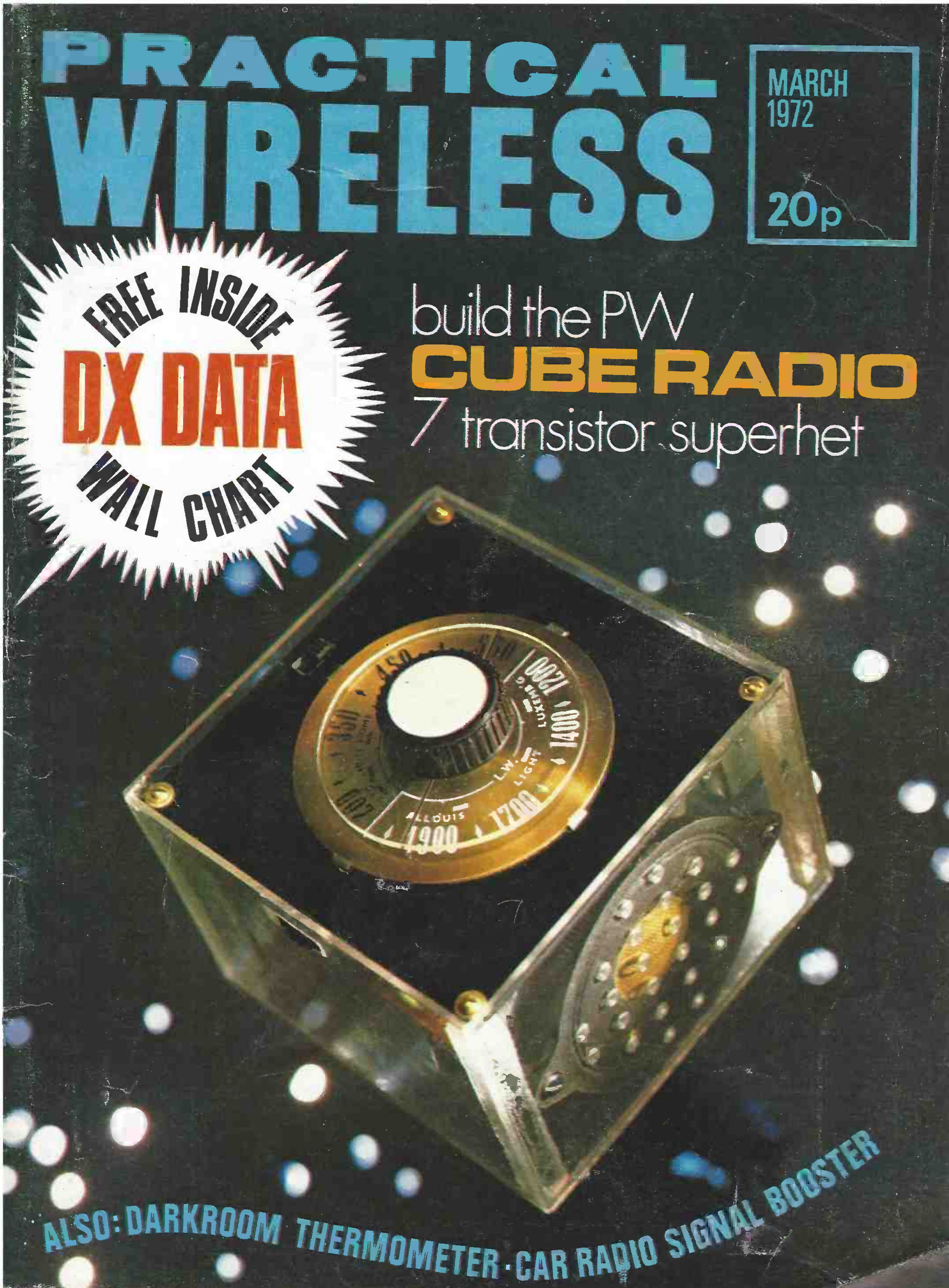

PRACTICAL WIRELESS
MARCH 1972
20p
FREE INSIDE
DX DATA
WALL CHART
build the PW
CUBE RADIO
7 transistor superhet
ALSO: DARKROOM THERMOMETER · CAR RADIO SIGNAL BOOSTER

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

Special Total Price **£79·80** Carr. £1·50
Terms: Deposit £12 and 9 monthly payments £8·55 (Total £88·95).

- ★ Super 30 Amplifier (15 + 15 watt) in veneered housing
- ★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
- ★ Goldring Magnetic P.U. Cartridge.
- ★ Pair of Stanway II speaker units.

Special Total Price **£97·75** Carr. £1·50
Terms: Deposit £15 and 9 monthly payments £10·53 (Total £114·55).

ATTRACTIVE TEAK OR AFRORMOSIA VENEERED CABINETS AND PLINTHS
Send S.A.E. for coloured brochure showing other money saving offers.

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

- ★ TA12 AMPLIFIER 6·5 + 6·5 watt in veneered housing
- ★ GARRARD SP25 MK III Player unit on Plinth
- ★ GOLDRING CS90 Ceramic P.U Cartridge with diamond stylus
- ★ PAIR OF DORCHESTER Loudspeaker Units

Special Total Price **£58**
Or Deposit £7·15 and 9 monthly payments £6·35 (Total £64·30). Carr. £1·25
Trans. Plastic Cover £3·15 extra.

PACKAGE AS ABOVE but with Garrard 3000 Autochanger and Sonotone 9TA Ceramic Cartridge in lieu of SP25 and CS90 Carr. £1·25 **£51·75**
Or Deposit £6 and 9 monthly payments £5·70 (Total £57·30)
Trans. Plastic cover £3·15 extra.

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

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

COMPLETE KIT **£23** Carr. 65p

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

DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUDSPEAKER UNITS

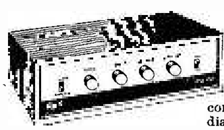
Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

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

STANWAY II Size 20×10¾×9¾in. approx. Rating 10 watts. Inc. 13×8in. 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 illustration **£17·85**

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

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

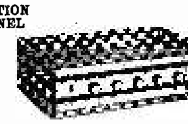


COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£11·50** Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £15·99 or dep. £3·20 and 9 monthly payments £1·70 (Total £18·50).

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

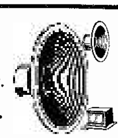
FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6·5 WATTS PER CHANNEL



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

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. £15·50 Carr. 40p. **Factory built with 12 mths. guarantee £19·50**
Deposit £3 and 9 mthly pymts £2·15 (Total £22·35). Or in Teak veneer housing **£23**
Dep. £3 & 9 mthly payments £2·55 (Total £25·95). Send S.A.E. for leaflet.

AUDIOTRINE HI-FI SPEAKER SYSTEMS



Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5·75** Carr. 30p
OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER **£6·75** Carr. 35p

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

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

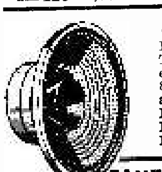
JE8 Size 16×11×9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi speaker. **£5·35**

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

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

SE12 For exclnt prfmcne with 12in Hi-Fi speaker and Tweeter. Size 25×16×10½in. **£7·87**

AUDIOTRINE HIGH FIDELITY SPEAKERS



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

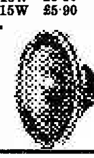
HF808T	8"	10W	£2·88	HF120D	12"	15W	£4·75
HF102D	10"	10W	£3·40	HF126	12"	15W	£5·50
HF120	12"	15W	£4·25	HF126D	12"	15W	£5·90

R.S.C. BATTERY/MAINS CONVERSION UNITS

TYPE BM1. An all-dry battery eliminator. Size 5½×4½×2in. approx. Completely replaces batteries supplying 1·5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available.

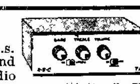
COMPACT KIT WITH DIAGRAM **£3·25** ASSEMBLED READY FOR USE **£3·75**

FANE 807 HIGH FIDELITY SPEAKER



A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Gauss 10,000. Impedance 3 or 8-15 Ω. STATE WHEN ORDERING **£3·50**

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

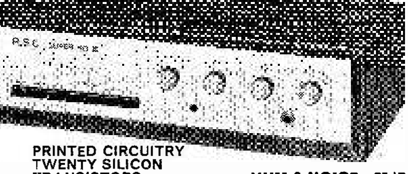


200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. −2dB. Harmonic Distortion 0·3% at 1,000 c.p.s. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV Output rating I.H.F.M. Fully enclosed enamelled case, 9¼×2¾×5¼in. Attractive brushed silver finish facia plate 10¼×3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7·50** Carr. 40p.
OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £9·75

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

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

Only high grade components by leading manufacturers. **£25** Carr. 65p
COMPLETE KIT OF PARTS
Or **FACTORY BUILT** with 12 months guarantee. Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25.) **£33·75**
Or **FACTORY BUILT** in cabinet as illustrated. Dep. £6 and 9 monthly payments £3·86 (Total £40·74) **£37·75**



PRINTED CIRCUITRY
TWENTY SILICON TRANSISTORS.
FOUR DIODES,
FOUR RECTIFIERS

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

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.

OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms. 10 watts R.M.S. (Continuous) into 15 ohms.
HUM & NOISE —75dB Min. Vol. —65dB Full Vol. **HARMONIC DISTORTION** 0·1% at 1000 Hz 10 Watts
FREQUENCY RESPONSE: —3dB 7Hz to 70kHz
TREBLE CONTROL: +16dB to —12dB at 14kHz
BASS CONTROL: +17dB to —16dB at 40Hz
CROSS TALK —58dB
SENSITIVITIES: Disc Mag. 2·5 mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio. (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for speaker connections.

RSC DISCOTHEQUE EQUIPMENT

SEND S.A.E. FOR LEAFLET

SAVINGS ON PACKAGE OFFER

(1) FAL FG1/2 Console
(2) 100W Power Amplifier
(3) Pair High Quality Headphones
(4) Matching Microphone fitted to Headphones
(5) Pair 50W Speakers black rexine covered Size approx. 16"×18"×8"

TOTAL COST OF ALL ILLUSTRATED UNITS **£136** Carr. £2·50
Terms: Deposit £30 and 9 monthly payments of £13·25 (Total £149·25)

FAL

F.G. 1/2 DISCO CONSOLE

Incorporating twin Garrard SP25 Mk.III turntables and Goldring CS90 Ceramic Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Rexine covered Cabinet with lid. **£69** Carr. £1·25
Terms: Deposit £15 and 9 monthly payments of £6·75 (Total £75·75

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

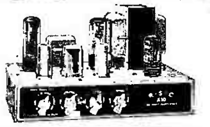
All types 15 Ohms covered in Rexine and Vynair
TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C48S 25-30 WATTS Fitted four 8" high flux 8 watt speakers Overall size approx. 48×10×5in. **£17·75** Terms: Dep £3 and 9 monthly payments £2 (Total £21) Carr. 50p.

TYPE C412S 50 WATTS Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56×14×9in Terms: Dep. £4 and 9 monthly payments £3 (Total £31) Carr. 75p **£27·50**

TYPE C4100 100 WATTS inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58×16×10" Acoustically filled and pressurised. Terms: Dep. £7·50 and 9 mthly. pyts. £5·45 (Total £56.55). Carr. £1 **£50·50**

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



Highly sensitive. Push-Pull high output, Hum level −70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. For Clubs, Schools, Theatres, Dance Halls, Outdoor Functions, etc. For Electronic Organ, Guitar, String Bass, etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes, 200-250v. 50 c/s A.C. mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover £1·90. Or factory built with EL34 output valves and 12 months' guarantee for £19·75 **£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.

Primaries 200-250v. 50c/s. Screened
MIDGET CLAMPED TYPE 2½×2¾×2½in.

250v., 60mA, 6·3v. 2a	99p
250-0-250v., 60mA 6·3v 2a	£1·05
FULLY SHROUDED UPRIGHT MOUNTING	
250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·40
250-0-250v. 100mA. 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 130mA, 6·3v. 4a. c.t., 6·3v. 1a. For Mullard 510 Amplifier	£2·45
350-0-350v. 100mA, 6·3v. 4a., 0 5-6·3v. 3a.	£2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·65
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	£4·95
425-0-425v. 200mA, 6·3v. 4a., 6 3v. 3a., 5v. 3a	£5·10
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	£5·50
TOP SHROUDED DROP-THRO' TYPE	
250-0-250v. 70mA, 6·3v. 2a., 0-5-6 3v. 2a.	£1·35
250-0-250v. 100mA, 6·3v. 3·5a.	£1·55
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a.	£1·60
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·65
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
300-0-300v. 130mA, 6·3v. 4a., c.t. 6·3v. 1a. Suitable for Mullard 510 Amplifier	£2·60
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·60

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

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

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

OUTPUT TRANSFORMERS

Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	50p
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω..	68p
Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω	£1·87
Push-Pull EL84 to 3 or 15 Ω 10-12 watts..	£1·85
Push-Pull Ultra Linear for Mullard 510, etc.	£2·20
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	£1·99
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	£3·30

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

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

LOW DEPOSIT CREDIT TERMS INTEREST CHARGES REFUNDED

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

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

'POP' 100 18" 100 Watt 14,000 gauss 8/15Ω **£22·50** Dep: £6 and 9 mthly payments £2·15 (Total £25·35)

'POP' 60 15" 60 Watt 14,000 gauss 8/15Ω **£12·90** Dep. £3.30 and 9 monthly payments £1.30 (Total £15).

'POP' 50 12" 50 Watt 13,000 gauss 15Ω **£10·50** Dep £2 and 9 monthly payments £1.15 (Total £12.35) Pair suitable all purposes

FOR BASS GUITAR, ELECT. ORGAN, ETC.

FANE LOUDSPEAKERS 'POP' 25/2 12·25 WATT

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

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER £34.75
PR. FANE POP 25/2 25W L/SPEAKERS £13.50
Terms: Deposit £6.50 and 9 monthly payments of £4.72 (Total £48.98) £48.25
PACKAGE PRICE **£45** carr. £1·25

F.A.L. PHASE 50 MK.III AMPLIFIER £34.75
PR. FANE POP 50 L/SPEAKERS £21
Terms: Deposit £12 and 9 monthly payments of £5 (Total £57.00) £55.75
PACKAGE PRICE **£51** carr. £1

F.A.L. PHASE 100 AMPLIFIER £61.95
PR. L125 50W L/S in cabinets £59.80
Terms: Deposit £22 and 9 monthly payments of £11.62 (Total £129.58) £121.75
PACKAGE PRICE **£118** carr. £2·50

F.A.L. PHASE 100 AMPLIFIER £61.95
4 FANE POP 50 L/SPEAKERS £42
Terms: Deposit £15 and 9 monthly payments of £10.52 (Total £109.50) £103.95
PACKAGE PRICE **£99** carr. £2

HIGH QUALITY LOUDSPEAKER UNITS

TWO TONE REXINE AND VYNAIR FINISH

L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Or deposit £4 and 9 monthly payts. of £3·35. Total £34·15 **£31** Carr 75p

L12 12" 25 WATT 10,000 lines 15 ohms. Also supplied Rexine covered Carr 45p **£10·50**

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

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/s 3·30 ohms. Size 17"×7"×7½" 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £7.25 & 9 monthly payments £3·50. Total £38.75. **£34·75** Carr. 75p.

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

BRADFORD 10 North Parade (Half-day Wed.). Tel. 25349
BLACKPOOL (Agent) O & C Electronics 227 Church Street
BIRMINGHAM 30/31 Great Western Arcade, Tel. 021-236 1279 (Half-day Wed)
DERBY 26 Osmaston Rd. The Spot (Half-day Wed.). Tel. 41361
DARLINGTON 18 Priestgate (Half-day Wed.). Tel. 68043
EDINBURGH 133 Leith St. (Half-day Wed.). Tel. 556 5766
GLASGOW 326 Argyle St. (Half-day Tues.). Tel. 248 4158
HULL 91 Paragon Street (Half-day Thurs.). Tel. 20505
LEICESTER 32 High Street (Half-day Thurs.). Tel. 56420
LEEDS 5-7 County (Mecca) Arcade, 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. 47096.
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 Blds.) (Half-day Thurs.), Tel. 20716

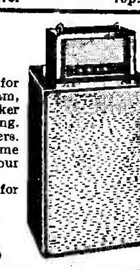
Another New Branch!

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, 13. Tel: Pudsey (09735) 77631.
TERMS C.W.O. or C.O.D. No C.O.D. under £1.
Postage 25p extra under £2. 30p extra over £2 or as quoted.
Trade supplied. S.A.E. please with enquiries.
Suppliers to Govt. Depts. Education Authorities, Schools, Hospitals, H.M. Forces etc.
MAIL ORDERS MUST NOT BE SENT TO SHOPS

R.S.C. BASS REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape, Peak Output rating Loudspeaker unit optional horizontal or vertical mounting.
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for instant use of up to four pick-ups or "mikes".
Bass and Treble controls. Send S.A.E. for leaflet.
Credit Terms: Deposit £16 and 9 monthly payments of £5·75 (Total £67·75) **£60** Carr. £1·50

30 WATT HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group.

A 4 input, 2 vol. control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers.
Send S.A.E. for leaflet. Terms: Deposit £3·70 and 9 monthly payments of £2·10 (Total £22·60). **£19·95** Carr. 65p

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

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

Look at the ADAMIN Model 15. If there is a smaller iron for mains use, we haven't seen it. It weighs a mere ½ oz (less flex) and is about 7 inches long.

But it has a big performance. Used with interchangeable bits from 3/64" to 3/16" it is suitable for all work, from Hearing Aids to Colour Television.

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Telephone 01-688 8589 and 4559

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1N4148 (=1N914)	Signal Diode	18 for 50p
1N5060 (=A14D)	1 Amp Rectifier 400V avalanche protected	7 for 50p
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2N2926 (Red)	NPN Silicon Transistor hfe 55 – 110	8 for 50p
2N3391A	Si NPN Hi Gain (250 – 500) low noise transistor	3 for 50p
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C6U	1.6 amp general purpose 25v SCR in T05 case	3 for 50p

Post and packing 10p for 1 or 2 packs; 3 packs or more post free.
Order any quantity, till sold (but we regret packs cannot be subdivided).

P.O. or Cheque payable
Jermyn Industries,
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Star Bargain
Sprague (Pirgo) Triacs
PT4065 (6 amp 400v)
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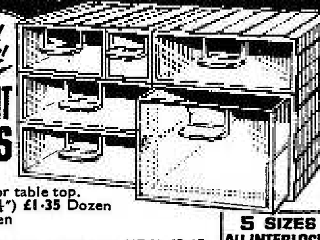

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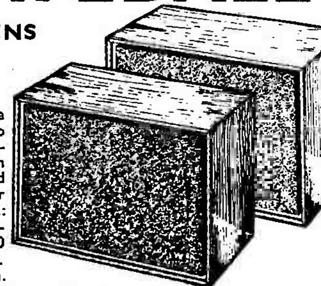

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DENTON 2
SAVE £8·40

Sold in matched pairs for a perfectly balanced stereo system. Each Denton contains an 8in. bass unit with 3in. pressure unit, coupled by a Wharfedale crossover network. Rated input: 18 watts maximum. Frequency response: 65-17,000 Hz. Impedance: 4/8 ohms. Cabinet 9¾in. x 14in. x 8¼in.

All speakers available in Teak or Walnut

List Price £39·90 — **LASKY'S PRICE** Per Pair **£31·50** C & P £2.00

	List Price	Lasky's Price	C &P
LINTON 2 p. pr.	£49·90	£39·95	£2
TRITON 3 p. pr.	£65·00	£53·50	£2
MELTON 2 p. pr.	£35·00	£25·50	£1
DOVEDALE 3 ea.	£45·00	£33·00	£1
ROSEDALE ea.	£65·00	£50·00	£1
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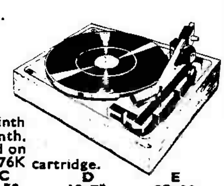
BSR McDONALD MP60

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

LASKY'S PRICE **£10·95** C & P 50p

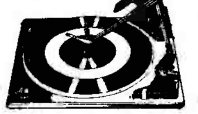


BSR McDONALD UNITS & PACKAGES

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

MODEL	A	B	C	D	E
MP.60	10·95	15·50	18·50	18·75	22·00
HT.70	15·90	19·90	23·50	23·75	27·00
610	14·50	18·75	23·00	22·25	25·50
510	12·10	16·50	18·85	20·00	22·85
310	9·75	14·00	16·50	17·25	20·25
210					9·95
MP.60 TPD2 Styrene base				17·50	21·00

GARRARD UNITS AND PACKAGES



GARRARD SL 55B
Four speed autochanger
LASKY'S PRICE **£10·25** C & P 50p

Now available ZERO 100S
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Garrard SP25 Mk. III ...	£11·50
Garrard SL40B	£9·95
Garrard AP76 without cart.	£20·95
Garrard 3000 with 9TA cart.	£10·50
Garrard 2025TC with KS40A cart.	£8·50

GARRARD PACKAGES

Post on packages 75p

Garrard AP76 with Micro M2100/e cart. and Lasky's plinth and cover	£31·50
Garrard AP76 with Shure M44E cart. and Lasky's plinth and cover	£33·75
Garrard SP25 Mk. III, AD76K cart. and Lasky's plinth and cover...	£18·50
Garrard SP25 Mk. III with Shure M3 cart. and Lasky's plinth and cover	£22·95

LASKY'S NEW LOW NOISE CASSETTES FROM THE USA

Type	Singles	5	10	20
C·60	32p	£1·52	£2·96	£5·60
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AT LASKY'S RECORD LOW PRICES

3in.	RT.20	Message Tape 225ft.	19p
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5in.	RT.23	Double play, 1,200ft.	75p
5in.	RT.18	Long play, 900ft Acetate	50p
5in.	RT.17	Standard play 600ft.	43p
5¾in.	RT.15	Double play, 1,800ft. Mylar	£1·13
5¾in.	RT.16	Long play 1,200ft. Acetate	75p
5¾in.	RT.24	Standard play 900ft. P.V.C.	60p
5¾in.	RT.14	Long play 1,200ft. Mylar	75p
5¾in.	RT.25	Triple play, 2,400ft.	£1·31
7in.	RT.22	Standard play, 1,200ft. Acetate	63p
7in.	RT.10	Standard play, 1,200ft. Mylar	63p
7in.	RT.12	Long play, 1,800ft. Mylar	95p
7in.	RT.13	Double play, 2,400ft. Mylar	£1·25
7in.	RT.11	Long play, 1,800ft. Acetate	75p
7in.	RT.19	Triple play, 3,600ft. Mylar	£2·50
3¼in.	RT.22	Quad play, 1,100ft.	£1·02

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

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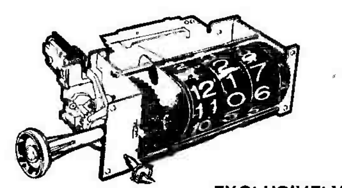
The great new 1972 edition of Lasky's famous Audio-Tronics catalogue is now available—**FREE** on request. The 44 newspaper size pages—many in full colour—are packed with 1,000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast, Electronics hobbyist,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

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

DIGITAL CLOCK SCOOP



EXCLUSIVELY FROM LASKY'S for you to mount into any housing. The clock measures 4¾ W x 1¾ H x 3¾ D (overall from front of drum to back of switch). SPEC.: 210/240V a.c., 50Hz operation; switch rating 250V, 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS.**

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

SPECIAL QUOTES FOR QUANTITES

LASKY'S PRICE **£6·50** C & P 52p

BARGAIN SCOOP!

PYE S.W. CAR RADIO CONVERTER MODEL 2649

High quality transistorised and ultra compact Shortwave Converter for use with any suitable MW (AM) Car Radio. Self powered for use on 12V positive or negative earth systems. The model 2649 is simply connected to the radio via the aerial socket and provides shortwave covering in 9 push button selected band spread ranges (13, 16, 19, 25, 31, 41, 49, 60 & 90 M) combined with the normal radio tuning to give full cover from 3·2MHz-21·75MHz. On/off switch and by-pass switch for normal M.W. radio use. Complete with mounting bracket fitting and alignment instructions. Black hammer crackle finished case—size: 6(W) x 1¼(H) x 3¼(D) in. C & P 20p.

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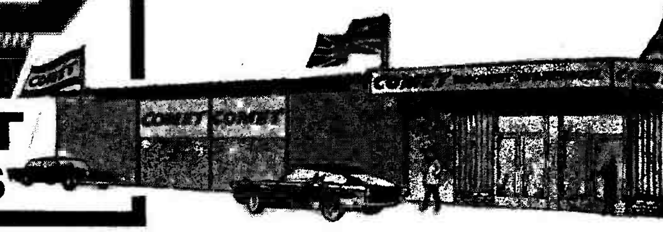

STEREO AMPLIFIERS	Rec. Retail Price	Comet Price
ALBA UA 700	34·50	24·95
ALPHA 212 By Highgate	36·75	27·95
AMSTRAD Stereo 8000 Mk 2	27·95	17·95
AMSTRAD I.C. 2000	42·95	27·95
ARMSTRONG 521	59·00	44·95
DULCI 207	26·00	16·95
DULCI 207M	32·00	19·95
FERROGRAPH F307 Mk. II (cased)	64·00	46·95
FERROGRAPH F307 MII (Metalcase)	60·00	43·95
GOODMANS Maxamp	54·00	37·95
LEAK Delta 30 (cased)	65·00	51·95
LEAK Delta 70 (cased)	79·50	63·95
METROSOUND ST20E	39·50	27·95
METROSOUND ST60	70·00	49·95
PHILIPS RH 591	79·00	54·95
PHILIPS RH 590	52·00	36·95
PHILIPS RH 580	29·00	19·95
PIONEER SA500A	53·62	38·95
PIONEER SA600	83·75	59·95
PIONEER SA700	97·97	66·95
PIONEER SA800	109·21	75·95
PIONEER SA900	133·83	93·95
PIONEER SA1000	137·56	95·95
PIONEER Reverberation 202W	46·35	33·95
RANK Rotel 310	47·50	35·95
RANK Rotel 610	74·50	53·95
RANK ROTEL 210	34·90	24·95
ROGERS Ravensbourne	59·50	42·95
ROGERS Ravensbourne (cased)	64·00	47·95
ROGERS Ravensbrook Mk. II	47·50	36·96
ROGERS Ravensbrook (cased) Mk.II	52·50	39·95
SINCLAIR 2000	35·00	23·75
SINCLAIR Project 60/2 x Z30/PZ5	23·90	15·95
SINCLAIR PROJECT 60/2 x Z50/PZ8/trans	34·86	23·25
SINCLAIR PROJECT 605	29·95	21·95
SINCLAIR AFU	5·95	4·45
SINCLAIR Neoteric	61·95	43·95
SINCLAIR 3000	45·00	31·50
TELETON SAQ 206	32·50	18·25
TELETON 307	30·00	19·95
VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs	185·00	139·00
WHARFEDALE Linton Amplifier	60·00	47·95

All take both ceramic and magnetic cartridges.

