amp.	...	21-95
10 amp. A.C.*	...	21-95	100mA	...	21-95
20 amp. A.C.*	...	21-95	500μA	...	21-95
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VU Meter	...	23-10			



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

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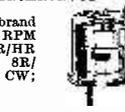
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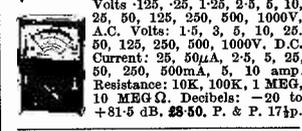
Built in gearbox. All brand new and boxed. 60 RPM CW; 30 RPM CW; 2R/HR ACW; 2R/HR CW; 8R/DAY CW; 10 RPM CW; 20R/HR ACW. 50p each Post 12p.



Model 100-TR MULTIMETER/TRANSISTOR TESTER

100,000 o.p.v. mirror scale/overload protection. 0/12/1/8/3/12/30/120/600 VDC. 0/6/30/120/600 VAC. 0/12/600μA/12/300mA/12 AMP DC. 0/1K/1MEG/100MEG. -20to +50 db. 0-01-2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. £13-50. P/P 25p.

TMK MODEL TW-50K 46 RANGES, MIRROR SCALE, 50K/VOL. D.C. 5K/VOL. A.C. D.C. VOLTS -125, -25, 1-25, 2-5, 5, 10, 25, 50, 125, 250, 500, 1000V. A.C. VOLTS: 1-5, 3, 3-10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50uA, 2-5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: -20 to +81-5 db. £25-50. P. & P. 17p.



HT100B4 MULTI-METER

Features A.C. current ranges. 100,000 o.p.v. mirror scale. Overload protection. 0/1/2-5/10/50/250/500/1000 V DC. 0/2-5/10/50/250/100 V A.C. 0/10/250μA/2-5/25/250 mA/10 Amp DC. 10 Amp AC. 0/20K/200K/2MEG/20 MEG. -20 to +9db. £12-50. P. & P. 25p.

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Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2-5/10/50/250/500V D.C. 2-5/10/50/250/500/1000V A.C. DC Current 100 uA/1/10/100mA/A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5-97 P. & P. 25p.

TO-3 PORTABLE OSCILLOSCOPE

3in. tube, Y amp. Sensitivity 0.1v p-p/CM. Bandwidth 1-5 cps-1.5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0.0v p-p/CM. Bandwidth 1-5cps -800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300KHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 330 mm. Weight 15lb. 220/240V. A.C. Supplied brand new with handbook. £37-50. Carr. 50p.

HONEYWELL DIGITAL VOLT/METER VT.100

Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt. currents and ohms with optional plug in cards. Specification: Accuracy: ±0.2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1.999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing. Full scale adjustment against an internal reference voltage. Overload: to 100V. D.C. Input: Fully floating (3 poles). Input power: 110-230V. A.C. 50/60 cycles. Overall size: 5 1/2 in. x 2 1/2 in. x 8 3/16 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. £49-97. Carr. 50p.

