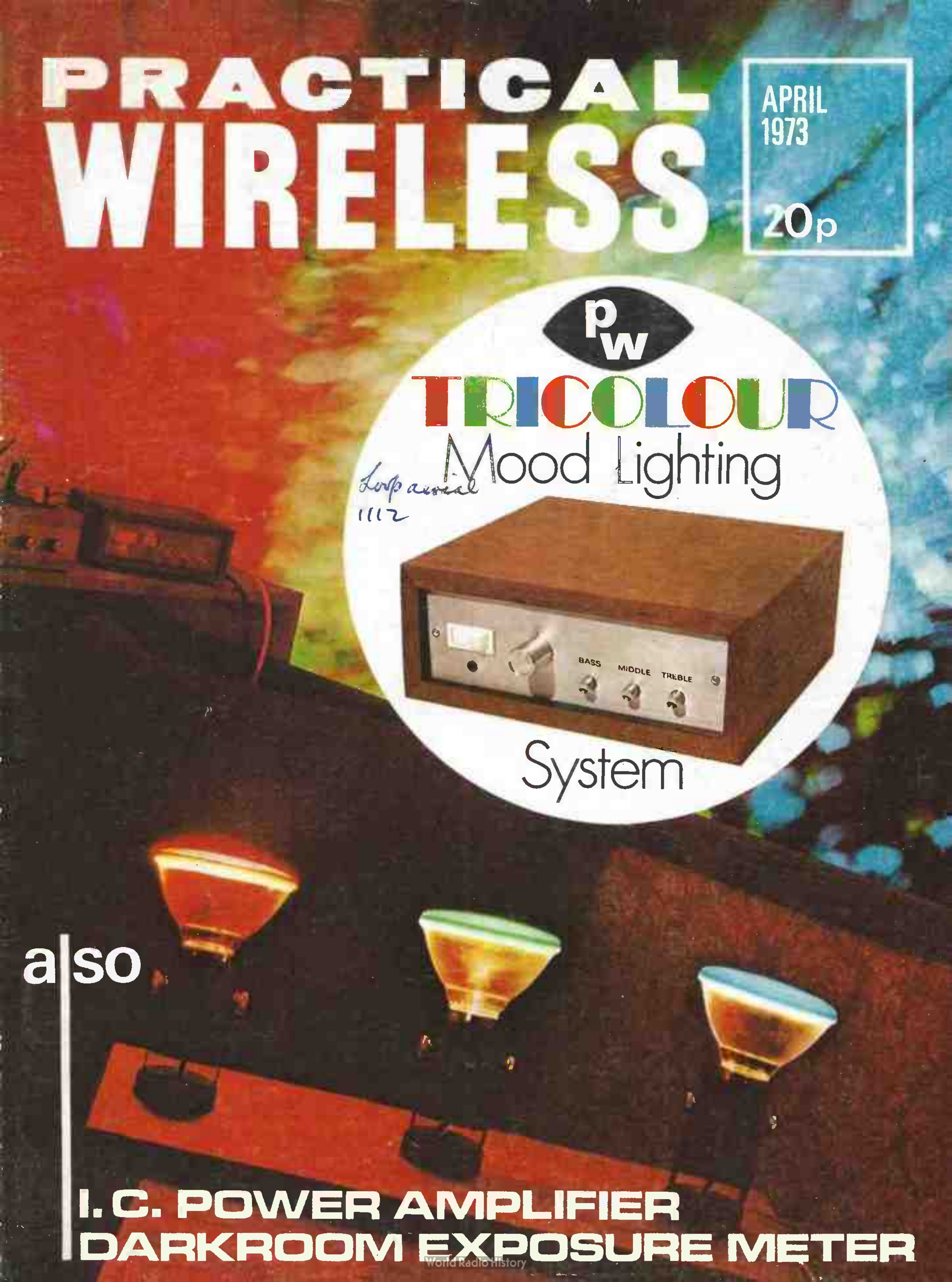
PRACTICAL WIRELESS
APRIL 1973
20p
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TRICOLOUR
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BASS
MIDDLE
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Loop aerial
1112
also
I.C. POWER AMPLIFIER
DARKROOM EXPOSURE METER

PACKAGE PRICE — R.S.C. STEREO PACKAGE OFFERS

FOR ILLUSTRATED UNITS

ONLY £39·59

Carr. £1·00
Or deposit £8·95 and 9 monthly payments £4·22 (Total £44·93).

Individual Rec. Retail Prices .

LINEAR 505 5 + 5 Watt Amplifier	£17 50
GARRARD 2025 Autochanger + K840A Cartridge ..	£13·58
Teak Veneer Plinth with Transparent Plastic Cover	£6·10
Pair A55 LOUDSPEAKERS (Inc 8" × 5" 10,000 Gauss)	£11·50
TOTAL	£48·68

SEND S.A.E. FOR FREE COLOUR BROCHURE

SAVE £31·60

HIGH FIDELITY UNITS

PACKAGE PRICE **£99·95** Carr. £1·75

FOR ILLUSTRATED UNITS

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

Individual Rec. Retail Prices :

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

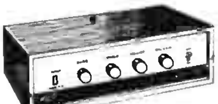
FANE 'MODE ONE' HIGH FIDELITY SPEAKER KIT

Incorporating a model 803 8" 13,000 Gauss Bass Speaker with ultra low resonance. P.V.C. surround cone. Printed circuit cross-over assembly with ferrite cored coils. Model 303 Pressure Tweeter, Acoustic damping material, Screws, Panels etc., and instructive diagrams, Frequency Response 25 Hz–2 KHz. Impedance 8 15 ohms **£9·95** post free

Or Dep. £2·25 & 9 mthly pymnts £1 (Tot. £11·25)

RSC G66 MkII 6+6 WATT high quality STEREO AMPLIFIER

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



COMPLETE KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS **£11·50** Carr. 40p

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

HIGH FIDELITY LOUDSPEAKER UNITS

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

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

MONARCH Size 19×10×9in. approx. Rating 10 watts. Inc. 13×8in. speaker with highly flexible P.V.C. cone surround, long throw voice coil and 10,000 line magnet. High flux pressure tweeter. Handsome design cabinet. Range 35-20,000 c.p.s. Imp. 8 ohms. Gives smooth realistic sound output. See 'package offers' for illustration. Carr. 50p **£19·35**

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

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

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

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

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

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

AUDIOTRINE HIGH FIDELITY SPEAKERS

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

Exceptional performance at low cost.

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

AUDIOTRINE HI-FI SPEAKER SYSTEMS

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

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

FANE 807T HIGH FIDELITY SPEAKER

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

PLEASE STATE IMPEDANCE WHEN ORDERING

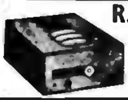
MODEL 803T 8" 15w. with parasitic Tweeter. Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8–15. **£4·95**

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, 9¼×2¼×5¼in. Attractive brushed silver finish facia plate 10½×3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7·75** Carr. 40p.

OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £10·95

R.S.C. BATTERY/MAINS CONVERSION UNITS



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

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

NOW IN STOCK!

FANE 'CRESCENDO' SUPER EFFICIENT GROUP/DISCO LOUDSPEAKERS

Send S.A.E. for leaflet on this range of extraordinarily efficient units including the very latest BASS CRESCENDO '12' 100 Watts.
FULL DISCOUNT to Genuine Trade Customers. CARR. FREE.

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

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

MIDGET CLAMPED TYPE 2½×2½×2½in.

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	£2·65
350-0-350v. 100mA, 6·3v. 4a., 0 5-6·3v. 3a.	£2·20
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	£2·65
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	£4·95
425-0-425v. 200mA, 6·3v. 4a., 6 3v. 3a., 5v. 3a	£5·10
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	£5·50

TOP SHROUDED DROP-THRO' TYPE

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

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 49p; 6·3v. 2a. 54p; 6·3v. 3a. 76p; 6·3v. 6a. £1 30; 12v. 1a. 55p; 12v. 3a. or 24v. 1·5a £1·35; 0·9-18v 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..	83p
Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω	£1·37
Push-Pull EL84 to 3 or 15 Ω 10-12 watts..	£1·35
Push-Pull Ultra Linear for Mullard 510, etc.	£2·20
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	£1·99
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	£3·30

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

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

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

BUILD AN AMPLIFIER WORTH APPROXIMATELY DOUBLE THE KIT PRICE INCLUDING CABINET

Only high grade components by leading manufacturers

- Push Button Selector Switching
- Jack Socket for Headphones
- Neon Indicator
- Satin Silver Finish Metal Fascia
- Solid State Circuitry
- Twenty Silicon Transistors
- Four Diodes, Four Rectifiers

For Magnetic or Ceramic Pick-Ups regardless of Price. Output (per channel) 15 watts RMS into 8Ω. Frequency Response 7 Hz to 70 KHz ± 1½ dB.

COMPLETE KIT (less cabinet). Carr. 65p. Cabinet if req. £5 extra. **£25**

FACTORY BUILT UNIT INC. CABINET with 12 months' guarantee. Or Dep. £7 and 9 monthly payments £3·99 (Total £42·91). **£38·75**

Send S.A.E. for full descriptive leaflet.

...C. STEREO FM TUNER. ...ally matches ... 30 Mk. III **£44·95**

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

- ★ Moderate size only 25×14×10in. approx.
- ★ 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).

RSC GROUP/DISCO UNITS

50 WATT SPEAKER

100 WATT AMPLIFIER

50 WATT SPEAKER

HEADPHONES MICROPHONE

TWIN TURNTABLE WITH PRE-AMP

PACKAGE OFFER

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

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

RSC TDI DISCO CONSOLE

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

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

R.S.C. COLUMN SPEAKERS

IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

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

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

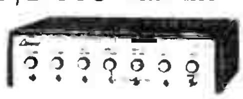
TYPE C412S 50 WATTS Fitted four 12" 11,000 line 15 watt speakers: Overall size approx. 56 × 14 × 9in Terms: Dep. £4 and 9 monthly payments £3·37 (Total £34·33) Carr. 75p **£31**

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

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

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

LINEAR T40/60D 50W GROUP/DISCO AMPLIFIER



★ FULL MONITORING FACILITIES
★ Individual Bass and Treble controls
★ Twin jack output sockets for speakers
★ Input sockets for medium or high impedance Microphones or Guitar P.Us and Crystal or Ceramic Gram. P.Us
★ Frequency response 30-20,000 Hz.
★ Output overload protection plus double fusing

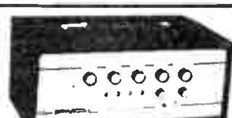
FRONT PANEL (Jack inputs)
Gram, Gram, Microphone/Guitar P.U; plus monitoring socket.
CONTROLS Vol. (1) (2) (3) and (4). Bass, Treble, Master Vol., Monitor Selection Switch Gram (1) or (2), Mains Switch

£49·50 Carr. free
Or Deposit £7·50 and 9 monthly payments £5·87 (Total £55·83)

Simulated black rexine, plastic bonded metal case.

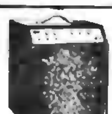
ALSO STOCKED LINEAR T80/100D £69·75

FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.



Solid state. 4 Separately controlled inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3 to 30 ohms. Size 17" × 7" × 7½". 200-250v. A.C. mains. Output 50 watts music rating.
Or deposit £7·25 & 9 monthly payments £3·55. Total £39 20. **£34·95** Carr. 75p.

RSC PHANTOM '50'



Combined 50w Amplifier and 12in. Loudspeaker. For Lead Guitar, mic., Gram, Radio, Tape (Not for use with Bass instruments). Inc. 3 inputs and 2 vol. controls plus Treble, Bass and Presence. Output Jack for additional 15 ohm Speaker. Attractively finished in black with silver-finished fascia and trimmings. Compact size. Fitted carrying handle.
Terms: Deposit £8·95 and 9 monthly payments £6 (Total £62·95). Carr. £1·50 **ONLY £55·95**

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

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

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

FOR BASS GUITAR, ELECT. ORGAN, ETC.

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

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

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

GROUP/DISCO EQUIPMENT PACKAGE OFFERS

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

HIGH QUALITY LOUDSPEAKER UNITS

ALL TWO TONE REXINE AND VYNAIR FINISH
L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1·50 **£34·50**
Or deposit £5·50 and 9 monthly payts. of £3·70. Total £38·80

L12/20 12" 20-25 WATT 13,000 lines 15 ohms. Carr. 50p. **£11·95**

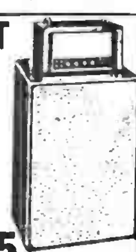
L13 13" × 8" 10 Watt 10,000 lines 3 or 15 ohms. State impedance required. Carr 40p **£5·25**

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

V.A.T!

PRICES QUOTED—INCREASE FROM APRIL 1st.

RSC BASS-REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak Output rating. Loudspeaker unit either horizontal or vertical mounting.
★ Two extra heavy duty 12in. 50w 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 £15 & 9 monthly payments of £6·25. (Total £71·25.) Carr. £2 **£65**

RSC GP30 HI-FI AMPLIFIER

For Guitar, Vocal or Instrumental Group

A 4 input. 2 vol. control Hi-Fi 30 watt unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/silver P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £4·40 and 9 monthly payments of £2 45 (Total £26·45). **£23·50** Carr. 65p

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STOCKPORT 8 LITTLE UNDERBANK
COVENTRY 17 SHELTON SOUARE

NEW LARGER PREMISES AT HULL, DARLINGTON & NEWCASTLE See Addresses

RSC HI-FI CENTRES LTD.

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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. H.M. FORCES. EDUCATION AUTHORITIES & HOSPITALS. Etc.
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With our know-how and our wide experience in teaching, plus your determination to study, we can turn your interest into the technical knowledge you need for success. Once you've got the qualifications you need, you'll be in a good position to take full advantage of the opportunities which exist today in all fields of electronics – in television (colour and black/white) and in radio. (We teach you the theory and practice of valve and transistor portable circuits while you build your own 5 valve receiver, transistor portable and high grade test instruments).

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Tick or state subject of interest and post to:
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Intertext House, Stewarts Road, London SW8 4UJ.

Subject of interest

- ☐ Society of Engineers Graduateship (Electrical Engineering)
- ☐ C & G Telecommunications Technicians Certificates
- ☐ C & G Electrical Installation Work
- ☐ C & G Certificate in Technical Communication Techniques
- ☐ MPT General Certificate in Radio Telegraphy
- ☐ Audio, Radio & TV Engineering & Servicing
- ☐ Electronic Engineering, Maintenance, Engineering systems, Instrumentation & Control systems
- ☐ Computer Engineering and Technology
- ☐ Electrical Engineering, Installations, Contracting, Appliances
- ☐ Self-build radio courses

Name ______

Address ______

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Occupation ______ Age ______

•Accredited by the Council for the Accreditation of Correspondence Colleges•

SOUND BARGAINS

GIANT POWER MULTI-WAVEBAND BROADCAST RECEIVER

WITH 3 in 1 AC/DC POWER SUPPLY SYSTEM
MAINS/BATTERY plus BUILT-IN BATTERY BOOSTER

OUR PRICE +40p P. & P. £10·50

No less than 3 VHP BANDS. Picks up Aircraft Transmissions, Pop Pirates, Taxis, Ambulances, Local Radio, Continental and all BBC. VHF Stations plus fascinating Public Service Transmissions we are not allowed to mention! Even TV sound in certain areas. PLUS A SPECIAL WEATHER-BAND. Frequency ranges: MW540–1600 KHZ. FM88–108MHZ. Airband 108–145 MHZ. VHF 145–175MHZ. 23 semi-conductors—12 transistors, 11 diodes and thermistors. Automatic frequency control. 31" telescopic aerial. Runs off mains AC 230/250 volts or off 4 U11 batteries, or use re-chargeable nickel alkali cell. Finished in strong leather grained case with carrying handle. Approx. size 10¼" × 6¾" × 3¼". Written guarantee Special magnetic ear-piece for personal listening, dry batteries FREE. **HURRY!** Limited quantity Fully guaranteed.

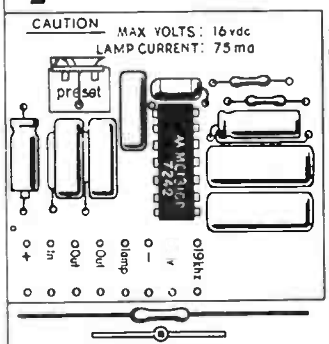
OUR PRICE £28·95 +50p P. & P

Tune into the world with this amazing world radio. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220–240 volt domestic mains supply. 14 Transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the **8 WAVEBANDS**. Complete with earphone for personal listening. Frequency ranges: Long wave 150–350Kcs. Medium 353–1605Kcs. Marine 1·6–4·5Mcs. Short Wave 12–24Mcs. FM/VHF 88–108Mcs. Aircraft 108–135 Mcs. PUBLIC SERVICE BANDS 135–174Mcs. Fully guaranteed.

N.B. The Ministry of Post & Telecommunications has pointed out that a licence (not generally available to the public) is required for reception of transmissions by Fire Brigade, Aircraft, Shipping, etc.

SONIC SOUND AUDIO LTD. (Dept. PW11), 372 EDGWARE ROAD, LONDON, W.2. Tel. 01-723 0094.
Callers welcome Monday to Saturday 9 a.m.–6 p.m.