TUNERS	Rec. Retail Price	Comet Price
*ARMSTRONG 523 AM/FM	54·22	42·95
*ARMSTRONG 524 FM	42·17	33·95
ARMSTRONG M8 Decoder	9·50	7·70
*DULCI FMT.7 FM	25·10	17·95
DULCI FMT.7S Stereo	33·79	27·25
GOODMANS Stereomax	80·07	47·95
LEAK Delta FM	75·00	58·95
LEAK Delta AM/FM	89·50	69·50
PHILIPS RH 690	45·30	36·50
PHILIPS RH 691	85·80	69·95
PIONEER TX500 AM/FM	66·09	57·95
PIONEER TX900 AM/FM	147·15	118·00
RANK ROTEL 320	54·94	43·95
ROGERS Ravensbourne Chassis	59·63	46·95
ROGERS Ravensbourne in teak case	64·45	48·95
ROGERS Ravensbrook chassis	43·37	34·95
ROGERS Ravensbrook (cased)	49·39	38·95
SINCLAIR 2000	45·00	34·95
SINCLAIR project 60 tuner (stereo)	25·00	19·95
TELETON GT 101	43·93	30·95

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

TUNER/AMPLIFIERS	Rec. Retail Price	Comet Price
AKAI AA 8500	221·85	175·00
AKAI 6600	137·34	108·00
AKAI 6300	128·85	99·95
AKAI 6200	91·56	79·95
ARENA 2600	111·30	69·95
ARENA T9000	303·45	285·00
ARMSTRONG M8 Decoder	9·50	7·70
ARMSTRONG 525	92·77	71·95
ARMSTRONG 526	105·72	84·95
GOODMANS Module 80, 35w. RMS	91·59	71·95
GOODMANS Module 80 Compact	165·00	129·00
GOODMANS Model 110 FM/MW/LW/SW 100W RMS	135·00	108·00
LEAK Delta 75	165·00	139·95
MIDLAND 19/542	49·56	37·50
PHILIPS RH 790	134·00	79·95
PIONEER SX770 AM/FM	139·23	109·95
PIONEER SX990 AM/FM	167·83	129·95
PIONEER 440	104·18	82·95
ROGERS Ravensbrook Chassis	99·39	81·95
ROGERS Ravensbrook (cased)	108·43	89·95
ROTEL RX150	69·90	54·95
TANDBERG 1171	110·00	91·95
TANDBERG TR200	99·00	82·95
TELETON F2000	51·50	28·95
TELETON 10AT1 150w. RMS	160·00	94·00
TELETON TFS50	79·65	52·95
TELETON TFS50 LA MW/LW/FM	86·64	60·95
TELETON CR55	125·26	67·95
WHARFEDALE 100-1	139·00	89·95

All the above Tuners and Tuner/Amplifiers take both ceramic and magnetic cartridges except Teleton F2000 which takes ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

COMET for after-sales service
THROUGHOUT THE U.K.

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

CARTRIDGES	Rec. Retail Price	Comet Price
AUDIO TECHNICA LT66	6·47	4·50
GOLDRING G800	12·55	6·75
GOLDRING G800E	18·16	10·50
GOLDRING G800 Super E	25·10	19·95
*GOLDRING CS90 Stereo	5·02	4·10
*GOLDRING CS91/E	7·53	6·00
GOLDRING G850	6·27	3·95
EMPIRE 1000ZE/X	60·34	51·25
EMPIRE 999VE/X	43·00	34·95
EMPIRE 999TE/X	25·09	21·00
EMPIRE 999SE/X	20·31	16·95
EMPIRE 999E/X	15·89	12·50
EMPIRE 999/X	12·55	10·25
EMPIRE 909E/X	12·37	9·95
EMPIRE 909/X	9·26	7·75
EMPIRE 90EE/X	9·56	7·95
ORBIT Magnetic NM 22	Special Price	2·95
ORTOFON SL15E	28·62	22·95
ORTOFON 2 X 15K Transformer	7·00	4·95
ORTOFON M15E	29·08	23·50
SHURE M3DM	7·16	4·75
SHURE M31E	11·63	8·70
SHURE M32E	10·73	8·05
SHURE M32-3	9·84	7·80
SHURE M44-5	10·73	7·19
SHURE M44-7	9·84	7·15
SHURE M-44C	9·84	7·15
SHURE M44E	11·63	7·95
SHURE M55E	12·52	8·95
SHURE M75G	16·99	13·75
SHURE M75-6	16·10	12·45
SHURE M75EJ	18·78	14·95
SHURE M75E	20·57	13·50
SHURE V15-11	39·35	27·95

Starred cartridges above are ceramic. All others are magnetic.

PICKUP ARMS	Rec. Retail Price	Comet Price
GOLDRING Lenco 75	13·98	9·50
GOLDRING Lenco L69	10·04	6·50
SME 3009 with S2 Shell	33·26	24·95
SME 3012 with S2 Shell	35·42	26·45

TURNTABLES

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

GARRARD SP25 Mk III with Goldring G.800 Special Price £19·95
GARRARD SP25 Mk III with Shure M.44/7 Special Price £22·95
GARRARD SP25 Mk III with Shure M.55E Special Price £23·95
GARRARD AP76 with Goldring G800 Special Price £32·95
GARRARD AP76 with Shure M55E Special Price £35·95
GARRARD AP76 with Shure M75EJ Special Price £39·95
GARRARD 2025 with Sonotone 9TAHC Special Price £14·50

	Rec. Retail Price	Comet Price
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
GARRARD Zero 100	56·25	42·95
GARRARD Zero 100S	51·75	41·95
GARRARD WB4 base Mk IIZ to fit Zero 100 & Zero 100S	6·40	4·95
Base and Cover to fit GARRARD SP25, SL55, SL65B	Special Price	3·95
GARRARD 40B	13·34	10·49
GARRARD AP76	27·85	18·90
GOLDRING 705/P with G850	26·00	16·95
GOLDRING GL75 with G800	Special Price	39·95
GOLDRING GL69 Mk. II	27·60	19·50
GOLDRING GL69P Mk. II	36·21	26·95
GOLDRING GL75	40·15	28·95
GOLDRING GL75P	48·76	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	19·95
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 3025	37·74	21·95
LEAK Delta	69·50	59·95
McDONALD MP 60	15·20	10·95
McDONALD 610	19·28	14·50
McDONALD HT 70	21·22	17·50
McDONALD HT70 Inc. plinth & cov.	30·68	24·95
Base and Cover for McDONALD MP 60 and 610	Special Price	4·25
PHILIPS 202 Electronic	66·50	49·95
PHILIPS 308 transcription unit complete with base and cover	37·60	29·95
PIONEER PL12A with base & cover	48.34	36·95
THORENS TX25 cover	8·52	6·95
THORENS TD125	76·03	58·95
THORENS TD125AB	115·57	94·50
THORENS TD150 Mk. II	34·67	28·95
THORENS TD150A Mk. II	44·40	34·50
THORENS TD150AB Mk. II	48·05	40·25
THORENS TX11 Cover	4·26	3·75
WHARFEDALE Linton with base and cover and Shure M447 cartridge	35·00	28·95

SPEAKERS	Rec. Retail Price	Comet Price
ARENA HT 227 (pair)	42·00	26·95
AKAI SW 155	58·48	39·95
B & W Model 70	159·50	114·95
B & W DM3	63·00	48·40
B. and W DM1 (per pair)	76·94	62·95
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GOODMANS Mezzo 3	34·00	24·95
GOODMANS Magnum K2	44·00	30·95
GOODMANS Dimension 8	69·00	49·95
GOODMANS DIN 20NT kit	12·54	9·95
KELETRON KN400 2-speaker System (pair)	16·10	12·95
KN600 3-speaker System (pair)	26·86	18·95
KN800 3-speaker System	15·90	10·95
KN1100 4-speaker System	20·40	14·20
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LOWTHER Ideal Baffle	37·50	32·00
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TANDBERG Tan 11 (per pair)	38·00	31·95
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Linton Mark II (per pair)	49·90	39·95
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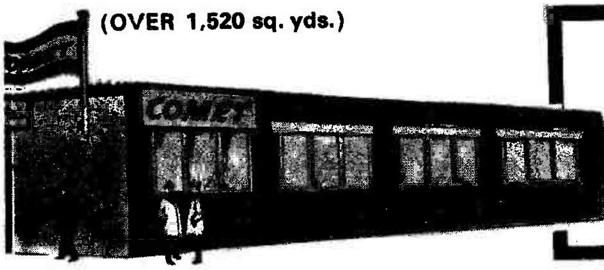

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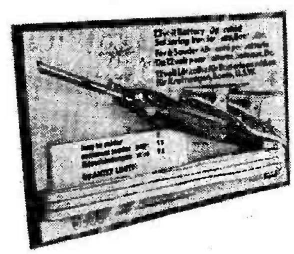

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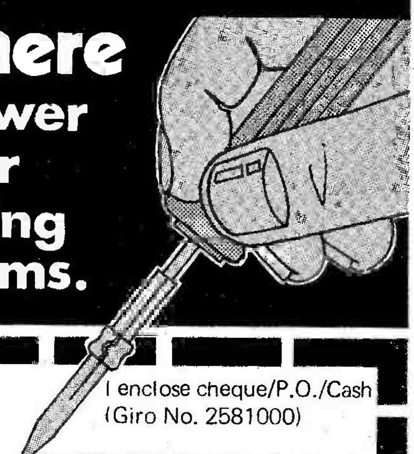

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EF80	7½p	PY33	17½p	30P4	20p
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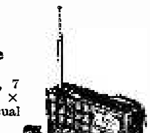

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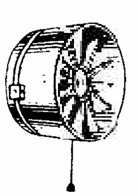

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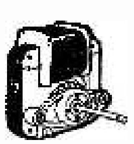

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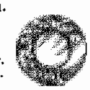

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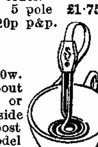
Complete with dial and hand set. Believed in good order **£1·50** plus 25p p. & p.

SELECTOR SWITCHES

Ex-G.P.P. All in good working order.
3 pole **£1·25** 4 pole **£1 50** 5 pole **£1·75**
6 pole **£2·00** Plus 20p p&p.

QUICK CUPPA

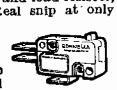


Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **£1·25**, post and insurance 14p. 12v. car model also available same price. Jug heater **£1·50** plus p. & p. 14p.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **83p**, plus 20p postage.

MICRO SWITCH

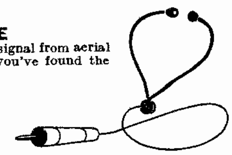


5 amp. changeover contacts, **9p** each, **£1** doz. 15 amp. Model **10p** each or **£1·05** doz.

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 (*Practical Wireless*, June). Price **£4·95** plus 20p post. When ordering please state whether for positive or negative systems. Also available, ready made ignition systems for 6v. vehicles, **£5·25** plus 20p.

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 stethoset instead of earpiece **75p** extra—post and ins. 20p.

STANDARD WAFER SWITCHES

Standard size 1½ wafer—silver-plated 5-amp contact standard ¼" spindle 2" long—with locking washer and nut.

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

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.

THIS MONTH'S SNIP

MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into ohms speakers. Input suitable for crystal mic. or pick-up. 9 volt battery operated. Size 2" long × 1¼" wide × 1" high. SPECIAL SNIP PRICE **60p** each. 10 for **£5.**

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.

HONEYWELL PROGRAMMER

This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price **£5.75** plus 25p post and insurance. Don't miss this terrific bargain.

INTEGRATED CIRCUIT BARGAIN

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

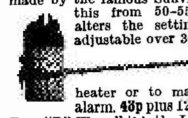
BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3¾" x 6¼" x 2" with leads and prods. Price **£1·75** plus 20p postage.

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F. **40p.** Calibrated dial **20p** extra. Suitable box for wall mounting **25p.**

Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting to this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flame-stat or fire alarm. **43p** plus 12½p post and insurance.

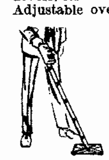


Type "D" We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing. If a length of our blanket wire (16 yd **50p**) is wound round the pipes. **40p.**

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. **50p**

Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types Adjustable over range 50° to 150° F. Price **80**

TREASURE TRACER



Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. **£2·95** plus 20p post and insurance.

DRILL CONTROLLER

NEW 1KW 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.

HIGH ACCURACY THERMO STAT

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

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. **£5·75** plus 25p post and ins.

AUTO-LITE

as Circuit in this month's issue Practical Wireless. Kit of parts **£1·20** post paid

TOGGLE SWITCH

3 amp. 250v. with fixing ring **7½p** each, **75p** doz.

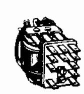
CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. **38p** each or 10 for **£3·42.**

ROCKER SWITCH

13 amp self-fixing into an oblong hole, size approximately 1" × ¾" **6p** each, 10 for **54p.**

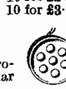
MAINS RELAY BARGAIN



Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Ex-unused equipment. Size approx. 1½" × 1". Open construction

Single pole	**25p** each	10 for **£2·25**
Treble pole	**40p** each	10 for **£3·06**

BALANCED ARMATURE UNIT



500 ohm, operates speaker or microphone, so useful in intercom or similar circuits, **33p** each, **£3·50** doz.

2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling —adjustable thermostat acts as auto control and safety cut-out. Complete kit **£3·95.** Post and ins. 38p.

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

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 7 Park Street, Croydon CRO IYD

Callers to: 102/3 Tamworth Road, Croydon.

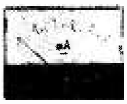
SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.

● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS



TYPE SW.100 100 x 80 mm.

50μA	£3·60	20V. D.C...	£3·10
50-0-50μA	£3·45	50V. D.C...	£3·10
100μA	£3·20	300V. D.C.	£3·10
100-0-100μA	£3·45	1 amp. D.C.	£3·10
500μA	£3·35	5 amp. D.C.	£3·10
1mA	£3·10	300V. A.C.	£3·10
		VU Meter	£3·75

BAKELITE PANEL METERS

TYPE S-80 80 mm. square fronts

50μA	£3·20	50V. D.C...	£2·60
50-0-50μA	£3·10	300V. D.C.	£2·60
100μA	£2·75	1 amp. D.C.	£2·60
100-0-100μA	£3·10	5 amp. D.C.	£2·60
500μA	£3·00	300V. A.C.	£2·60
1mA	£2·60	VU Meter..	£3·37
20V. D.C...	£2·60		

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4½in. × 4¾in. fronts.

50μA	£3·60	50mA	£2·80
50-0-50μA	£3·10	100mA	£2·80
100μA	£3·10	500mA	£2·80
100-0-100μA	£3·00	1 amp.	£2·80
200μA	£3·00	5 amp.	£2·80
500μA	£2·90	15 amp.....	£2·80
500-0-500μA	£2·80	30 amp.....	£2·90
1mA	£2·80	20V. D.C...	£2·80
1-0-1mA ..	£2·80	50V. D.C...	£2·80
5mA	£2·80	150V. D.C.	£2·80
10mA	£2·80	300V. D.C.	£2·80
		15V. A.C...	£2·80
		300V. A.C.	£2·80
		S Meter 1mA	£2·87
		VU Meter..	£3·60
		1 amp. A.C.*	£2·80
		5 amp. A.C.*	£2·80
		10 amp. A.C.*	£2·80
		20 amp. A.C.*	£2·80
		30 amp. A.C.*	£2·80

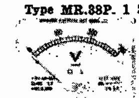
Type MR.52P. 2⅝in. square fronts.

50μA	£3·10	10V. D.C...	£2·00
50-0-50μA	£2·60	20V. D.C...	£2·00
100μA	£2·60	50V. D.C...	£2·00
100-0-100μA	£2·50	300V. D.C.	£2·00
500μA	£2·30	15V. A.C...	£2·10
1mA	£2·00	300V. A.C.	£2·10
5mA	£2·00	S Meter 1mA	£2·10
10mA	£2·00	VU Meter ..	£3·20
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3⅞in. × 3¼in. fronts.

50μA	£3·37	10V. D.C...	£2·20
50-0-50μA	£2·75	20V. D.C...	£2·20
100μA	£2·75	50V. D.C...	£2·20
100-0-100μA	£2·65	150V.D.C...	£2·20
200μA	£2·65	300V. D.C.	£2·20
500μA	£2·40	15V. A.C...	£2·30
500-0-500μA	£2·20	50V. A.C...	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	S Meter 1mA	£2·37
100mA	£2·20	VU Meter..	£3·37
500mA	£2·20	50mA A.C. *	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.....	£2·20	500mA A.C.*	£2·20
15 amp. ..	£2·20	1 amp. A.C.*	£2·20
20 amp. ..	£2·20	5 amp. A.C.*	£2·20
30 amp. ..	£2·30	10 amp. A.C.*	£2·20
50 amp. ..	£2·50	20 amp. A.C.*	£2·20
5V. D.C. ..	£2·20	30 amp. A.C.*	£2·20

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



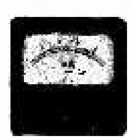
50μA	£2·10	200mA	£1·60
50-0-50μA	£1·90	300mA	£1·60
100μA	£1·90	500mA	£1·60
100-0-100μA	£1·75	750mA	£1·60
200μA	£1·75	1 amp.	£1·60
500μA	£1·65	2 amp.	£1·60
500-0-500μA	£1·60	5 amp.	£1·60
1mA	£1·60	10 amp. ..	£1·60
1-0-1mA ..	£1·60	3V. D.C. ..	£1·60
2mA	£1·60	10V. D.C...	£1·60
5mA	£1·60	15V. D.C...	£1·60
10mA	£1·60	20V. D.C...	£1·60
20mA	£1·60	100V. D.C.	£1·60
50mA	£1·60	150V. D.C.	£1·60
100mA	£1·60	300V. D.C.	£1·60
150mA	£1·60	500V. D.C.	£1·60
		750V. D.C.	£1·60
		15V. A.C...	£1·70
		50V. A.C...	£1·70
		150V. A.C.	£1·70
		300V. A.C.	£1·70
		500V. A.C.	£1·70
		S Meter 1mA	£1·70
		VU Meter..	£2.10

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

50μA	£2·25	5 amp.	£1·70
50-0-50μA	£2·10	10V. D.C...	£1·50
100μA	£2·10	20V. D.C...	£1·50
100-0-100μA	£1.87	50V. D.C...	£1·50
200μA	£1·87	300V. D.C.	£1·50
500μA	£1·75	15V. A.C. ..	£1·80
500-0-500μA	£1·70	300V. A.C.	£1·80
1mA	£1·70	S Meter 1mA	£1·85
5mA	£1·70	VU Meter..	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp	£1·70	30 amp. A.C.*	£1·70

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts.



25μA	£3·50	500mA	£1·90
50μA	£2·75	1 amp.	£1·90
50-0-50μA	£2·35	5 amp.	£1·90
100μA	£2·35	15 amp.....	£1·90
100-0-100μA	£2·25	30 amp.....	£1·90
500μA	£2·20	50 amp.....	£1·90
1mA	£1·90	5V. D.C. ..	£1·90
1-0-1mA ..	£1·90	10V. D.C. ..	£1·90
5mA	£1·90	20V. D.C...	£1·90
10mA	£1·90	50V. D.C...	£1·90
50mA	£1·90	150V. D.C.	£1·90
100mA	£1·90	300V. D.C.	£1·90
		30V. A.C.*	£1·95
		50V. A.C.*	£1·95
		150V. A.C.*	£1·95
		300V. A.C.*	£1·95
		500mA A.C.*	£1·95
		1 amp. A.C.*	£1·95
		5 amp. A.C.*	£1·95
		10 amp. A.C.*	£1·95
		20 amp. A.C.*	£1·95
		30 amp. A.C.*	£1·95
		50 amp. A.C.*	£1·95
		VU Meter ..	£3·10

*MOVING IRON— ALL OTHERS MOVING COIL

Please add postage

SEW EDUCATIONAL METERS

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

50μA	£5·00	20V d.c.	£4·40
100μA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c. ...	£4·40
50-0-50μA ...	£4·65		
1-0-1mA.....	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c...	£4·65
10V d.c.	£4·40		

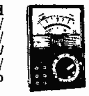
EDGWISE METERS

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

50μA	£3·10	500μA	£2·75
50-0-50μA	£3·00	1mA	£2·45
100μA	£3·00	300V. A.C.	£2·45
100-0-100μA	£2·90	VU Meter..	£3·40
200μA	£2·90		

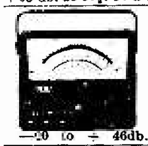
Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

MULTIMETERS for EVERY purpose!



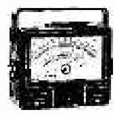
MODEL TE-300. 30,000 **O.P.V. Mirror scale, overload** protection 0/.6/3/15/60/300/ 1,200V. D.C. 0/6/30/120/600/ 1,200V. A.C. 0/30uA/6mA/ 60mA/300mA/600mA. 0/8K/ 80K/800K/8 meg. ohm −20 to +63 db. **£5·97½**. P. & P. 15p.

MODEL LT.101 1000 O.P.V 0/10/50/250/1000 V. D.C. 0/10/50/250/1000 V. A.C. 0/1/100 M.A. 0/150 K ohms. **£1·97**. P. & P. 15p.



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

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



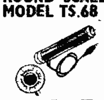
MODEL 5025 57 Ranges. Giant 5½in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 501A, 2·5, 5. 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. **£12·50.** P. & P. 17½p.

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

TMK MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUTTON. **Sensitivity: 20K Ω/Volt D.C.** 5K Ω/Volt A.C.
D.C. Volts: 0-0·5, 2·5, 10, 50, 250, 1,000V. A.C. Volts: 0-2·5, 10, 50, 250, 1,000V. D.C. Currents: 0-0·05, 0·5, 5, 50, 500mA. 10 amp. Resistance: 0·5K, 50K, 0·500K. 5 MEG. Decibels: −20 to +52bB. **£11·50. P. & P. 17½p.**

TMK LAB TESTER. 100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K /Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K. 100K, 10MEG, 100 MEGΩ. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size 7½in. x 6¾in. x 3¼in. **£18·90.** P. & P. 25p.

ROUND SCALE TYPE PENCIL TESTER MODEL TS.68

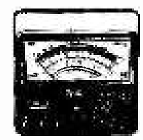


Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY **£1·97** P. & P. 13p.

RUSSIAN 22 RANGE MULTIMETER

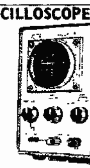
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/ 50/250/500/1000v D.C. 2·5/ 10/50/250/500/1000v AC. DC Current 100 wA/1/10/ 100mA/1A. Resistance 300 ohms/3/30/300K/3MΩ. Complete with batteries, test leads, instructions and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

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



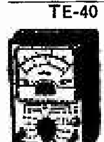
Battery operated, 11 meg input, 26 ranges. Large 4⅝" mirror scale. Size 5¾" x 4⅝" x 2⅝". DC VOLTS 0.3 - 1200V. AC VOLTS 3 - 300V RMS. 8·0 - 800V P-P. DC CURRENT ·12 - 12MA. Resistance up to 2000M ohm. Decibels - 20 to + 51 db Complete with leads/instructions. **£17.50,** P. & P. 20p.

TO-2 PORTABLE OSCILLOSCOPE



A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS-1 MHZ. Input imp. 2 meg Ω 25 P.F. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240 V a.c. Supplied brand new with handbook. **£22.50.** Carr. 50p.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: 01/·003/·1/·3/1/3/10/30/100/ 300V. R.M.S. 4cps.-1-2 Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. **£17·50.** Carr. 25p.

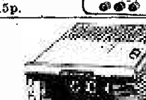
FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and ICO. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6·97½. P. & P. 15p.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

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

HONEYWELL DIGITAL VOLTMETER VT.100

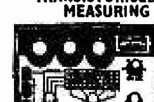


Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0·2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5¾in. x 2 13/16in. x 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. **£49·97½.** Carr. 50p.

TE-20RF SIGNAL GENERATOR

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

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω-11·1 megΩ 6 Ranges ±1% L.1 μ H - 111 HENRYS 6 Ranges2 = %C.10pF ± 1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000-1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7¾ × 5 × 2in. **£20.** P. & P. 25p

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2N404	20p
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2N697	15p
2N698	25p
2N699	30p
2N706	10p
2N706A	12p
2N708	12p
2N709	45p
2N718	25p
2N718A	30p
2N726	25p
2N727	25p
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2N916	17p
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2N1638	27p
2N1639	27p
2N1701	160p
2N1711	24p
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2N1893	37p
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XB112	12p
XC141	35p
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ZTX108	12p
ZTX109	15p
ZTX300	12p
ZTX301	15p
ZTX302	20p
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CA3047	137p
CA3048	204p
CA3049	160p
CA3050	185p
CA3051	134p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	102p
FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
IC10	250p
IC12	250p
L900	40p
L914	40p
L923	40p
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MC780P	247p
MC788P	146p
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PA264	190p
PA265	200p
SN7400	20p
SN7401	20p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	80p
SN7408	20p
SN7409	20p
SN7410	20p
SN7411	23p
SN7413	30p
SN7420	20p
SN7430	20p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7446	100p
SN7447	135p
SN7448	125p
SN7450	20p
SN7451	20p
SN7453	20p
SN7454	20p
SN7460	20p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
SN7493	87p
SN7495	87p
SN7496	87p
SN74107	52p
SN74153	140p
SN74154	220p
SN74160	180p
SN74161	260p
SN74164	220p
SN74165	225p
SN74192	175p
SN74193	175p
TAA241	162p
TAA242	425p
TAA243	150p
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4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
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3·3-33 V	2·4—100	3·9—100V
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6AQ5	38p	807	50p	PCC88	55p
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6AU6	25p	6146	160	PCF80	30p
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6BA6	25p	CY31	35p	PCF84	60p
6BE6	30p	DAF91	30p	PCF86	60p
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6BJ6	50p	DF91	22p	PCF801	50p
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AA129	10p	BAY38	15p	OA9	10p
AAZ13	10p	BY100	15p	OA47	10p
AAZ15	10p	BY103	22p	OA70	10p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	10p
BA110	25p	BY126	12p	OA81	8p
BA111	27p	BY127	15p	OA85	7p
BA112	70p	BY164	57p	OA90	8p
BA115	7p	BY210	35p	OA91	7p
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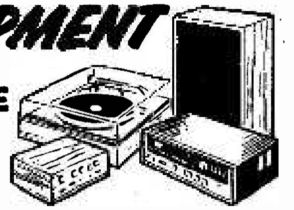

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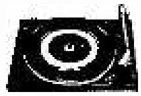

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† Mono * Stereo Cartridge
All other models less Cartridge
Carriage 50p extra any model.