G. W. SMITH & CO (RADIO) LTD.
Also see next two pages

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Transistors	2N3415	2N3416	2N3417	2N3418	2N3419	2N3420	2N3421	2N3422	2N3423	2N3424	2N3425	2N3426	2N3427	2N3428	2N3429	2N3430	2N3431	2N3432	2N3433	2N3434	2N3435	2N3436	2N3437	2N3438	2N3439	2N3440	2N3441	2N3442	2N3443	2N3444	2N3445	2N3446	2N3447	2N3448	2N3449	2N3450	2N3451	2N3452	2N3453	2N3454	2N3455	2N3456	2N3457	2N3458	2N3459	2N3460	2N3461	2N3462	2N3463	2N3464	2N3465	2N3466	2N3467	2N3468	2N3469	2N3470	2N3471	2N3472	2N3473	2N3474	2N3475	2N3476	2N3477	2N3478	2N3479	2N3480	2N3481	2N3482	2N3483	2N3484	2N3485	2N3486	2N3487	2N3488	2N3489	2N3490	2N3491	2N3492	2N3493	2N3494	2N3495	2N3496	2N3497	2N3498	2N3499	2N3500	2N3501	2N3502	2N3503	2N3504	2N3505	2N3506	2N3507	2N3508	2N3509	2N3510	2N3511	2N3512	2N3513	2N3514	2N3515	2N3516	2N3517	2N3518	2N3519	2N3520	2N3521	2N3522	2N3523	2N3524	2N3525	2N3526	2N3527	2N3528	2N3529	2N3530	2N3531	2N3532	2N3533	2N3534	2N3535	2N3536	2N3537	2N3538	2N3539	2N3540	2N3541	2N3542	2N3543	2N3544	2N3545	2N3546	2N3547	2N3548	2N3549	2N3550	2N3551	2N3552	2N3553	2N3554	2N3555	2N3556	2N3557	2N3558	2N3559	2N3560	2N3561	2N3562	2N3563	2N3564	2N3565	2N3566	2N3567	2N3568	2N3569	2N3570	2N3571	2N3572	2N3573	2N3574	2N3575	2N3576	2N3577	2N3578	2N3579	2N3580	2N3581	2N3582	2N3583	2N3584	2N3585	2N3586	2N3587	2N3588	2N3589	2N3590	2N3591	2N3592	2N3593	2N3594	2N3595	2N3596	2N3597	2N3598	2N3599	2N3600	2N3601	2N3602	2N3603	2N3604	2N3605	2N3606	2N3607	2N3608	2N3609	2N3610	2N3611	2N3612	2N3613	2N3614	2N3615	2N3616	2N3617	2N3618	2N3619	2N3620	2N3621	2N3622	2N3623	2N3624	2N3625	2N3626	2N3627	2N3628	2N3629	2N3630	2N3631	2N3632	2N3633	2N3634	2N3635	2N3636	2N3637	2N3638	2N3639	2N3640	2N3641	2N3642	2N3643	2N3644	2N3645	2N3646	2N3647	2N3648	2N3649	2N3650	2N3651	2N3652	2N3653	2N3654	2N3655	2N3656	2N3657	2N3658	2N3659	2N3660	2N3661	2N3662	2N3663	2N3664	2N3665	2N3666	2N3667	2N3668	2N3669	2N3670	2N3671	2N3672	2N3673	2N3674	2N3675	2N3676	2N3677	2N3678	2N3679	2N3680	2N3681	2N3682	2N3683	2N3684	2N3685	2N3686	2N3687	2N3688	2N3689	2N3690	2N3691	2N3692	2N3693	2N3694	2N3695	2N3696	2N3697	2N3698	2N3699	2N3700	2N3701	2N3702	2N3703	2N3704	2N3705	2N3706	2N3707	2N3708	2N3709	2N3710	2N3711	2N3712	2N3713	2N3714	2N3715	2N3716	2N3717	2N3718	2N3719	2N3720	2N3721	2N3722	2N3723	2N3724	2N3725	2N3726	2N3727	2N3728	2N3729	2N3730	2N3731	2N3732	2N3733	2N3734	2N3735	2N3736	2N3737	2N3738	2N3739	2N3740	2N3741	2N3742	2N3743	2N3744	2N3745	2N3746	2N3747	2N3748	2N3749	2N3750	2N3751	2N3752	2N3753	2N3754	2N3755	2N3756	2N3757	2N3758	2N3759	2N3760	2N3761	2N3762	2N3763	2N3764	2N3765	2N3766	2N3767	2N3768	2N3769	2N3770	2N3771	2N3772	2N3773	2N3774	2N3775	2N3776	2N3777	2N3778	2N3779	2N3780	2N3781	2N3782	2N3783	2N3784	2N3785	2N3786	2N3787	2N3788	2N3789	2N3790	2N3791	2N3792	2N3793	2N3794	