Stereo radio from your existing tuner.



A complete set of parts from Jermyn to build a stereo decoder module that will convert your existing mono tuner for stereo reception whilst maintaining a high standard of reproduction.

The distortion is very low (typically 0.3% at 560 mV RMS composite input signal) with 40dB channel separation.

The stereo switching is automatic and there is a light emitting diode which acts as a stereo beacon.

The kit requires no coil and there are no alignment problems.

Fitting. The module requires a 10-16 volt power supply which can normally be tapped off the existing tuner. The signal input is taken off before the de-emphasis circuit which in practice means disconnecting one, or at the most, two capacitors. Any radio engineer will be able to spot these capacitors, but if you're really stuck send the circuit with a SAE to us and one of our engineers will indicate the output point. (This is the full extent of our involvement, no hardware please).

Of course, if you have a modern mono tuner with a multiplex output our module simply plugs in.

The outputs go via a screened twin cable to the tuner inputs of your stereo amplifier.

And the cost? £4.90 for the Kit with 100% tested integrated circuit. Also available assembled and aligned, checked and ready for use at £6.90 (includes 12 month guarantee). Beat that!

To Jermyn Industries
74 Vestry Estate
Sevenoaks
Kent

Please rush me ☐ Kit(s). ☐ made up Stereo decoders.
I enclose cheque/postal order for £
Name
Address

Block Capitals Please

There are 195 other good reasons for buying AMTRON electronic kits

Apart from the five items shown above, there are another 195 kits to choose from in the vast AMTRON range of electronic kits.

A few examples of equipment you can construct from AMTRON kits are:

Power supplies, preamplifiers, amplifiers, L.F. instruments, accessories for musical instruments, amateur and radio control transmitters and receivers, battery chargers, electronic car accessories, psychedelic lighting equipment, measuring instruments, tuners, receivers, I.C. digital equipment.

Only 1st class fully guaranteed components are used —solder is included with every kit.

Prices range from £1.10 to £80 and each kit is sold in protective blister pack containing complete instructions.

Should you experience any difficulty in obtaining AMTRON Kits please contact us direct.

PLEASE SEND FOR BROCHURE

AMTRON® UK

TRADE & EDUCATION ENQUIRIES WELCOME

AMTRON U.K. 4 & 7 CASTLE STREET HASTINGS SUSSEX TELEPHONE HASTINGS 2875

ZN414 £1.25 POST FREE

The I.C. Radio in a TO18 can. Supplied complete with data sheet No. 10 which contains specification, circuit and details and prices of components such as ferrite rods, compression trimmers etc.

I.C. Sockets

Dual-in-line or Zig-Zag (Quil), 14 and 16 pin

Our Price 1p per pin

Slider Pots

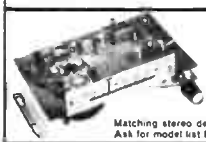
Single	Dual	log
10K	10 + 10K	or
25K	25 + 25K	lin
50K	50 + 50K	
100K	100 + 100K	Knobs
	50p	10p.

NEW LISTS
LOUDSPEAKERS No. 4
COILS AND INDUCTORS No. 5
TRANSFORMERS No. 6
(postage 5p)

Diodes & Rectifiers

AA119	9p	BA156	15p	BY176	£1 50
AA120	9p	BA243	56p	BY182	£1 50
AA129	9p	OA47	10p	BY250	23p
BA102	25p	OA79	9p	IN4001	6p
BA115	17p	OA90	7p	IN4002	7p
BA130	10p	OA91	7p	IN4003	8p
BA145	20p	OA200	10p	IN4004	8p
BA148	20p	BY100	15p	IN4005	10p
BA154	13p	BY126	15p	IN4006	12p
BA155	14p	BY127	15p	IN4007	15p

BZY88 ZENER SERIES 10p each



FM TUNER chassis fully transistorised 9 volt operation. OUR PRICE £6 25

Matching stereo decoder £4 97
Ask for model list No. 11.

VDR's & Thermistors

A15B	75p	GL23	£1 00	VA1005	15p
CZ1	15p	R53	£1 32	VA1026	13p
CZ4	13p	R54	£1 46	VA1033	13p
CZ13A	13p			VA1040	10p
E298 ED A258	10p			VA1053	10p
E298 ZZ/06	10p			VA1055S	10p
GL16	£1			VA1034	10p

Resistors

½ watt 5% Carbon Film - low noise Hi-Stabs
All E24 values 1p each plus p. & p. 7p for up to 50 Resistors and a further 2p for each additional 50 Deduct 33⅓% for 100 of one type or 25% for mixed orders over £1 in value

1 W	10%	Carbon Composition	3p each
2 W	10%	Carbon Composition	6p each
2½ W	5%	Wire wound	9p each
5 W		Wire wound	9p each
10 W		Wire wound	10p each

plus p & p 7p for up to 25 resistors plus 1p for each additional 25

SGS

EA1000

3 Watt Audio Amplifier

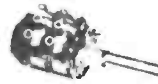
Our Price inc. handbook £2 49

10 + less 15%
25 + less 25%
100 + less 33⅓%

5 Watt Audio Amplifier

Our Price £3 90
Less quantity discount.

Potentiometers



5KΩ	50KΩ	500KΩ
10KΩ	100KΩ	1MΩ
25KΩ	250KΩ	2MΩ

log or lin less switch (& 1KΩ lin)	12p
log or lin with switch	24p
dual less switch	40p
dual with switch 10K, 100K & 1M log only	52p
10K log 10K antilog less switch	40p

Eliminators

9 volt 20mA (PP3)	£1.25
6 volt 50mA	£1.50
9 volt 50mA	£1.50
6 6 volt 50mA	£2.50
9 9 volt, 50mA	£2.50
7½ volt for cassette recorders	£2.00
6, 7½ or 9 volt	£3.00
3, 4½, 6, 7½, 9, 12 500mA (illus.)	£3.99
Car Battery Converter fully stabilised to provide 6, 7½ or 9 volts	£4.99

(p & p 15p on all types)

Presets

Vertical or Horizontal

0 1 watt 5p		0 25 watt 7p		
100	1KΩ	10KΩ	100KΩ	1MΩ
250	2 5KΩ	25KΩ	250KΩ	2 5MΩ
500	5KΩ	50KΩ	500KΩ	5MΩ

Capacitors

disc ceramic		low voltage		
01μF 18v	5p	0·1μF	30v	5p
·022μF 18v	5p	0·22μF	6v	5p
047μF 12v	5p	0·47μF	3v	5p
ceramic plate		30V		
1000pf	10p	4700pf		10p
2200pf	10p	10,000pf		10p

Ceramic plate		63V (C333)	
1 8pf	8 2pf	33pf	120pf
2 2pf	10pf	39pf	150pf
3 3pf	12pf	47pf	180pf
3 9pf	15pf	56pf	220pf
4 7pf	18pf	68pf	270pf
5 6pf	22pf	82pf	330pf
6 8pf	27pf	100pf	

all 5p. each

mylar film		100V			
1000pf	2p	01μF	3p	068μF	4p
2000pf	2p	02μF	3p	1μF	4p
5000pf	2p	04μF	3p	2μF	5p
		·05μF	3p		

polystyrene 160V
10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68. **3p each**

metallised polyester		250V (C280)			
01μF	3p	068μF	3½p	·47μF	8p
015μF	3p	1μF	4p	68μF	11p
022μF	3p	15μF	4p	1μF	13p
033μF	3p	·22μF	5p	1 5μF	20p
047μF	3p	·33μF	6½p	2 2μF	24p

metallised polyester		400V (C281)			
01μF	4½p	047μF	6p	22μF	10p
015μF	4½p	068μF	6p	33μF	14p
·022μF	4½p	1μF	7p	·47μF	15p
033μF	5½p	15μF	8p		

silvered mica 1% (50pf) 500V			
2·2pf—820pf	7p	4·7nF—5600pf	19p
1nF—2·2nf	9p	6800pf—·01μF	29p
2·7nF—3·6nF	16p		

mixed dielectric		600V			
01μF	7p	047μF	7p	22μF	16p
022μF	7p	068μF	8p	47μF	24p
033μF	7p	1μF	8p	1μF	33p

CHROMASONIC electronics

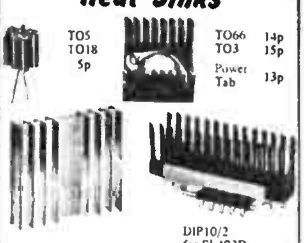
MAIL ORDERS Where no p & p charge is shown a minimum of 7p applies, p & p on overseas orders is charged at cost

ADDRESS TO: **Component Dept.**
56, Fortis Green Road, London N10 3HN
Telephone 01-883 3705

mixed dielectric		1000V			
1000pf	6p	6800pf	9p	1μF	12p
2200pf	6p	01μF	9p	22μF	22p
3300pf	6p	·022μF	9p	47μF	30p
4700pf	6p	·047μF	12p		

Ceramic 12KV.d.c.		8KV.d.c.		HI-K 750V.	
10pf	9p	200pf	9p	1000pf	5p
15pf	9p	220pf	9p	1500pf	5p
22pf	9p	250pf	9p	2000pf	5p
68pf	9p	270pf	9p	3000pf	5p
82pf	9p	300pf	9p	5000pf	5p
100pf	9p	750V OISC		10,000pf	5p
120pf	9p	470pf	5p	feed-through	
140pf	9p	1000pf	5p		
150pf	9p	5000pf	5p		
180pf	9p	10,000pf	5p	1000pf	5p

Heat Sinks



TO5 TO18 5p

TO66 14p
TO3 15p
Power Tab 13p

DIP10/2 for SL403D 15p

10D 50p

Veroboard

	Copperclad 0.1"	Copperclad 0.15"	Plain 0.15"
2½" x 1"	6p	6p	—
2½" x 3¾"	20p	16p (9)	10p
2½" x 5"	24p	21p (7)	12p
3¾" x 3¾"	24p	21p (8)	—
3¾" x 5"	27p	27p (10)	17p
17" x 2½"	67p	50p	37p
17" x 3¾"	90p	70p	52p
17" x 5"	—	—	75p

Spot-face Cutter	36p
Pin Insertion Tool	47p
Terminal Pins	18p per pack of 36

NEW LISTS
BOXES, CHASSIS, etc. No. 7
TRANSISTORS, I.C.'s, etc. (soon)
(postage 5p)

Aluminium Boxes

Including baseplate and screws

No.	L.	W.	D.	Price	p. & p.
(7)	2¾"	x 5¼"	x 1½"	35p	8p
(8)	4"	x 4"	x 1½"	35p	8p
(9)	4"	x 2¾"	x 1½"	35p	8p
(10)	4"	x 5¼"	x 1½"	40p	8p
11	4"	x 2½"	x 2"	35p	8p
12	3"	x 2"	x 1"	32p	9p
13	6"	x 4"	x 2"	50p	10p
14	7"	x 5"	x 2½"	58p	12p
15	8"	x 6"	x 3"	75p	18p
16	10"	x 7"	x 3"	85p	20p

Transistors & Integrated Circuits

AC107	25p	BC147	10p	BF196	15p	OC81	19p	2N1304	22p	2N5172	15p
AC126	17p	BC148	10p	BF197	15p	OC140	20p	2N1711	25p	L005T1	£1 50
AC127	15p	BC149	10p	BF272	53p	OC170	23p	2N1893	30p	L036T1	£1 50
AC128	15p	BC157	12p	BFY50	24p	OC171	30p	2N2926 all	10p	L037T1	£1 50
AC176	15p	BC158	10p	BFY51	21p	ZTX107	15p	2N3053	23p	MC1303L	£1 75
AC187	25p	BC159	12p	BRY39	36p	ZTX108	12p	2N3054	50p	MC1330	80p
AC187K	25p	BC169	15p	BSX21	26p	ZTX109	15p	2N3055	49p	MC1350	75p
AC188	25p	BC268	15p	BSY95A	14p	ZTX300	12p	2N3702	12p	MC1351	£1 00
AC188K	25p	BD115	67p	BU105/02	£1.75	ZTX301	15p	2N3703	12p	MC1352	£1 00
ACY20	20p	BD131	70p	MJE340	67p	ZTX302	20p	2N3704	10p	MFC4000B	49p
AD140	40p	BD132	70p	MPF102	40p	ZTX303	20p	2N3705	10p	MFC4010A	55p
AD149	40p	BD131/2M P		MPF103	37p	ZTX304	25p	2N3706	10p	LM380	£1 45
AD161 AD162	60p		149p	MPF104	37p	ZTX341	20p	2N3707	15p	PA234	£1 99
		BF160	21p	MPF105	40p	ZTX500	15p	2N3708	12p	SL403D	£1 50
AF114	18p	BF167	20p	MPF106	45p	ZTX501	15p	2N3709	12p	TAD100	£1 50
AF115	18p	BF173	20p	OC28	40p	ZTX502	20p	2N3710	12p	FILTER LP1175	£1.50
AF116	18p	BF180	21p	OC35	40p	ZTX503	17p	2N3711	12p	μA709C	34p
AF117	18p	BF181	30p	OC44	15p	ZTX504	50p	2N3819	35p	μA710	45p
AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3903	15p	μA723C	85p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3904	17p	μA741C	47p
BC108	10p	BF194	15p	OC72	17p	2N706	12p	2N3905	21p	μA748C	60p
BC109	10p	BF195	15p	OC76	15p	2N708	15p	2N3906	12p		

THE TEXAN

Complete Kit (inc. Teak Case) **£28.50** P&P 45p

20 Watts per channel integrated stereo amplifier developed by engineers of Texas Instruments Ltd. This designer approved kit, has a state-of-the-art specification, including distortion of only 0.09% at 20 Watts into 8 ohms and a bandwidth of 5 - 35,000 at 3db. The semiconductor compliment of this superb kit includes no less than 6 integrated circuits, 10 Silicon transistors, 4 rectifiers and 2 zeners. Controls include bass; treble, volume, balance, on/off; 'on' indicator, headphone sockets, scratch filter, rumble filter, inputs for magnetic phono, tuner; aux or tape, tape head etc, input; selector; mono/stereo switch. The construction of this kit was featured in 'Practical Wireless' May - Aug 1972.

Mullard & Siemens Electrolytics

CAP μF	VOLTAGE 4	6.3	10	16	25	40	63
1	—	—	—	—	—	—	6p
1·5	—	—	—	—	—	—	6p
2·2	—	—	—	—	—	—	6p
3·3	—	—	—	—	—	—	6p
4·7	—	—	—	—	—	—	6p
6·8	—	—	—	—	—	6p	6p
10	—	—	—	—	6p	—	6p
15	—	—	—	6p	—	6p	6p
22	—	—	6p	—	6p	—	6p
33	—	6p	—	6p	—	6p	—
47	6p	—	6p	—	6p	6p	6p
68	—	6p	—	6p	—	—	10p
100	6p	—	6p	—	6p	6p	12p
150	—	6p	—	6p	6p	10p	12p
220	6p	—	6p	6p	10p	12p	18p
330	6p	—	6p	10p	—	—	21p
470	—	6p	10p	—	12p	18p	40p
680	—	10p	—	12p	18p	21p	—
1000	10p	—	12p	18p	21p	40p	60p
1500	—	12p	18p	21p	—	—	—
2200	—	18p	21p	40p	45p	55p	93p
3300	—	21p	—	—	—	—	—
4700	21p	—	—	60p	75p	93p	—

CAP μF	VOLTAGE 16	25	40	64
500			33p	40p
1250			50p	—
1600			—	75p
2000	40p	50p	—	—
2500	—	—	75p	93p
3200	50p	—	—	—
4000		75p	93p	—
6400	75p	93p	—	—

Quantity Prices on application

Hi~Volt Electrolytics

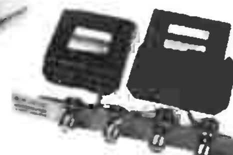
1, 2, 4, 8μF	450V	14p	32μF	450V	20p
16μF	450V	15p	50μF	350V	20p
8 + 8μF, 450 V.W		18p	32 + 32μF, 350 V.W		25p
8 + 16μF, 450 V.W		20p	32 + 32μF, 450 V.W		43p
16 + 16μF, 450 V.W		25p	50 + 50μF, 350 V.W		3[illegible]

UNISOUND FOR THE NEW SOUND

AT **£26·12** INC. VAT

It's the RT-VC system that screws together to save you pounds! Unisound comprises two superb speakers and an amplifier/record deck plinth—all beautifully finished in simulated teak. The stereo amplifier (4 watts per channel into 8 ohms) is based on the famous Mullard Unilex system brought up-to-date by RTVC using intergrated circuits. Turntable is the proven Garrard 2025TC complete with stereo cartridge and tinted acrylic cover. Speakers are big EMI Twin-cone units all ready for mounting in their elegant cabinets, which simply need screwing and glueing together. Easy step-by-step instructions. £26·12 complete plus £1·40 packing + £1·40 post. Diamond Stylus £1·25 extra. Stereo headphones with adaptor £4 extra. Send for leaflet.

AN RTVC EXCLUSIVE DESIGN



UNISOUND MODULES ONLY £6·95 + 50p. p. & p.