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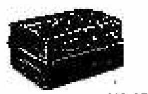

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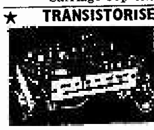

6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6×4×2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 V battery. Coverage 88–108Mc/s. Ready built ready for use. Fantastic value for money. £6·37½. P. & P. 12½p. Stereo multiplex adaptors £4·97½.

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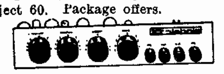

2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. £16·75 Carr. 37½p. Or with PZ6 power supply £18·85 Carr. 37½p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. £20·25. Carr. 37½p.
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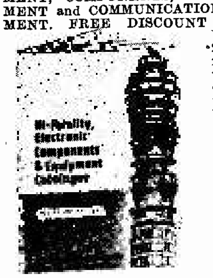

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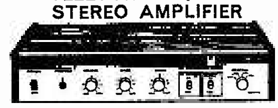

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MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½" x 5" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 600 ohm. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K. £8.97. P. & P. 20p.

HA-10 STEREO HEADPHONE AMPLIFIER

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

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Exceptional budget price amplifier. All silicon transistor. Handsome Walnutcase. Switched input selector, separate balance, volume, treble, bass controls. Output 2×6W RMS. Inputs Mag. Tape. Xtal, Tuner, Tape Out. £14·75. Carr. 37p.

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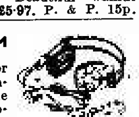

Moving coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms £4·62. P. & P. 15p.

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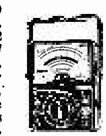
Features unique mechanical 2 way units and fitted adjustable level, controls. 8 ohm impedance. 20–20,000cps Complete with spring lead & stereo jack plug £7·97½. P. & P. 12½p.

Model S-100TR MULTIMETER TRANSISTOR TESTER

100,000 o.p.v. MIRROR SCALE OVERLOAD PROTECTION



0/·12/·6/3/12/30/120/600 V DC. 0/6/30/120/600 V AC. 0/12/600µA/12/300MA/12 AMP DC. 0/10K/1 MEG/100 MEG. −20 to +50 db. 0·01 −2 MFD. Transistor tester measures Alpha, Beta and Ico. Complete with batteries, instructions and leads. £13·50. P. & P. 25p.

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

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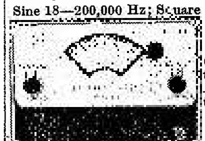
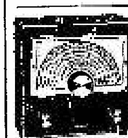
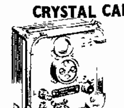


Sine 18—200,000 Hz; Square 18—50,000 Hz Output max. + 10 dB (10 K ohms) Operation internal batteries Attractive 2-tone case 7¼" × 5" × 2". Price £17·50. Carr. 17½p.



TE-16A Transistorised Signal Generator. 5 ranges 400kHz—30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¾ × 3¾in. Complete with instructions and leads. £7·97½. P. & P. 20p.

CRYSTAL CALIBRATORS NO. 10



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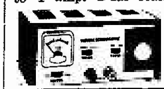

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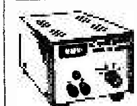

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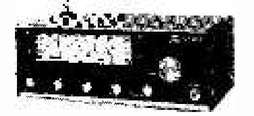

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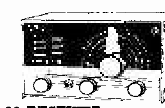

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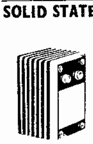

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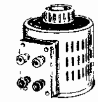

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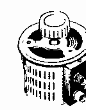

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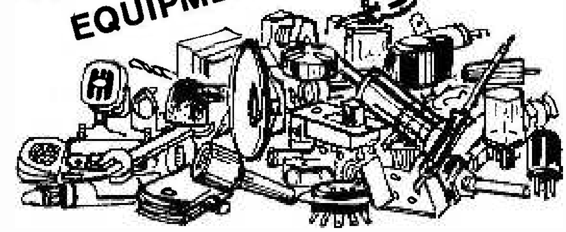

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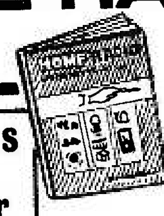

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OA71	10
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OA85	12
OA91	07
OA211	30
OAZ201	50
OAZ207	47
OAZ210	32
OAZ222	45
OAZ224	45
OAZ241	22
OAZ242	23
OAZ246	23
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OC45	12
OC57	60
OC58	60
OC59	65
OC71	12
OC72	20
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PRACTICAL WIRELESS

VOL 47 NO 11

Issue 781

MARCH 1972

DX JUBILEE

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

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

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

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

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

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

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

W. N. STEVENS—*Editor*.

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

APRIL ISSUE WILL BE PUBLISHED ON MARCH 3rd

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

The BBC Stereo Service

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

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

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

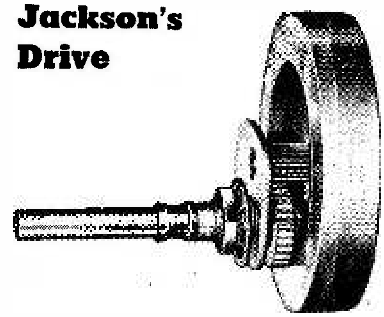
(3.) *The extension of the three network stereo service northwards to Central Scotland and westwards to the Bristol Channel area.* The Post Office Corporation and the BBC are working towards this phase which it is expected will start in 1974. The transmitters expected to be included are Kirk o'Shotts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

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

Golden Silence

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

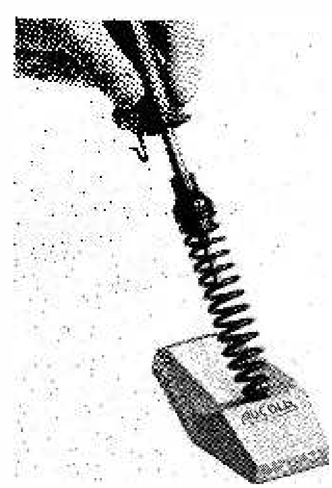
Jackson's Drive



The *Accelerator Spinwheel Drive* is a cord drive unit intended for modern radio receivers with extra-long scales. It incorporates a 2¼-inch-diameter (57mm) zinc-alloy flywheel driven through nylon-to-brass step-up gears at more than twice the speed of the drive-shaft. The complete unit weighs only 6oz (170g) but provides an inertial effect equivalent to a much larger flywheel, permitting rapid traverse of the scale. *Jackson Brothers (London) Ltd., Croydon CR9 4DG, England.*

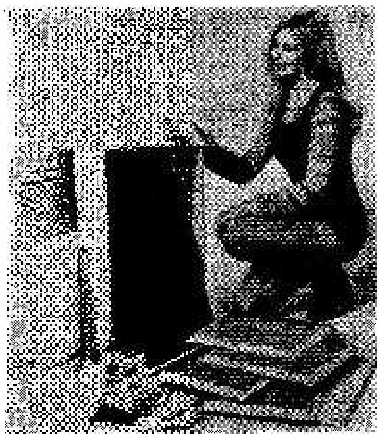
Adcola Soldering Station

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



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

EMI Speaker Kits



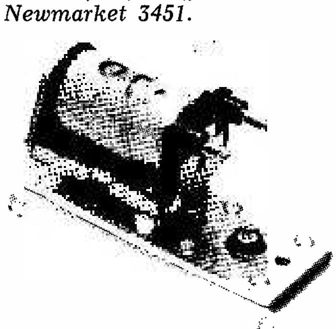
EMI has entered the loudspeaker enclosure market with a range of high quality enclosures in kit form. Available in polished wood veneers, the enclosures have been introduced by EMI Sound Products Limited, of Hayes, Middlesex, for use with its range of matched loudspeaker systems.

The enclosures are priced from £5·80, for a 12in. x 6in. x 8in. bookshelf model, to £29·50 for a large floor-standing enclosure measuring 33in. x 20in. x 15in. They have been designed to incorporate each of the eight different EMI loudspeaker systems which cover the 6 to 35 watts r.m.s. output range.

Coax Relay

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

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



BBC Scholarship

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

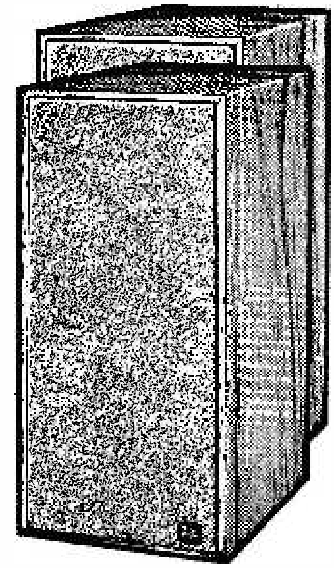
Radio Amateur Invalid & Bedfast Club

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

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

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

Criterion Mk. X



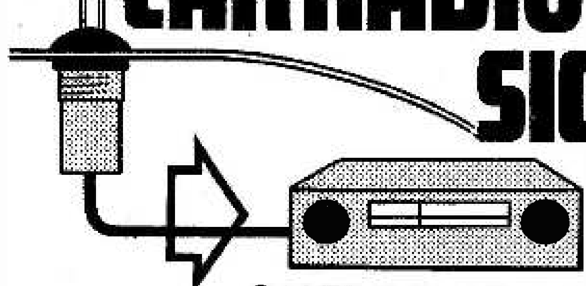
We recently had the opportunity to try the Lasky's Criterion Mk X speakers. They are bookshelf types employing the sealed infinite baffle enclosure principle and they are well worthy of consideration by the budget-conscious Hi-Fi enthusiast. An 8in. woofer, 5in. mid-range and $2\frac{1}{2}$in. tweeter are used and the cabinets are oiled walnut with black woven speaker grilles. Frequency response is 40Hz-20kHz and maximum power handling capacity is 20W. The impedance is 8Ω. A useful feature of these speakers is that two types of speaker lead connection are supplied—phono or screw terminals. Cabinet size is $18\frac{3}{4} \times 9\frac{7}{8} \times 9\frac{7}{8}$in. and the very reasonable price is £25 the pair. Postage is 50p and the speakers are available singly for £13·50. *Lasky's Radio Limited, 3-15 Cavell Street, Tower Hamlets, London, E.1. Tel. 01-790-4821.*

The Practical Wireless CQ! Column

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

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

CAR RADIO SIGNAL BOOSTER



CALEB R.BRADLEY

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

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

INTERFERENCE REDUCTION

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

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

All modern cars are fitted by law with ignition suppression in the form of resistance in the high voltage paths, possibly in the form of spark plug connectors incorporating resistors, or special resistive h.t. cable. Add-on suppressor resistors, typically 50kΩ, are sold for older cars or addition to others, and can be screwed into the middle of the h.t. lead from coil to distributor (e.g. Belling-Lee Sparkmaster L.1274/S). In conjunction with stray capacitance, such resistors form a top-cut filter which bypasses the r.f. component of the fast-rising spark voltage but has negligible effect on the strength of the spark.

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

Another type of interference is a whine which also changes with engine speed and is caused by the generator. This is cured by connecting a standard car suppressor capacitor (still called *condenser* in the motor trade) between chassis and the brush (larger) terminal. Switches, both manual and automatic such as the brake pressure switch, and the motors of the wipers and heater can similarly be silenced by capacitors across their terminals. Car suppressor capacitors are usually about 0·5μF and are built much more ruggedly than corresponding electronics components.

Other circuits, such as the lights, should not cause interference unless there is an intermittent connection somewhere. Indicator flashers normally contain their own suppressor capacitors.

HEAD AMPLIFIER

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

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

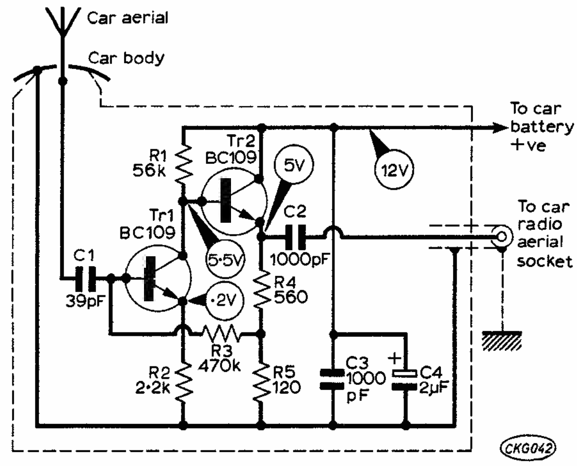


Fig. 1: Circuit suitable for negative chassis cars. All resistors are $\frac{1}{8}$W, 5% and the capacitors should be at least 20V working.

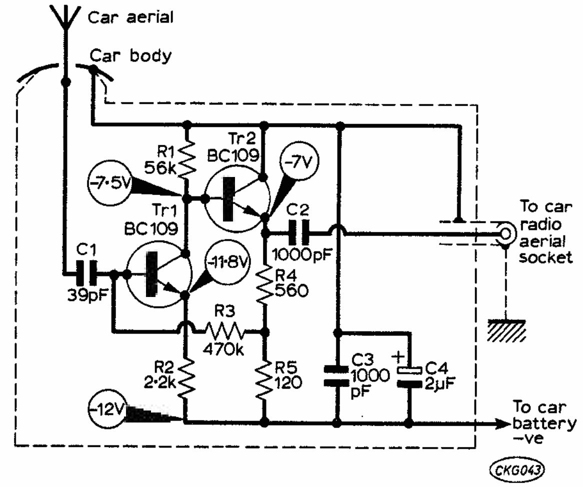


Fig. 2: The modified circuit designed for use with cars having a positive chassis.

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

CONSTRUCTION

While conventional wiring on, say, a piece of Veroboard can be employed, the method used by the author is simplicity itself. The components are simply wired together and encapsulated in candle wax inside a 35mm film cassette tin which serves as a screen. The arrangement is shown in Fig. 3. If you have a choice of cans use an Ilford tin as it has slightly more room than the Kodak one. The tin cap is held under the aerial mounting nut (with insulating washer between) so it makes good contact with the car chassis. The body of the tin is then screwed onto the cap from underneath. The aerial cable and power wire leave through holes in the base of the tin. The input end of C1 is anchored under the aerial nut with sufficient lead to allow the tin to be screwed through about ¾ turn, all that is required. The chassis connection to the circuit is by a short length of wire that can conveniently be trapped between the body and the cap threads. Note that if this connection is not made the circuit will still amplify, due to the chassis return via the aerial cable screen, but interference will be at a high level.

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

PERFORMANCE

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

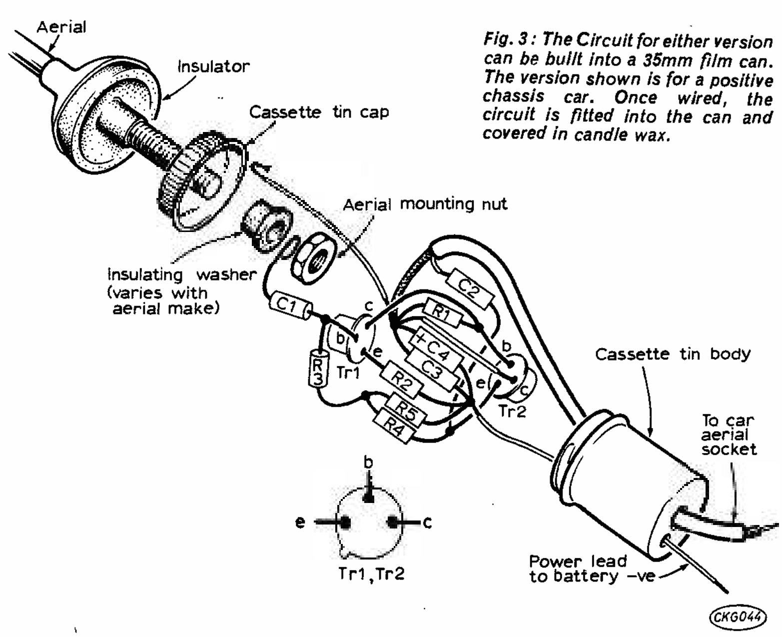


Fig. 3: The Circuit for either version can be built into a 35mm film can. The version shown is for a positive chassis car. Once wired, the circuit is fitted into the can and covered in candle wax.

A DARKROOM THERMOMETER

R.A. BOTTOMLEY

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

Principle of operation

The thermistor is a resistor with a very pronounced negative temperature co-efficient. In other words its resistance decreases with increasing temperature. By measuring the value of its resistance, one can arrive at the temperature of the medium in which the thermistor is immersed. One might, as with an ordinary resistor, apply a known voltage and measure the resultant current which flows . . . the principle of the simple ohmmeter. A more precise way to measure resistance, however, is to incorporate the unknown in one arm of a Wheatstone bridge and this is the principle which has been adopted in the instrument to be described. By a suitable choice of component values an expanded scale has been achieved and this scale, as far as can be determined, is linear. The scale can be read to an accuracy of $\pm 0{\cdot}1°C$ and, with 20°C at mid scale and plus and minus 6°C spread over the rest of the scale, it should meet most of the darkroom workers' needs.

SPECIFICATION

Temperature range	14°C. to 26°C.
Mid-scale	20°C.
Reading accuracy ..	±1°C. (Hand cal. scale).
,, ,, ..	±0·1°C. (From graph). (Straight line graph, microamps v. temp.)
Inherent accuracy ..	As good as standard thermometer used for calibration.
Battery consumption	12mA.
Stability	Readings unaffected until battery drops below 8V.
Life of battery ..	Very extended with average use.

Circuit description

A 9V battery (type PP6) powers the instrument. This is preferable to a mains unit since the instrument is going to be handled in proximity to a water supply. This voltage is reduced by way of two zener diodes, ZD1, ZD2, to approximately 3·3V. There are two reasons for this. By adopting a relatively low voltage to energise the bridge, self-heating effects

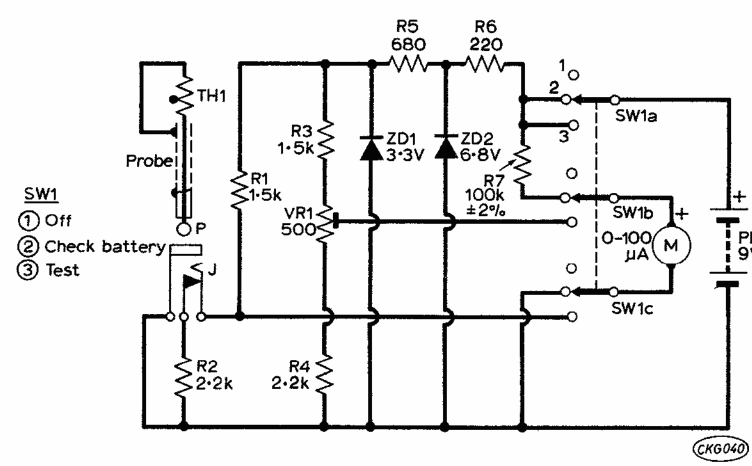


Fig. 1: The circuit of the thermometer.

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

★ components list

Resistors

R1 [illegible] 5%	R5 680Ω 5%
R2 2·2kΩ 5%	R6 220Ω 5%
R3 [illegible] 5%	R7 100kΩ 5%
R4 [illegible] 5%	

All resistors [illegible] high stability carbon film
VR1 [illegible] wirewound preset

Zener diodes

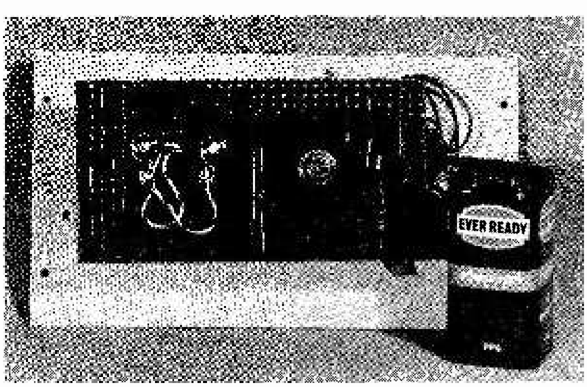
ZD1 [illegible] at 5mA   ZD2 6·8V at 5mA

Thermistor

TH1 Type [illegible] (ITT) (Available direct from ITT Electronic Services, Edinburgh Way, Harlow, Essex. Price £1·10 plus [illegible] postage. Quote Catalogue No. [illegible])

Miscellaneous

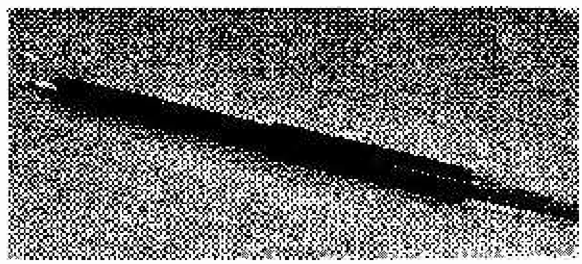
Meter 0-100 μA (resistance 1,650Ω) Eagle KM65; Switch 2-pole, 3-way; Jack plug and socket, 3·5mm.



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

Construction

The circuit is so simple that there is no need to elaborate upon its construction. There is absolutely nothing critical about its layout and tag strip, tag board or Veroboard (as in the prototype) can be employed. If a Veroboard layout is adopted there should scarcely be any need to stress that the copper strip should be cleared away around the meter terminals. All the components, with the exception of the switch and the jack, are mounted on the Veroboard panel which is supported by the meter terminals. The meter, switch and jack are mounted on a small aluminium panel and this panel is mounted in a small plywood box covered with leatherette. The thermistor itself is mounted into a suitable housing with the aid of Araldite. In the case of the prototype, this housing took the form of a redundant test-meter probe, turned to a smaller diameter at one end. The case of a spent ballpoint pen suggests itself as another suitable container and in this instance the thermistor tip would be protected, when not in use, by the cap of the pen.



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

There is nothing difficult about calibration but it should be borne in mind that the final accuracy of the instrument depends both on the care with which this is done and upon the accuracy of the thermometer which is used as standard. It is also worth noting that hot and cold water, like most dissimilar liquids, do not mix immediately. It is for this reason that it is recommended that a fairly large basin be used when calibrating and that the water be stirred thorougly before making a reading. First the water bath should be adjusted to 20°C exactly and, when this is stabilised, VR1 should be adjusted so that the meter indicates exactly 50μA or mid scale. Once again adjust the temperature of the water bath, this time to 15°C and when this is stable note the reading on the meter. Increase the temperature of the water bath to 25°C and, once again, note the reading. When plotted on a graph these three points will be found to lie on a straight line and the intermediate points on the scale can be determined from this graph. In the case of the prototype an increase of 1°C was represented by an increase of 8μA, which is four divisions on the meter scale. Thus it can be seen that it is not difficult to read to 0·1°C.

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

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

DX reception of VHF 'LOCAL' radio

KEITH PITT

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

The BBC local radio stations are, at present, on v.h.f. mainly in the band 94·6 to 97·0MHz. The main BBC networks, Radios 2, 3 and 4, transmit almost exclusively between 88·1 and 94·5MHz.

The powers used for the local radio transmitters range from 9W for the Rotherham relay to 16·5kW for Radio London. The complete list of stations is given in Table 1. All except Blackburn, Derby and Manchester, use horizontal polarisation. These three use slant polarisation. Very little loss of quality will be observed, except in the weakest signal strength areas, if horizontal aerials are used to receive slant polarisation.

COVERAGE

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

One of the most important factors in determining signal strength at any point is the distance from the transmitter, since the field strength is inversely proportional to the square of the distance. Transmitter power, however, has less effect than might be expected, as the signal is proportional to the square root of the power. The height of both aerials is also of prime importance since these will determine whether or not the receiver is within the radio horizon. Signal strength diminishes quite rapidly beyond it because only diffracted waves bend over it. To a close approximation the distance of the horizon **in miles** is given by 1·3 times the square root of the height **in feet**. To approximate still further, the sum of the distances for the receiving and transmitting aerials gives the radio line of sight between them, assuming there are no major obstacles in the way.

To determine whether worthwhile results may be obtained from any given station, the following actions are necessary. First, the approximate receiving and transmitting aerial heights should be found. Secondly, using an Ordnance Survey map, measure their distance apart and determine whether any large hills get in the way. Thirdly, determine the transmitter power. In practice, a low power station, under half a kilowatt will not be effective for more than 25-30 miles, except under very favourable conditions. Medium power, up to 10-20 kW, will often give reasonable results up to 40-50 miles. A high power station may often be receivable regularly at distances of up to 100 miles.

As a general rule, for long distance reception, the higher the receiving aerial above sea level, the greater the chance of good reception. The author lives in North London at about 350ft. above sea level and regularly has reliable reception from both Rowridge and Tacolneston at about 80-90 miles. Of the "local" stations, both London and Medway, which are transmitted from Wrotham, are received well. (It should be noted that quoted powers are usually the maximum, but that the power radiated may be very low in some directions to avoid interference with other stations or to reduce wastage where coverage is not required.) For this reason, Medway is relatively weak, despite being within line of sight, because its power in a NW direction is very low, while London is beamed strongly in that direction.