2N3795	2N3796	2N3797	2N3798	2N3799	2N3800	2N3801	2N3802	2N3803	2N3804	2N3805	2N3806	2N3807	2N3808	2N3809	2N3810	2N3811	2N3812	2N3813	2N3814	2N3815	2N3816	2N3817	2N3818	2N3819	2N3820	2N3821	2N3822	2N3823	2N3824	2N3825	2N3826	2N3827	2N3828	2N3829	2N3830	2N3831	2N3832	2N3833	2N3834	2N3835	2N3836	2N3837	2N3838	2N3839	2N3840	2N3841	2N3842	2N3843	2N3844	2N3845	2N3846	2N3847	2N3848	2N3849	2N3850	2N3851	2N3852	2N3853	2N3854	2N3855	2N3856	2N3857	2N3858	2N3859	2N3860	2N3861	2N3862	2N3863	2N3864	2N3865	2N3866	2N3867	2N3868	2N3869	2N3870	2N3871	2N3872	2N3873	2N3874	2N3875	2N3876	2N3877	2N3878	2N3879	2N3880	2N3881	2N3882	2N3883	2N3884	2N3885	2N3886	2N3887	2N3888	2N3889	2N3890	2N3891	2N3892	2N3893	2N3894	2N3895	2N3896	2N3897	2N3898	2N3899	2N3900	2N3901	2N3902	2N3903	2N3904	2N3905	2N3906	2N3907	2N3908	2N3909	2N3910	2N3911	2N3912	2N3913	2N3914	2N3915	2N3916	2N3917	2N3918	2N3919	2N3920	2N3921	2N3922	2N3923	2N3924	2N3925	2N3926	2N3927	2N3928	2N3929	2N3930	2N3931	2N3932	2N3933	2N3934	2N3935	2N3936	2N3937	2N3938	2N3939	2N3940	2N3941	2N3942	2N3943	2N3944	2N3945	2N3946	2N3947	2N3948	2N3949	2N3950	2N3951	2N3952	2N3953	2N3954	2N3955	2N3956	2N3957	2N3958	2N3959	2N3960	2N3961	2N3962	2N3963	2N3964	2N3965	2N3966	2N3967	2N3968	2N3969	2N3970	2N3971	2N3972	2N3973	2N3974	2N3975	2N3976	2N3977	2N3978	2N3979	2N3980	2N3981	2N3982	2N3983	2N3984	2N3985	2N3986	2N3987	2N3988	2N3989	2N3990	2N3991	2N3992	2N3993	2N3994	2N3995	2N3996	2N3997	2N3998	2N3999	2N4000
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Integrated Circuits	FJH101	FJH111	FJH121	FJH131	FJH141	FJH151	FJH161	FJH171	FJH181	FJH191	FJH201	FJH211	FJH221	FJH231	FJH241	FJH251	FJH261	FJH271	FJH281	FJH291	FJH301	FJH311	FJH321	FJH331	FJH341	FJH351	FJH361	FJH371	FJH381	FJH391	FJH401	FJH411	FJH421	FJH431	FJH441	FJH451	FJH461	FJH471	FJH481	FJH491	FJH501	FJH511	FJH521	FJH531	FJH541	FJH551	FJH561	FJH571	FJH581	FJH591	FJH601	FJH611	FJH621	FJH631	FJH641	FJH651	FJH661	FJH671	FJH681	FJH691	FJH701	FJH711	FJH721	FJH731	FJH741	FJH751	FJH761	FJH771	FJH781	FJH791	FJH801	FJH811	FJH821	FJH831	FJH841	FJH851	FJH861	FJH871	FJH881	FJH891	FJH901	FJH911	FJH921	FJH931	FJH941	FJH951	FJH961	FJH971	FJH981	FJH991	FJH1001
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VALVES	6X4	6X5	6X6	6X7	6X8	6X9	6X10	6X11	6X12	6X13	6X14	6X15	6X16	6X17	6X18	6X19	6X20	6X21	6X22	6X23	6X24	6X25	6X26	6X27	6X28	6X29	6X30	6X31	6X32	6X33	6X34	6X35	6X36	6X37	6X38	6X39	6X40	6X41	6X42	6X43	6X44	6X45	6X46	6X47	6X48	6X49	6X50	6X51	6X52	6X53	6X54	6X55	6X56	6X57	6X58	6X59	6X60	6X61	6X62	6X63	6X64	6X65	6X66	6X67	6X68	6X69	6X70	6X71	6X72	6X73	6X74	6X75	6X76	6X77	6X78	6X79	6X80	6X81	6X82	6X83	6X84	6X85	6X86	6X87	6X88	6X89	6X90	6X91	6X92	6X93	6X94	6X95	6X96	6X97	6X98	6X99	6X100
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TE-40 HIGH SENSITIVITY A.C. VOLTMEETER