For the man who wants to design his own stereo—here's your chance to start, with Unisound—pre-amp, power amplifier and control panel. No soldering—just simply screw together. 4 watts per channel into 8 ohms. Inputs: 120mV (for ceramic cartridge). The heart of Unisound is high efficiency I.C. monolithic power chips very low distortion at all power levels, over the audio spectrum.

RTVC No price in

If you can solder on printed circuit board, you can build this push-button car radio kit. It's simple—just follow the step-by-step instructions.

THE TOURIST PB CAR RADIO KIT

AN INCREDIBLE BUY

ONLY FROM RTVC

The Tourist PB is suitable for 12 volt working on both negative and positive earth vehicles. It covers the full medium and long wave bands. It is permeability tuned and sturdily constructed. Output is a full 2·5 watts into an 8ohms speaker. But the Tourist PB will operate into any loudspeaker from 8 to 15 ohms.

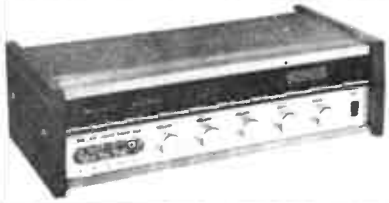
Apart from the output stage, which is an intergrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulised IF stages which are pre-aligned before despatch. As well as electronic components this kit also contains 2 diamond-spun aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

The Tourist PB can be mounted in any standard size dash panel and it has an illuminated tuning scale. Chassis size is: 7" wide, 2" high and 4$\frac{11}{16}$" deep.

* Circuit diagram and comprehensive instructions 50p free with parts.
* Fully retractable lockable car aerial £1·25 post paid.

PRICE ONLY £7·70 p. and p. 55p

Speaker with baffle and fixing strips £1·50. 25 p. & p., post free if bought with the kit. Send for leaflet.



RELIANT MkIV

A GOOD QUALITY AMPLIFIER—12 Watts £10·50 (inc. VAT). 20 Watts £13·50 (inc. VAT)

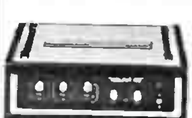
*5 Electrically Mixed inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling INPUTS 1. Crystal Mic or Guitar 9mV. 2. Moving coil Mic. or Guitar 8mV Inputs. 3, 4 & 5 are suitable for a wide range of medium output equipment (Gram. Tuner, Monitor, Organ, etc.) All 250mV sensitivity. Power output: 12/20 watts into 8 ohms. Size approx. 12½ x 6 x 3½ ins.

12W version **£10·50** plus 60p p & p

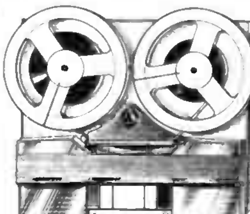
20W version **£13·50**

SOUND 50

50 WATT AMPLIFIER. Output Power: 45 watts R.M.S. (Sine Wave) Frequency Response 3dB points 30Hz and 18KHz. Total Distortion: less than 2% at rated output. Signal to noise ratio: better than 60dB. Bass Control Range: 13dB at 60Hz. Treble Control Range: 12dB at 10KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs conrotlled by separate volume control. 2 inputs at 200mV into 470K. Size: 19½ x 10½ x 8ins. Amplifier £31·85 plus £1·50 p. and p.



£38·51 (inc. VAT)



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PRICES: SYSTEM I

Viscount III R 101 amplifier	£24·20	+ £1 p & p
2 Duo Type II speakers	£15·40	+ £2·20 p & p
Garrard SP25 Mk.III with MAG. cartridge plinth & cover	£25·00	+ £1·75 p & p
total	£64·60	

Available complete for only £52* + £3·50 p & p

PRICES: SYSTEM 2

Vicount R 101 amplifier	£24·20	+ £1 p & p
2 Duo Type III speakers	£35·20	+ £3·30 p & p
Garrard SP25 Mk. III with MAG. cartridge plinth & cover	£25·00	+ £1·75 p & p
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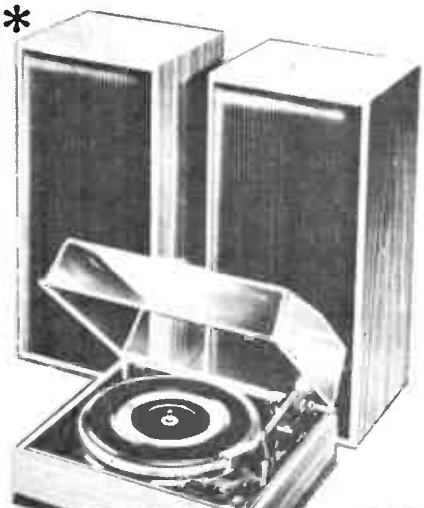
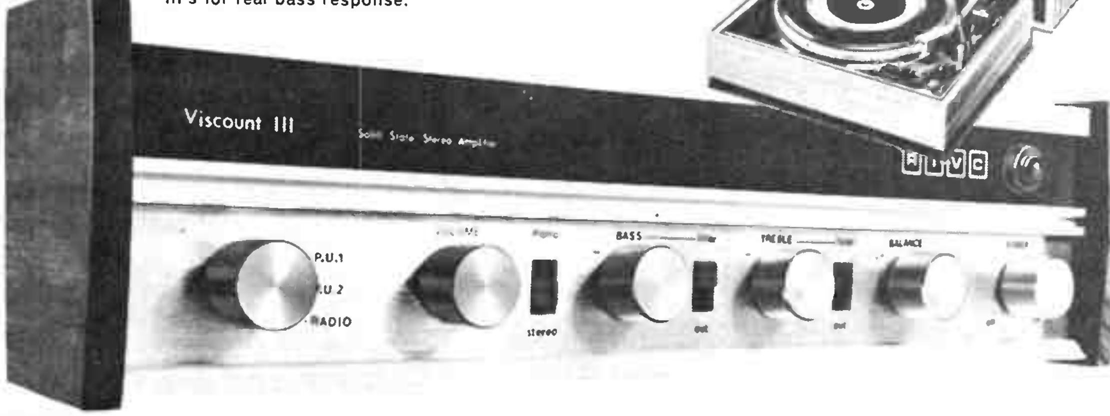


14 + 14w. r.m.s. 40Hz to 40kHz ± 3dB. Total distortion at 10w. at 1kHz - 0·1%. This is real value for money! We have designed 2 systems and the heart of them both is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect, transistors) are incorporated on the input stages, just like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder.

For both systems we have chosen the famous Garrard SP25 Mk. III deck, with fitted magnetic cartridge, which comes complete with simulated teak plinth and tinted acrylic cover.

The exclusive Duo loudspeaker systems are incomparable for quality within their price range. Large speakers in extremely substantial cabinets. There's a choice of the Duo II's for the smaller room or the big Duo III's for real bass response.



SPEAKERS: Duo Type II Size approx. 17in. × 10¾in. × 6¾in. Drive unit 13in. × 8in. with parasitic tweeter. Max. power 10 watts ohms. Simulated Teak cabinet. £15·40 a pair (inc. VAT), £3·30 p. and p. Duo Type III Size approx. 23½in. × 11½in. × 9½in. Drive unit 13½in. 8½in. with H.F. speaker. Max. power 20 watts ohms. Freq. range 20Hz to 20KHz. Teak veneer cabinet.
SPECIFICATION R101: 14 watts per channel into 3 to 4 ohms (suitable 3–15 ohms.) Total distortion @ 10W 1kHz @ 0·1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within idB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. Signal-to-noise ratio: (all controls at max.)—P.U.I. and radio — 65dB, P.U.2 — 58dB. Cross talk better than — 35dB on all inputs. Size approx. 13¾in. × 9in. × 3¾in. Send S.A.E. for fully illustrated brochure. 12 month's written guarantee.

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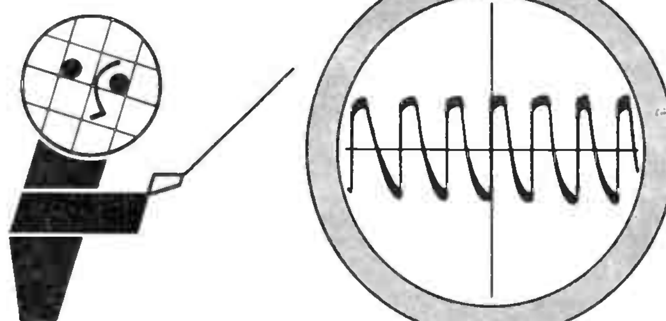

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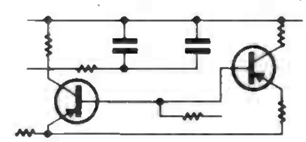

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AC107	0·20	AD162	0·33	BC148	0·10	BD137	0·45	BF188	0·40	OC19	0·35	2G371	0·16	2N2219	0·20	2N3054	0·46	2N4059	0·10
AC113	0·20	AD161 &		BC149	0·12	BD138	0·50	BF194	0·12	OC20	0·63	2G371B	0·12	2N2220	0·22	2N3055	0·50	2N4060	0·12
AC115	0·23	AD162 (MP)		BC150	0·18	BD139	0·55	BF195	0·12	OC22	0·38	2G373	0·17	2N2221	0·20	2N3391	0·14	2N4061	0·18
AC117K	0·20		0·55	BC151	0·20	BD140	0·60	BF196	0·14	OC23	0·42	2G374	0·17	2N2222	0·20	2N3391A	0·16	2N4062	0·12
AC122	0·12	ADT140	0·50	BC152	0·17	BD155	0·80	BF197	0·14	OC24	0·56	2G377	0·30	2N2368	0·17	2N3392	0·14	2N4284	0·17
AC125	0·17	AF114	0·24	BC153	0·28	BD175	0·60	BF200	0·45	OC25	0·38	2G378	0·16	2N2369	0·14	2N3393	0·14	2N4285	0·17
AC126	0·17	AF115	0·24	BC154	0·30	BD176	0·60	BF222	0·95	OC26	0·25	2G381	0·16	2N2369A	0·14	2N3394	0·14	2N4286	0·17
AC127	0·17	AF116	0·24	BC157	0·18	BD177	0·65	BF257	0·45	OC28	0·50	2G382	0·16	2N2411	0·24	2N3395	0·17	2N4287	0·17
AC128	0·17	AF117	0·24	BC158	0·12	BD178	0·65	BF258	0·60	OC29	0·50	2G401	0·30	2N2412	0·24	2N3402	0·21	2N4288	0·17
AC132	0·14	AF118	0·35	BC159	0·12	BD179	0·70	BF259	0·85	OC35	0·42	2G414	0·30	2N2646	0·47	2N3403	0·21	2N4289	0·17
AC134	0·14	AF124	0·30	BC160	0·45	BD180	0·70	BF262	0·55	OC36	0·50	2G417	0·25	2N2711	0·21	2N3404	0·28	2N4290	0·17
AC137	0·14	AF125	0·25	BC161	0·50	BD185	0·65	BF263	0·55	OC41	0·20	2N388	0·35	2N2712	0·21	2N3405	0·42	2N4291	0·17
AC141	0·14	AF126	0·28	BC167	0·12	BD186	0·65	BF270	0·35	OC42	0·24	2N388A	0·55	2N2714	0·21	2N3414	0·15	2N4292	0·17
AC141K	0·17	AF127	0·28	BC168	0·12	BD187	0·70	BF271	0·30	OC44	0·15	2N404	0·20	2N2904	0·17	2N3415	0·15	2N4293	0·17
AC142	0·14	AF139	0·30	BC169	0·12	BD188	0·70	BF272	0·80	OC45	0·12	2N404A	0·28	2N2904A	0·21	2N3416	0·28	2N5172	0·12
AC142K	0·17	AF178	0·50	BC170	0·12	BD189	0·75	BF273	0·35	OC70	0·10	2N524	0·42	2N2905	0·21	2N3417	0·28	2N5457	0·32
AC151	0·15	AF179	0·50	BC171	0·14	BD190	0·75	BF274	0·35	OC71	0·10	2N527	0·49	2N2905A	0·21	2N3525	0·75	2N5458	0·32
AC154	0·20	AF180	0·50	BC172	0·14	BD195	0·85	BFW10	0·60	OC72	0·14	2N598	0·42	2N2906	0·15	2N3646	0·09	2N5459	0·40
AC155	0·20	AF181	0·45	BC173	0·14	BD196	0·85	BFX29	0·27	OC74	0·14	2N599	0·45	2N2906A	0·18	2N3702	0·10	2S301	0·50
AC156	0·20	AF186	0·45	BC174	0·14	BD197	0·90	BFX84	0·22	OC75	0·15	2N696	0·12	2N2907	0·20	2N3703	0·10	2S302A	0·42
AC157	0·24	AF239	0·37	BC175	0·22	BD198	0·90	BFX85	0·30	OC76	0·15	2N697	0·13	2N2907A	0·22	2N3704	0·11	2S302	0·42
AC165	0·20	AL102	0·65	BC177	0·19	BD199	0·95	BFX86	0·22	OC77	0·25	2N698	0·24	2N2923	0·14	2N3705	0·10	2S303	0·55
AC166	0·20	AL103	0·65	BC178	0·19	BD200	0·95	BFX87	0·24	OC81	0·15	2N699	0·35	2N2924	0·14	2N3706	0·09	2S304	0·70
AC167	0·20	ASY26	0·25	BC179	0·19	BD205	0·80	BFX88	0·22	OC81D	0·15	2N706	0·08	2N2925	0·14	2N3707	0·11	2S305	0·84
AC168	0·24	ASY27	0·30	BC180	0·24	BD206	0·80	BFY50	0·20	OC82	0·15	2N706A	0·09	2N2926 (G)		2N3708	0·07	2S306	0·84
AC169	0·14	ASY28	0·25	BC181	0·24	BD207	0·95	BFY51	0·20	OC82D	0·15	2N708	0·12		0·12	2N3709	0·09	2S307	0·84
AC176	0·20	ASY29	0·25	BC182	0·10	BD208	0·95	BFY52	0·20	OC83	0·20	2N711	0·80	2N2926 (Y)		2N3710	0·09	2S321	0·56
AC177	0·24	ASY50	0·25	BC182L	0·10	BDY20	1·00	BFY53	0·17	OC84	0·20	2N717	0·85		0·11	2N3711	0·09	2S322	0·42
AC178	0·28	ASY51	0·25	BC183	0·10	BF115	0·24	BPX25	0·85	OC139	0·20	2N718	0·24	2N2926 (O)		2N3819	0·28	2S322A	0·42
AC179	0·28	ASY52	0·25	BC183L	0·10	BF117	0·45	BSX19	0·15	OC140	0·20	2N718A	0·50		0·10	2N3820	0·50	2S323	0·56
AC180	0·17	ASY54	0·25	BC184	0·12	BF118	0·70	BSX20	0·15	OC169	0·25	2N726	0·28	2N2926 (R)		2N3821	0·35	2S324	0·70
AC180K	0·20	ASY55	0·25	BC184L	0·12	BF119	0·70	BSY25	0·15	OC170	0·25	2N727	0·28		0·10	2N3823	0·28	2S325	0·70
AC181	0·17	ASY56	0·25	BC186	0·28	BF121	0·45	BSY26	0·15	OC171	0·25	2N743	0·20	2N2926 (B)		2N3903	0·28	2S326	0·70
AC181K	0·20	ASY57	0·25	BC187	0·28	BF123	0·50	BSY27	0·15	OC200	0·25	2N744	0·20		0·10	2N3904	0·30	2S327	0·70
AC187	0·22	ASY58	0·25	BC207	0·11	BF125	0·45	BSY28	0·15	OC201	0·28	2N914	0·14	2N3010	0·70	2N3905	0·28	2S701	0·42
AC187K	0·20	ASZ21	0·40	BC208	0·11	BF127	0·50	BSY29	0·15	OC202	0·28	2N918	0·30	2N3011	0·14	2N3906	0·27	40361	0·40
AC188	0·22	BC107	0·09	BC209	0·12	BF152	0·55	BSY38	0·18	OC203	0·25	2N929	0·21	2N3053	0·17	2N4058	0·12	40362	0·45
AC188K	0·20	BC108	0·09	BC212L	0·11	BF153	0·45	BSY39	0·18	OC204	0·25	2N930	0·21						
ACY17	0·25	BC109	0·10	BC213L	0·11	BF154	0·45	BSY40	0·28	OC205	0·35	2N1131	0·20						
ACY18	0·20	BC113	0·10	BC214L	0·14	BF155	0·70	BSY41	0·28	OC309	0·40	2N1132	0·22						
ACY19	0·20	BC114	0·15	BC225	0·25	BF156	0·48	BSY95	0·12	P346A	0·20	2N1302	0·14	**DIODES AND RECTIFIERS**					
ACY20	0·20	BC115	0·15	BC226	0·35	BF157	0·65	BSY95A	0·12	P397	0·42	2N1303	0·14	AA119	0·08	BY133	0·21	OA10	0·35
ACY21	0·20	BC116	0·15	BCY30	0·24	BF158	0·55	BU105	2·00	OCP71	0·43	2N1304	0·17	AA120	0·08	BY164	0·50	OA47	0·07
ACY22	0·16	BC117	0·15	BCY31	0·26	BF159	0·60	C111E	0·50	ORP12	0·43	2N1305	0·17	AA129	0·08	BYX38/30		OA70	0·07
ACY27	0·18	BC118	0·10	BCY32	0·30	BF160	0·40	C400	0·30	ORP60	0·40	2N1306	0·21	AAY30	0·09		0·42	OA79	0·07
ACY28	0·19	BC119	0·30	BCY33	0·22	BF162	0·40	C407	0·25	ORP61	0·40	2N1307	0·21	AAZ13	0·10	BYZ10	0·35	OA81	0·07
ACY29	0·35	BC120	0·80	BCY34	0·25	BF163	0·40	C424	0·20	ST140	0·12	2N1308	0·23	BA100	0·10	BYZ11	0·30	OA85	0·09
ACY30	0·28	BC125	0·12	BCY70	0·14	BF164	0·40	C425	0·60	ST141	0·17	2N1309	0·28	BA116	0·21	BYZ12	0·30	OA90	0·06
ACY31	0·28	BC126	0·18	BCY71	0·18	BF165	0·40	C426	0·35	TI843	0·80	2N1613	0·20	BA126	0·22	BYZ13	0·25	OA91	0·06
ACY34	0·21	BC132	0·12	BCY72	0·14	BF167	0·22	C428	0·20	UT46	0·27	2N1711	0·20	BA148	0·14	BYZ16	0·40	OA95	0·07
ACY35	0·21	BC134	0·18	BCZ10	0·20	BF173	0·22	C441	0·30	2G301	0·09	2N1889	0·32	BA154	0·12	BYZ17	0·35	OA200	0·06
ACY36	0·28	BC135	0·12	BCZ11	0·25	BF176	0·35	C442	0·30	2G302	0·19	2N1890	0·45	BA155	0·14	BYZ18	0·35	OA202	0·07
ACY40	0·17	BC136	0·15	BCZ12	0·25	BF177	0·35	C444	0·35	2G303	0·19	2N1893	0·37	BA156	0·13	BYZ19	0·28	SD10	0·05
ACY41	0·18	BC137	0·15	BD121	0·60	BF178	0·30	C450	0·22	2G304	0·24	2N2147	0·72	BY100	0·15	CG62		SD19	0·05
ACY44	0·35	BC139	0·40	BD123	0·65	BF179	0·30	MAT100	0·19	2G306	0·40	2N2148	0·57	BY101	0·12	(Eg) OA91		IN34	0·07
AD130	0·38	BC140	0·30	BD124	0·60	BF180	0·30	MAT101	0·20	2G308	0·35	2N2160	0·60	BY105	0·17		0·05	IN34A	0·07
AD140	0·48	BC141	0·30	BD131	0·50	BF181	0·30	MAT120	0·19	2G309	0·35	2N2192	0·35	BY114	0·12	CG651		IN914	0·06
AD142	0·48	BC142	0·30	BD132	0·60	BF182	0·40	MAT121	0·20	2G339	0·20	2N2193	0·35	BY126	0·14	(Eq) OA70-		IN916	0·06
AD143	0·38	BC143	0·30	BD133	0·65	BF183	0·40	MPF102	0·42	2G339A	0·16	2N2194	0·35	BY127	0·15	OA79	0·06	IN414B	0·06
AD149	0·50	BC145	0·45	BD135	0·40	BF184	0·25	MPF104	0·37	2G344	0·18	2N2217	0·22	BY128	0·15	OA5	0·35	IS021	0·10
AD161	0·33	BC147	0·10	BD136	0·40	BF185	0·30	MPF105	0·37	2G345	0·16	2N2218	0·20	BY130	0·16	OA5SL	0·21	IS951	0·06