TABLE 1 BBC LOCAL RADIO STATIONS

Station	*Frequency (MHz)*	*Max. ERP (kW)*	*Approx height (ft) (a.s.l.)*
Sheffield	88·6	0·03*	900
Durham	94·5	2·0	1400
Stoke-on-Trent	94·6	2·5	750
Leeds	94·6	0·14*	
Nottingham	94·8	0·14*	
Oxford	95·0	4·5	900
Rotherham	95·05	0·009	
Manchester	95·1	4·0S	2210
Leicester	95·2	0·195*	
London	95·3	16·5	
Humberside	95·3	4·6	
Bristol	95·4	5·0	1000
Newcastle	95·4	3·5	1400
Birmingham	95·6	3·5	1250
Brighton	95·8	0·5	550
Merseyside	[illegible]	5·0	
Solent	96·1	5·0*	300
Blackburn	96·4	1·5S	
Derby	96·5	5·5S	
Teesside	96·6	5·0	
Medway	97·0	5·5	

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

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

AERIALS

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

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B79	4	IN4007 Sil. Rec. diodes. 1,000 PIV lamp plastic	50p
B81	10	Reed Switches, mixed types large and small	50p
B99	200	Mixed Capacitors. Approx. quantity, counted by weight	50p
H4	250	Mixed Resistors. Approx. quantity counted by weight	50p
H7	40	Wirewound Resistors. Mixed types and values.	50p
H8	4	BY127 Sil. Recs. 1000 PIV. 1 amp. plastic	50p
H9	2	OCP71 Light Sensitive Photo Transistor	50p
H12	50	NKT155/259 Germ. diodes, brand new stock clearance	50p
H18	10	OC71/75 uncoded black glass type PNP Germ.	50p
H19	10	OC81/81D uncoded white glass type PNP Germ.	50p
H28	20	OC200/1/2/3 PNP Silicon uncoded TO-5 can	50p
H29	20	OA47 gold bonded diodes coded MCS2	50p

NEW UNMARKED UNTESTED PACKS

B66	150	Germanium Diodes Min. glass type	50p
B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	50	Sil. Diodes sub. min. IN914 and IN916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
H10	25	Mixed volts, 1½ watt Zeners Top hat type	50p
H17	20	3 amp. Silicon Stud Rectifiers, mixed volts	50p
H15	30	Top Hat Silicon Rectifiers, 750mA. Mixed volts	50p
H16	8	Experimenters' Pak of Integrated Circuits. Data supplied	50p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	50p

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	£p		£p
AC107	0·15	OC170	0·23
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		
BFY50	0·20	OC20	0·50
BSY25	0·57	OC23	0·30
BSY26	0·13	OC25	0·25
BSY27	0·13	OC26	0·25
BSY28	0·13	OC28	0·30
BSY29	0·13	OC35	0·25
BSY95A	0·15	OC36	0·37
OC41	0·13	AD149	0·30
OC44	0·13	AUY10	1·25
OC45	0·13	2S034	0·25
OC71	0·13	2N3055	0·50
OC72	0·13	**Diodes**	
OC81	0·13	AAY42	0·10
OC81D	0·13	OA95	0·19
OC83	0·20	OA79	0·09
OC139	0·13	OA81	0·09
OC140	0·17	IN9114	0·07

F.E.T. PRICE BREAKTHROUGH!!

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.

BULK BUYING CORNER

NPN/PNP Silicon Planar Transistors. mixed, untested, similar to 2N706/6A/B, BSY26-29, BSY95A, BCY70, etc. £4·25 per 500; £8 per 1,000.

Silicon Planar NPN Plastic Transistors, untested, similar to 2N3707-11, etc., £4·25 per 500; £8 per 1,000.

Silicon Planar Diodes, DO-7 Glass, similar to OA200/202, BAY31-36, £4·50 per 1,000.

NPN/PNP Silicon Planar Transistors, Plastic TO-18, similar to BC113/4, BC153/4, BF153/160, etc., £4·25 per 500; £8 per 1,000.

OC44, OC55 Transistors fully marked and tested, 500+ at **8p** each; 1,000+ at **6p** each.

OC71 Transistors, fully marked and tested, 500+ at **6p** each; 1,000+ at **5p** each.

3823E Field effect Transistors. This is the 2N3823 in Plastic Case. 500+ **13p** each; 1,000+ **10p** each.

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IN4004, 500+ at **5p** each, 1,000+ at **5p** each.
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Matched Sets of OC45's 1st and 2nd IF	15p	12p	10p
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10-watt Zener Diodes 5·1, 8·2, 11, 13, 16, 24, 30, 100 Volts	20p	17p	15p
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709C Linear Opp. Amp.	50p	40p	35p
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has some directional properties and thus does not receive equally well from all directions. The maximum signal strength is obtained with the aerial at right angles to a line joining the transmitter and the receiver. An improvement in directivity and gain can be obtained by the addition of a reflector and, perhaps, one or more directors.

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

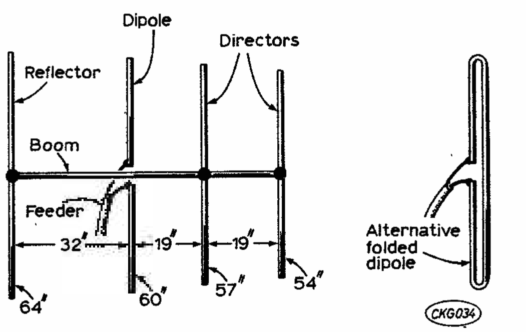


Fig. 1: A four element Yagi beam. If the dipole is folded it will provide a better match to 70Ω feeder. If constructed of metal tubing the centres of the directors and reflector may be clamped directly to the boom.

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

RECEIVERS

Most commercial v.l.f. receivers can resolve clearly two adjacent stations 0·5MHz apart, but, in some cases, the spread of a local may be so great that it can cover almost a whole MHz of the spectrum, rendering adjacent stations very difficult to find and resolve. On one portable the author could just separate Oxford on 95MHz from London on 95·3MHz and listen to the former, and yet the same set produced some traces of London on Solent on 96·1MHz. Similarly, other sets spread Wrotham Radio 4 on 93·5MHz from just over 93 to 94MHz. BBC 4 Oxford on 93·9MHz cannot be separated from Wrotham on any of the four sets the author has tried. This spread rather limits the usefulness of some of the weaker stations.

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

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

TAKE 20

JULIAN ANDERSON

No. 34
MAGIC CANDLE

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

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

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

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

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

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

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

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

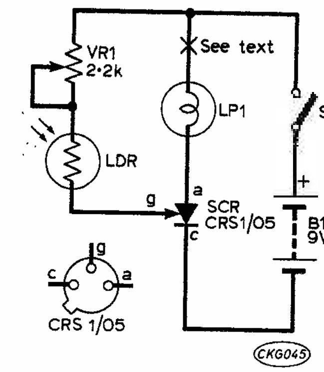


Fig. 1: Circuit of the 'Magic Candle'.

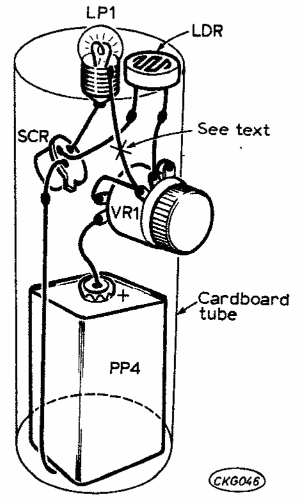


Fig. 2: The components can all be mounted inside a cardboard tube.

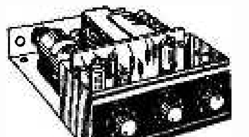
★ components list

VR1	2·2kΩ lin. pot with switch	24p
LDR	Light dependent resistor	43p
SCR	CRS1/05 Thyristor, 50V, 1A	23p
LP1	6V, 40mA bulb, see text	5p
		95p

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

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

SUPERSOUND 13 HI-FI MONO AMPLIFIER



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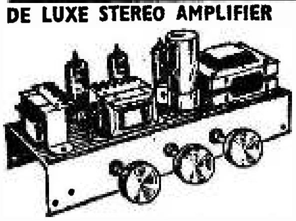
DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built & tested to a high standard. **PRICE £8·92 P. & P. 45p.**

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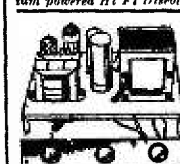

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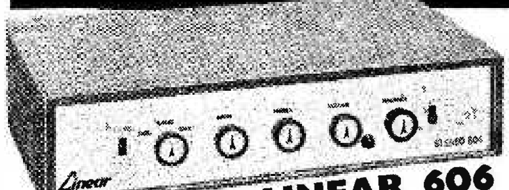

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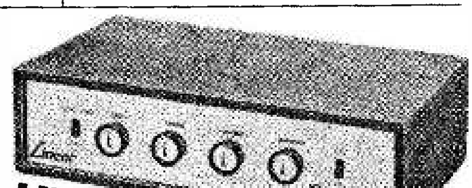

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- ★ Speaker impedances between 3 and 15 ohms are suitable.

TECHNICAL DETAILS

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3S4	·26	30C18	·61	EB41	·40	EM84	·32	PCL85	·38	UBF80	·34
3V4	·37	30F5	·64	EB91	·10	EM87	·34	PCL86	·38	UBF89	·33
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6BW7	·52	35W4	·25	ECH42	·59	LN329	·72	PM84	·33	UY41	·42
6F14	·40	35Z4GT	·25	ECH81	·29	LN339	·63	PX25	·95	UY85	·25
6F23	·68	807	·45	ECH83	·40	N78	·87	PY32	·55	VP4B	·77
6F25	·53	6063	·62	ECH84	·36	P61	·40	PY33	·55	W77	·43
6J7G	·24	AC/VP2	·77	ECL80	·30	PABC80	·34	PY81	·25	Z77	·22
6K7G	·12	B349	·65	ECL82	·31	PC86	·47	PY82	·25	Transistors	
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6V6GT	·28	DAF96	·36	EF85	·28	PCC84	·29	R19	·30	AF116	·20
6X4	·23	DF33	·38	EF86	·30	PCC85	·25	R20	·56	AF117	·20
6X5GT	·28	DF91	·16	EF89	·26	PCC88	·40	U25	·64	AF118	·48
10P13	·58	DF96	·36	EF91	·13	PCC89	·45	U26	·56	AF125	·17
12AT7	·17	DH77	·20	EF92	·30	PCC189	·48	U47	·64	AF127	·17
12AU6	·20	DK32	·33	EF98	·65	PCC805	·56	U49	·56	OC26	·25
12AU7	·20	DK91	·28	EF183	·28	PCF80	·28	U50	·26	OC44	·12
12AX7	·22	DK92	·38	EF184	·31	PCF82	·31	U52	·31	OC45	·12
		DK96	·38	EH90	·35	PCF86	·48	U78	·24	OC71	·12
19BG6G	·80	DL35	·40	EL33	·55	PCF800	·58	U191	·59	OC72	·12
20F2	·67	DL92	·26	EL34	·45	PCF801	·28	U193	·42	OC75	·12
20P3	·77	DL94	·37	EL41	·54	PCF802	·40	U251	·64	OC81 OC81D	·12 ·12
20P4	·92	DL96	·38	EL84	·23	PCF805	·61	U301	·38	OC82	·12
25L6GT	·19	DY86	·24	EL90	·26	PCF806	·56	U329	·66	OC82D	·12
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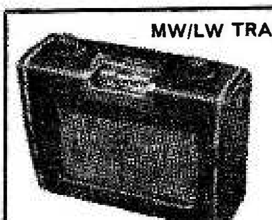

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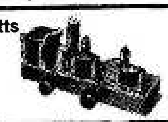

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New Books

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HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
Published by Babani Press
78 pages, 7 × 4in. Price: 40p.

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

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

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

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

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

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

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

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

There is little theoretical depth. The author argues that you would not be reading the handbook if you had not at least a glimmering of the background and the acumen to seek out more in the appropriate places. But he takes full cognisance of our probable ignorance where public address is concerned and guides us through the mysteries of microphones and mixers, amplifiers and loudspeakers—always from a practical point of view.

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

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

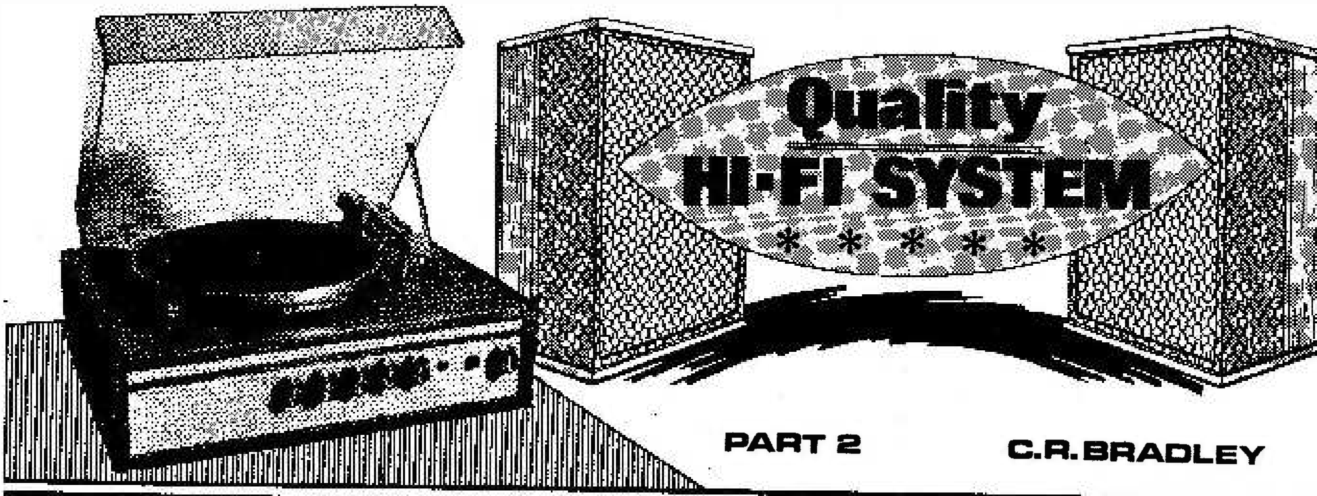
GUIDE TO PRINTED CIRCUITS
By Gordon J. King
Published by Fountain Press
148 pages, $8\frac{1}{2} \times 5\frac{1}{4}$in. Price: £2·50

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

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

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

The book is well written with many photographs and line drawings. £2·50 is little enough to pay for such a mine of information. **A.E.D.**



Continued from the February issue

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

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

Preamplifier Circuit

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

The low level signal is received by the equalisation stage Tr1 and Tr2. These are connected as a d.c. coupled pair in which Tr1 runs at a low collector current of 75μA to minimise the electrical noise introduced at this vital point. D.C. stabilisation is performed by R8 since if Tr1 collector current should rise, Tr2 base voltage drops, Tr2 emitter voltage follows and Tr1 base bias is therefore reduced. R8 also provides some signal feedback but the main signal feedback path is from Tr2 collector through C3 and the components selected by S1b to Tr1 emitter. For radio tuner input the feedback through R11 provides flat frequency response and 150mV sensitivity at the input. For magnetic cartridge input R13/C5/C6 provide frequency conscious feedback to obtain the standard RIAA disc playback response—see Fig. 8. Almost any desired input sensitivity and impedance can be made available at the AUXILIARY position of S1 by choosing component values from Table 1. Clearly there is scope for arranging any desired selection of inputs by S1 from the values given, although if planning to introduce more complex switching it is important to bear in mind that this area of circuit is where hum pickup and cross-talk are most likely to occur. For the purpose of the components list it is assumed that the AUXILIARY position is fitted with components for 300mV input sensitivity, useful for, say, the low level outputs from a stereo tape recorder.

TABLE 1
Component values for different AUXILIARY input characteristics

R1	Rx	Sensitivity	Input impedance	Suitable for:
470kΩ	0	300mV	500kΩ	Tape recorder
0	62kΩ	3·5mV	22kΩ	Dynamic mic.
1MΩ	62kΩ	300mV	1MΩ	Crystal mic. or pickup

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

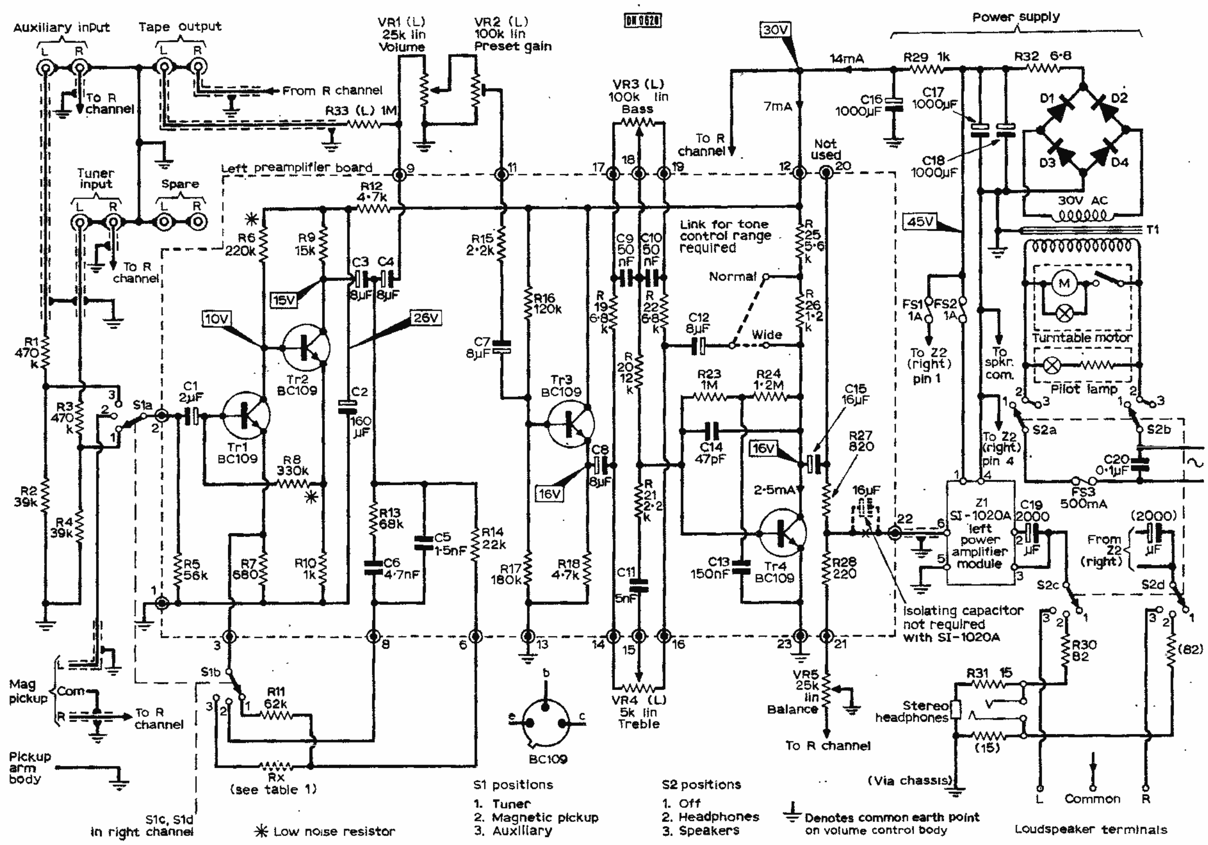


Fig. 6: Circuit of plinth unit. Preamplifier and power amplifier for left channel only are shown, plus balance control VR5. Some components in right channel speaker output shown for clarity. Right channel is identical. All voltages are positive with respect to chassis.

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

Emitter Follower Buffer

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

Tone Controls

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

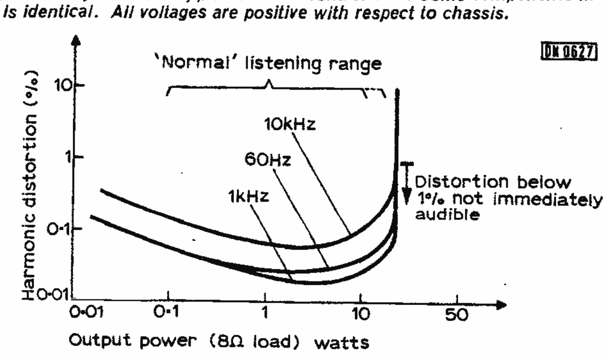


Fig. 7: Distortion curves for Sanken SI-1020A amplifier module, taken from manufacturer's data sheet

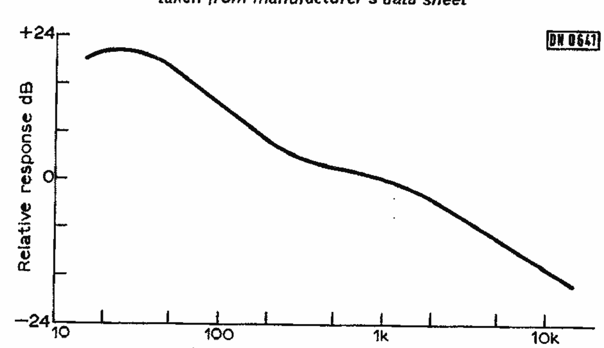


Fig. 8: On modern L.P. recordings high frequencies are boosted to a standard (RIAA) specification to overcome surface noise. The output of a magnetic pickup must be passed through a preamplifier whose frequency response shown above is a mirror image of the recording response i.e. boost at low frequencies,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

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

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

Now both the simplified circuits are just elaborations of Fig. 10c in which a transistor base is fed from the slider of a potentiometer connected between input and output. Assuming the transistor itself has sufficiently high gain, the stage gain is $\frac{Rb}{Ra}$ (which simple relation is the root of all operational amplifier theory). This confirms what is fairly obvious, that the gain is high when the slider is at the input

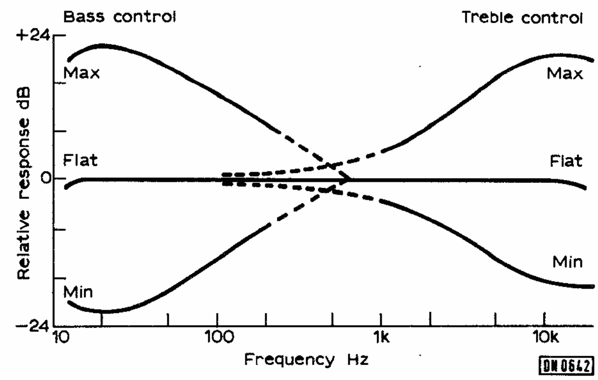


Fig. 9: Tone control response with C12 linked to NORMAL. Curves are dotted over mid-frequency range where both Bass and Treble controls have some effect.

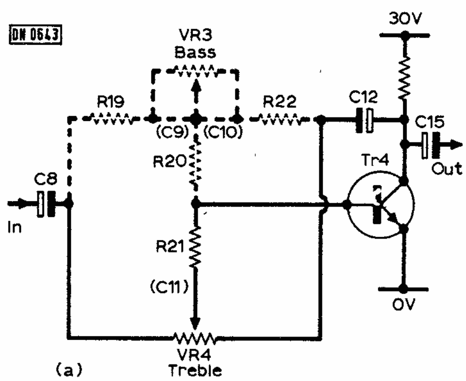


Fig. 10a: Active parts of tone control circuit at very high audio frequencies

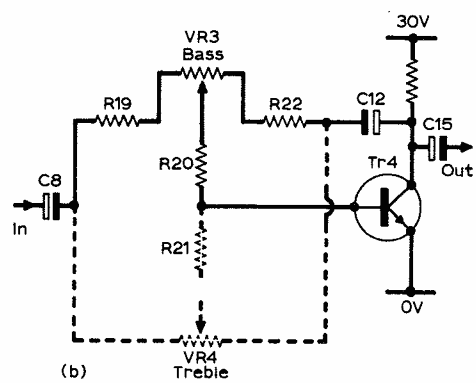


Fig. 10b: Active parts of tone control at very low audio frequencies

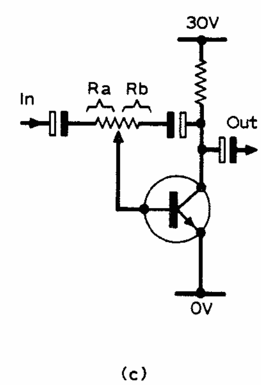


Fig. 10c; Simplified operation of both Figs 10a and 10b.

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

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

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

The signal at Tr4 collector is taken to a spare pin on the edge connector in case a mono-stereo switch is required. This would just link pin 20 on the left and right preamplifiers for mono operation. But for record playing at least, where a mono record reproduces through both channels anyway, such a switch seems superfluous. If occasionally one wishes to feed an external mono signal (e.g. from an a.m. radio tuner) into both channels, this can be done by making up a suitable linking adaptor to plug into the auxiliary input sockets.

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

Power Amplifiers Z1, Z2

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

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

Power Supply

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

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

Turntable, Arm and Pickup

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

The author's equipment illustrated uses a Connoisseur Craftsman turntable (very simply but soundly made), Goldring L75 pickup arm and Eagle LC07 moving magnet cartridge. The latter is a fairly recent Japanese product which the author regards as a "best buy" at about £7 since its performance on a test record is comparable to, say, a Goldring G800E at several pounds more. Tracking is at 1½gm, which can be set accurately on the Goldring arm without a gauge. Readers might well find the Connoisseur BD1 "do-it-yourself" turntable kit a good buy for the system. For economy one of the better BSR or Garrard players would give fair results but a cheap autochanger should certainly not be used since the amount of wow and flutter would be unacceptable.

Photograph shows inside of assembled plinth

Plinth Construction

The carpentry is straightforward, the cabinet being made up from five pieces of ½in. chipboard fixed by countersunk screws to ½in. square corner battens—see Fig. 11. A rectangular aperture is cut in the rear board for the rear panel. The turntable mounting board is cut out to suit the unit and arm chosen after having made sure everything will fit under the Goldring perspex lid. The space available here is about 17¼in. wide×13½in. deep×2¾in. high and it was only barely possible to fit in the author's units, the Craftsman turntable having to be positioned with the motor at rear left. It is not essential for the turntable board to be screwed down to the battens on which its rests, so there need be no screw heads visible after all exposed wood surfaces have been veneered. For access to the electronics the turntable board is simply lifted clear.