10 meg. input 10 ranges: 01/003-1/3/13/10/30/100/300V. R.M.S. 4eps.-1.2 Mc/s. Decibels -40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. \$17-50. Carr. 25p.

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER

Battery operated, 11 meg. input, 26 ranges. Large 4 1/2" mirror scale. Size 5 1/2" x 4 1/2" x 2 1/2". DC VOLTS 0.3-1200V. AC VOLTS 3-300V R.M.S. 8.0-300V P-P. DC CURRENT 12-12MA. Resistance up to 200k ohms. Decibels -20 to +51dB. Complete with leads/instructions. \$17-50. P. & P. 20p.

230 VOLT A.C. 50 CYCLES RELAYS

Brand new. 3 sets of changeover contacts at 5 amp rating. 50p each. P. & P. 10p (100 lots \$40) Quantities available.

HOMER INTERCOMS



Ideal for home, office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.
2 Station \$2-97. P. & P. 15p.
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4 Station \$6-62. P. & P. 17p.

EMI LOUDSPEAKERS

Model 350. 13" x 8" with single tweeter/crossover. 20-20,000 Hz. 16 watt RMS. Available 8 or 15 ohms. \$7-50 each. P. & P. 37p.
Model 450. 13" x 8" with twin tweeters/crossover. 55-13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. \$3-50 each. P. & P. 25p.

TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive, soft carpians. adjustable headband. Magnetic impedance 2,600 ohms. \$1-97. P. & P. 15p.

MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9 1/2" x 5" x 5". Inputs Mics: 3 x 3mV 50K: 2 x 3mV 600 ohm. Phono meg. 4mV 50K. Car. 30mV ceramic 100mV 1 meg. Output 250mV 100K. \$8-97. P. & P. 20p.

HOSIDEN DH-025 STEREO HEADPHONES

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High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range of sizes. Single hole fixing. 1/4" dia. shafts. Bulk quantities available.
25 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, 72 1/2p. P. & P. 7 1/2p.
50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, \$1-05 P. & P. 7 1/2p.
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Inexpensive warning counting system consisting of an encoder and relay unit. Relay unit has variable sensitivity control and switch for intermittent alarm operation. Encoder unit has removable infra red filter and A.C. outlet socket to operate bells, counters, etc. 240V A.C. Complete with cables and instructions. \$9-97. P. & P. 25p.

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4 Bands covering 550kc/s-30mc/s. FET. S Meter. Variable BFO for SSB, Built-in Speaker, Bandspread, Sensitivity Control. 220/240V. A.C. or 12V. D.C. 12 1/2" x 4 1/2" x 7 1/2". Brand new with instructions. \$28. Carr. 87 1/2p.

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General coverage 150-400kc/s. 550 kc/s-30mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter. S. Meter. Bandspread. RF Gain. 15" x 8 1/2" x 8 1/2". 18 lbs. 220/240V. A.C. or 12V. D.C. Brand new with instructions. \$45. Carr. 50p.

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50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, \$1-05 P. & P. 7 1/2p.
100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms, \$1-37 1/2 P. & P. 7 1/2p.

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Brand new. 3 sets of changeover contacts at 5 amp rating. 50p each. P. & P. 10p (100 lots \$40) Quantities available.

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THE SHELLEY

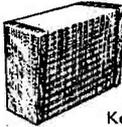
Size 21 x 11 x 6 1/2 in.

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.

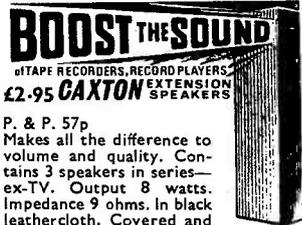


IMP

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

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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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CLARENCE



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Sonotone 9TA H/C Diamond £2.40. Ronette S105 Medium Output, £1.40. S106 High Output £1.40. Acos GP93/1 Sapphire, £1.90. GP94 1 Sapphire, £2. TA700 equivalent to B.S.R. SX1M, £1.75. Japanese equivalent to B.S.R. TC8s, £1.75. P. & P. 7p on each.

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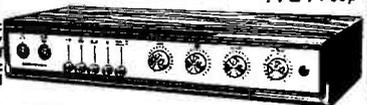


This system includes this elegantly styled solid state Teak finished cabinet tuner/amplifier. Covering VHF/FM. Short, medium and long wavebands. The latest 4 Speed B.S.R. Mono/Stereo record changer with 2-10in. x 6in. matching elliptical speakers supplied ready for housing. A complete Hi-Fi Stereo Radiogram at less than half normal price.