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C 7	1	Pack Wire 50 metres assorted colours	0·50
C 8	10	Reed Switches	0·50
C 9	3	Micro Switches	0·50
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C17	10	Assorted Control Knobs	0·50
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PIV	1A	3A	5A	5A	7A	10A	16A	30A
	TO5	TO66	TO66	TO64	TO48	TO48	TO48	TO48
50	0·23	0·25	0·35	0·35	0·47	0·50	0·53	1·15
100	0·25	0·33	0·47	0·47	0·50	0·58	0·63	1·40
200	0·35	0·37	0·49	0·49	0·57	0·61	0·75	1·60
400	0·43	0·47	0·56	0·56	0·67	0·75	0·93	1·75
600	0·53	0·57	0·68	0·68	0·77	0·97	1·25	—
800	0·65	0·70	0·80	0·80	0·90	1·20	1·50	4·00

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PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·05	0·05	0·07	0·14	0·21	0·60
100	0·04	0·06	0·06	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·25	0·34	0·45	1·86
800	0·10	0·17	0·11	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·14	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·38	0·57	0·75	—

TRIACS

VBOM	2A	6A	10A
	TO-1	TO-66	TO-88
	£p	£p	£p
100	30	50	76
200	50	60	90
400	70	75	1-10

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FOR USE WITH TRIACS
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Coded and Guaranteed

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

All 50p each pak

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

120 VCB MIXIE DRIVER TRANSISTOR. Sim. BSX21 & C407, 2N1893 FULLY TESTED AND CODED ND 120. 1-24 17p each. TO.5 N.P.N. 25 up 15p each.

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

FULL RANGE OF ZENER DIODES VOLTAGE RANGE

2-33V. 400mW (DO-7 Case) 13p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 25p ea. All fully tested 5% tol. and marked. State voltage required.

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

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Plastic Encapsulated
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50 v RMS	32p each
100 v RMS	37p ..
400 v RMS	46p ..

Size 15 mm × 6 mm.

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ORP60, ORP61 40p each

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50	For	1·00
100	For	1·75
500	For	7·50
1000	For	13·00

SIL. G.P. DIODES £p

300mW	30	0·50
40PIV(Min.)	100	1·50
Sub-Min.	500	5·00
Full Tested	1,000	9·00

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U3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·50
U4	40	Germanium Transistors like OC81, AC128	0·50
U5	60	200mA Sub-Min. Silicon Diodes	0·50
U6	30	Sil. Planar Trans. NPN like BSY95A, 2N706	0·50
U7	16	Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·50
U8	50	Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·50
U9	20	Mixed Voltages, 1 Watt Zener Diodes	0·50
U10	20	BAY50 charge storage Diodes DO-7 Glass	0·50
U11	25	PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·50
U12	12	Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·50
U13	30	PNP-NPN Sil. Transistors OC200 & 2S 104	0·50
U14	150	Mixed Silicon and Germanium Diodes	0·50
U15	25	NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·50
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·50
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·50
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·50
U19	25	Silicon NPN Transistors like BC108	0·50
U20	12	1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·50
U21	30	AF. Germanium Alloy Transistors 2G300 Series & OC71	0·50
U23	30	MADT's like MHz Series PNP Transistors	0·50
U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·50
U25	25	300 MHz NPN Silicon Transistors 2N708, BSY27	0·50
U26	30	Fast Switching Silicon Diodes like 1N914 Micro-Min.	0·50
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·50
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·00
U30	15	Plastic Silicon Planar Trans. NPN 2N2926	0·50
U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·50
U32	25	Zener Diodes 400mW DO-7 case 3-18 volts mixed	0·50
U33	15	Plastic Case 1 Amp Silicon Rectifiers 1N4000 Series	0·50
U34	30	Silicon PNP Alloy Trans. TO-5 BCY26 2S302/4	0·50
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·50
U36	25	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·50
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U38	20	Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·50
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U40	10	Dual Transistors 6 lead TO-5 2N2060	0·50
U41	25	RF Germanium Transistors TO-5, OC45, NKT72	0·50
U42	10	VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·50
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U44	20	Sil. Trans. Plastic TO-5 BC115/NPN	0·50
U45	7	3A SCR. TO66 up to 600PIV	1·00

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

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Q5	4	OC 75 transistors	0·50
Q6	5	OC 72 transistors	0·50
Q7	4	AC 128 transistors PNP high gain	0·50
Q8	4	AC 126 transistors PNP	0·50
Q9	7	OC 81 type transistors	0·50
Q10	7	OC 71 type transistors	0·50
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·50
Q12	3	AF 116 type transistors	0·50
Q13	3	AF 117 type transistors	0·50
Q14	3	OC 171 H.F. type transistors	0·50
Q15	7	2N2926 Sil. Epoxy transistors mixed colours	0·50
Q16	2	GET880 low noise Germanium transistors	0·50
Q17	5	NPN 2 × ST.141 & 3 × ST.140	0·50
Q18	4	MADT'S 2 × MAT 100 & 2 × MAT 120	0·50
Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·50
Q20	4	OC 44 Germanium transistors A.F.	0·50
Q21	4	AC 127 NPN Germanium transistors	0·50
Q22	20	NKT transistors A.F. R.F. coded	0·50
Q23	10	OA 202 Silicon diodes sub-min.	0·50
Q24	8	OA 81 diodes	0·50
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·50
Q26	8	OA95 Germanium diodes sub-min IN69	0·50
Q27	2	10A PIV Silicon rectifiers IS425R	0·50
Q28	2	Silicon power rectifiers BYZ 13	0·50
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7	Silicon switch transistors 2N706 NPN	0·50
Q31	6	Silicon switch transistors 2N708 NPN	0·50
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·50
Q33	3	Silicon NPN transistors 2N1711	0·50
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·50
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·50
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·50
Q37	3	2N3053 NPN Silicon transistors	0·50
Q38	7	NPN transistors 4 × 2N3703, 3 × 2N3702	0·50

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The MK Slide Rule, designed to simplify Electronic calculations features the following scales:— Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and 'e' Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 2 cm × 4cm. Complete with case and instructions.

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Qty.	1-24	25-99	100 up
Price each	45p	40p	35p

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INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00	12 × 7400	0·50	UIC46	5 × 7446	0·50	UIC86	5 × 7486	0·50
UIC01	12 × 7401	0·50	UIC47	5 × 7447	0·50	UIC90	5 × 7490	0·50
UIC02	12 × 7402	0·50	UIC48	5 × 7448	0·50	UIC91	5 × 7491	0·50
UIC03	12 × 7403	0·50	UIC50	12 × 7450	0·50	UIC92	5 × 7492	0·50
UIC04	12 × 7404	0·50	UIC51	12 × 7451	0·50	UIC93	5 × 7493	0·50
UIC05	12 × 7405	0·50	UIC53	12 × 7453	0·50	UIC94	5 × 7494	0·50
UIC06	8 × 7406	0·50	UIC54	12 × 7454	0·50	UIC95	5 × 7495	0·50
UIC07	8 × 7407	0·50	UIC60	12 × 7460	0·50	UIC96	5 × 7496	0·50
UIC10	12 × 7410	0·50	UIC70	8 × 7470	0·50	UIC100	5 × 74100	0·50
UIC13	8 × 7413	0·50	UIC72	8 × 7472	0·50	UIC121	5 × 74121	0·50
UIC20	12 × 7420	0·50	UIC73	8 × 7473	0·50	UIC141	5 × 74141	0·50
UIC30	12 × 7430	0·50	UIC74	8 × 7474	0·50	UIC151	5 × 74151	0·50
UIC40	12 × 7440	0·50	UIC75	8 × 7475	0·50	UIC154	5 × 74154	0·50
UIC41	5 × 7441	0·50	UIC76	8 × 7476	0·50	UIC193	5 × 74193	0·50
UIC42	5 × 7442	0·50	UIC80	5 × 7480	0·50	UIC199	5 × 74199	0·50
UIC43	5 × 7443	0·50	UIC81	5 × 7481	0·50			
UIC44	5 × 7444	0·50	UIC82	5 × 7482	0·50	UICXI	25 Assorted 74's	1·50
UIC45	5 × 7445	0·50	UIC83	5 × 7483	0·50			

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

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Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACE.:– OC25-28-29-30-35-36. NKT 401-403-404-405-406-430-451-452-453. TI3027-3028. 2N250A. 2N456A-457A-458A. 2N511 A & B. 2G220-222, ETC. VCBO 80V VCEO 50V IC 10A PT. 30 WATTS Hfe 30–170.

PRICE	1-24	25-99	100 up
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SILICON High Voltage 250V NPN TO-3 case. G.P. Switching & Amplifier Applications. Brand new Coded R 2400 VCBO 250/VCEO 100/IC 6A/30 Watts. HFE type 20/fT 5MHZ.
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2N3055

115 WATT SIL POWER NPN 50p EACH

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SN7430	0·15	0·14	0·12	SN7493	0·67	0·64	0·58	SN74181	£5·50	£5·00	£4·75
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SN7442	0·67	0·64	0·58	SN74107	0·40	0·38	0·36	SN74194	£2·70	£2·60	£2·50
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BP 710—72710	44p	42p	40p
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S.G.S. EA1000 2·68

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BP945	25p	24p	22p
BP946	12p	11p	10p
BP948	25p	24p	22p
BP951	65p	60p	55p
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BP9099	40p	38p	35p

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

NUMERICAL INDICATOR TUBES

MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·5	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1·70	£1·55	£1·90

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

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TSO 16	35p	32p	30p
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BPS 14	15p	13p	11p
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50W pk 25w (RMS)

0·1% DISTORTION!
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THE AL50

★ Frequency Response 15Hz to 100,000—1dB.

★ Load—3, 4, 8 or 16 ohms.

★ Distortion—better than ·1% at 1KHz.

★ Signal to noise ratio 80dB.

ONLY **£3.25p** each

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★ Overall size 63mm × 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.F. amplification needs.
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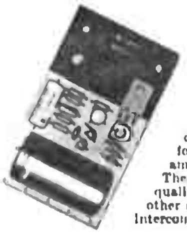
STABILISED POWER MODULE SPM80



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

TRANSFORMER BMT80 £1·95 p. & p. 25p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz — 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs: 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB, from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters: Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than — 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

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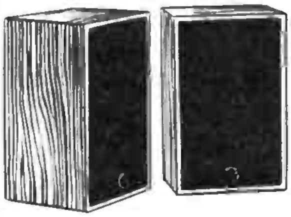
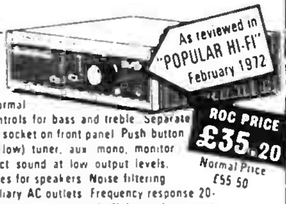


R.088 MATCHED STEREO LOUD SPEAKERS. Here's real value in stereo speakers! Each unit comes complete with 10-foot lead and phono plug, and look really smart. Power handling per speaker: 4 watts rms, 8 watts peak. Frequency range: 40-16,000 Hz. Flux density: 8,500 gauss. Impedance: 8 ohms. Dimensions: 9" high, 5½" wide, 4¾" deep. Finish: oiled walnut.

ROC PRICE £9·50 pair.

Normal Price £10 75



REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500

A superb hi fi amplifier with all the features you've ever wanted - for under £46 00 Saving over £10 00 on the normal retail value Up-to-the-minute slider controls for bass and treble Separate volume and balance controls. Headphone socket on front panel Push button input controls – magnetic phono (high low) tuner, aux mono, monitor Loudness push-button control for perfect sound at low output levels. Left and right push-button on/off switches for speakers Noise filtering and tape monitoring facilities. Two auxiliary AC outlets Frequency response 20-20,000 Hz - 1 db at full power 15 watts rms per channel Walnut cabinet with satin aluminium trims Inputs phono 2 5mV and 5mV RIAA, tuner aux 250mV Hum and noise: phono - 50db; tuner aux - 65db How's that for a specification! Size 14¼" wide, 3½" high 10½" deep

OLSON RA-310 AM FM MPX STEREO TUNER

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier In price and value, as well as it's good looking design! But of course it's also ideal for use with any other amplifier The RA 310 costs £10 00 less than the normal retail value and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station holding capability You can connect this Tuner to a stereo amplifier to a tape deck or a tape recorder And of course it covers all the stations in the AM and FM bands FM 87-108 MHz, AM 525 1605 kHz FM Sensitivites FM 3μV AM, 250μV Stereo separation 30dB at 1kHz, image rejection 60dB. Size 11$\frac{1}{16}$" wide, 4" high, 7½" deep.

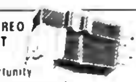
REALISTIC SA-100B 6-WATT STEREO AMPLIFIER

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide 3" high 5⅞" deep And yet it has separate ganged volume, balance and tone controls Plus speaker in out, mono/stereo, phono/tuner and power on off slide switches The ends are oiled walnut, with matching enamelled metal top The front panel is satin aluminium and walnut-brown enamel Frequency response is 50 to 10 000 Hz 3dB. Output 3 watts r.m.s. per channel into 8 ohms Inputs are 100mV for both phono and tuner.

TEC HR-007 HEADPHONE RADIO

When you want to listen to the radio all by yourself. Then this will solve the problem. Separate volume and tuning controls with easy to use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW.

Normal Price £[illegible] **ROC PRICE £5·80**



EAGLE LC 07 STEREO MOVING-MAGNET CARTRIDGE

Here's your opportunity to own a transcription cartridge for the price of a ceramic! Is specially designed to match top quality tone arms, and to get the very best from your hi-fi amplifier. 0 7 mil diamond stylus Output, 7mV per channel Frequency range 20-21,000 Hz. Channel balance - 1dB. Channel separation 28dB Compliance 12 10-6 cm/dyne.