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

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

★ components list

PLINTH

Resistors:
All 10% ¼W carbon unless otherwise specified

†R1	470kΩ	†R17	180kΩ
†R2	39kΩ	†R18	4·7kΩ
†R3	470kΩ	†R19	6·8kΩ
†R4	39kΩ	†R20	12kΩ
†R5	56kΩ	†R21	2·2kΩ
†R6	220kΩ ¼W 5% high stability	†R22	6·8kΩ
		†R23	1MΩ
†R7	680Ω	†R24	1·2MΩ
†R8	330kΩ ¼W 5% high stability	†R25	5·6kΩ
		†R26	1·2kΩ
†R9	15kΩ	†R27	820Ω
†R10	1kΩ	†R28	220Ω
†R11	82kΩ	†R29	1kΩ
†R12	4·7kΩ	†R30	82Ω 1W carbon
†R13	68kΩ	†R31	15Ω
†R14	22kΩ	R32	6·8Ω 5W wirewound
†R15	2·2kΩ		
†R16	120kΩ	†R33	1MΩ

VR1 25kΩ + 25kΩ linear double-ganged carbon potentiometer
†VR2 100kΩ linear miniature skeleton preset potentiometer
VR3 100kΩ + 100kΩ linear double ganged carbon potentiometer
VR4 5kΩ + 5kΩ linear double ganged carbon potentiometer
VR5 25kΩ linear carbon potentiometer

Capacitors:
†C1 2µF 6V electrolytic
†C2 160µF 25V electrolytic
†C3 8µF 15V electrolytic
†C4 8µF 15V electrolytic
†C5 1·5nF ceramic or polyester
†C6 4·7nF ceramic or polyester
†C7 8µF 15V electrolytic
†C8 8µF 15V electrolytic
†C9 50 (or 47) nF ceramic
†C10 50 (or 47) nF ceramic
†C11 5 (or 4·7) nF ceramic or polyester
†C12 8µF 15V electrolytic
†C13 150nF ceramic or metallised film
†C14 47pF ceramic
†C15 12·5 (or 15) µF 25V electrolytic
C16 1000µF 30V electrolytic
C17 1000µF 50V electrolytic
C18 1000µF 50V electrolytic
†C19 2000µF 25V electrolytic
C20 0·1µF 500V paper tubular

Semiconductors:
†Tr1, †Tr2, †Tr3, †Tr4 BC109
D1, D2, D3, D4 100 PIV 2A silicon diodes
Z1, Z2 Sanken SI-1020A (Photain Controls Ltd., Randalls Road, Leatherhead, Surrey)

† indicates one needed for each channel.

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

Fuses:
FS1, FS2 1¼in. 1A (or 500MA—see text)
FS3 1¼in. 500MA
3 fuseholders to suit

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

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

Miscellaneous: Veroboard, 2 24-way Vero edge connectors (0·15in. matrix), knobs, mains pilot neon, screened cable, wood, aluminium, etc.

ENCLOSURE (components for each channel)

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

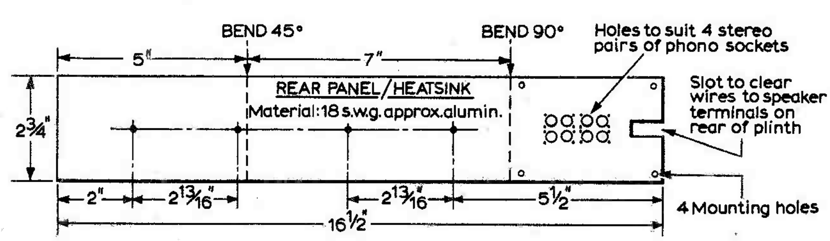
Switch:
S1 2P 6W rotary

Crossover:
Eagle CN28 8Ω

Woofer:
Baker Major 8Ω

Tweeter:
Eagle MHT10 8Ω

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



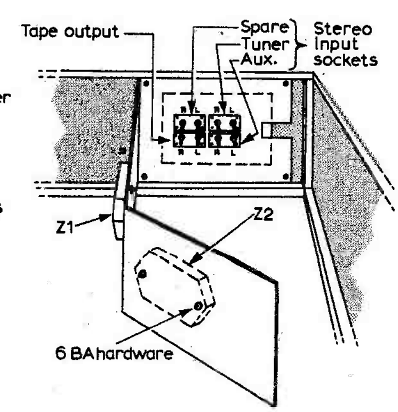


Fig. 13: Cutting out and mounting details of rear panel/heatsink.

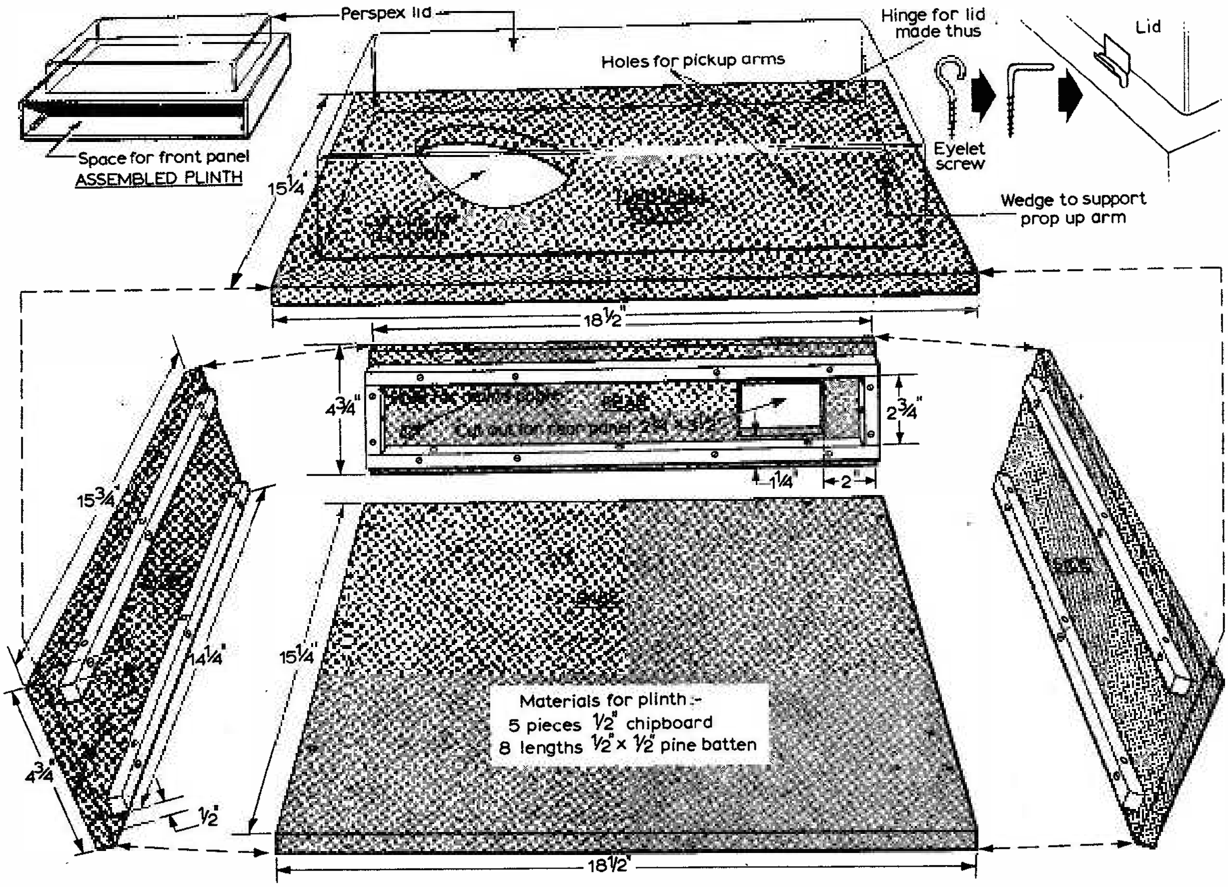


Fig. 11 : Construction of plinth

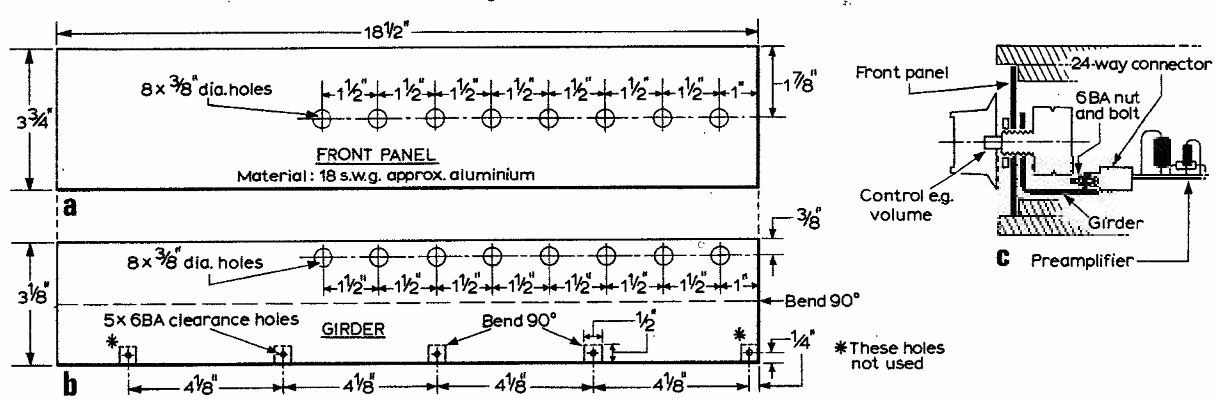


Fig. 12(a) : Front panel (front view). Fig. 12(b) : Girder. Fig. 12 (c) : Cross section of front panel and girder showing method of fixing connectors.

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

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

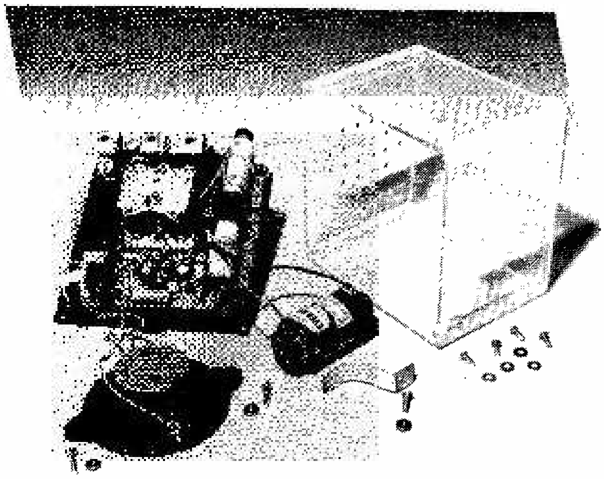
NOTE

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

To the materials list on page 907, the following shouold be added to the FRAME: 4 off 16 in. × ⅞ in. × ⅞ in. pine.

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

TO BE CONTINUED



The pw Cube Radi

7 Transistor Superhe

R. F. GR

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

CIRCUIT

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

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

Oscillator Coil L3. This is tuned by VC2, with trimmer TC2. Capacitor C4 provides "tracking" so that the oscillator circuit always tunes 470kHz higher in frequency than the aerial circuit. With S1 in the l.w. position C3 and TC4 are across the oscillator winding for long wave reception.

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

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

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

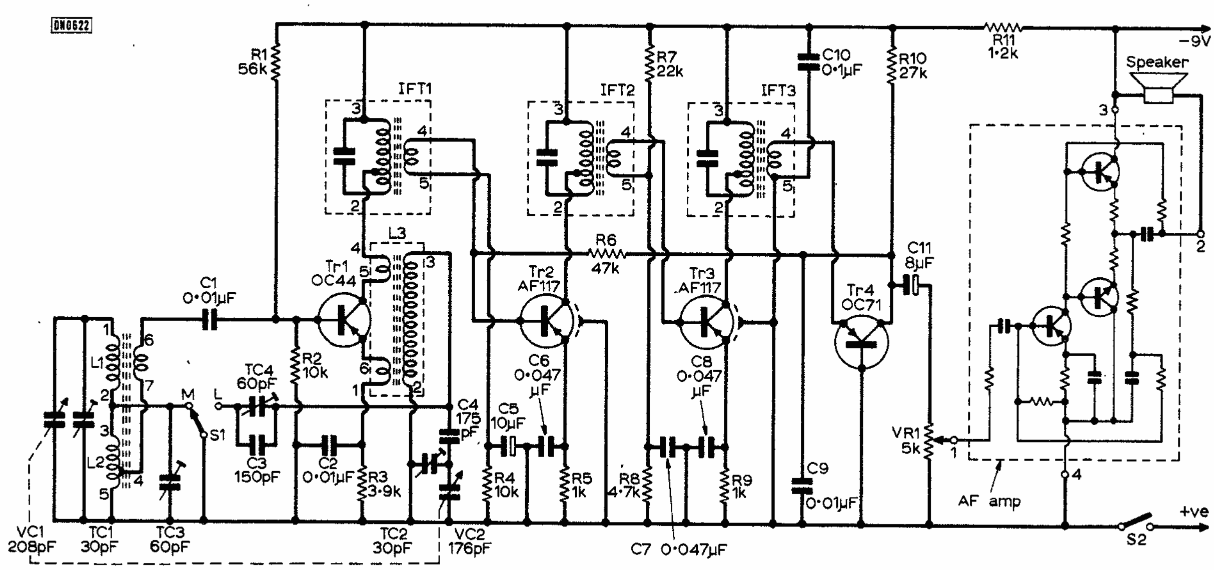


Fig. 1: Circuit of the Cube Radio. The audio amplifier is obtained as a module, the circuit being given here for reference purposes only.

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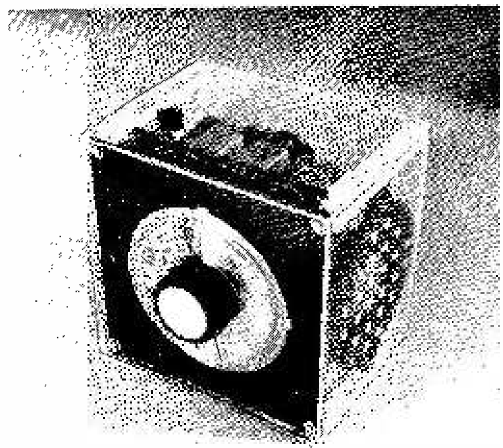
AHAM



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

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

CIRCUIT BOARD

The plain Veroboard is $3\frac{7}{8} \times 3\frac{5}{8}$in. to fit inside the 4×4in. case. It is cut to clear the corner strips and speaker as in Fig. 2.

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

Holes are also drilled for TC3 and TC4, the rod mounting and 6BA bolts holding the a.f. amplifier. A clearance hole is needed for VC1/2, and three holes which match up with the tapped holes in the front of the capacitor frame.

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

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

FERRITE AERIAL

As the ferrite rod normally supplied is too long for the case, it was snapped off at about $3\frac{1}{2}$in. by securing it in a vice and giving the rod a sharp tap.

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

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

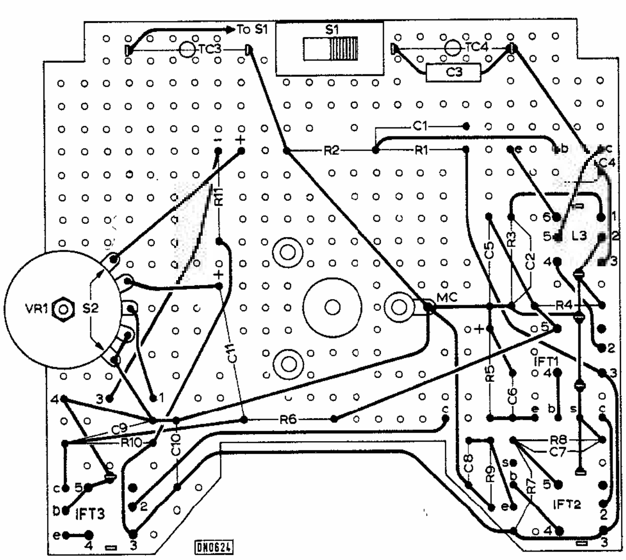


Fig. 2 : Wiring details of the underside of the Veroboard panel on which the receiver is constructed.

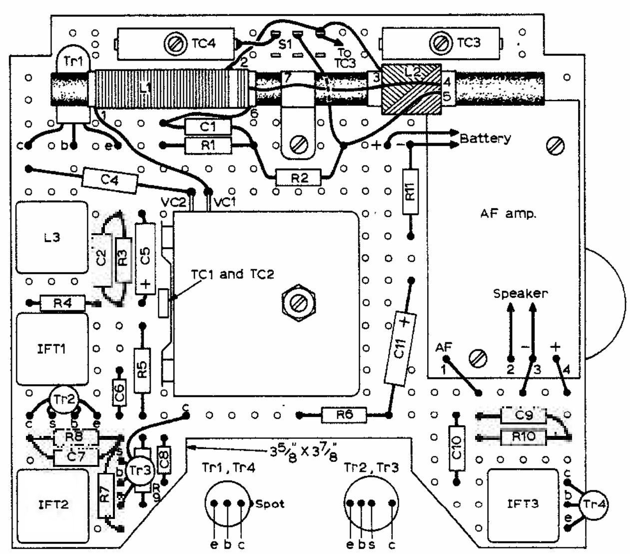


Fig. 3 : Topside of board showing location of the major components. Ensure that IFT's and L3 are correctly orientated to give pin positions shown in Fig. 2.

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

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

The rod is mounted by means of a strip of plastic material clamped round it, with a ¾in. 6BA bolt and spacer, or extra nuts, so that it easily clears TC3, TC4, etc. It is as well to leave fitting of the rod until last.

WIRING

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

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

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

★ components list

Resistors:

R1	56kΩ	R5	1kΩ	R9	1kΩ
R2	10kΩ	R6	47kΩ	R10	27kΩ
R3	3·9kΩ	R7	22kΩ	R11	1·2kΩ
R4	10kΩ	R8	4·7kΩ		

All ¼W 10%

VR1 5kΩ miniature pot, with switch (S2)

Capacitors

C1	0·01μF	C7	0·047μF
C2	0·01μF	C8	0·047μF
C3	150pF 2% SM	C9	0·01μF
C4	175pF 2% SM	C10	0·1μF
C5	10μF	C11	8μF
C6	0·047μF		

Minimum working voltage, 9V

TC1/2 part of VC1/2

TC3 60pF compression trimmer

TC4 60pF compression trimmer

VC1/2 208 + 176pF, slow motion, with trimmers (Jackson)

Semiconductors

Tr1	OC44	Tr3	AF117
Tr2	AF117	Tr4	OC71

Inductors

L1/2 Ferrite rod aerial (Denco MW/LW5FR)

L3 Oscillator coil (Denco TOC1)

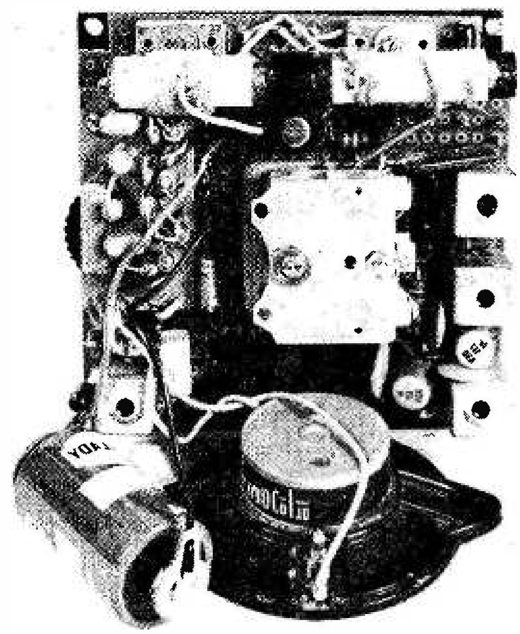
IFT1 IF Transformer (Denco IFT13)

IFT2 IF Transformer (Denco IFT13)

IFT3 IF Transformer (Denco IFT14)

Miscellaneous

Switch S1, two-way slide switch. Audio amplifier 125mW (Newmarket PC1). Dial and knob (Home Radio DL64 and KN64). Plain veroboard 0·15in. matrix, 3⅞ × 3⅝in. Speaker, 2¼in. diameter, 30 to 80 ohms.



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

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

AF AMPLIFIER

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

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

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

IF ALIGNMENT

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

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

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

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

MW ALIGNMENT

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

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

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

LW ALIGNMENT

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

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

CABINET

The cabinet is made of clear Perspex for its novelty effect. The bottom is 4×4in. and $\frac{1}{8}$in. thick while the sides are 4×3in. and $\frac{1}{16}$in. thick. Front and back are also $\frac{1}{16}$in. thick, but are $4\frac{1}{8} \times 3$in. to overlap the sides. The front is drilled to take the speaker with a grid of holes over the cone area.

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

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

DIAL

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

The panel is fixed in the manner described earlier and the dial then put on the lugs being turned over behind the panel. The tuning indicator fitted was a disc of $\frac{1}{16}$in. Perspex, with a black line each side to travel over the m.w. and l.w. scales, and fixed to a brass bush which is locked on the capacitor spindle with a set-screw. A Perspex disc is readily cut with an adjustable tank cutter and the bush made by sawing through a $\frac{1}{4}$in. brass shaft coupling. An alternative is to use a stout wire pointer. ■

Electronotes..

S. GINSBERG

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

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

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

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

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

A British company has now developed a machine which will align the mask and chip automatically. The secret is the printing of two minute crosses between the pattern for the circuit required. These crosses have their members made up of shaded lines. The machine uses these to align subsequent masks to within 10 micro-inches. Circuit patterns down to 0·0001in. can be printed. The entire printing process from when the operative puts the new slice into the holder to the time it is ejected is only 25 seconds.

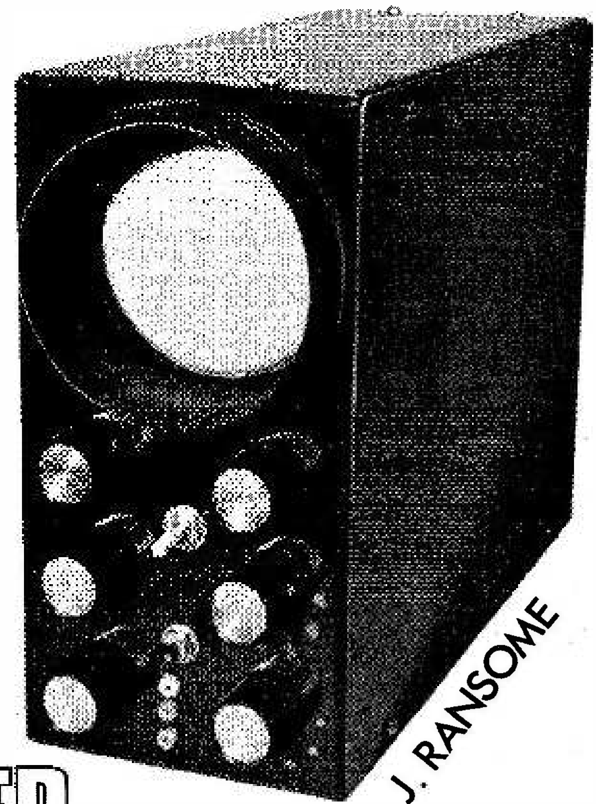
A further advantage of this British invention is that the masks are not in direct contact with the slice. Thus there is no abrasion on either slice or mask and the life of the masks, which are very expensive indeed to produce, is considerably prolonged.

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

TRANSISTORISED OSCILLOSCOPE

PART 2

J. RANSOME



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

DEFLECTION AMPLIFIERS

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

The theoretical circuit of the deflection amplifiers is shown in Fig. 10. Tr3a acts as a phase splitter and low gain amplifier. Counterphase signals of equal amplitude appear across R15a and R16a. The only disadvantage of this type of phase splitter is that the two signals have differing source impedances. We therefore push the outputs from the phase splitters into the emitter followers of Tr4a and Tr6a which have a high impedance and are not fussy about signal source impedance. The emitter followers serve a further purpose of controlling the working points of the output transistors Tr5a and Tr7a by means of the standing currents in R19a and R20a. Tr5a and Tr7a are directly coupled to these emitter followers. The voltage gain of the complete amplifier is 12 when referred to a single ended output or 24 when referred to the push-pull output. As the transistors Tr4a and Tr6a control the working points of the output transistors they must be low leakage types. Suspect transistors must be avoided at all costs.

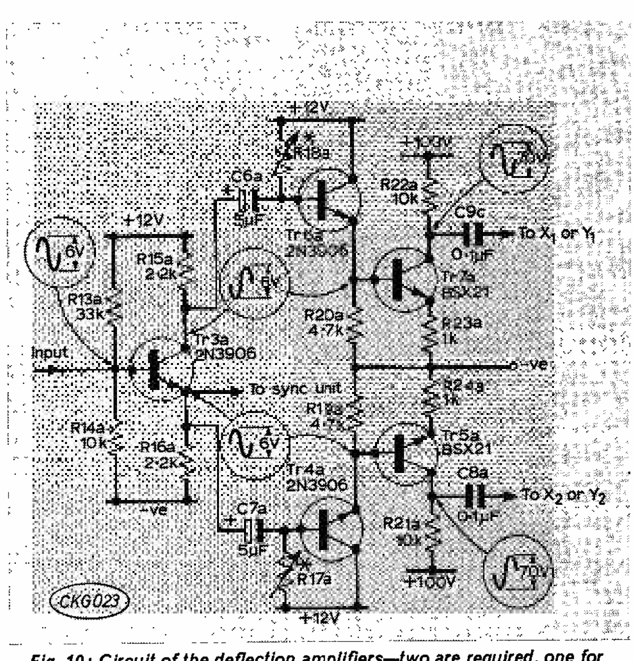


Fig. 10: Circuit of the deflection amplifiers—two are required, one for the X and one for the Y amp. See text regarding R17 and R18.

CONSTRUCTION

The remaining units are built up on a 0·1in matrix Veroboard panel. The board used in the prototype was $6\frac{1}{2}$in × 4in. It is recommended that at this stage all the breaks in the copper strip should be milled out before construction commences. This prevents disasters due to cross wiring as a result of forgetting a hole (here again the voice of experience speaks). The Veroboard layout, also including the Timebase and Y preamplifier, is shown in Fig. 13.