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AC127	25p	BDY17	OC28	60p	2N1809	25p	
AC127Z	50p	BDY38	OC29	60p	2N1613	20p	
AC128	20p	BDY38	OC35	50p	2N2147	75p	
AC178	20p	BDY60	OC36	60p	2N2160	80p	
AC187	25p	OC42	40p	2N2217	25p		
AC188	25p	OC45	50p	2N2218	20p		
AC17	20p	BF115	25p	OC44	2N2218A		
ACY18	25p	BF154	20p	OC46	12p		
ACY19	25p	BF158	15p	OC70	12p		
ACY20	25p	BF159	35p	OC71	12p		
ACY21	20p	BF180	35p	OC72	25p		
ACY22	20p	BF181	35p	OC73	25p		
ACY23	20p	BF185	25p	OC74	25p		
ACY24	20p	BF186	15p	OC77	40p		
ACY40	15p	BF197	15p	OC81	20p		
ADY44	25p	BFX13	25p	OC81D	20p		
ADY49	50p	BFX30	35p	OC81Z	40p		
AD161	35p	BFX39	25p	OC83	25p		
AD162	35p	BFX44	25p	OC84	25p		
AD163	35p	BFX85	30p	OC139	25p		
AF114	25p	BFX86	25p	OC140	40p		
AF115	25p	BFX87	25p	OC141	60p		
AF116	25p	BFX88	20p	OC170	25p		
AF117	25p	BFY11	25p	OC171	30p		
AF118	60p	BFY50	20p	OC200	40p		
AF124	25p	BFY51	20p	OC201	75p		
AF125	20p	BFY52	20p	OC202	80p		
AF126	20p	BFY53	15p	OC206	95p		
AF127	20p	BFY90	65p	OC271	97p		
AF130	30p	BSX30	15p	ORP12	50p		
AF180	50p	BSX31	20p	ORP33	35p		
AF181	45p	BSY27	15p	ST140	15p		
AF185	50p	BSY95A	12p	ST141	20p		
AF186	40p	BSY95	12p	TIP29A	50p		
AF239	40p	BU106	42.25p	TIP30A	60p		
ASV27	30p	BY128	15p	TIP31A	60p		
ASV28	30p	BY129	15p	OC200	40p		
ASV29	30p	BY124	15p	TIP33A	2N3053		
ASV28	30p	BY182	90p	BYZ10	1.00		
AS221	55p	BYZ10	85p	TIP34A	2N3055		
BA100	15p	BYZ11	30p	TI2843	40p		
BA102	30p	BYZ12	30p	TI2843	40p		
BA103	30p	BYZ13	25p	TI2843	40p		
BA115	7p	BZY7841	10p	TI851	10p		
BAX13	5p	GET103	25p	TI852	10p		
BAX16	7p	GET103	25p	TI860	18p		
BAY31	7p	GET111	45p	TI861	20p		
BYZ38	15p	GET118	25p	TI862	25p		
BC108	10p	GET114	20p	W405A	25p		
BC109	10p	GET115	50p	VR525	35p		
BC109C	10p	GET116	50p	W01	30p		
BC113	10p	GET180	45p	W06	45p		
BC114	20p	GET882	30p	ZTX107	15p		
BC115	20p	GEM66	ZTX108	12p			
BC116	20p	BY128	ZTX109	15p			
BC116A	20p	GX378A	50p	ZTX300	2N3771		
BC117	20p	MAT101	25p	ZTX301	15p		
BC118	20p	MAT121	25p	ZTX302	20p		
BC119	20p	MCT24P	60p	ZTX303	20p		
BC120	20p	MJ420	80p	ZTX304	25p		
BC125	15p	MJ2601	15p	ZTX600	15p		
BC126	20p	MJ2601	15p	ZTX502	20p		
BC137	20p	MJ2901	ZTX503	17p			
BC138	20p	MJE340	50p	ZTX504	40p		
BC147	12p	MJE370	20p	ZTX521	20p		
BC148	10p	MJE370	20p	IN814	7p		
BC149	12p	MJE370	20p	IN815	7p		
BC153	20p	MJE520	75p	IN4148	7p		
BC154	20p	MJE521	70p	IN844	7p		
BC167	15p	MJE2955	IS821	7p			
BC169	12p	MJE2955	IS822	8p			
BC169C	15p	MJE3055	2G301	25p			
BC177	20p	MPSA06	25p	2G303	85p		
BC178	20p	MPSA06	25p	2N4871	35p		
BC179	20p	MPSA56	20p	2N404	20p		
BC182L	10p	MPSA70	15p	2N696	15p		
BC183L	10p	MPSU06	50p	2N697	15p		
BC184L	12p	MFR256	55p	2N698	30p		
BC212L	12p	NK7214	20p	2N706	10p		
BC213L	12p	NK7216	35p	2N706A	10p		
BC214L	15p	NKT403	75p	2N708	15p		
BCY30	35p	NKT404	55p	2N930	20p		
BCY31	40p	OA5	25p	2N987	40p		
BCY32	60p	OA10	25p	2N1131	25p		
BCY33	30p	OA10	25p	2N1182	25p		
BCY34	35p	OA70	10p	2N1302	10p		
BCY38	45p	OA71	10p	2N1302	10p		
BCY39	1.00	OA81	8p				
BCY40	50p	OA91	7p				
BCY71	15p	OA200	7p				