ROC PRICE £6 37

OLSON AM-395 40-WATT STEREO AMPLIFIER

An ideal unit for your new stereo separate system. It is more than £10 00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3 0mV RIAA, crystal phono 100mV, tape 160mV, tuner 160mV. Size 11$\frac{1}{16}$" wide, 4" high, 7½" deep. The specification reads well – sounds even better!

A-3000 36-WATT SOLID STATE STEREO AMPLIFIER

The A-3000 looks as good as it sounds! Giving you a big performance this superb audio amplifier has a full range of facilities on the front and rear panels. On the front – all the controls you're ever likely to need plus a headphone socket. On the rear – signal inputs, speaker outputs and a line fuse for circuit protection.

Specifications: 18 watts rms per channel into 8 ohms. Frequency response 20-35,000 Hz (± 2db) Inputs Magnetic, Ceramic, Tuner, Tape, Aux, Tape Play. Size: 345mm × 300mm × 130mm.

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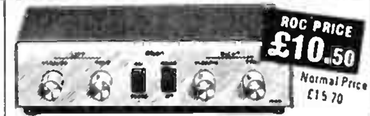
R.446 3-WAY MATCHED SPEAKERS

These will do justice to your amplifier - and to your pocket At only £20 00 a pair they are real value for-money. Each cabinet is heavily lagged and teak finished They handle 16 watts rms (8 watts rms each) Each loudspeaker contains a 6½" base unit plus tweeter Frequency range 40 to 19,000 Hz Size 14" high 9" wide 6¼" deep

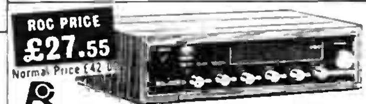


OLSON AM-400 4 WATT STEREO AMPLIFIER

Here's marvellous value for someone just starting to set themselves up in audio! At only £10 50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz - 3dB. Output 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV, tuner/aux 80mV. Size 8" wide, 2¾" high, 4¾" wide.

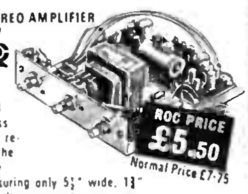
25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-56

This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units an 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r m.s into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10¾" × 7½" × 8¾". Exactly right for matching the most modern decor.



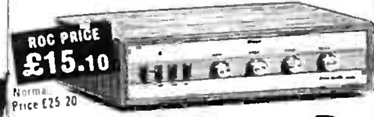
PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-16

This is one of the lowest priced stero tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received – that's the time to switch to "Stereo"! The SSA-16 has all the facilities you'd expect to find on tuners costing twice as much – separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz, AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4¾" high, 8" deep.



ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317

This exclusive R O C Stereo Chassis is completely self-contained, and it costs £2 25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5½" wide, 1¾" high and 6¼" deep It contains its own mains power supply, and has a ganged volume control and separate treble controls for each channel. Specification: frequency response 40-17 000 Hz ± 3dB; output 3 5 watts music power per channel into 8 ohms, input, phono, 600mV; signal-to-noise ratio better than 45dB.



OLSON AM-372 16-WATT STEREO AMPLIFIER

Here's a really good amplifier at a really down-to-earth price – nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you – reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 8 watts r m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12¼" wide, 3½" high, 7½" deep.

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1A3	.23	6BR8	.63	6R7G	.35	14H7	.48	90C1	.59	EAF801	.50
1A7GT	.32	6BS7	1·25	6R7M	55	14S7	.75	90CG	1·70	EB34	.20
1B3GT	.35	6BW6	.72	6SA7M	.35	19AQ5	.24	150B2	.58	EB91	.10
1H5GT	.33	6BW7	.50	6SC7GT	.33	19G6	.50	807	.59	EBC41	.48
1L4	.13	6BZ6	.31	6SG7	.33	20D4	1·05	5702	·80	EBC81	.29
1N5GT	.37	6CB6A	.26	6SH7	.53	20F2	.65	5763	.50	EBF80	.30
1R5	.26	6C4	·28	6SJ7	.35	20L1	.98	7475	70	EBF83	.38
1S4	.22	6C9	.73	6SK7GT	.23	20P1	.50	AC/PEN	·98	EBF89	.26
1U4	.29	6CD6G	1.06	6SQ7GT	.38	20P3	.76	AC2/PEN/		EBL21	.60
1U5	.48	6CG8A	.50	6U4GT	60	20P4	.89	DD	.98	EC86	.59
2D21	.35	6CH6	.38	6V6G	.17	20P5	1.00	AC6PEN	.38	EC88	.59
2GK5	·50	6CL6	.43	6V6GT	.27	25A6G	.29	AC/TH1	·50	EC92	.34
3A4	.25	6CM7	·50	6X4	.20	25L6G	.20	AC/TP	.98	ECC33	1.50
3D6	.19	6CU5	.30	6X5GT	.25	25Y5G	.43	AL60	.78	ECC35	·95
3Q4	.38	6CW4	.63	7B6	.58	25Z4G	.28	ATP4	.12	ECC40	.60
3Q5GT	.35	6DE7	.50	7B7	.32	25Z5	.40	AZ1	.40	ECC81	.16
3S4	.23	6DT6A	.50	7H7	.28	25Z6G	.43	AZ31	.46	ECC82	.19
4CB6	·50	6EW6	.55	7R7	.65	30A5	.44	AZ41	.53	ECC83	.21
5CG8	50	6E5	.55	7Y4	.60	30C15	.55	CL33	.90	ECC84	·28
5T4	·30	6F1	.59	7Z4	.50	30C17	.74	CV63	.53	ECC85	.32
5U4G	30	6F6	.63	9BW6	·50	30C18	.58	CY1C	.53	ECC88	.35
5V4G	.33	6F13	·33	9D7	.78	30F5	.61	CY31	.29	ECC189	.48
5Y3GT	.25	6F14	.40	10C2	.49	30FL1	.58	DAF91	.20	ECC807	1·70
5Z4G	33	6F18	.45	10DE7	.50	30FL2	.58	DAF96	.33	ECF80	.27
5Z4GT	·38	6F23	.65	10F1	.75	30FL12	.67	DC90	.80	ECF82	.25
6/30L2	.53	6F24	.68	10F9	.45	30FL13	.47	DF91	.14	ECF86	.64
6A8G	.33	6F25	.51	10F18	.35	30FL14	.66	DF96	.34	ECF804	
6AC7	.15	6F28	.60	10LD11	.53	30L15	.55	DH76	.28		2.10
6AG5	.25	6F32	.15	10P13	.54	30L17	.65	DK40	.55	ECH21	.63
6AH6	.50	6GH8A	.50	10P14	1.08	30P4MR	.95	DK92	.35	ECH35	.50
6AJ5	.75	6GK5	·50	12A6	.63	30P12	.69	DK96	.35	ECH42	.57
6AK5	.25	6GU7	.50	12AC6	.40	30P19/		DL92	.23	ECH81	.25
6AK6	.30	6H6GT	.15	12AD6	.40	30P4	.55	DL96	.35	ECH83	.38
6AM8A	·50	6J5G	.19	12AE6	.48	30PL1	.57	DM70	.30	ECH84	.34
6AN8	·49	6J5GT	.29	12AT6	.23	30PL13	.75	DM71	.38	ECL80	.28
6AQ5	·21	6J6	.18	12AU6	.21	30PL14	.62	DY87/6	.22	ECL82	.28
6AR5	·30	6J7G	.24	12AV6	.28	30PL15	.87	DY802	.29	ECL83	.52
6AT6	18	6J7(M)	.38	12BA6	.30	35A3	.48	E80CC	1·65	ECL84	.54
6AU6	.19	6JU8A	·50	12BE6	.30	35D5	·70	E80F	1.20	ECL85	.54
6AV6	.28	6K7G	.10	12BH7	.27	35L6GT	.42	E83F	1.20	ECL86	.33
6AW8A	.54	6K8G	.16	12J7GT	.33	35W4	.23	E88CC	.60	EF22	.63
6AX4	.39	6L1	.98	12K5	.50	35Z4GT	.24	E92CC	.40	EF40	.49
6B8G	.13	6L6GT	.39	12K7GT	.34	35Z5GT	.30	E180F	.90	EF41	.58
6BA6	.19	6L7	.38	12Q7GT	·28	50C5	·32	E182CC	1.00	EF42	.33
6BC8	.50	6L18	.44	12SC7	.35	50CD6G		E1148	.53	EF73	·75
6BE6	.20	6L19	1.38	12SG7	.23		2·17	EA50	.27	EF80	.21
6BH6	.43	6LD20	.48	12SH7	.15	50EH5	·55	EA76	.88	EF93	.54

EF85	.25												
EF86	.27	KT44	1.00	PL83	.30	UL41	.54	AC128	.20	BC118	.23	OA70	.15
EF89	.23	KT66	·80	PL84	.28	UL84	.28	AC132	.20	BCY10	.45	OA73	·15
EF91	.17	KT81	2.00	PL504/500		UM80	.33	AC154	.25	BCY12	.50	OA79	.09
EF92	.28	KTW61	.63		·60	UY41	.38	AC156	.20	BCY33	.20	OA81	.09
EF98	.65	KTW62	.63	PL505	1.30	UY85	.23	AC157	.25	BCY34	.23	OA85	.08
EF183	.25	KTW63	.50	PL508	.90	U10	.45	AC165	.25	BCY38	.23	OA90	.13
EF184	.27	MHLD6	.75	PL509	1.30	U12/14	.38	AC166	.25	BCY39	.25	OA91	.09
EH90	.34	P61	.44	PL802	.75	U19	1.73	AC168	.38	BCZ11	.38	OA95	.09
EL32	·18	PABC80	.32	PM84	.31	U22	.39	AC176	.55	BF158	29	OA200	.09
EL34	.44	PC86	.44	PY33/2	.50	U25	.62	AC177	.28	BF159	.25	OA202	.10
EL35	1.00	PC88	.44	PY80	.33	U26	.53	ACY17	.25	BF163	.20	OC22	.38
EL37	·74	PC95	.53	PY81	.24	U191	.56	ACY18	.20	BF173	.38	OC23	.38
EL41	.53	PC97	.36	PY82	.23	U251	.62	ACY19	.19	BF180	.30	OC24	.38
EL81	.50	PC900	.29	PY83	·26	U301	·40	ACY20	.18	BF181	.40	OC25	.38
EL83	.38	PCC84	.27	PY88	.31	U403	.33	ACY21	.19	BF185	.40	OC28	.60
EL84	.21	PCC85	.24	PY500	.95	U404	.38	ACY22	.15	BF194	.15	OC29	.63
EL85	.40	PCC88	.39	PY800	.31	U801	.76	ACY28	.18	BFY50	.23	OC35	.32
EL86	.38	PCC89	.42	PY801	.31	U4020	.38	AD140	.36	BFY51	.19	OC36	.43
EL91	.23	PCC189	.46	PZ30	.48	VP23	.40	AD149	.50	BFY52	.20	OC44	.10
EL95	.32	PCF80	.26	QQV03/10		VP41	.38	AD161	.45	BY100	.18	OC45	.11
ELL80	·75	PCF82	.30		1.20	VT61A	.35	AD162	.45	BY105	.18	OC46	.15
EM80	.37	PCF84	.40	Q875/20	.63	VU111	.44	ADT140	.63	BY114	.18	OC70	.13
EM81	.37	PCF86	.44	Q895/10	.49	VU120	.60	AF106	.50	BY126	.15	OC71	.11
EM83	.75	PCF200	.67	QV04/7	.63	VU120A	.60	AF114	.25	BY127	.18	OC72	.11
EM84	.31	PCF801	.28	R19	.28	VU133	.35	AF115	.15	BYZ10	.25	OC74	.23
EM85	1.00	PCF802	.37	SP41	·75	W107	.50	AF117	.19	BYZ11	.25	OC75	.11
EM87	.34	PCF806	.55	SP61	.75	W729	.60	AF121	.30	BYZ12	.25	OC76	.15
EY51	.29	PCH200	.62	TH233	.98	X66	.50	AF124	.25	BYZ13	.25	OC77	.27
EY81	.35	PCL82	.29	TP2620	.98	Transistors		AF125	.17	CG12E	.20	OC78	.15
EY83	.54	PCL83	.54	UABC80	.30	& Diodes		AF126	.18	FSY11A	.23	OC78D	.15
EY84	.50	PCL84	.32	UAF42	.49	2N404	.18	AF139	.65	FSY41A	.23	OC81	.11
EY87/6	.27	PCL805/85		UBC41	.45	2N966	·53	AF178	.68	GD9	.20	OC81D	.11
EY88	.40		.37	UBC81	.40	2N1756	·50	AF180	.48	GET113	.20	OC82	.11
EZ40	.40	PCL86	.36	UBF80	.28	2N2147	·85	AF186	.55	GET118	.20	OC82D	.11
EZ41	.42	PD500	1.44	UBF89	.28	2N2297	.23	AF239	.38	GET119	.20	OC83	.20
EZ80	.19	PEN4DD		UBL21	.55	2N2369	.22	BA102	.45	GET573	.38	OC84	.24
EZ81	.20		1.38	UC92	.35	2N2613	·39	BA115	.14	GET587	.43	OC123	.23
GY501	.75	PEN45	.40	UCC84	.33	2N3053	.33	BA116	.25	GET873	.15	OC139	.23
GZ32	.39	PEN45DD		UCC85	.33	2N3121	2·50	BA129	.13	GET887	.23	OC169	.23
GZ33	.70		.75	UCF80	.31	2N3703	·19	BA130	.10	GET897	.23	OC172	.35
GZ34	.47	PEN46	.20	UCH21	.60	2N3709	.20	BA153	.15	GET898	.23	OC200	.22
GZ37	.67	PEN453DD		UCH42	.57	2N3988	.50	BC107	.13	M1	.15	OC201	.38
HABC80	.44		.98	UCH81	.29	28323	.50	BC108	.13	OA5	.28	OC203	.30
HL23DD	.40	PENDD-		UCL82	.30	AA119	·15	BC113	.25	OA9	.13	OC204	.30
HL41DD	.98	4020	.88	UCL83	.48	AA120	·15	BC115	.15	OA10	.43	OC205	.43
HL42DD	.50	PFL200	.50	UF41	.50	AA129	·15	BC116	.25	OA47	.10	ORP12	.53
HN309	1·40	PL33	.38	UF42	.60	AAZ13	.18						
HVR2	.53	PL36	.46	UF80	.35	AC107	.15						
HVR2A	.53	PL81	.42	UF85	.34	AC113	.25						
KT2	.25	PL81A	.48	UF86	.63	AC126	.13						
KT41	.98	PL82	.28	UF89	.27	AC127	.17						

MATCHED TRANSISTOR SETS:— LP15 (AC113, AC154, AC157, AA120) ·53p per pack. 1—OC81D & 2—OC81, 43p. 1—OC44 & 2—OC45, ·43p. 1—OC82D. & 2—OC82 ·48p. Set of 3—OC83 ·65p.

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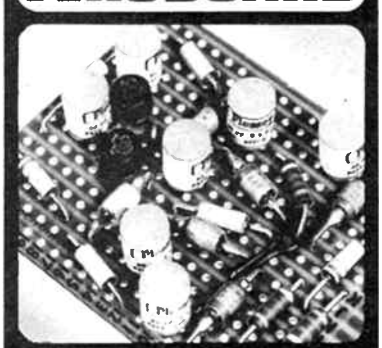

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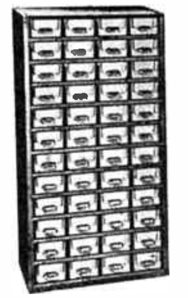

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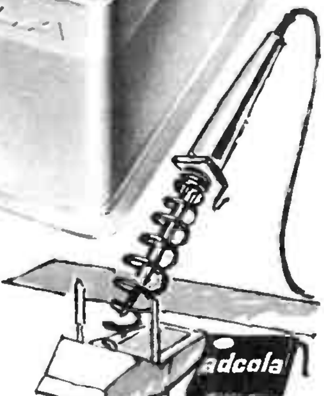
HINTS ON SOLDERING
686 SOLDERING STAND
646 INVADER SOLDERING TOOL



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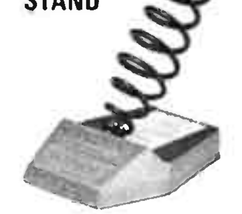

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GOODWIN RH 25 25	59·95	47·95
GLIXOR MW3000, 15 watts RMS per channel	49·50	23·95
JVC NIVICO VN 300	58·00	48·95
MCA 104Z	85·00	70·95
MCA 105E	130·50	109·95
MCA V5E VN550 Quadraphonic	89·00	74·95
MCA V9E VN880 Quadraphonic	148·00	124·95
KELETRON KSA 700	29·00	17·95
KELETRON KSA 1500	39·00	23·95
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LEAK Delta 70 (cased)	85·90	57·95
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PHILIPS RH521	109·00	89·95
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SA600	95·48	57·95
SA800	126·55	75·95
SA1000	155·82	94·95
QL600A Quadraphonic Convertor	118·95	78·95
QD 210 Quadraphonic decoder	42·85	29·95
QA 800 Quadraphonic	188·60	122·95
Reverberation 202w	54·95	35·95
RANK ROTEL 210	34·90	22·95
RANK ROTEL 310	52·00	34·95
RANK ROTEL 610	78·50	51·95
RANK ROTEL RA 810	105·50	72·95
RANK ROTEL RA 1210	129·00	89·95
ROGERS Ravensbourne	70·00	53·95
Ravensbourne (cased)	75·00	58·95
Ravensbrook Mk. II	52·50	40·95
Ravensbrook (cased) Mk. II	57·50	43·95
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3000	45·00	28·95
PROJECT 605	29·95	18·90
SOLARVOX 20. 10 watts RMS per channel	39·95	24·95
SOLARVOX 30. 15 watts RMS per channel	46·95	32·95
SOLARVOX MA801 2 x 8 watts. RMS plus MATRIX 4 channel	38·45	26·95
SOLARVOX MA813 2 x 18 watts. plus MATRIX 4 channel	51·38	38·95
TANDBERG TA300	69·90	54·95
TANDBERG TA300M	79·50	65·95
WHARFEDALE Linton amplifier	65·00	42·95

All take both ceramic and magnetic cartridges.