When using 0·1in matrix Veroboard, some care is necessary to avoid shorting out between conductor strips and when the wiring is complete, run a penknife along between the strips to make sure that no solder overlaps the conductors and that no small blobs of solder are shorting out any of the copper

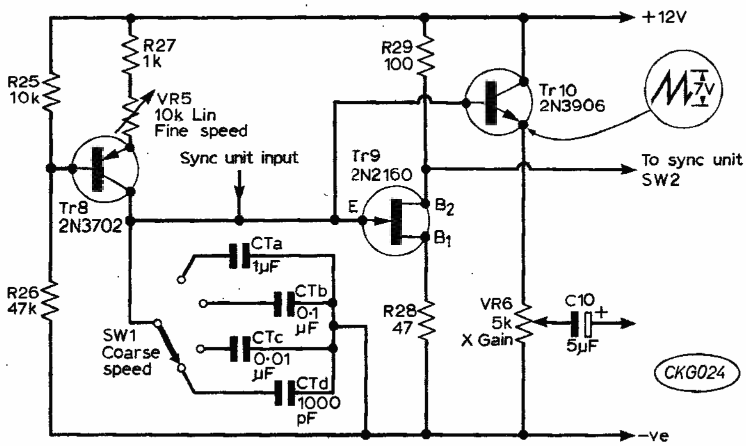


Fig. 11 : The Timebase unit circuit.

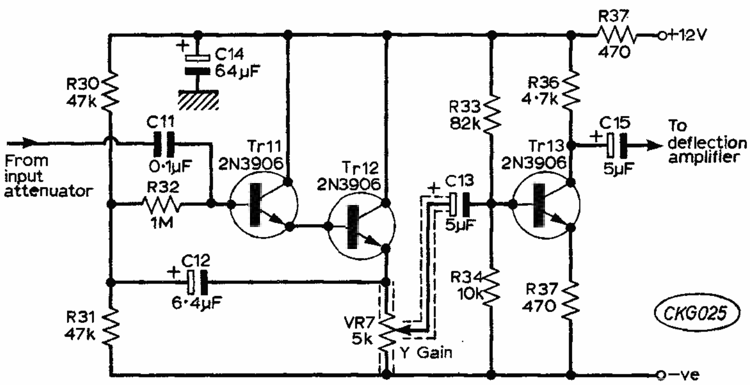
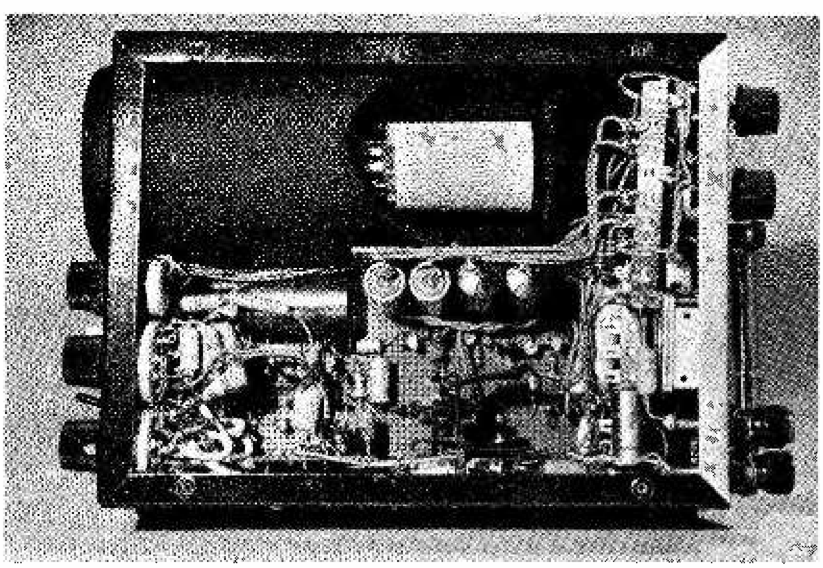


Fig. 12: The Y-preamp circuit. Note that the emitter resistor of Tr13 should be shown as R35, not as R37; the value shown is correct.



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

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

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

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

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

TESTING

Switch on the complete unit and connect the low level signal to the X amplifier input. A horizontal line of approximately 4cm long should be shown on the tube face. Next apply the signal to the Y amplifier input when a similar line in the vertical plane should be displayed. Next couple the X and Y inputs to the test unit via two 0·1μF capacitors when a circle or ellipse similar in shape to that shown when testing the display unit should be seen. Whatever shape is displayed it should be regular with no flats, ripples or waves in it. Any distortions which do occur will almost certainly be due to incorrect selection of the bias resistors R17a and b and R18a and b.

TIMEBASE UNIT

The theoretical diagram of the ramp generator is shown in Fig. 11. Tr8 acts as a constant current source—the current being determined by the variable resistor VR5 and R27. The output from the constant current source is used to charge the timing capacitor CT selected by SW1. The charge on the capacitor rises until the voltage on the capacitor is sufficient to cause the unijunction transistor Tr9 to fire. When

Tr9 fires it discharges the capacitor and the cycle repeats.

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

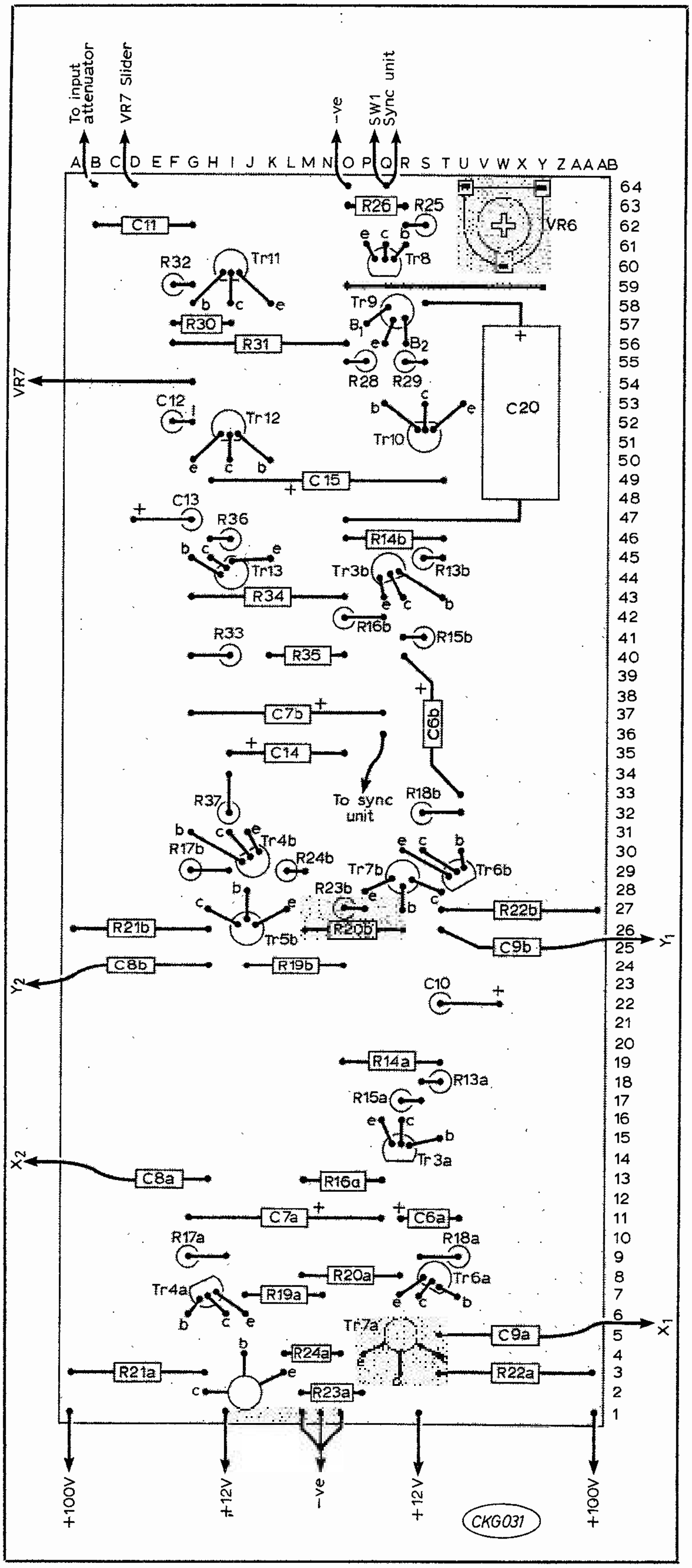


Fig. 13 (left): The main component board. The deflection amplifiers are in the middle and at the bottom; the Y-preamp is top left and the Timebase top right.

CONSTRUCTION

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

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

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

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

Y PREAMPLIFIER

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

The input impedance of the original unit was measured as $1{\cdot}8M\Omega$ and the voltage gain 7.

CONSTRUCTION

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

TESTING

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

INPUT ATTENUATOR

The circuit of the input attenuator is shown in Fig. 14. The attenuation provides two decades of attenuation—10 and 100. As is the convention, the 100 stage is assigned the level 1 and the two other switch positions are referred to this and represent x10 and x100 gain. In the x1 position the sensitivity is 20V/cm, 2V/cm in the x10 and 200mV/cm in x100 position.

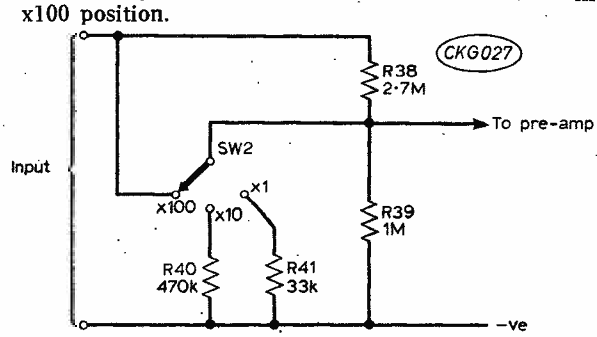


Fig. 14: The input attenuator circuit.

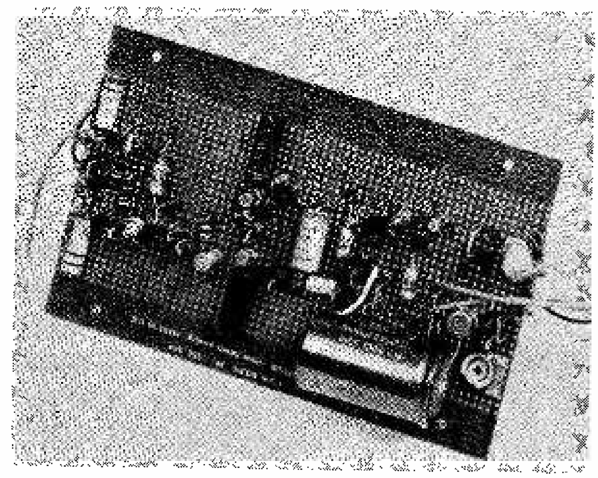
CONSTRUCTION

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

SYNC CIRCUIT

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

Tr17 acts as a switch and is effectively wired across



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

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

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

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

The sync pulses are derived from the Y amplifier by means of the squarer circuit around Tr14. Tr14 is an over-driven amplifier producing square waves from any sine-wave or square wave input. The square-wave produced across R42 is put into the differentiator circuit of C16 and R43. From the differentiator circuit two sets of pulses are produced —one set positive going and the other negative going. The positive pulses are rejected by D7 and only negative going pulses are applied to Tr15. It must be noted that the resistor R43 does not represent the full resistance in the differentiator as the resistance of R45 is effectively across R43 during the negative pulse.

The input to the squarer circuit is derived either from R16 "b" in the Y amplifier or from an input on the front panel for external sync.

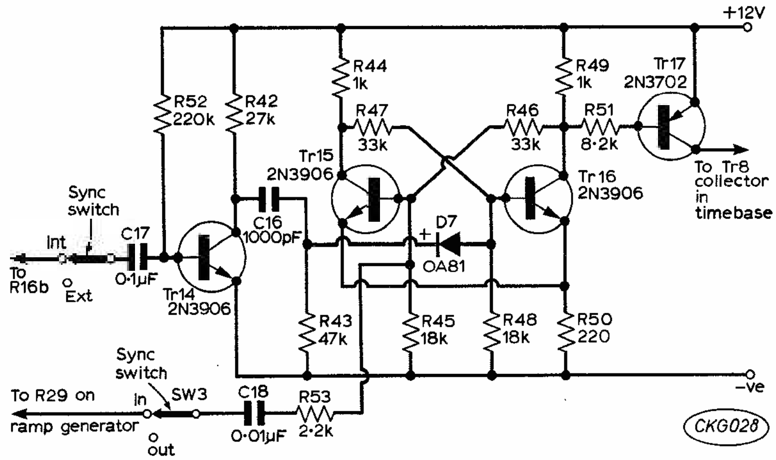


Fig. 15: The sync unit circuit.

CONSTRUCTION

The original unit was built as a separate unit from the main chassis although there is more than ample room for the sync unit on this board. The layout is shown in Fig. 16.

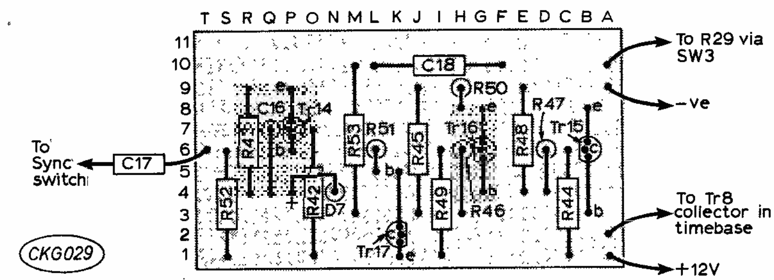


Fig. 16: The component layout of the sync unit.

TESTING

Wire in the complete unit with the exception of the connection to R29. Switch on and apply a signal to the Y input. The timebase should run as normal. Disconnect the input to the Y pre-amplifier and make up the connection to R29. It will be found that the timebase will not run. Next apply a signal to the Y input when the timebase will fire normally. The degree of synchronisation can be assessed by noting the intensity of the spot at the right hand side of the trace. The brighter the spot the wider the difference between the fundamental frequency of the timebase and the input frequency signal. The "pull-in" range of the sync unit will be found to be very wide.

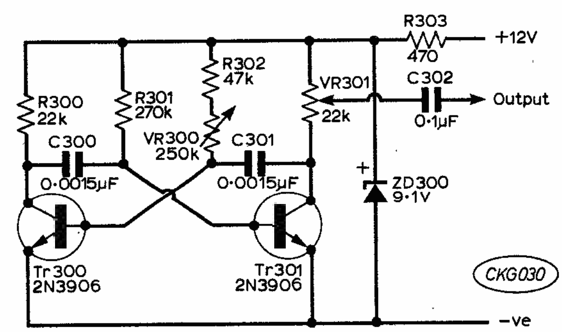


Fig. 17: A circuit which may be used for calibration.

CALIBRATION

For maximum usefulness the Y amplifier must be calibrated to determine the deflection sensitivity and the timebase frequency evaluated. The Y amplifier sensitivity can be calibrated using the circuit of Fig. 7. With a mains input of 240V, a peak-to-peak voltage of 48V is obtained from the high level output and 4·3V peak-to-peak from the low level output. By feeding the appropriate output from the calibrator into the Y input, the deflection sensitivities can be measured. It is usual to express the sensitivity in terms of volts per centimetre.

The timebase frequency may now be determined. Before proceeding further the multivibrator of Fig. 17 must be constructed. With the highest value capacitor switched into the CT position, feed in a 50Hz signal from the calibrator (Fig. 8). Count the number of complete cycles displayed. As each complete cycle occupies 20 milliseconds, the ramp speeds may be computed. The timebase speed is expressed in terms of milliseconds per centimetre. Set the timebase speed so that only one complete cycle is displayed with the sync unit switched off. Apply the output from the calibration multivibrator to the Y input. Set the timing resistor VR300 so that 20 sets of complete square waves are seen. The multivibrator is now set to 1kHz and is, therefore, producing pulses with a repetition speed of 1 millisecond. This 1 millisecond calibrator may then be used to measure the

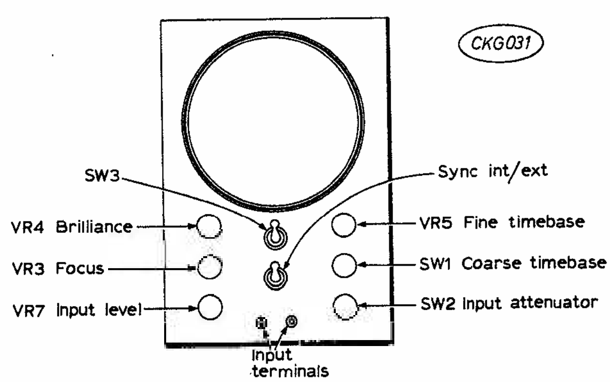
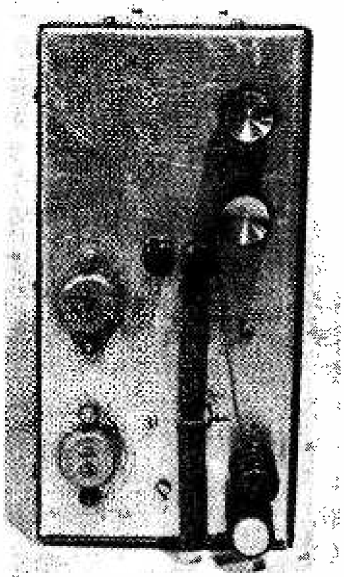


Fig. 18: The siting of the controls on the front panel.

speed of the timebase on the higher ranges.

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



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

GENERAL

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

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

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

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

Back Numbers

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

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

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

COMPREHENSIVE MULTIBAND RECEIVER
(PW Nov-Dec. 1971)
FURTHER NOTES
By
F. G. RAYER

On the short wave ranges, coverage is approximately 1·7-5·0MHz, 5-15MHz and 11-31MHz, similar to that provided with many receivers. As plug-in coils are used, it is easy to split up coverage to include one extra range. This opens out tuning a little, but its main advantage arises if a v.h.f. convertor requiring continuous tuning from 4-6MHz is added, as this then falls in a single range, avoiding coil-changing.

To add this range, adjust the coil cores for ranges of 1·6-3·8MHz, 7-14·5MHz and 13-31MHz. The new or additional range is 2·5-6·0MHz. The coils for this coverage are as follows:

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

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

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

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

TUNING METER

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

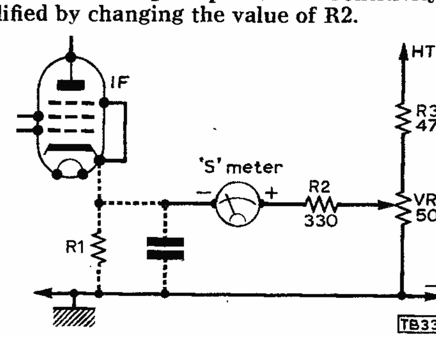
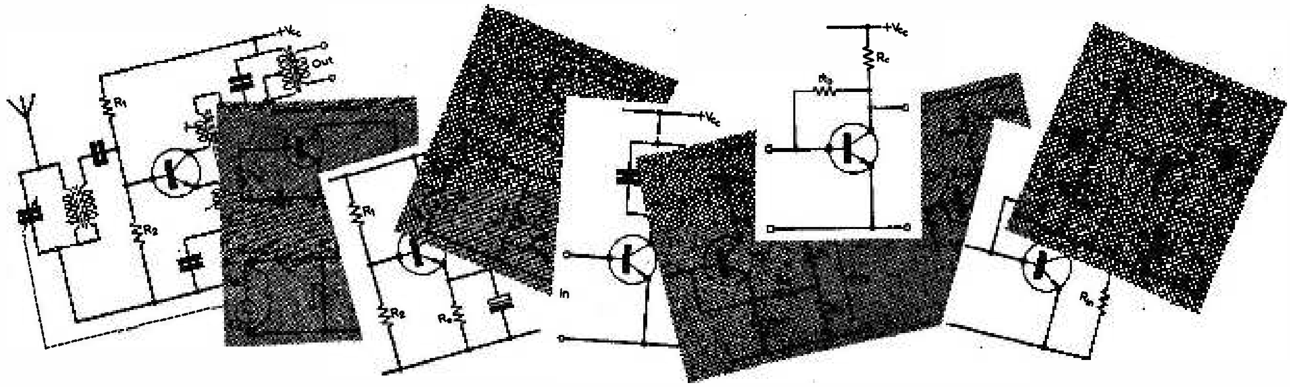


Fig. 1: Additional circuitry required for installing the S-meter

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



TRANSISTOR CIRCUITRY for beginners

PART 6

H. W. HELLYER & MICHAEL HOLLIER

Upper and Lower-case

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

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

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

Later on, talking about the base bias, I committed a similar crime. "The base current I_B is found from the formula $I_B = \dfrac{I_C}{H_{FE}}$ where H_{FE} is the d.c. current gain of the transistor.

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

Super Alpha

Back then to our subject, the Darlington Pair of transistors, or, to give them their alternative title, the Super Alpha circuit. Their purpose, to recap to the end of Part 5, to increase the input impedance of our buffer amplifier circuit, without despoiling any other of its good points. Remember, we pointed out that good matching was more easily achieved if the impedance of the device into which the signal was being fed was ten times or more that of the output which was feeding it.

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

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

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

Why high?

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

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

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

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

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

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

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

Darlington Pair

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

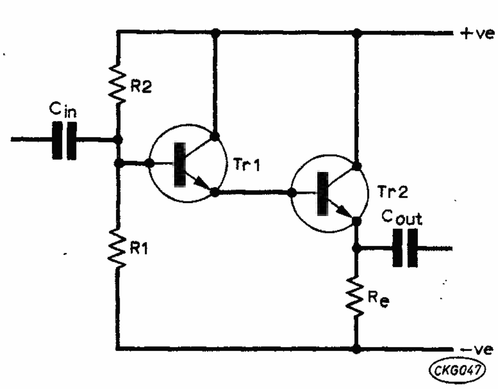


Fig. 26: The rudiments of the Darlington Pair circuit.

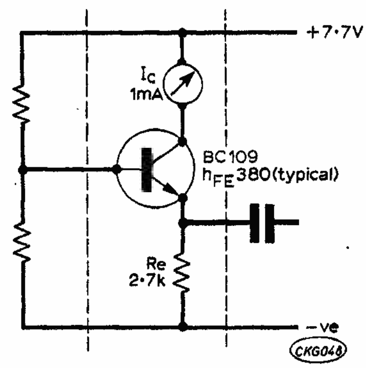


Fig. 27: Consider only Tr2, isolated from the rest of the circuit, with imaginary bias.

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

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

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

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

Calculations

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

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

which is $2{\cdot}6\mu$A.

If now we refer back to Fig. 26. and connect Tr1 in the base circuit of Tr2, making them similar transistors, as it happens, though they don't necessarily have to be, we shall see that base current of Tr2 will flow through Tr1 emitter, so we can immediately say that the emitter current of Tr1 is $2{\cdot}6\mu$A.

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

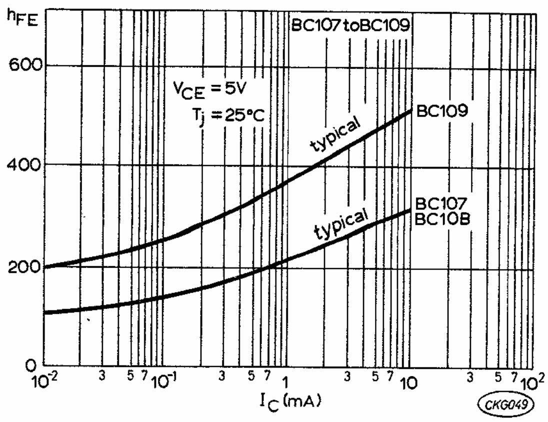


Fig. 28: Typical variations of forward current transfer ratio h_{FE} with collector current I_C. Note that curve is for specific collector voltage V_{CE}.

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

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

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

Increasing I_E

We have 2·6μA of emitter current so far, and we need 50μA. Let's just revert to previous theory and stick in another resistor R_{e1} from the emitter of Tr1 to the negative line, as in Fig. 29. Now, this circuit is not for construction: it is deliberately drawn to illustrate the design theory; please bear with me!

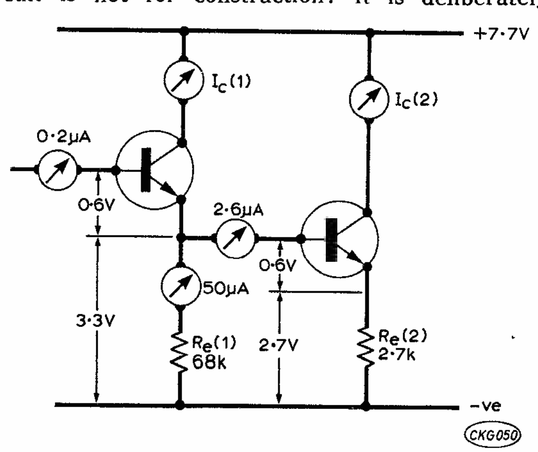


Fig. 29: The voltage and current plan of the simple circuit from which the final working model will evolve.

We have included the known voltages and currents, that is the collector current of Tr2, which is 1mA, and the base current of Tr2, which is 2·6μA. So the emitter current is effectively the same as the collector current, as the effect of the very small base current, which also flows through R_{e2}, can be ignored. 1mA flowing through 2·7kΩ gives a voltage drop of 2,700/1,000 or 2·7V. That's our emitter voltage of Tr2 fixed.

The base to emitter voltage of a silicon transistor is around 0·6V, so we come up with a base voltage for Tr2 of 2·7 + 0·6=3·3V. Take another look at Fig. 29. This is now the emitter voltage of Tr1, which was one of the missing factors. Again add 0·6V and we get a figure for the base voltage of Tr1, i.e., 3·3 + 0·6=3·9V.

R_{e1} is the mystery component. The emitter current of Tr1 will be the sum of that base current previously considered and the current flowing through R_{e1}. But we have already said that the required emitter current is to be 50μA. So that leaves us with 50 + 2·6 or 52·6μA as the actual emitter current.