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7403	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7404	Hex inverters	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/Nixie driver	20p	18p	16p	14p	12p
7442	BCD-Decimal decoder (4-10-line) TTL O/P	20p	18p	16p	14p	12p
7443	Excess-3-Decimal decoder TTL outputs	20p	18p	16p	14p	12p
7447	BCD-Decimal 7 seg. decoder/indicator driver	21.75	15.60	11.45	11.80	11.15
7448	BCD-Decimal 7 seg. decoder/indicator driver TTL O/P	21.75	15.60	11.45	11.80	11.15
7449	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
7460	Dual 4-input expanders	20p	18p	16p	14p	12p
7470	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7472	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7473	Dual J-K flip-flop	40p	37p	35p	32p	30p
7474	Dual D flip-flop	40p	37p	35p	32p	30p
7475	Quad 2-input multiplexer	45p	42p	40p	35p	35p
7476	Dual J-K flip-flops with Preset and Clear	40p	37p	35p	32p	30p
7480	Gated Full Adder	80p	72p	67p	58p	55p
7481	16-bit read/write memory	11.25	11.15	11.10	11.00	10.90
7482	2-bit binary Full Adder	80p	70p	65p	60p	55p
7483	4-bit binary Full Adder	11.00	90p	85p	80p	78p
7484	4-bit RAM with gated write inputs	80p	75p	70p	65p	60p
7486	Quad 2-input Exclusive OR gates	80p	75p	70p	65p	60p
7489	BCD decade counter	75p	70p	65p	60p	55p
7491	8-bit shift register	11.00	95p	90p	80p	70p
7492	Divide by two counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	75p	70p	65p	60p	55p
7494	Dual 2-input 4-bit shift register	80p	75p	70p	65p	60p
7495	Dual 2-input 4-bit shift register	80p	75p	70p	65p	60p
7496	5-bit parallel/serial in/out shift register	11.00	97p	95p	90p	83p
7410	8-bit bistable latch	22.50	22.30	22.00	21.75	21.50
74113	Hexuple Set-Reset latches	11.00	95p	90p	80p	70p
74121	Monostable multivibrators	60p	55p	50p	46p	41p
7412	BCD-Decimal decoder/Nixie driver	21.00	18p	16p	14p	12p
7415	BCD-Decimal decoder (4-10-line) TTL O/P	21.50	11.40	11.30	11.00	10.70
74150	16-bit data selector/multiplexer	43.35	43.20	42.95	42.15	42.05
74151	8-bit data selector/multiplexer	11.10	95p	90p	80p	70p
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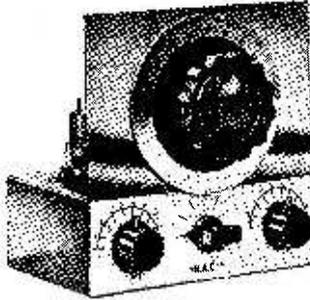
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1R6	0.80	6BA6	0.25	6P26	0.35	10P14	1.10
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1X2B	0.60	6BJ6	0.50	6J6	0.20	12AL5	0.50
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6P0L2	0.85	6A08	0.50	6S67	0.45	12BY7	0.60
6A04	0.85	6C6	0.60	6SK7	0.40	12C7	0.75
6P4A	0.55	6CL6	0.55	6SL7GT0.35	12K7GT0.40	35B5	0.65
6AG5	0.22	6CW4	0.65	6SN7GT0.35	12Q7GT0.40	35C5	0.50
6AG7	0.40	6CY5	0.45	6S9Q7	0.40	35D5	0.75
6AH6	0.60	6CY7	0.70	6R7	0.40	20D1	0.50
6A78	0.50	6D7	0.50	6T8	0.35	20L1	1.10
6A78	0.35	6C6	0.60	6U4GT	0.60	35Z4	0.85
6AK6	0.60	6DK6	0.50	6T8A	0.40	20P4	1.10
6AL3	0.43	6DQB6	0.70	6V6GT	0.40	20P5	1.20
6AL5	0.60	6EA8	0.60	6X4	0.35	25C5	0.50
6AM6	0.35	6EH7	0.30	6X5GT	0.40	25L6GT	0.50
6AM6	0.35	6E7	0.35	6X8	0.60	25Z4G	0.30
6AM6	0.35	6E6W	0.70	6Y6G	0.70	25Z6GT	0.65