	Rec. Retail Price	Comet Price
TUNERS		
AMSTRAD Multiplex 3000 FM	39·95	28·95
*ARMSTRONG 523 AM/FM	52·68	40·95
*ARMSTRONG 524 FM	40·97	31·95
ARMSTRONG M8 Decoder	9·50	6·95
*DULCI FMT 7 FM	24·43	14·95
GOODMANS Stereomax	75·74	35·95
JVC Nivico MCT V5E/VT500 AM FM	86·00	69·95
MCT V7E AM/FM	122·42	99·95
LEAK Delta FM	79·50	57·95
LEAK Delta AM/FM	89·50	69·95
METROSOUND FMS 20	54·92	38·75
PHILIPS RH 690	48·50	31·95
PHILIPS RH 621	109·00	89·95
PIONEER TX500A AM/FM	75·52	50·95
PIONEER TX600 AM/FM	104·57	73·95
RANK ROTEL 320	59·50	42·95
RANK ROTEL 620	93·50	67·95
ROGERS Ravensbourne Chassis	60·29	45·95
Ravensbourne in Teak Case	64·97	49·95
Ravensbrook Chassis	43·90	33·50
Ravensbrook (cased)	49·75	38·50
SINCLAIR 2000	45·00	29·95
3000	45·00	29·95
Project 60 Tuner (stereo)	25·00	17·50

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

	Rec. Retail Price	Comet Price
TUNER/AMPLIFIERS		
AKAI CR80T AM/FM Tuner Amplifier with built in Eight Track Tape Recorder	149·84	89·95
AKAI AA8030	139·50	106·95
AKAI AA8080	189·50	145·95
AKAI AA8500	249·00	179·85
AKAI 6300	137·50	79·95
ARENA 2600	111·30	59·95
ARMSTRONG M8 Decoder	9·50	6·95
ARMSTRONG 525	90·14	69·95
ARMSTRONG 526	102·72	77·95
GOODMANS Module 80, 35w. RMS	93·00	69·95
Module 80 Compact	168·00	127·95
Module 90	119·00	91·95
Module 110 FM/MW/LW/SW/100w. RMS	139·00	105·95
GOODMANS Module 110, Compact	245·00	187·50
JVC Nivico 4MM 1000 Quadraphonic	159·50	134·95
JVC Nivico VR 5500/5501 AM/FM	96·96	81·65
VR 5521L AM/FM and SEA	175·00	146·95
4VR 5414 Quadraphonic	212·00	179·95
KYOTO 1000 AM/FM Tuner/Amplifier with built in Stereo Cassette Recorder. Complete with two speakers and two microphones	85·00	61·95
TUNER AMPLIFIERS—continued		
LEAK Delta 75	175·00	129·95
PHILIPS RH 720	215·00	179·95
PIONEER SX525	140·53	98·95
SX626	192·49	134·35
SX727	231·74	162·95
SX828	297·20	208·95
QX 4000 Quadraphonic	225·93	164·95
QX 8000 Quadraphonic	286·24	198·95
ROGERS Ravensbrook Chassis	96·57	73·95
ROGERS Ravensbrook (cased)	105·35	78·45
ROTEL RX 150A	69·90	50·95
ROTEL RX200A	89·50	65·85
ROTEL RX 400A	107·50	78·95
ROTEL RX 600A	149·00	109·95
ROTEL RX 800A	189·50	139·95
ROTEL RX 154A Quadraphonic	129·50	84·95
SOLARVOX TAM 1105 2 x 5 watts RMS AM/FM Multiplex comp. with 2 speakers and featuring Matrix 4 channel	38·50	29·95
TANDBERG TR200 MPX	106·00	85·95
TANDBERG TR1000 FM MPX (teak)	156·00	129·60
TANDBERG TR 1010 AM/FM MPX	169·00	139·95
TELETON CR55	125·26	68·50
TELETON R8000 AM FM	42·16	21·95
WHARFEDALE LINTON WE40	115·00	95·95

All the above take magnetic cartridges except Teleton R8000 and Kyoto 1000 which take ceramic only. All include MPX Stereo Decoder with the exception of Armstrong where M8 decoder is extra

	Rec. Retail Price	Comet Price
TURNTABLES		
CONNOISSEUR BD1 kit	13·34	10·95
CONNOISSEUR BD2 Chassis	32·71	25·95
CONNOISSEUR BD2 P/C/SAU2	41·29	33·95
GARRARD SP25 Mk. III	16·17	10·50
GARRARD 40B	13·63	10·95
GARRARD SL65B	20·93	13·75
GARRARD SL95B	49·21	32·25
GARRARD 401	42·88	29·50
GARRARD SL72B	32·60	21·95
GARRARD AP76	28·44	17·25
GARRARD Zero 100A	57·42	38·95
GARRARD Zero 100S	52·83	36·95

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

GARRARD SP25 Mk. 111 with Goldring G800	Special Price £18·50
McDONALD MP60 with Goldring G800	Special Price £17·50
McDONALD MP60 with SHURE M 44/7	Special Price £18·95
McDONALD MP60 with SHURE M 44/E	Special Price £19·95
McDONALD HT70 with Goldring G800	Special Price £25·50
GARRARD AP76 with Goldring G800	Special Price £26·50
GARRARD AP76 with Shure M55E	Special Price £30·50
GARRARD AP76 with Shure M75EJ	Special Price £32·50
GARRARD 2025 with Sonotone 9TAHC	Special Price £12·75
GOLDRING GL75 with G800	Special Price £39·50
GOODMANS TD100 with G800E	75·00 51·95

	Rec. Retail Price	Comet Price
Base and cover to fit GARRARD SP25, SL55, SL65B	Sp. Price	3·60
GOLDRING G101P/C	29·64	20·50
GOLDRING GL72 Chassis	31·39	20·95
GOLDRING GL72P	40·81	27·50
GOLDRING GL75	41·86	26·95
GOLDRING GL75P	51·62	35·25
GOLDRING GL85P/Cover	87·19	56·95
Cover for 72P	4·71	3·25
Cover for 75P (de Luxe)	5·23	3·50
Cover for 85P	6·98	4·95
C99-plinth and cover for G99	15·35	11·95
GOLDRING G99	29·64	19·25
LEAK Delta	69·50	52·50
JVC Nivico SRP 473 Quadraphonic, including plinth and cover	69·50	56·95
McDONALD MP60	14·78	9·50
McDONALD 610	18·75	12·95
McDONALD HT70	20·63	14·50
Base and cover for MP60 and 610	Sp. Price	3·95
PHILIPS GA212 Electronic	69·00	57·50
PIONEER PL12D with base and cover	49·18	34·50
PIONEER PL61 with base and cover	176·83	119·95
THORENS TX25 cover	8·85	6·50
THORENS TD125 Mk. II	82·63	66·50
THORENS TD125AB	115·69	79·95
THORENS TD125AB Mk. II with TP 16 arm	124·54	99·95
THORENS TD160/c including base and cover	69·80	56·95
THORENS TX11 cover	4·49	3·60
WHARFEDALE Linton	37·50	26·95

	Rec. Retail Price	Comet Price
SPEAKERS		
***Speakers are tax free—buy now before V.A.T.**		
*AMSTRAD 138 (pair) Teak	26·00	13·95
*AKAI SW 155	64·50	44·85
*B and W Model 70	159·50	109·95
B and W DM2	69·99	47·50
B and W DM4	49·66	37·95
B and W DM5 (pair)	59·48	43·95
CELESTION COUNTY (pair)	47·94	35·95
Ditton 120 (pair)	56·40	38·50
Ditton 15	37·40	26·00
*Ditton 25	65·00	42·50
*Ditton 44	54·00	35·00
*Ditton 66	99·00	70·95
*FERROGRAPH S1 inc. stand	95·00	67·95
GOODMANS Minister Pair	49·20	35·95
Havant (pair)	57·12	39·40
*Magister	65·63	42·50
Double Maxim (pair)	67·40	47·95
*Mezzo 3	35·70	23·45
*Magnum K2	46·20	29·50
*Goodwood	55·00	36·95
*Dimension 8	72·44	44·95
DIN 20 NT Kit	12·19	8·50
KELETRON KN 400 2-speaker system (pair)	15·44	11·95
KN600 3-speaker system (pair)	25·82	16·95
*KN800 3-speaker system (pair)	31·80	18·95
*KN1100 4-speaker system (pair)	40·80	23·95
*KN1600 3-speaker system	25·20	14·95
*KN2100 3-speaker system	30·60	18·95
LEAK 150 (pair)	50·00	37·50
LEAK 250 (pair)	63·00	47·95
*LEAK 600	49·50	34·50
*LINEAR 10 watt Teak (Pair)	Sp. Price	12·95
METROSOUND HFS 103 (pair)	29·21	20·95
*202	21·50	14·75
*Duplex 15	32·00	23·95
*Duplex 25	56·00	37·50
*PIONEER CS53	46·72	29·95
SINCLAIR Q16	8·98	6·50
TANDBERG Tan 7	29·50	23·60
Tan 11 (pair)	40·00	31·95
TL 12 Teak (pair)	55·50	44·50
TL 25 Teak (pair)	71·50	56·95
*TL 50 Teak	68·00	50·95
TELETON 8000 (pair)	21·08	11·95
*THORPE GRENVILLE TG100 (pair)	28·95	16·95
*TG200 (pair)	41·95	24·95
*TG300 (pair)	55·95	29·95
WHARFEDALE Denton Mark II (pair)	42·00	28·95
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Triton 111 (pair)	65·00	46·95
*Melton Mark II	35·00	23·75
*Dovedale 3 Mark II	47·50	32·25
*Rosedale	69·00	44·95
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*Unit 4 speaker kit	19·00	12·95
*Unit 5 speaker kit	27·50	18·75
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AUDIO Technica L2 lifts	2·61	1·95
CONNOISSEUR SAU2	14·61	11·95
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GOLDRING Lenco L69	10·46	6·50
GOLDRING PH6 Head Shell	2·97	1·99
SME 3009 ser 11 improved	36·75	28·50
SME 3009-S2 ser 11 improved	40·25	30·95
SME S2 Headshell	2·59	1·95
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***Items are tax free—buy now before V.A.T.**		
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Twin Axiom 10	10·06	7·50
*Axiom 401	17·68	11·85
Audiom 8P	5·49	4·15
Audiom 10P	5·97	4·50
*Audiom 12P	13·00	9·15
*Audiom 15P	21·00	14·60
*Audiom 18P	35·70	24·45
*Audiom 100 40 watts din.	12·00	8·35
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AMSTRAD 900D	8·10	5·40
AMSTRAD 900 EX	11·90	8·50
AUDIO TECHNICA AT 66	6·47	3·45
*CONNOISSEUR Ceramic SCU1	6·09	4·05
GOLDRING G850	6·10	3·19
GOLDRING G800	12·21	4·50
GOLDRING G800E	17·67	7·00
GOLDRING G820	11·62	8·25
GOLDRING G820E	17·44	12·25
GOLDRING G820 Super E	23·25	16·25
GOLDRING G800 Super E	24·41	15·25
EMPIRE 1000ZE/X	62·22	39·95
EMPIRE 999VE/X	44·44	28·95
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CARTRIDGES—*continued*

	Rec. Retail Price	Comet Price
EMPIRE 909E/X	12·79	8·50
EMPIRE 90EE/X	9·94	6·95
SHURE M3DM	6·10	3·75
SHURE M31E	11·63	6·95
SHURE M32E	10·73	6·50
SHURE M44-G	8·30	4·95
SHURE M44-7	7·90	4·50
SHURE M-44C	7·90	4·90
SHURE M44E	8·60	4·75
SHURE M55E	9·70	5·45
SHURE M75G	14·70	8·35
SHURE M75-6 (S)	8·36	5·45
SHURE M75-6	13·60	7·60
SHURE M75EJ	15·40	8·75
SHURE M75ED	19·00	10·15
SHURE M75E/95G	20·80	12·95
SHURE M91ED	18·45	9·95
SHURE V15-11	39·40	24·95
*SONOTONE 9TAHC Diam/Saph	3·75	1·45

Starred cartridges above are ceramic. All others are magnetic.

BASES AND COVERS

	Rec. Retail Price	Comet Price
CONNOISSEUR Plinth BD1	5·57	4·50
CONNOISSEUR Cover	4·17	3·40
CONNOISSEUR P.U. Mount Board	0·95	0·75
GARRARD WB1 Base	3·78	2·95
GARRARD WB4 Base	5·60	4·25
GARRARD SPC1 Cover	3·68	2·75
GARRARD SPC4 Cover	4·38	3·25
Special Offer of Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500	Sp. Price	3·60
GOLDRING Plinth 75	9·77	6·75
GOLDRING Plinth 72	9·42	6·50
GOLDRING Covers for 72P	4·71	3·25
Cover for 75P De Luxe	5·23	3·60
Cover for 85P	6·98	4·95
THORENS TX 25 (for TD125AB)	8·85	6·50
THORENS TX11 Cover	4·49	3·60
SME Plinth System 2000 with motorboard	46·20	35·95
MOTORBOARDS only	5·85	4·45
SME P1 Spacer	0·98	0·75

BLANK TAPES

	Rec. Retail Price	Comet Price
SCOTCH DYNARANGE CASSETTES		
C60	0·71	0·40
C90	0·99	0·50
C120	1·49	0·75
SCOTCH HIGH ENERGY COBALT CASSETTES		
C60	1·10	0·65
C90	1·45	0·85
SCOTCH Low Noise 8-TRACK BLANK CARTRIDGES		
40 mins.	1·50	0·90
80 mins.	1·80	1·10
SCOTCH HI-FI DYNARANGE SPOOLED TAPES		
5" L.P. 900	1·88	1·10
5¾" L.P. 1200	2·20	1·30
7" L.P. 1800	2·95	1·80
SCOTCH HI-FI DYNARANGE DOUBLE PLAY		
5" D.P. 1200	2·31	1·40
5¾" D.P. 1800	3·15	1·95
7" D.P. 2400	4·03	2·50

Postage—Tape, cassettes and 8T cartridges 1-9 items 5p per order. Packs of ten post free.

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Are now tax free—buy now before V.A.T.