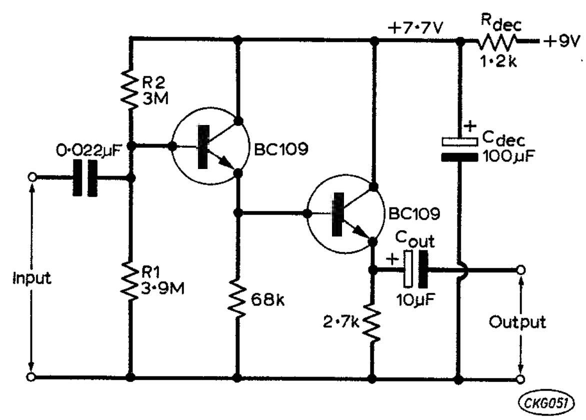


Fig. 30: The end result, a Darlington Pair input circuit with reasonably high impedance, good stability and the gain required.

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

$$= \frac{3\cdot3\text{V}}{50\mu\text{A}} \text{ or } \frac{3\cdot3}{50 \times 10^{-6}} \text{ or } \frac{3\cdot3 \times 1{,}000{,}000}{50} = 66{,}000\Omega$$

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

Base current Tr1

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

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

Taking the collector current I_c of Tr1 to be the same as its emitter current, 52·6μA, we prove this point by saying:

$$I_b(1) = \frac{I_c(1)}{h_{FE}(1)} = \frac{52 \cdot 6\mu A}{260}$$

somewhere near $0 \cdot 2\mu A$.

Developing our final circuit, Fig. 30., and ignoring for the moment that I've already marked in the values of R1 and R2, let's calculate their ohmic values from what we already have. First, a proviso: for good stability, we want about five times as much current flowing in the bias chain as we have base current. So, $0 \cdot 2 \times 5 = 1\mu A$ as a guiding value.

We know the base voltage of Tr1 is $3 \cdot 9$V. The lower resistor, R1, has our desired figure of $1\mu A$ through it, so the value is

$$R1 = \frac{3 \cdot 9}{1 \times 10^{-6}} \text{ or } 3 \cdot 9 \times 1{,}000{,}000 = 3 \cdot 9M\Omega$$

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

R2 has a voltage dropped across it which is the difference between the collector voltage (in this case, the positive rail after decoupling) and the base voltage, $= 7 \cdot 7 - 3 \cdot 9 = 3 \cdot 8$V. So

$$R2 = \frac{3 \cdot 8}{1 \cdot 2 \times 10^{-6}}$$

where the denominator in this case is the $1\mu A$ flowing through R1 plus the $0 \cdot 2\mu A$ of base current.

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

A $3M\Omega$ resistor, 5%, is near enough, and two $1 \cdot 5M\Omega$ resistors in series may be a more practical solution.

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

Input resistance

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

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

Harking back to the formula for R_{in}, we get the h_{fe} figures from the published data sheets (h_{fe} rising as collector current rises, remember), see Fig. 31. $R_{in} = 240 \times 440 \times 2{,}700 = 285 \cdot 12M\Omega$ to be exact.

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

$$\frac{1}{R_{IN}} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R_{in}} = \frac{1}{3 \cdot 9M\Omega} + \frac{1}{3M\Omega} + \frac{1}{285M\Omega}$$

approximately $1 \cdot 6M\Omega$

Decoupling

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

The components used are shown in Fig. 30. and are calculated from the voltage difference $9V - 7 \cdot 7V = 1 \cdot 3V$ divided by the total current. This is the collector current of Tr1, $0 \cdot 05$mA, of Tr2, 1mA and in R2, $0 \cdot 0012$mA, total $1 \cdot 0512$mA.

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

$$\frac{1 \cdot 3}{1 \times 10^{-3}}$$ or $1 \cdot 3k\Omega$. Again, using the nearest preferred value, within tolerance, we'll settle for $1 \cdot 2k\Omega$ at 5%.

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

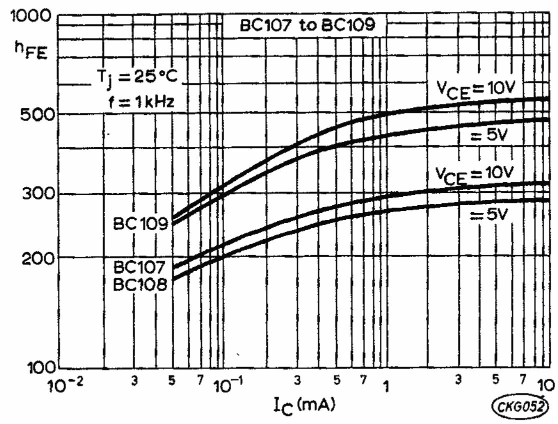


Fig. 31: Graph of variation of input impedance with collector current.

But C_{in} need not now be so large as we previously needed. The a.c. resistance (impedance) into which it is feeding is so much higher than before that a value such as $0 \cdot 022\mu F$ could be used. To check this, take the value that gives the same reactance to your desired lower frequency limit as does the input impedance of the circuit—i.e., the -6dB point (voltage). This works out to around 4Hz for $0 \cdot 022\mu F$ which is plenty good enough for our purpose.

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

Other uses

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

The use of the Darlington pair in power amplifiers

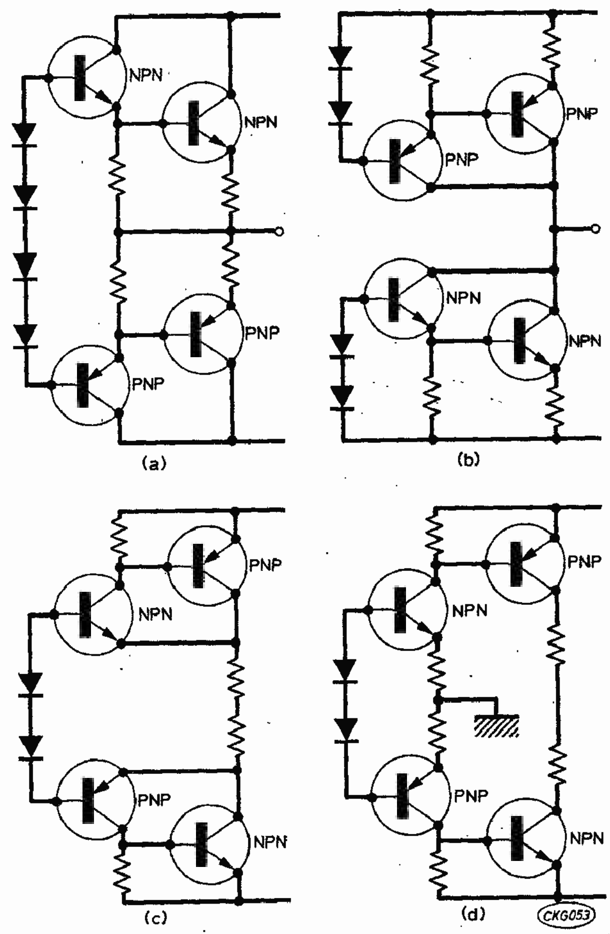


Fig. 32: Four variations of the Darlington Pair as used in push-pull output circuits of commercial power amplifiers.

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

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

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

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

TO BE CONTINUED

CHARLES MOLLOY

THE Medium Wave Column

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

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

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

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

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

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

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

Logs

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

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

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

5960 *H.C.J.B. Quito,* Ecuador at 0800.
5990 *Radio Canada* at 0715.
7310 *Radio Vilnius,* Lithuania at 2230.
9530 *All India Radio* at 1930.
9690 *WNYW, U.S.A.* at 2100.
9805 *Radio Cairo* at 2145.
11935 *FEBA, Seychelles* noted at 1730.
15130 *WNYW, U.S.A.* at 2000.
15155 *Radio Havana, Cuba* at 2010.
17720 *WINB, Red Lion* noted at 1930.
17855 *NHK, Japan* at 0800.

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

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

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

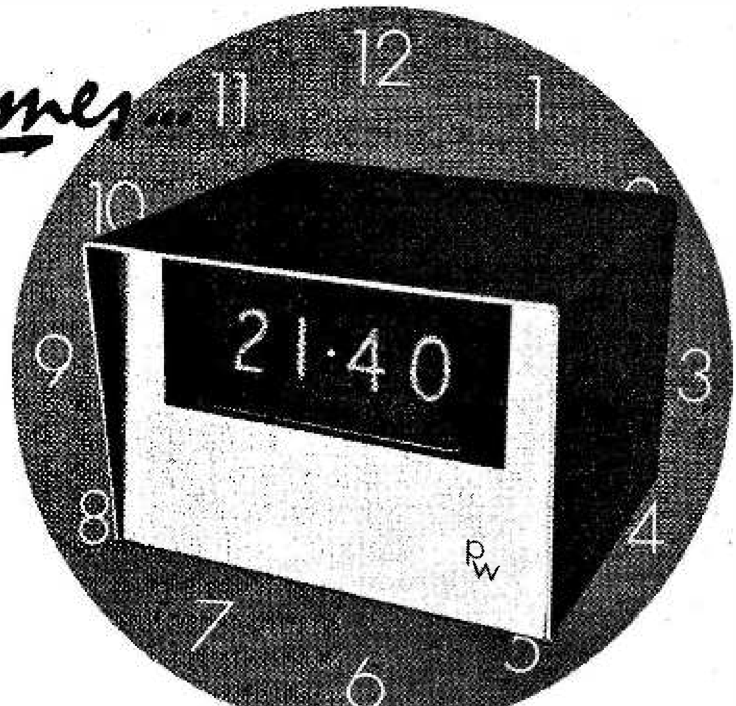
5960 *H.C.J.B., Quito,* Ecuador at 0815.
6025 *R. Portugal,* Voice of the West at 2130.
7235 *R. Australia* in English at 1530.
9460 *R. Pakistan* with news at 2100.
9525 *R.S.A., South Africa,* English at 2245.
9530 *A.I.R., Delhi* in English at 1915.
9530 *V.O.A., Monrovia,* sign-off at 2230.
9545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

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

IN NEXT MONTH'S PRACTICAL WIRELESS

Changing Times...

Digital Clock



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

WIPER DELAY UNIT

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

TRANSISTOR TESTER

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

PLUS MANY OTHER CONSTRUCTIONAL ARTICLES AND ALL THE REGULAR FEATURES. BE CERTAIN NOT TO MISS THE NEXT ISSUE. PRICE 20p

ALL IN THE APRIL ISSUE ON SALE 3rd. MARCH

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

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

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

Another aid is the many slow morse transmissions which members of the R.S.G.B. put out specifically for those wishing to learn to read c.w. Topband is a favourite and since these stations are located all over the country there is almost certain to be a local station near you. In any case, you can see how many of the slow c.w. members you can log. There is some very good d.x. to be heard on c.w. On topband, for example, down very close to 1·8MHz you can often hear W stations. So get a copy of the code, learn it and start using your receiver to the full. Incidentally, you need a b.f.o. for c.w. reception and if you are one of the many who are just getting your feet wet on the amateur bands with a commercial broadcast-type receiver which happens to cover short waves but which doesn't have a b.f.o., then take a peep at the January 1972 issue of Practical Wireless. On page iii of the Experimenters Circuits Supplement you will find a very simple circuit for a b.f.o. which can be used in conjunction with most receivers. Check that your receiver has an i.f. of 465kHz or 1·6MHz otherwise you will need to change the i.f. transformer shown in the circuit. Incidentally, this external b.f.o. will also enable you resolve single sideband too.

If you kid yourself that you are already well proficient in the gentle art of reading c.w., try tuning in at 1900g.m.t. on the first Tuesday of each month. Listen on 3·520MHz for the G3BZU morse proficiency transmissions. These rattle merrily away at 20, 25, 30, 35, and 40 words per minute. If you get it all down 100 per cent correct and send it with 10p to the QRQ Manager, RNARS, H.M.S. Mercury, Leydene, Petersfield, Hants, you get a nice certificate which tells all and sundry what a super dot and dash sorter-outer you really are.

Another query which keeps cropping up in the mail is the one involving some poor s.w.l. who, while reading about beams and long wires, is stuck in a room on the umpteenth floor of a "no aerials allowed" block of flats.

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

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

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

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

Howard Dearing has dropped the s.w.l. prefix and now talks back signing G3XVX. Rig is a homebrew running 25W p.e.p. and 10W c.w. Receiver is a Hammerlund Super Pro with a homebrew topband converter using 3·1-3·3MHz as an i.f. Howard's log for 1·8MHz stations worked (I'm green already) reads: K2GNC, K8RNE, VE3EK, W1WQC, W2FD, W2IU, W2UEZ, W3GM, W4WFL/1, W4QCW, ZD8AY (Ascension Island) all on c.w. On s.s.b. the log reads: W1WQC, W1HGT, W2HCW. Antenna is an inverted L Marconi with 55ft. vertical section some 10ft. longer than an electrical quarter wave and tuned with a series capacitor. Earth system is a radial affair plus 12 buried copper pipes.

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

12 Cross Way, Harpenden, Herts.

HENRY'S FOR LOW COST FIRST GRADE BRAND NEW BRANDED GERMANIUM and SILICON TRANSISTORS, DIODES, RECTIFIERS, TRIACS, FETS, ZENERS, BRIDGES and INTEGRATED CIRCUITS

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TRANSISTORS

A SELECTION FROM OUR LIST

AAY30	10p
AAY42	15p
AAZ13	10p
AAZ15	10p
AAZ17	10p
AC107	35p
AC126	30p
AC127	25p
AC127Z	50p
AC128	20p
AC176	20p
AC187	25p
AC188	25p
ACY17	30p
ACY18	25p
ACY19	25p
ACY20	20p
ACY21	20p
ACY22	10p
ACY39	55p
ACY40	20p
ACY41	15p
ACY44	25p
AD140	50p
AD149	50p
AD161	35p
AD162	35p
AF114	25p
AF115	25p
AF116	25p
AF117	20p
AF118	60p
AF124	25p
AF125	20p
AF126	20p
AF127	20p
AF139	30p
AF180	50p
AF181	45p
AF185	50p
AF186	40p
AF239	40p
ASY26	25p
ASY27	30p
ASY28	25p
ASY29	30p
ASZ21	55p
BA100	15p
BA102	30p
BA110	25p
BA115	7p
BAX13	5p
BAX16	7p
BAY31	7p
BAY38	15p
BC107	10p
BC108	10p
BC109	10p
BC109C	12p
BC113	10p
BC114	20p
BC115	20p
BC116	20p
BC116A	25p
BC117	20p
BC118	20p
BC119	30p
BC134	20p
BC135	15p
BC136	20p
BC137	20p
BC138	20p
BC147	12p
BC148	10p
BC149	12p
BC153	20p
BC154	20p
BC167	15p
BC169	12p
BC169C	15p
BC177	20p
BC178	20p
BC179	20p
BC182L	10p
BC183L	10p
BC184L	12p
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BF195	15p
BF196	15p
BF197	15p
BFX13	25p
BFX29	25p
BFX30	25p
BFX84	25p
BFX85	30p
BFX86	25p
BFX87	25p
BFX88	20p
BFY18	25p
BFY50	20p
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NKT404	55p
OA5	25p
OA10	25p
OA47	10p
OA70	10p
OA79	10p
OA81	8p
OA90	8p
OA91	7p
OA95	7p
OA200	7p
OA202	10p

OC16	50p
OC20	85p
OC22	50p
OC23	60p
OC24	60p
OC25	40p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC42	40p
OC43	50p
OC44	15p
OC45	12p
OC70	12p
OC71	12p
OC72	20p
OC75	25p
OC76	25p
OC77	40p
OC81	20p
OC81D	20p
OC81Z	40p
OC83	25p
OC84	25p
OC139	25p
OC140	40p
OC141	60p
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ZTX304	25p
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ZTX501	15p
ZTX502	20p
ZTX503	17p
ZTX504	40p
ZTX531	26p
IN914	7p
IN916	10p
IN4148	7p
IS44	7p
IS921	7p
IS922	8p
2G301	25p
2G302	30p
2G303	35p
2N404	20p
2N696	15p
2N697	15p
2N698	30p
2N706	10p
2N706A	12p
2N708	15p
2N930	20p
2N987	40p
2N1131	25p
2N1132	25p
2N1302	18p

2N1303	18p
2N1304	22p
2N1305	22p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1613	20p
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2N2160	60p
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2N2218	20p
2N2218A	25p
2N2219	20p
2N2219A	25p
2N2220	25p
2N2221	20p
2N2221A	25p
2N2222	20p
2N2222A	25p
2N2369	15p
2N2369A	15p
2N2646	40p
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2N2905	25p
2N2905A	25p
2N2906	20p
2N2906A	25p
2N2907	23p
2N2907A	25p
2N2925	15p
2N2926	10p
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7404	Hextuple inverters	20p	18p	16p	14p	12p
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7413	Dual 4-input Schmitt triggers	30p	27p	25p	22p	20p
7420	Dual 4-input NAND gates	20p	18p	16p	14p	12p
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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	33p	30p
7474	Dual D flip flop	40p	37p	35p	33p	30p
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7492	Divide twelve counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	75p	70p	65p	60p	55p
7494	Dual entry 4-bit shift register	80p	75p	70p	65p	60p
7495	4-bit up-down shift register	80p	75p	70p	65p	60p
7496	5-bit parallel/serial in/out shift register	£1·00	97p	95p	90p	88p
74100	8-bit bistable latch	£2·50	£2·30	£2·00	£1·75	£1·50
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74141	BCD-Decimal decoder/Nixie driver	£1·00	95p	90p	80p	70p
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75151	8-bit data selector/multiplexer	£1·10	95p	90p	80p	70p
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74154	16-bit decoder/demultiplexer	£2·00	£1·75	£1·55	£1·30	£1·05
74155	Dual 2-line to 4-line decoder/demultiplexer	£1·55	£1·47	£1·35	£1·10	£1·05
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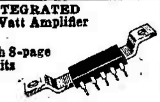

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SC40B	200	6 amps	£1·05
SC40D	400	6 amps	£1·00
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SC45B	200	10 amps	£1·15
SC45D	400	10 amps	£1·25
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IN4004	400	8p	7p	6p	5p	4½p
IN4005	600	10p	9p	8p	7p	6p
IN4006	800	12p	10p	9p	8p	7p
IN4007	1000	15p	12p	10p	9p	8p

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2002	200	2a	65p	6004	600	4a	80p
4002	400	2a	75p	1006	100	6a	70p
6002	600	2a	80p	2006	200	6a	75p
1004	100	4a	65p	4006	400	6a	£1·00
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LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

Bottled-up

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

* * *

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

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

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

* * *

I too suffer from being one of that dying breed. Mr. Smith has my complete sympathy. 99·9% of my equipment is fully "bottleized," including a 50 watt r.m.s. (sine wave drive) amplifier which has given no trouble for about 3 years. Everything I build with valves works first time and goes on working. Few people realize how easy and cheap valve equipment is to make, and in my opinion valves are best for starting people off on electronics, because, electrically, they are infinitely more robust than transistors. To any other valve enthusiasts—please, please write to this column and make your existence known. Incidentally the 50 watt amplifier can be made for £30 complete.—**T. Watton** *(Hull)*.

* * *

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

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

Cassette deck

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

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

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

Join the club

I should be most grateful if some publicity could be given to our club through the medium of *Practical Wirless*. The club was formed early in 1970 and today, with over a hundred members, has its own club rooms at 81 Virginia Street, Glasgow, C1.

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

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

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

Transformed!

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

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

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

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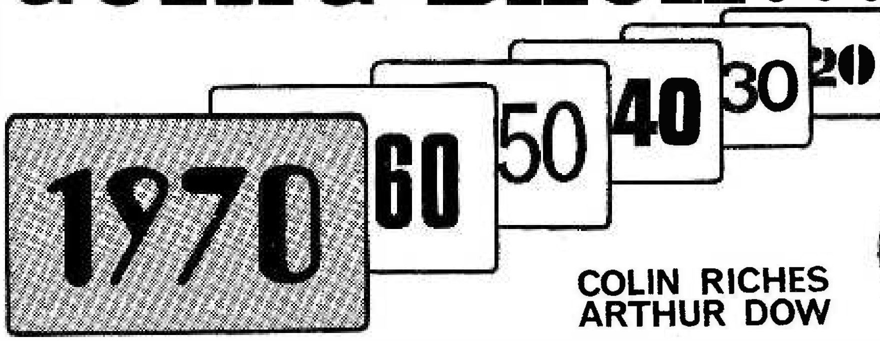
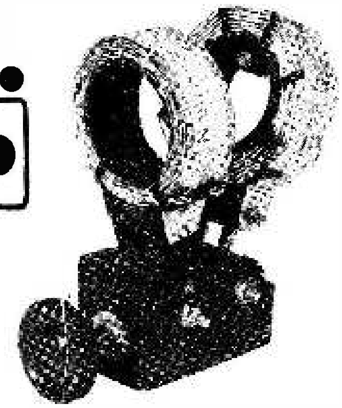
GOING BACK...





COLIN RICHES
ARTHUR DOW

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

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

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

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

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

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

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

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

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

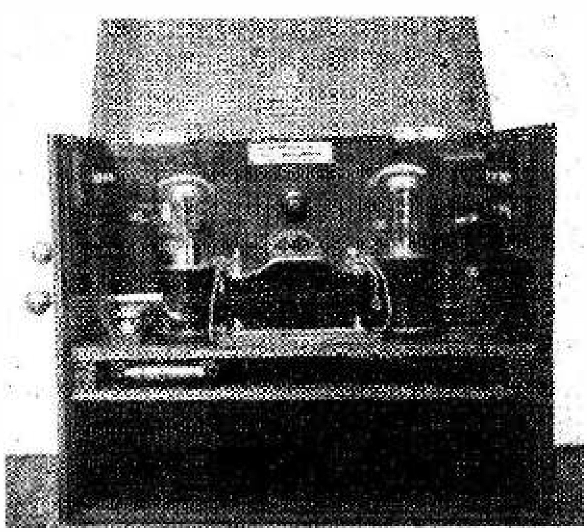
Mr. Lord enclosed a photograph of his set, the details of which are:—

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

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

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

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



Mr. D. J. Lord's receiver.

Vintage CQ

BOOKS FOR DISPOSAL

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

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

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

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

I.C. OF THE MONTH

L.A.J. IRELAND

Number 27 — Toshiba TH9013P 20W Audio Amplifier

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

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

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

The device is available from Erie Distribution Division, Erie Electronics Ltd., Gt. Yarmouth, Norfolk, and is quoted in the latest available price list at £4·31 for small numbers.

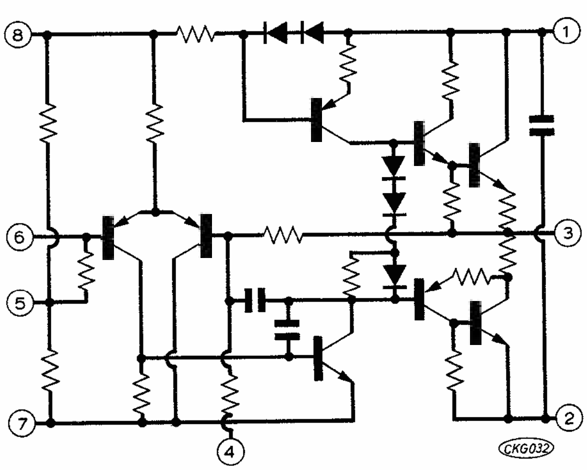


Fig. 1: Circuit of the hybrid audio amplifier.

Circuit

Now for a detailed consideration of the capabilities of the unit. The high intercomponent leakage resistance possible with hybrid construction permits the use of supply voltages higher than is usual in i.c. work, with consequent lower currents for the same output, and the TH9013P therefore has a maximum supply rating of 50 volts at a current of 1·2 amps. The device should be attached to a heat sink of 300 sq.cms., giving a thermal resistance of 4°C/W or lower. This should retain the operating temperature of the device at 50°C or lower, but allowable case temperatures range from 0 to 90°C during operation, giving considerable latitude.

The circuit in Fig. 1 indicates that the device follows fairly conventional Class B lines, with identical n.p.n. silicon power transistors in push-pull, preceded by a complementary pair phase-splitter driving stage. A considerable advantage is the self-regulating character of the circuit, which does not require an external preset resistor to obtain symmetry of operation. Crossover distortion is therefore minimised, and ease of operation assured. In fact, the overall distortion figure quoted for the unit, at a signal frequency of 1kHz, is 0·3% at the full rated output of 20 watts, while the frequency response is flat to within 2dB from 10Hz to 40kHz. So it follows that if a pair of these devices is incorporated in a stereo outfit, departures from hi-fi standards should be sought in the record deck, the speakers or the preamps. Anywhere, in fact, except the power output stages!

Power supplies

It is recommended that operation of the unit should be from twin power supplies rated at ±22·5 volts. Such supplies are easily constructed using four silicon diodes of appropriate rating to make up a dual full wave rectifier set, working from a transformer with centre-tapped 45 volt secondary followed by suitable smoothing capacitors (at least 500μF, 50V).

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

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

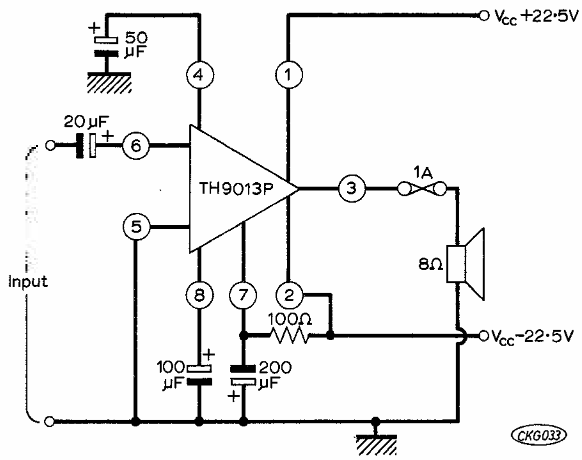


Fig. 2a: Connections to the TH9013P when using a dual power supply.