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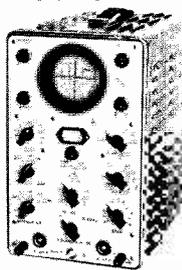
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20A5	0.50	50E15	0.60	DL92	0.55	ECC85	0.40		
20AE3	0.40	50L6GT0.55	DL96	0.45	ECC89	0.50			
30C1	0.30	58A2	0.50	DM160	0.65	ECC91	0.20		
30C15	0.80	90A2	2.40	DY86	0.32	ECC189	0.65		
30C17	0.80	90A2	2.50	DY87	0.33	ECC807	1.25		
30C18	0.80	90C1	0.65	EY82	0.35	ECP80	0.35		
30F6	0.85	90CV	2.40	EB8C2	0.65	ECP82	0.35		
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30FL12	1.20	813	3.75	E10F	2.90	ECP804.165	EM71	0.80	
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30L1	0.40	5642	0.70	EAF42	0.55	ECH42	0.75	EM81	0.60
30L16	0.85	5670	0.50	EB33	0.60	ECH81	0.30	EM84	0.35
30L17	0.80	6060	1.60	EB41	0.55	ECH83	0.45	EM85	1.00
30P12	0.80	6146	1.80	EB81	0.30	ECH84	0.45	EM87	0.70
30P19	0.85	6146B	2.50	EBF80	0.40	ECL80	0.45	EN91	0.38
30PL1	0.75	6360	1.25	EBF83	0.40	ECL81	0.50	EY61	0.40
30PL13	0.93	6939	2.25	EBF89	0.30	ECL82	0.35	EY80	0.55
30PL14	0.80	7199	0.80	EC33	0.50	ECL83	0.70	EY81	0.40
35A3	0.85	7380	2.00	EC86	0.60	ECL84	0.55	EY83	0.55
35A5	0.75	7386	1.25	EC88	0.60	ECL85	0.55	EY86	0.40
35B5	0.65	7895	1.25	EC90	0.33	ECL86	0.40	EY87	0.43
35C5	0.50	9002	0.40	EC91	0.60	EFA0	0.50	EY88	0.43
35D5	0.75	9003	0.50	EC92	0.35	EFA1	0.85	EZ40	0.50
35L6GT0.50	AZ1	0.55	EC98	0.55	EFA2	0.70	EZ41	0.50	
35W4	0.85	AZ21	0.55	EC8010	2.25	EF80	0.25	EZ80	0.27
35Z4	0.70	CB1A	0.90	EC95	1.00	EF83	0.55	EZ81	0.25
35Z4G	0.85	CB13L	1.00	EC94A	0.65	EF85	0.35	GT1C	3.00
35Z5GT0.60	CY31	0.35	EC81	0.35	EF86	0.30	GY501	0.80	
50A5	0.75	DAF96	0.45	EC82	0.30	EF89	0.28	GY50	0.40
50A5	0.75	DF96	0.45	EC83	0.30	EF91	0.33	GZ80	0.40
50C5	0.50	DK90	0.50	EC84	0.30	EF92	0.35	GZ81	0.35
50CD8G1.20	DK40	0.80	EC85	0.40	EF95	0.35	GZ82	0.48	