	Rec. Retail Price	Comet Price
AMSTRAD HPS5A	7·50	3·90
HPS6A with volume control	10·70	6·70
HPS7A bass and treble controls	13·95	9·90
AKAI ASE9	7·25	4·25
AKAI ASE22	11·90	7·25
AKG K180	28·00	16·95
AKG K60	15·00	8·95
AKG 100	8·00	4·95
AKG 120	10·00	4·50
KOSS HV1	20·00	15·95
KOSS ESP-9 Electrostatic	69·00	52·95
KOSS ESP-6 Electrostatic	45·00	34·95
KOSS K2 plus 2 Quadrafone	45·00	35·95
KOSS PRO 5 L/C	30·00	23·95
KOSS PRO-4AA	28·00	20·95

HEADPHONES—*continued*

	Rec. Retail Price	Comet Price
KOSS KO-727B	16·50	12·45
KOSS 747	20·00	14·95
KOSS K-711	10·00	7·75
KOSS K6	12·50	9·50
KOSS K6/LC (with volume control)	14·00	10·50
KOSS K6/LCQ Quadrafone	20·00	16·95
PIONEER SE 50	21·90	13·25
PIONEER SE 30A	12·60	8·25
PIONEER SE 20A	7·88	4·95
PIONEER SEL 20	10·53	6·80
PIONEER SEL 40	17·43	11·30
SOUND MD806	6·50	2·80
WHARFEDALE DD1	12·50	8·75
WHARFEDALE ISODYNAMIC	19·95	14·95

HI-FI STEREO SYSTEMS—COMPLETE

	Rec. Retail Price	Comet Price
ALBA UA 552	47·75	29·95
BUSH A1005	69·89	50·95
DANSETTE Consort Stereo	34·43	23·95
DANSETTE 4005	71·45	49·95
DANSETTE 4020	47·99	31·95
DECCA SOUND 613	Sp. Price	46·50
DECCA SOUND 614	Sp. Price	52·95
DECCA COMPACT 2 with Radio	Sp. Price	78·95
DECCA COMPACT 3 with Radio	Sp. Price	97·95
DECCA 403	Sp. Price	44·95
FERGUSON 3450 B with Radio (new model)	79·50	61·95
FERGUSON 3451 B with Radio (new model)	107·00	82·95
FERGUSON 3454	41·50	32·95
FIDELITY UA1 Music Master with Radio	100·00	69·95
FIDELITY UA2 Music Master	43·50	30·95
FIDELITY Stereo Nine	38·50	22·95
G.E.C. 2810	79·00	59·95
GROSVENOR MPX 8400 AM/FM' MPX Tuner/Amplifier, magnetic input with built-in 8-track cartridge player with speakers	69·95	41·50
HMV 2451	122·00	95·95
HMV 2452	66·00	49·95
HMV 2455	175·00	136·95
KB 1025 with 662 speakers	48·25	37·95
KB 1250 with KS 653 Speakers	71·00	53·95
KB 2010 with 658 speakers and Radio	101·50	77·95
KB 2250 with 658 speakers and Radio	124·00	95·95
MURPHY 902 Studio 1, with AM/VHF/Radio	84·50	64·95
MURPHY 940	69·89	52·95
PHILIPS 808	105·00	74·95
PHILIPS GF 824	65·30	49·65
PHILIPS 825	49·50	37·95
PHILIPS 826	75·00	51·95
PHILIPS 835 with Radio	69·50	47·95
PHILIPS 836 with Radio	95·00	67·95
RIGONDA Party Time	28·50	20·95
STEEPLETONE Stereo System	41·75	22·95
ULTRA 6027	57·50	44·95
ULTRA 6028	59·95	45·95
ULTRA 6450B (new model) with Radio	79·50	61·95
ULTRA 6451	79·50	61·95
ULTRA 6455	41·35	31·95
ULTRA 6454	38·85	29·95

TAPE RECORDERS

	Rec. Retail Price	Comet Price
AKAI 1721L	99·90	73·95
AKAI 4000 DS	99·50	73·95
AKAI X201D	179·00	132·95
AKAI X1810	229·00	169·95
AKAI GX221D	229·00	169·95
AKAI GX1900D	239·00	177·95
AKAI GX370D	350·00	259·95
AKAI CR80D 8-track stereo tape deck	85·02	55·95
AKAI CR80 8-track stereo recorder	106·39	69·95

TAPE RECORDERS—*continued*

	Rec Retail Price	Comet Price
AKAI CR80DSS Quadraphonic	159·50	121·95
AKAI CR80T 8-track stereo recorder and tuner amplifier	149·84	89·95
AKAI CR81	109·50	80·95
AKAI CR81D	89·50	65·95
FERGUSON 3258 4-track	70·45	51·95
FERROGRAPH 702/704 Dolby	285·53	241·95
FERROGRAPH 702H Dolby	297·28	251·95
FERROGRAPH 722/724 Dolby	326·65	276·95
FERROGRAPH 722H Dolby	338·40	286·95
FERROGRAPH 702/704	235·00	172·95
FERROGRAPH 722/724	276·15	198·95
FIDELITY Braemar 4-track	34·75	19·95
GROSVENOR RP900, 8-track, record/playback deck	54·50	38·95
GROSVENOR MPX 8400 AM/FM MPX Tuner/Amplifier, magnetic input with built-in 8-track cartridge player with speakers	69·95	41·50
GRUNDIG TK 121 (twin-track)	56·25	39·95
GRUNDIG TK 141 (4-track)	62·10	45·95
GRUNDIG TK 146 (4-track auto)	66·95	49·95
GRUNDIG TK 147 (4-track auto)	98·65	76·95
GRUNDIG TK 148 (4-tr. auto 2 spd.)	74·10	57·95
GRUNDIG TK 246 4-track Stereo Deck	131·85	101·95
GRUNDIG TK 3200 Hi-Fi (Battery)	141·10	105·95
MARCONI 4248 4-track, 2 speed	52·30	39·95
PHILIPS 4303 Twin-track	39·46	24·95
PHILIPS 4307 4-track	50·00	35·95
PHILIPS 4308 De Luxe 4-track	59·00	42·95
PHILIPS 4416 4-track stereo rdr	145·00	109·95
PHILIPS 4418 4-track stereo	200·00	145·95
TANDBERG 3341X 4-track stereo deck	129·90	109·95
TANDBERG 6041X 4-track stereo	199·30	159·95
TANDBERG 9021X 2-track stereo deck	230·00	194·95
TANDBERG 9041X 4-track stereo deck	230·00	194·95

TAPE RECORDERS (CASSETTE)

	Rec Retail Price	Comet Price
AKAI CS35D tape deck	79·95	59·50
AKAI CS35 Stereo Inc. Speakers	112·50	82·95
AKAI GXC 40D tape deck	95·50	67·95
AKAI GXC 40	112·50	82·95
AKAI GXC 40T recorder, tuner/amp.	167·50	123·95
AKAI GXC 45D tape deck	119·50	89·95
AKAI GXC 46 Dolby tape recorder	152·50	115·95
AKAI GXC 46D Dolby tape deck	139·50	103·50
AKAI GXC 65D Dolby auto-reverse deck	154·50	110·25
BUSH Discassette DC70	20·62	12·95
BUSH TP 60	27·62	15·95
BUSH TP 66 Battery/Mains	28·18	21·50
FERGUSON 3240 with case	24·90	15·95
FERGUSON 3253 (Mains)	42·40	27·95
FERGUSON 3256 (mains)	37·75	25·95
FERGUSON 3257	56·45	41·95
FERGUSON 3257/7 spkrs. for above	16·00	12·00
GEC CR200 AM/FM Cassette/Radio, Battery/Mains with slide controls	Sp. Price	35·95
GRUNDIG C210 Batt./mains	48·75	36·95
HARVARD Elite Cassette/AM/FM Radio (battery/mains)	44·75	23·95
JVC Nivico 9420 LS with AM/FM radio, battery/mains	61·45	45·95
JVC Nivico 1710 Radio/Cassette, AM/FM	61·00	42·95
PHILIPS 2202/2203	24·00	17·95
PHILIPS 2204 battery/mains	29·10	24·95
PHILIPS 2405 Stereo with 2 RH401 L/S	72·00	52·95
PHILIPS 3302	21·50	15·95
PIONEER CT 4141 Dolby Deck	150·02	104·95
PYE 9116 Stereo	69·90	49·95
WHARFEDALE Dolby DC9 Mk. II	119·00	85·95

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Dept. PW ROCHDALE: Corner of Well i'th'Lane and Queensway. *Tel.: 50606*
Dept. PW LEICESTER: Syston Street. *Tel: 0533 52236*
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Dept. PW RENFREW: Blythswood Trading Estate, Argyle Ave., Renfrew, RA4 9EL. *Tel.: 041-886 5731*
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PRACTICAL WIRELESS

VOL 48 NO 12

Issue 794

APRIL 1973

The Buyer and VAT

During these last few weeks before Value Added Tax takes effect, readers will be contemplating whether to buy now or wait until after April 1st. It will undoubtedly pay to wait on such items as domestic receivers, some Hi-Fi equipment and electrical goods, but component suppliers are being hard pressed to meet demand before the infliction of VAT.

One way of circumventing purchase tax has been to supply equipment in kit form, but these items in any form will be liable for VAT at one common percentage rate, since VAT is a tax on the basic purchase price or charge for service.

We would expect that all suppliers will make it quite clear to all customers, at the trading premises and through advertisements, whether quoted prices include VAT. The basic retail price should remain the same as now. Whatever you pay for goods or services from April 1st, you should not be paying any purchase tax or selective employment tax levies; you should be paying VAT on top of the normal retail price, based on the Chancellor's Budget announcement on March 6th.

Kit and component prices should not be raised before April 1st and manufactured goods subject to purchase tax of more than 15% should be noticeably reduced after April 1st.

Shopkeepers and other traders are not legally bound to show the amount of VAT in cash transactions; neither will they necessarily show special "tax invoices" for retail sales, but it is worth remembering that if you purchase at a cut price rate, the VAT charged will be correspondingly lower. Goods obtained by hire purchase or credit agreements will be subject to tax at the current rate at the time when transaction documents are signed. Interest rates on these terms are not taxable. Private sales between individuals do not attract VAT because neither party is defined as a "taxable person", unless the seller is a trader required to register with H.M. Customs and Excise.

Our advice to readers who are thinking of buying goods by mail order during March is to determine first whether purchase tax is chargeable; if it is then wait until April. Items not subject to purchase tax (such as components and secondhand or used goods) should be ordered early. If of substantial value, send your order by P.O. "Recorded Delivery" and keep the counterfoil of your Postal Order, Money Order, or cheque.

You should be prepared for a VAT levy on charges for packing service but not for postage.

continued on next page

NEWS AND COMMENT

CONSTRUCTIONAL

OTHER FEATURES

THE MAY ISSUE WILL BE PUBLISHED ON APRIL 6th

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

by Colin Riches

VAT

To the best of our knowledge, the prices quoted in this issue were correct at the time of going to press.

From April 1st 1973, there will be no purchase tax but a large number of goods will carry Value Added Tax. For further details, see our Leader article.

Tulip Time Rally

The 1973 "Tulip-Time" mobile rally will be held on Sunday May 6th at Surfleet, 4 miles north of Spalding on the A16.

The Spalding and District Amateur Radio Society will also be operating a Special Activity station, GB3STF on 12th-13th May from The Grammar School, Priory Road, Spalding, in connection with the 1973 Tulip Festival. Operation will be on s.s.b./c.w. on all bands 160-10m. with a.m. on 2m. All contacts will be confirmed by special QSL cards.

Of interest to "Going Back" fans—the Wireless Preservation Society will have an exhibition of vintage radio on show to the public. I hope to be able to publish further details later.

RSGB "Jubilee Year" President

Photograph by P. M. Fletcher.

This picture shows Dr. J. A. Saxton, D.Sc., PhD, CEng, FIEE, FInstP, the new President of the RSGB. On the left of the picture is Swedish Amateur Lt. Col. Per Anders Kinman, SM5ZD, who received the Calcutta Silver Key award. Sir John Eden, the P.M.G. is on the right.

In his address, Dr. Saxton said he felt very proud that he had been chosen as President of the RSGB for its Diamond Jubilee Year. He also said that he was extremely delighted that Sir John had been able to attend and that all there were greatly honoured by his presence.

Dr. Saxton went on to say that the Society would continue to do all in its power to continue to deserve the Ministry's support.

Per Anders Kinman has been made an Honoury Vice President of the RSGB in recognition of his outstanding service with the IARU Region 1 in which he has served for many years.

The Calcutta Key he received was first presented 20 years ago and it has been awarded annually by the RSGB to the person they feel has made, in any one year, the most significant contribution to international friendship and goodwill through the medium of Amateur radio.

The Buyer and VAT

continued from previous page

If you order from a current catalogue or advertisement after April 1st, you should add the VAT percentage rate to the basic retail price shown. Then add the estimated or stated charge for postage and packing. If a service is chargeable, such as equipment repair or consultation, VAT will be levied at the standard rate. Trading in second-hand and used goods will also be taxable under VAT.

Finally, good news for P.W. readers: newspapers and magazines will be "zero-rated", which means that no VAT is chargeable on these. Transactions of any kind in the U.K. for the direct exportation of goods and services are exempt from VAT.

M. A. COLWELL—Editor.

Feb P.W. Cover

Many enquiries have been received for information on the book and log-book shown on the front cover of the February issue of *PW*. Both can be obtained from the Radio Society of Great Britain, 35 Doughty Street, London, W.C.1. "How to Listen to the World" costs £2 post paid. The log book shown is intended for transmitting Amateurs and costs 60p post paid but another one, intended for listeners, is available at 45p post paid.

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

Cordless Iron

This cordless soldering iron comes from the U.S.A. It is completely portable needing no mains power for operation. It has its own power supply which is automatically charged from the stand which itself is connected to the mains. There is a small light near the tip which is very useful for seeing exactly where you are applying heat.

The iron heats up in under 5 seconds and has an "indestructible" iron-plated bit. It costs £9·25 complete with charging stand and fine bit. A heavy-duty bit is also available.

The exclusive distributors in Great Britain are *Pact International Electronics Ltd., P.O. Box 19, Royston, Herts, SG8 5HH.*

Sonex 1973

The technical author and writer Donald Aldous will be heading a small team to organise the Special Features at "Sonex '73".

Two recital/lecture sessions will be presented each day at the Exhibition's new venue the *Excelsior Hotel, London Airport, Heathrow.*

Speakers will include Bert Webb, who will lecture on pick-ups, arms and turntables and Kenneth Shearer, speaking on listening room acoustics.

There will also be a lecture on tape cassettes and an examination of current loudspeakers and trends.

Sonex '73 will run from Friday, March 30th to Sunday, April 1st, inclusive.

Sound '73

"Sound '73" is the exhibition run by the Association of Public Address Engineers. New P.A. equipment and new techniques in the public address and allied fields will be on show.

As in past years, there will be a lecture programme held in the hotel's "City Room". John Maunder from Shure Electronics will give a lecture and demonstration on microphones on Tuesday, 13th March at 14.30hrs.

Mike Beville from Audio and Design Recordings Ltd. will lecture on Components and Limiters (Wednesday at 14.30hrs.)

On Thursday March 15th at 10.30hrs, a member of the Hornsey College of Art will talk on Industrial design of Public Address Equipment.

Venue will be the Bloomsbury Centre Hotel, March 13-15, from 10.00-18.00hrs.

I.E.E. Conferences

The following new conferences to be held in 1973 and 1974 are being organised by the Institution of Electrical Engineers.

"Electrical Signals from the Brain" 27-30 August 1973—in Oxford.

"Symposium on Electromagnetic Wave Theory" 8-12 July 1974—in London.

Further details of the conferences mentioned above are available from the *Conference Department, IEE, Savoy Place, London WC2R 0BL.*

De-soldering Unit

In the February issue we mentioned the Litesold De-Soldering Unit and a misprint stated the price at £·75. This should have read £2·75. Apologies to Light Soldering Developments and any readers that may have been inconvenienced.

Jermyn Inverters

Jermyn Distribution market two inverters, both giving an output of 250V. Input for the 150W version is 12V and for the 300W type, 24V.

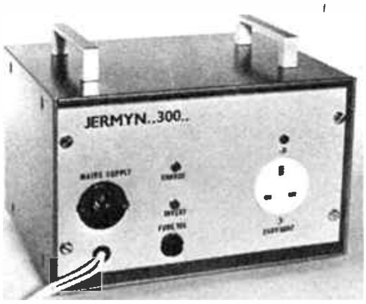
A feature of the design enables these inverters to charge the 12/24V batteries up to 10A when plugged into a power socket.

If the mains supply fails, the inverter automatically switches to its "invert mode" providing 240V emergency power immediately.

Should the unit be accidentally overloaded its drive is so adjusted, that the output voltage falls completely, switching the unit off, eliminating any problems.

An internal 15A fuse blows should the battery leads be connected wrongly. Indicator lights illuminate to show whether the unit is charging a battery or providing a 250V 50Hz output.

Both types of inverter can be obtained in kit form or already built. The kit for 150W costs £25 (£29 built) and 300W £34 (£39 built). *Jermyn Distribution, Vestry Estate, Sevenoaks, Kent.*



improving VHF radio

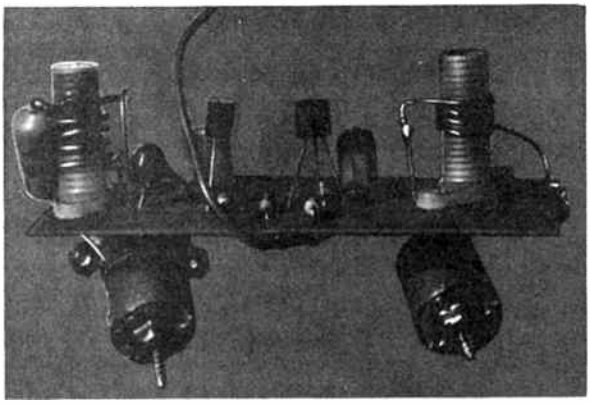
A.N.AINSLIE

VHF radio provides a most useful signal source for any hi-fi enthusiast and, despite the 15 kHz frequency limits, the live BBC broadcasts are certainly up to the standards of the finest records.

The advantages are numerous—being a non-mechanical system the distortion is very low and the self-generated noise is also very low, the result being a large dynamic range and the possibility of encoding two channels on a single signal. This, plus the excellent BBC technique, makes f.m. radio an invaluable source of material. Unfortunately there are several difficulties in securing top quality f.m., regardless of the equipment used.

SIGNAL-TO-NOISE

Referring to Fig. 1, it can be seen that the performance of a receiver depends on the strength of the signal applied to the aerial socket of the receiver. The mono signal-to-noise ratio assumes an optimum value (usually 50 or 60 dB) with only a few μV input—even on cheap tuners. The signal-to-noise performance does not improve so rapidly on stereo, however, and in many cases could be improved on even with inputs in the region of a few hundred μV—hence the increase in noise on stereo



First of the two VHF amplifiers described in the article. This one uses field-effect transistors.

in most situations. A person who gets no increase in noise is indeed most fortunate and need read no further!

As regards crosstalk and distortion, these parameters usually reach optimum values with fairly small inputs and usually there is not much improvement to be had by an increase in the signal.