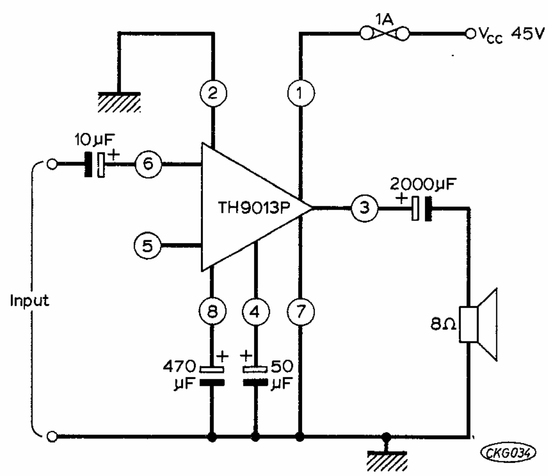


Fig. 2b: A single 45 volt power supply simplifies the external circuitry.

Notes

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

The unit is presented in a sealed package 3×2×⅝in. with a machined face and mounting holes for heat sink attachment. Connections are via eight pins on the side of the package; the numbering in Fig. 1 is from left, when facing the pins with the heat sinking face downwards. For a convenient, economical and effective power amplifier for domestic applications, the TH9013P is certainly worth consideration. ■

CQ!CQ!CQ!CQ!

ISSUES WANTED

...Practical Electronics Feb. 1971.—P. Arden, Hallam Grange, Hallam Grange Rise, Fulwood, Sheffield, S10 4BE.

...Practical Wireless for June 1969 (final part of "Double 12" article).—W. Pidduck, 128 Lodge Hill, Welling, Kent.

...Practical Wireless December 1963.—D. Hillman, 46 Spenser Street, Bootle, Lancashire, L20 4LW.

...Practical Wireless for May and June 1969. M. Jones, 44 Sturge Street, Sheffield, S2 3DP, Yorkshire.

...Practical Wireless December 1964, January 1969 to July 1970, September 1970, December 1970 and Practical Electronics for June and July 1970.—I. Moor, 6 Dykelands Road, Sunderland, Co. Durham, SR6 8EP.

...Practical Wireless Data Rule.—C. Jolliffe, 43 Holmlea Road, Goring-on-Thames, Reading, Berkshire, RG8 9EX.

...blueprint for the P.W. 35W Guitar Amplifier (May 1964 issue).—R. Cross, 38 Priory Road, Fishtoft, Boston, Lincs.

...Feb. 1971 issue of P.W. and April, May and June 1971 issues of P.E. and any other issues of P.E.—B. Boddy, 27 Gimble Way, Penbury, Kent.

...May 1969 issue of P.W. and Jan to Feb. 1968 issues. T. McKernan, 55 Maryland, Hatfield, Herts.

...P.E. for Jan., Feb., Mar. and Oct. 1965, Feb., Apl., Aug. and Sept. 1966. "Television" for Oct 1967, Apl., Jun. to Dec. 1968, Jan., Feb., Mar. and May 1969 and Feb., Dec. 1970. P. Mohan, 28 Hyde Park Terrace, Leeds, 6.

...P. W. Jan. 1968 to Feb. 1969 and P.E. Jan. 1968 to Dec. 1970.—M. F. Green, 12A West Road, Weaverham, Northwich, Cheshire, CW8 3HQ.

...July 1960 P.W. with article on mods to the R1392 Rx.—G. W. Kilbee, 10 Woodands Road, Ilford, Essex.

...Jan., Feb., Mar. and May P.W. for 1971.—C. Jennings, 13 Stonefield Street, Islington, London, N1 OHW.

...May and Jun. 1969 P.W.—G. A. Brooks, 227 St. Andrews Road, Couldson, Surrey.

...P.W. back numbers in exchange for Indian magazines.—N. Mohanty, M.Sc., Townhall Road, Cuttack-9, Orissa, India.

...P.W. for Apl. 1970 (General Coverage Receiver).—J. L. Littler, 61 Kent Road, Orpington, Kent, BR5 4AB.

.. the issue of P.W. containing Mr. Cameron's decoder (May 1970).—G. R. Hunt, 53 Hand Lane, Leigh, Lancs.

...P.W. 1952-1955 and Radio Constructor 1952-1959.—Luxton, 12 The Vale, Acton, London, W3. 7SB.

...P.W. for Aug. 1967, Oct. 1969 and Jan. 1971. P.E. for Mar. 1971 and Radio Constructor for Feb. 1970.—A. D. Tuppen, "Greyholm" Geldeston, Beccles, Suffolk.

...Apl. 1965 issue of P.W. containing PC tuner article.—W. Pleass, 12 Farmadine Grove, Saffron Walden, Essex.

...P.W. for Jan. and June 1970 and P.E. for Jul 1967, Jan. 1968, May 1968, Sept. 1968, Oct. 1968, Feb. 1969, April 1969 and Mar. 1969.—C. Zammit Mangion, 59 St. Mary Street, Sliema, Malta.

...P.W. previous to Jan. 1969. Preferably complete sets. State details and price.—M. Tracey, 2 Manewas Way, Newquay, Cornwall.

...P. W. for June 1969.—M. J. Burrows, 7 Lyndhurst Road, Keynsham, Bristol.

...May 1971 issue of P. W.—A. Vermaak, 82 Kruger Avenue, Discovery, Transvaal. South Africa.

ISSUES FOR DISPOSAL

...Three years P. W. 1967-1971. Hi Fi News and Sound 1967-1971. ?£2.—W. Pearce, 32 Wathen Road, Dorking, Surrey.

...most issues from 1966 of P. W., P.E., and R.C.—J. Partington, 30 Ings Way, Bradford, Yorkshire, BD8 OLU.

EQUIPMENT FOR DISPOSAL

...Beeson & Co. "Prototype" trombone, perfect condition and is silver. It is complete with mute and music clips.—Mrs. M. G. Brundrett. 8 Merlin Street, Carmarthen, South Wales.

...Willesden "Blenheim" series oil-cooled mains transformer, ex-oscilloscope. Solartron spares dept. quote is £30·75. Any offers?—R. Knight, "Lincoln's Imp", Roedowns Road, Medstead, Alton, Hants.

...S. H. Electronic equipment for sale. Transistors, Valves, all types of capacitors, resistors, tagboards, transformers, variable resistors, tuning capacitors, diodes etc. All at ridiculously low prices. Send for list.—A. Harman, 27 Norby Estate, Thirsk, Yorkshire.

CORRESPONDENTS AND TAPESPONDENTS WANTED

...girl of my own age (16). I have a Bush cassette recorder.—S. Martin, 77 Meadow Rise Road, Norwich, Norfolk, NOR 97F.

...girl near my own age (16). I have Marconiphone 4-track machine with speeds 1⅞ and 3¾ips. I am interested in all forms of music.—S. Gibbs, 382 Dereham Road, Norwich, Norfolk, NOR 42J.

...anyone who is interested in short wave and radio listening and LP records to correspond. Aged 18-23.—Geoff Dickinson, 5 Quarry Brow, Hawcoat, Barrow-in-Furness, Lancashire.

...Club secretaries of radio clubs near my home, as I am interested in joining to learn wireless as a hobby.—J. Tyson, 3 Friars Rise, Scaws Estate, Penrith, Cumberland.

...anyone to correspond. I am 13 and interested in electronics and simple circuits.—M. Wigglesworth, 4 Ellabridge Close, Keynsham, Bristol.

...boy or girl of my own age (15) interested in electronics.—Sidney Birla, 3/1 Raja Santosh Road, Calcutta-27, India.

APPARATUS REQUIRED

...a direct Disck Recorde and information about this piece of apparatus.—F. Legrande, 81 Bangaree Road, Wilson, W. Australia 6107.

...spares for HMV transistor set model 26063. Push button or will buy complete set. Also anywhere where I can Get Dansette spares.—James Wood, 76a Arncliffe Road, Liverpool, 2C.,

...Philips Novosonic loudspeaker system type AD5010.—J. C. Wilson, 59 Meadway, Harpenden, Herts.

...Radivet type 211 by Airmec Ltd. New or in working condition. Details and price to —G. A. Gray, 4 Bengal Road, Ilford, Essex.

...Grundig TK8 motor.—A. Panton, 49 Peaksfield Avenue, Grimsby, Lincs.

...Denco blue coils range 4, white range 4 (one of each). Two 2N2626 transistors, one OCP71 and data of 2N2926 against stamps, view cards and International Reply Coupons.—P.S. Chalokia, 2192, Sector 27C Chandigarh, India.

EXCHANGE

...sale or exchange quantity of electrical/electronic "junk" including valves, transformers, capacitors and 1W audio amp, for small quantity of LP and single records (POP only). Send s.a.e. for lists.—Mike Barnett, 17 Randall Avenue, London, NW2 7RL.

...100 small and 30 big valves which are all marked clearly. All these I will exchange for a second-hand general purpose audio amplifier of about 10W or a second-hand multimeter.—A. Harman, 27 Norby Estate, Thirsk, Yorkshire, Y07 1BN.

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1S940	5p	ACY18	19p	BF173	19p
2N696	17p	ACY19	23p	BF177	25p
2N697	18p	ACY20	20p	BF194	14p
2N706	12p	ACY21	21p	BF195	15p
2N930	29p	ACY22	21p	BF254	14p
2N1132	29p	ACY39	63p	BF255	15p
2N1302	19p	ACY40	17p	BFX29	31p
2N1303	19p	ACY41	18p	BFX84	25p
2N1304	26p	ACY44	31p	BFX85	32p
2N1305	26p	AD142	50p	BFX87	29p
2N1306	33p	AD149	58p	BFX88	26p
2N1307	33p	AD150	50p	BFY50	23p
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2N1613	23p	AD162	36p	BFY52	23p
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2N1893	54p	AF115	24p	BY164	45p
2N2147	95p	AF116	22p	BY238	18p
2N2218	34p	AF117	22p	BYX38-300	38p
2N2218A	44p	AF118	82p	BYX38-300R	38p
2N2219	38p	AF124	24p	C407	17p
2N2270	62p	AF125	24p	C762	19p
2N2369A	19p	AF126	22p	EA403	10p
2N2483	35p	AF127	22p	EB383	10p
2N2484	42p	AF139	33p	EC401	18p
2N2646	47p	AF239	36p	EC402	17p
2N2904	38p	ASY26	27p	NKT211	25p
2N2905	44p	ASY27	30p	NKT212	25p
2N2905A	47p	ASY28	27p	NKT213	25p
2N2924	20p	ASY29	36p	NKT214	23p
2N2925	22p	AU111	97p	NKT217	50p
2N2926	11p	B30C250	24p	NKT261	21p
2N3053	27p	B1912	66p	NKT271	18p
2N3054	60p	B5041	72p	NKT274	18p
2N3702	13p	BA102	25p	NKT403	65p
2N3703	13p	BA130	22p	NKT405	79p
2N3704	13p	BA145	27p	NKT613F	30p
2N3705	13p	BA156	13p	NKT674F	24p
2N3706	13p	BB103/B	16p	OA47	8p
2N3708	10p	BB103/G	16p	OA90	6p
2N3709	11p	BC108	11p	OA91	5p
2N3710	13p	BC109	12p	OA95	6p
2N3711	13p	BC122	21p	OA200	9p
2N3794	15p	BC125	15p	OA202	10p
2N3819	23p	BC126	22p	OC19	50p
2N3820	53p	BC140	30p	OC25	42p
2N3904	35p	BC147	10p	OC29	76p
2N3906	35p	BC148	9p	OC35	60p
2N4036	55p	BC149	10p	OC36	65p
2N4058	13p	BC153	19p	OC41	42p
2N4059	10p	BC169	11p	OC44	42p
2N4060	11p	BC177	14p	OC70	21p
2N4061	11p	BC178	13p	OC71	38p
2N4124	18p	BC179	14p	OC75	40p
2N4126	27p	BC182L	11p	OC81	25p
2N4284	15p	BC183L	10p	OC81D	25p
2N4286	15p	BC184L	11p	OC83	25p
2N4289	16p	BC186	42p	OC84	25p
2N4291	15p	BC212L	16p	P346A	26p
2N4410	24p	BC213L	16p	82CN1	10p
2N4991	82p	BC214L	16p	8D1	10p
2N5062	61p	BC257	9p	8D4	12p
2N5457	49p	BC259	9p	V763	28p
2N5459	49p	BC267	17p	W106B1	45p
40250	71p	BC268	15p	W02	40p
40251	89p	BC269	17p	WP02	95p
40361	55p	BC300	49p	ZTX300	14p
40362	68p	BC301	37p	ZTX301	16p
40602	52p	BC303	60p	ZTX302	22p
AC107	46p	BCY30	60p	ZTX303	22p
AC126	20p	BCY31	75p	ZTX304	27p
AC127	20p	BCY70	18p	ZTX330	23p
AC128	20p	BCY71	33p	ZTX331	27p
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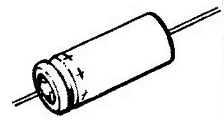

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C	1/8W	5%	4·7-470K	E24	1	0·8	0·7
C	1/4W	10%	4·7-10M	E12	1	0·8	0·7
C	1/2W	5%	4·7-10M	E24	1·2	1	0·9
C	1W	5%	4·7-10M	E12	2·5	2	1·9
MO	1/2W	2%	10-1M	E24	4	3·5	3
WW	1W	10% ± 1/20 Ω	0·22-3·9	E12	7	7	6
WW	3W	5%	12-10K	E12	7	7	6
WW	7W	5%	12-10K	E12	9	9	8

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E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades
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Dual gang linear	4·7K Ω to 2·2M Ω	42p
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Log/antilog	10K, 47K, 1M Ω only	42p
Any type with ½A D.P. mains switch, extra		12p

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

Handbook of transistor equivalent and substitutes, 40p.
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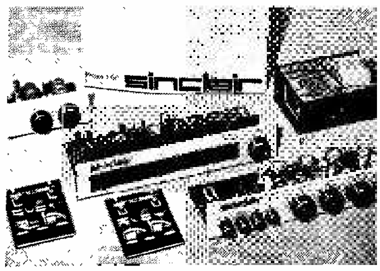
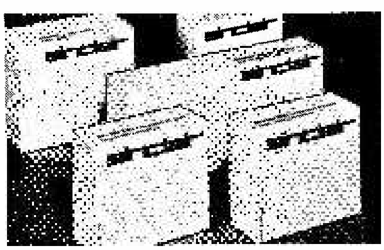
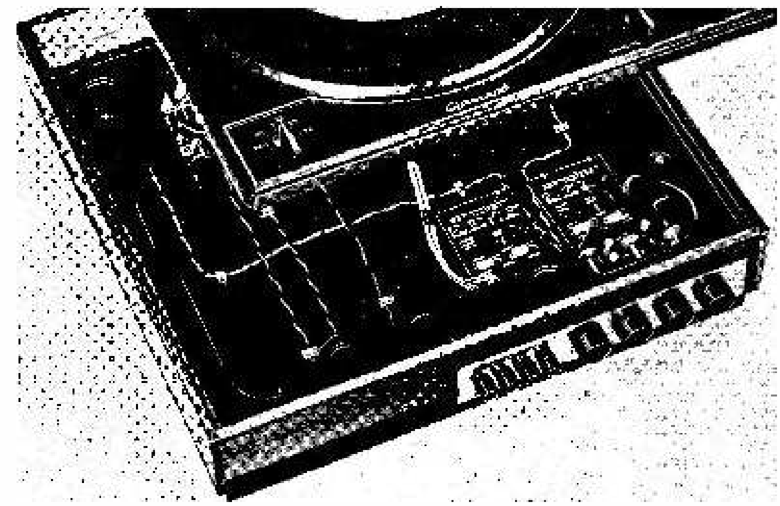
Sinclair Project 60

The World's leading range of high fidelity modules







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Project 605

The easy way to buy and build Project 60

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

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

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

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

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System	The Units to use	together with	Cost of Units
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Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**

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Tel: St. Ives (048 06) 4311

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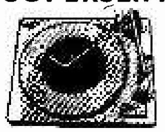
BSR LATEST SUPERSLIM

STEREO AND MONO



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13¾ × 11¼in. Above motor board 3⅜in. below motor board 2⅜in. with STEREO and MONO XTAL **£7·75** Post 25p.

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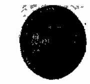
Comprising a fine example of a Woofer 10¾ × 6¼in. with a massive Ceramic Magnet, 44oz, Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3¼in. square has a special light-weight paper cone and magnet flux 10,000 lines.



Impedance Standard	8 ohms
Maximum Power	12 watts
Useful Response	35 to 18,000 cps
Base Resonance	45 cps

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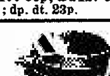
"THE INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER

200/250v. A.C. Leaflet S.A.E. **£2·35** Post 15p



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All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240v. AC. Output voltages available 6 or 9 or 12 or 15 or 18 or 20v. DC at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. Size 3½ × 1½ × 1¼in. **£2** POST FREE

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Ideal for Mike, Tape, P.U., Guitar. Can be used with Battery 9–12v or H.T. line 200–300v D.C. operation. Size 1¾" x 1½" x ½". Response 25 c.p.s. to 25 Kc/s. 26db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **90p** Post 10p

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16/450V	15p	1000/50V	47p	32+32/250V	18p
32/450V	20p	8+8/450V	18p	32+32/450V	33p
25/25V	10p	8+16/450V	20p	350+50/325V	50p
50/50V	10p	16+16/450V	25p	32+32+32/350V	43p
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All transformers Postage 25p extra.

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With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4** Post 15p

With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·25** Post 15p

Recommended Teak Cabinet Size 16 × 10 × 9in. Post 25p **£5**

10W MINI-MODULE LOUDSPEAKER KIT £3·25

Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8¾ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 15 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9in. Modern design with fluted wood front. Highly recommended. **£5** Post 25p

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30-14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. Voice coils 3 or 8 or 15 ohms. Post Free

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11·50**

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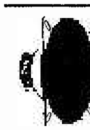
'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front For 12in. or 10in. dia. speaker 20 × 13 × 9in. £9. Post 25p For 13 × 8in. or 8in. speaker 16 × 10 × 9in. £5. Post 25p For 10 × 6in. or 6in. speaker 16 × 8 × 6in. £4. Post 25p LOUDSPEAKER CABINET WADDING 18in. wide. 15p ft.

GOODMANS 6½ in. HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30–12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosures Systems, etc. **£4**

ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watts. 3 ohm or 15 ohm models. **£1·90** Post 10p.

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4 inputs speech and music. Mixing facilities. Response 10–30,000 cps. Matches all loudspeakers. A.C. 200/250v. Separate Treble and Bass controls. Guaranteed Details S.A.E. **£39** POST FREE

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BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **£3** STEREO VERSION OF ABOVE £4·25.

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PIV	1A TO-5	3A TO-66	7A TO-66	10A	16A TO-48	30A TO-48
	£p	£p	£p	£p	£p	£p
50	0·23	0·25	0·47	0·50	0·53	1·15
100	0·25	0·33	0·53	0·58	0·63	1·40
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	0·97	1·25	—
800	0·63	0·70	0·90	1·20	1·50	4·00

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PIV	300mA	750mA	1A	1·5A	3A	10A	30A
	£p	£p	£p	£p	£p	£p	£p
50	0·40	0·05	0·05	0·07	0·14	0·21	0·47
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·23	0·34	0·45	1·85
800	0·10	0·17	0·13	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·15	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·33	0·57	0·75	—

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VBOM	2A TO-1	6A TO-66	10A TO-88
	£p	£p	£p
100	30	50	76
200	50	60	90
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35 amp, 400 p.i.v. stud type. **£1·10p** each.

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

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BC107/8/8, **10p** each; 50–99 **9p**; 100 up, **8p** each; 1,000 off, **7p** each. Fully-tested and coded TO-18 case.

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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

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10 for **50p**, 25 for **£1**
20,000 TO CLEAR

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

PHOTO TRANS.

OCP71 Type. **43p**

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T6	8	2G344B	OC44
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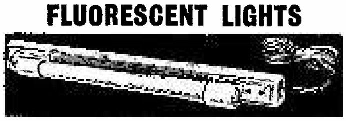

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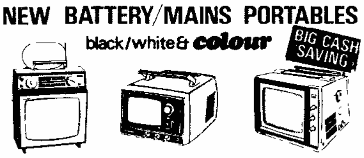

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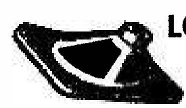

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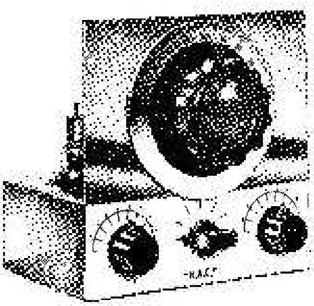

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35B5	0.65	9002	0.40	EC91	0.60	EF40	0.50
35C5	0.50	9003	0.50	EC92	0.35	EF41	0.65
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50B5	0.50	DK96	0.50	ECC84	0.30	EF92	0.35
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EF97	0.65	GZ33	0.70	PL36	0.55	U281	0.40
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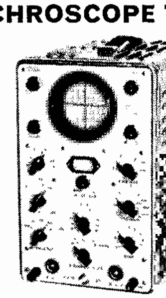
2N1309	0.30	ADZ11	1.25	BFX88	0.25
2N1613	0.22	ADZ12	1.25	BFY17	0.40
2N1711	0.25	AF114	0.20	BFY19	0.60
2N1756	0.75	AF115	0.20	BFY50	0.25
2N2147	0.75	AF116	0.20	BFY51	0.20
2N2160	0.65	AF117	0.20	BFY52	0.25
2N2217	0.30	AF118	0.45	BSY26	0.20
2N2218	0.30	AF125	0.25	BSY27	0.20
2N2219	0.35	AF127	0.20	BSY28	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	0.60
2N2924	0.15	ASY26	0.25	OC24	0.60
2N2926	0.125	ASY27	0.30	OC25	0.35
2N3053	0.25	ASY28	0.25	OC26	0.25
2N3054	0.60	ASY29	0.30	OC28	0.60
2N3055	0.75	ASY54	0.25	OC29	0.60
2N3133	0.30	ASZ15	0.70	OC30	0.75
2N3134	0.30	ASZ16	0.70	OC35	0.50
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
2N3702	0.12	BC149	0.15	OC81	0.25
2N3703	0.12	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	BCY33	0.25	OC171	0.25
2S702	0.50	BCY34	0.30	OC200	0.30
2S746	0.25	BCY72	0.20	OC201	0.60
AC113	0.15	BCZ10	0.30	OC202	0.65
AC125	0.30	BCZ11	0.40	OC203	0.40
AC126	0.20	BD121	0.65	OC204	0.40

SYNCHROSCOPE TYPE C1-5



3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
Bandwidth 10 c/s—10 mc/s. Triggered sweep pre-set at 1-2-5-10-30-100-300-1000-3000 μsec per stroke. Free-running time base 20 c/s to 2000kc/s with built-in crystal calibrator providing timing marks at .05-.2-1-5-20-100 μ sec.
Amptitude calibrator directly calibrated in volts.
Input attenuator 1-10-100.
Power supplies 127/230v AC.

PRICE £39.00. Packing and carriage 1.50

INTEGRATED CIRCUITS

TAA263 Direct coupled 3-stage amplifier up to 600kc. Supply voltage 6-8V output 10mW TO72 outline .. .. 0·75
TAA293. Medium frequency amplifier up to 600kc. Supply voltage 6V. output 10mW TO74 outline .. .. 0·95
TAA320. MOST stage followed by a bi-polar stage Gate-to-source voltage 9-14V. Power dissipation 200mW. TO18 outline .. .. 0·65
TAA570. Four-stage limiter-amplifier with F.M. quadrator detector and remote D.C. volume control facility. Nominal supply voltage 12V. TO74 outline .. .. 0·95
TAD100. AM receiver circuit containing all active components (except output stage) required to build a complete receiver .. £1·95
SL403D PLESSEY 3-Watts Audio Amplifier £1·50
SL432A PLESSEY, limiting I.F. Amplifier and F.M. discriminator .. .. .. £0·75

OUR NEW 1971/1972 CATALOGUE IS NOW READY AND AVAILABLE FREE OF CHARGE. PLEASE SEND QUARTO STAMPED AND ADDRESSED ENVELOPE FOR THIS VALUABLE SOURCE OF REFERENCE LISTING MANY THOUSAND TYPES OF VALVES, SEMICONDUCTORS, TUBES, ETC.

MULTIMETERS

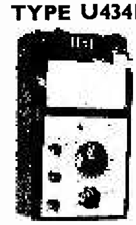
WITH TAUT BAND SUSPENSION MOVEMENT

TYPE U4312

Low sensitivity (667 ohms per volt), 1% accuracy DC and 1·5% AC. 9 DC current ranges 300μA to 6A. 8 AC current ranges (1·5mA to 6A). 9 AC/DC voltage ranges 0·3-900V. Resistance 0·2-30K. £9·75

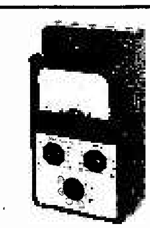
TYPE U4313. High sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC. Accuracy 1·5% DC and 2·5% AC. 8 DC current ranges 60μA to 1·5A. 6 AC current ranges 0·60mA to 1·5A. 9 AC and DC Voltage ranges 1·5 to 500V. Resistance ranges 0·5-500 Kohms. £10·50

TYPE U4341 MULTIMETER AND TRANSISTOR TESTER



8-DC voltage ranges 0·3-900V
6-AC voltage ranges 1.5-750V
5-DC current ranges 0·06-600mA
4-AC current ranges 0·3-300mA
4-resistance ranges 0·5-500 Kohms
Transistor cut-off current 60μA max
Transistor DC current gain 10-350
Sensitivity: 16700 Ω/V DC; 3300 Ω/V AC
PRICE £10·50

TYPE U435



Sensitivity 20 Kohms/volt DC and 2 Kohms/volt AC.
7 DC current ranges 50μA to 2·5A.
5 AC current ranges 5mA to 2·5A.
7 AC/DC Voltage ranges 2·5 to 1000V.
3 Resistance ranges 0–300 Kohms.
Capacity range 0·5μF. £9·00

All instruments are supplied with steel carrying case and leads.
No protection is incorporated .As the movement can withstand overloads up to 100 times, only basic precautions should be taken to prevent damage through misuse

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