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2N696	0.17	AC127	0.20	BD123	0.80
2N697	0.17	AC128	0.15	BD132	0.85
2N698	0.17	AC132	0.15	BD132	0.85
2N705	0.70	AC153	0.20	BF115	0.20
2N706	0.10	AC154	0.15	BF167	0.18
2N708	0.15	AC157	0.20	BF173	0.20
2N753	0.25	AC169	0.10	BF179	0.30
2N929	0.22	AC176	0.25	BF180	0.85
2N930	0.22	AC187	0.30	BF181	0.85
2N997	0.20	AC188	0.30	BF184	0.25
2N1131	0.25	ACY17	0.275	BF185	0.20
2N1132	0.25	ACY18	0.20	BF194	0.15
2N1184	1.25	ACY19	0.25	BF195	0.15
2N1801	0.40	ACY20	0.20	BF196	0.20
2N1809	0.75	ACY21	0.20	BF197	0.20
2N1804	0.25	ACY22	0.15	BF200	0.35
2N1805	0.25	AD140	0.50	BFW87	0.25
2N1806	0.25	AD149	0.50	BFW88	0.23
2N1807	0.30	AD161	0.35	BFW89	0.20
2N1808	0.25	AD162	0.35	BFW91	0.20
2N1809	0.30	ADZ11	1.25	BFX85	0.25
2N1813	0.25	ADZ12	1.25	BFY17	0.40
2N1711	0.25	AF114	0.20	BFY19	0.60
2N1756	0.75	AF115	0.20	BFY50	0.25
2N2147	0.75	AF116	0.20	BFY51	0.20
2N2160	0.65	AF117	0.20	BFY52	0.25
2N2217	0.30	AF128	0.45	BSY26	0.20
2N2218	0.35	AF129	0.45	BSY27	0.20
2N2219	0.35	AF127	0.20	BSY28	0.20
2N2369A	0.20	AF180	0.35	BSY65	0.20
2N2477	0.65	AF181	0.35	BSY95A	0.15
2N2646	0.60	AF186	0.40	OC16	0.50
2N2905	0.35	AF239	0.40	OC22	0.50
2N2923	0.15	AFZ11	0.45	OC23	0.80
2N2924	0.15	ASY26	0.25	OC24	0.60
2N2926	0.125	ASY27	0.20	OC25	0.35
2N3053	0.25	ASY28	0.25	OC26	0.25
2N3054	0.60	ASY29	0.30	OC28	0.80
2N3055	0.75	ASY64	0.25	OC29	0.60
2N3133	0.30	ASZ15	0.70	OC30	0.75
2N3134	0.35	ASZ16	0.70	OC35	0.60
2N3391	0.20	ASZ17	0.75	OC36	0.60
2N3392	0.15	ASZ18	0.75	OC42	0.20
2N3393	0.15	ASZ20	0.25	OC44	0.20
2N3394	0.15	ASZ21	0.40	OC45	0.15
2N3395	0.20	BC107	0.125	OC70	0.10
2N3402	0.15	BC108	0.125	OC71	0.12
2N3403	0.15	BC109	0.125	OC72	0.25
2N3404	0.35	BC113	0.25	OC73	0.30
2N3414	0.20	BC118	0.30	OC75	0.20
2N3415	0.15	BC134	0.30	OC76	0.20
2N3416	0.25	BC147	0.175	OC78	0.25
2N3417	0.25	BC148	0.15	OC78D	0.20
2N3795	0.15	BC149	0.15	OC81	0.25
2N3708	0.15	BC152	0.15	OC81D	0.15
2N3704	0.17	BC158	0.15	OC83	0.20
2N3707	0.15	BC175	0.20	OC139	0.30
2N3709	0.12	BC186	0.25	OC140	0.35
2N3710	0.12	BCY30	0.25	OC141	0.60
2N3819	0.35	BCY31	0.40	OC170	0.25
2N3906	0.20	BCY32	0.25	OC175	0.25
28702	0.80	BCY34	0.30	OC200	0.30
28746	0.25	BCY72	0.20	OC201	0.60
AC113	0.15	BC210	0.30	OC202	0.65
AC125	0.30	BC211	0.40	OC203	0.40
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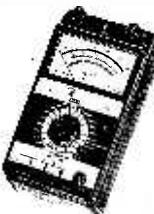
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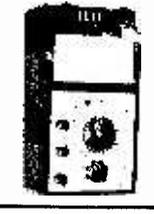


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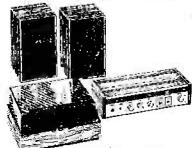
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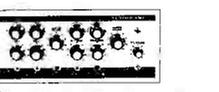
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