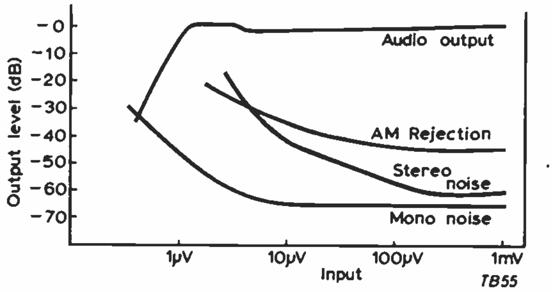


Fig. 1: Graphs comparing receiver performance with the input signal level.

Very few people are fortunate enough to be able to receive "near perfect" stereo without a large aerial, loft or roof mounted. A large aerial, besides having the necessary gain usually has the advantage that it is highly directional and eliminates multi-path distortion from reflected signals. In many situations, a reasonably large aerial, three or more elements, carefully sited, and with a low loss feeder gives good stereo but perhaps not of the very highest quality.

The major downfall in domestic stereo reception is that of "stereo" noise—perhaps not excessive but sufficient to mar an otherwise excellent signal. The obvious way to reduce this noise is to increase the signal feeding the tuner by an "aerial amplifier". At present in this discussion we must assume that the amplifier be perfect, having gain but generating no noise itself.

OTHER NOISE

At this point many readers may well be wondering about the other forms of noise, thermostats, car ignition and other spurious signals. These signals are picked up by the aerial and sometimes, even, by the feeder, and consequently will be amplified, together with the f.m. signal, by our "ideal" amplifier, which we are using to combat stereo noise. This brings us to the last important parameter of f.m. receivers, amplitude modulation limiting.

The "ideal" f.m. tuner is designed to respond to f.m. only and a.m. signals are rejected to an infinite degree. Unfortunately, no receiver is perfect and some degree of sensitivity to a.m. is unavoidable.

The a.m. limiting of the receiver improves with increasing signal input, as seen from Fig. 1, so that increasing the signal and spurious a.m. together actually reduces the level of audible interference. Unfortunately, when the receiver is switched to receive a stereo transmission, the stereo decoder in the receiver is actually only sensitive to amplitude modulation of the stereo subcarrier. In the decoder some measure of a.g.c. is applied to the subcarrier amplifier and this maintains a constant level of stereo interference from an a.m. signal regardless of the actual input voltage to the tuner.

It can therefore be seen that whilst increasing the tuner input with an "ideal" amplifier, the "stereo" interference level remains substantially constant whilst the "mono" component of the audible interference has been reduced by virtue of the amplitude limiting of the f.m. discriminator.

AERIALS

Earlier in this discussion, we talked of elaborate and efficient aerial systems but the previous discussion on aerial signal amplification implies that, with a good amplifier, an aerial providing only a minimal "clean" signal can be used to run an f.m. tuner with a high degree of success.

Unfortunately, some tuners are not so sensitive as others and sometimes require millivolts to function at their best. This means considerable amplification of the few tens of microvolts coming from a rather poor aerial!

The better tuners nowadays use f.e.t.'s in the input circuits to keep noise to a minimum and to keep cross modulation low; so any proposed amplifier should have at least as good a performance as the front end of the tuner.

This is very demanding when tuners such as Sony, Radford and Fisher are considered, but it is possible to improve these tuners on a very poor signal by a remarkable degree.

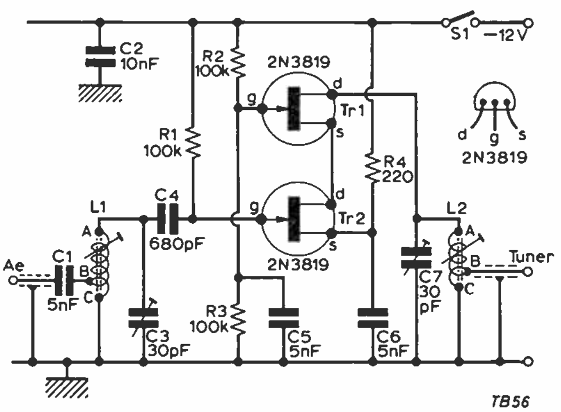


Fig. 2: Circuit of the amplifier using two f.e.t.'s.

To design an amplifier with a front-end comparable to the best tuners use has to made of f.e.t. devices which possess the best noise properties of all the common solid state devices presently available and are responsible for the excellent performance of the best tuners.

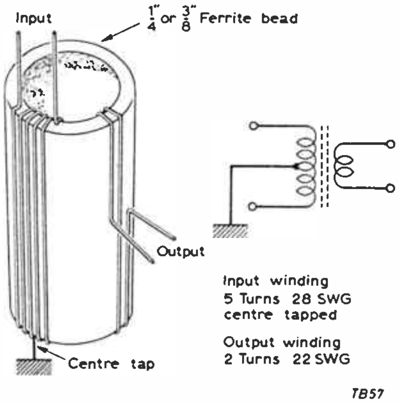


Fig. 3: Details of simple transformer to match balanced 400Ω feeder to 75Ω coaxial feeder.

The design chosen for the amplifiers in this article is not often used with solid state devices but was once very common with valve Band III television tuners. The amplifier is a cascode configuration giving reasonable gain with very low noise and good cross modulation.

The input to the amplifier, Fig. 2, is 75Ω co-axial feeder so Fig. 3 shows a transformer that can be constructed from a small ferrite bead for 400Ω balanced feeder.

THE PCB

The amplifier can be very easily built on a single piece of printed circuit 4"×2" and it is recommended that fibreglass board be used.

To etch the required print design as shown in Fig. 4 (full size), the diagram is traced on to the copper side of the print with carbon paper and the marked areas painted in with high quality enamel. When the paint is dry, the print is immersed in the etching solution and agitated until completely etched (only paint and base material can be seen). The etching solution can be ferric chloride solution but a useful alternative is "Liquor-Ferri Perchloridi Fort" which is obtainable from chemists and should be used undiluted. Rub the copper surface of the board with "Ajax" or similar scourer before painting, to ensure a clean surface.

The enamel paint can be removed with paint stripper once the etching is complete and the board washed and cleaned with wire-wool. The holes for the components should be drilled with a 1/32" drill, preferably in a wheel brace.

Construction is straightforward except that the f.e.t.'s should be left until last and soldered in with the iron disconnected from the mains—surprisingly little voltage will break down the gate junction.

The coils, Fig. 5, are wound on the formers which are located on the board and stuck with Araldite. The 30pF variable capacitors must be connected so that the rotor is connected to the earth line. The author used 30pF Philips beehive trimmers mounted

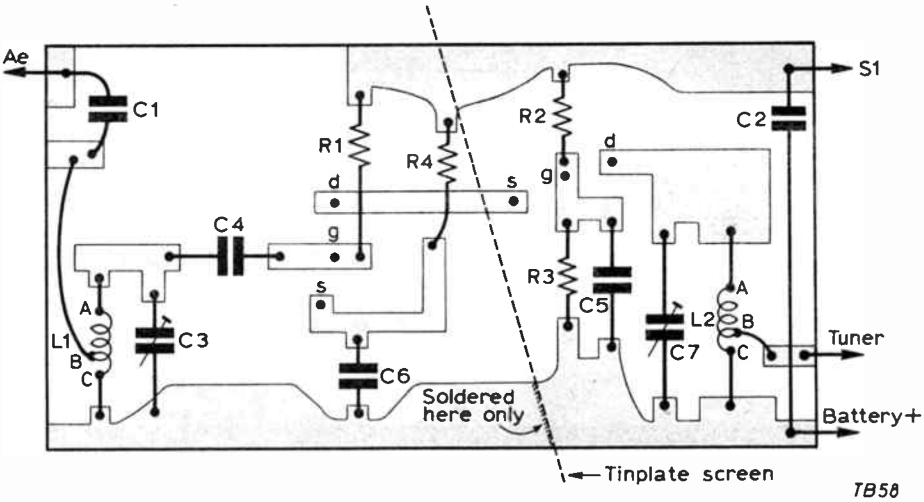


Fig. 4: Printed circuit board, for the circuit of Fig. 2, shown actual size.

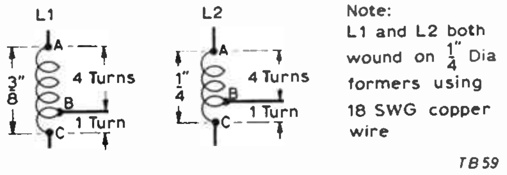


Fig. 5: Winding information for L1 and L2.

★ components list

FET AMPLIFIER

Resistors

R1 100kΩ R2 100kΩ R3 100kΩ R4 220Ω
All ¼W 5%

Capacitors

C1 5nF 400V
C2 10nF 12V
C3 30pF Trimmer
C4 680pF 12V
C5 5nF 12V
C6 5nF 12V
C7 30pF Trimmer

Miscellaneous

Tr1-Tr2, 2N3819. On-off switch. 12V battery. Co-axial sockets (2). PCB, see text. Coil formers.

BF200 AMPLIFIER

Resistors

R1 1·5kΩ
R2 10kΩ
R3 6·8kΩ
R4 1·5kΩ
R5 10kΩ
R6 6·8kΩ
All ¼W 5%

Capacitors

C1 1nF 400V
C2 30pF Trimmer
C3 10nF 12V
C4 680pF 12V
C5 1nF Feed-through
C6 30pF Trimmer
C7 10nF 12V
C8 680pF 12V
C9 1nF Feed-through
C10 30pF Trimmer

Miscellaneous

Tr1-Tr2, BF200. On-off switch. 12V battery. Co-axial sockets (2). PCB, see text. Coil formers.

POWER SUPPLY

Capacitors

C1 100nF 1kV C3 2000μF 10V C5 100nF 12V
C2 2000μF 10V C4 1000μF 15V

Miscellaneous

R1, 10Ω ¼W 5%. D1-D2, 1N4002. D3, 12V zener 2W, mounted on aluminium 2" × 1" minimum. T1, 8V bell transformer. Fuse, 1A. On-off DP mains switch. LP1, 3·5V 20mA for FET amp + 2 stages or 3·5V 40mA for FET amp + 4 stages.

on the copper side of the board. The resistors should be small low noise types and the capacitors need only be low working voltage.

The completed amplifier should be screened by placing tin plate at the position indicated and soldered to the positive line as support.

The amplifier is mounted in a small wooden box, measuring approx. 4" cube internally, covered inside with tin foil, which is connected to the positive supply line. A front panel can be made from a piece of double-sided copper board with the input and output sockets and the on/off switch. The printed board is soldered to the front panel by the positive line, so earthing the front panel.

With a 12V battery connected, the output is fed to the tuner and the input is fed by an "inefficient" aerial, in most cases a short piece of wire.

With the amplifier on, the tuner is switched to the local stereo station and the tuning capacitors C3 and C7 set midway. The cores in the coils (L1 and L2) are then adjusted to give the strongest signal, best observed on a tuning meter or audibly by judging least noise.

The amplifier is then assembled in the case and the capacitors C3 and C7 tuned to give the best signal. The tuning will be sharp and critical, so care should be taken when adjusting.

The amplifier, when connected between the proper aerial and tuner, should have sufficient gain to overcome most of the tuner noise, without introducing significant noise itself. When used on weak local radio stations, the improvement will be very marked, especially in mono. Unfortunately, this usually requires the amplifier to be re-tuned to the local channels. However, connecting 27Ω resistors across L1 and L2 will broaden the bandwidth considerably, enabling the amplifier to be used over a number of channels.

BF200 AMPLIFIER

However, for many of the "poorer" tuners, this amplifier will still not be good enough to fully drive the tuner on a moderate signal. For optimum stereo in such cases two of the amplifiers could be

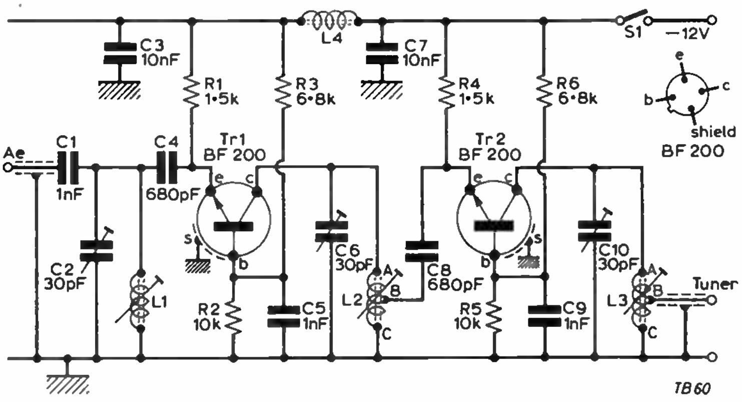


Fig. 6: Circuit of the second amplifier, using BF200 transistors.

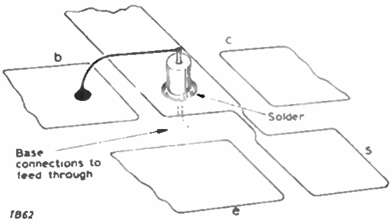


Fig. 8 Method of mounting feed-through capacitors

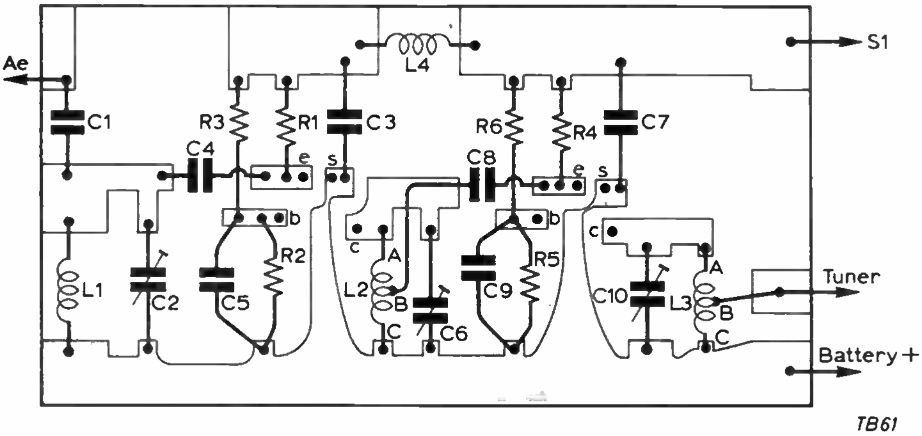


Fig. 7: Illustration, actual size, of the printed circuit board for the BF200 amplifier.

connected in series. The price of f.e.t.'s, however, makes this uneconomical and ordinary low-noise silicon transistors used after the f.e.t.'s work very well. The proposed amplifier, Fig. 6, is two stages of a conventional r.f. amplifier design. Fig. 7 shows a full size print layout for two stages, although for additional gain or bandwidth more stages can be used, although greater than five would be difficult to keep stable.

The board is etched in the same manner as before and a similar front panel and box are prepared. Alignment is the same, tuning the coils and finishing with the capacitors.

The transistors specified are BF200 and these should be used for at least the first two stages to keep the noise level down; after this such transistors as 2N706 work very well. An alternative for the BF200 is BF180 or BF181.

Fig. 8 shows how C5 and C9 are constructed with 1000pF feed-through capacitors. L4 is made by wrapping a few turns of 36s.w.g. d.c.c. copper wire round a ferrite bead. Fig. 9 gives the winding information for L1, L2 and L3.

The two amplifiers just described will enable good stereo to be obtained from a mediocre signal without the need for a "fancy" tuner. The improvement that can be expected depends greatly on the individual circumstances. The author has used the amplifiers with a Sony ST5100 tuner and a poor aerial and found the results almost as good as when a proper aerial was correctly installed on the roof. The cost of a pair of amplifiers is comparable to a decent

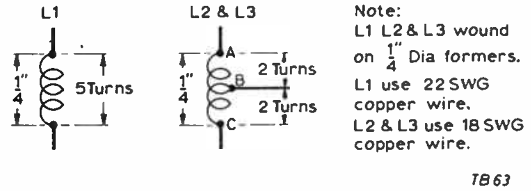
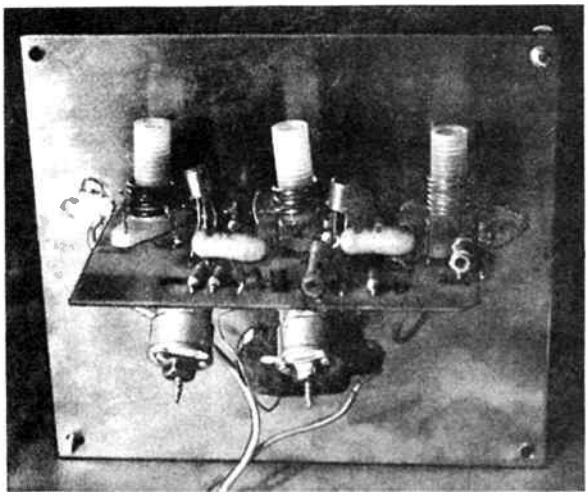


Fig. 9: (above) Details of the three coils shown in Fig. 6. In the photograph (below) the second amplifier board is shown soldered to the front panel consisting of double-sided p.c.b.



aerial less downlead and fitting, so financially it is a viable proposition, although not a substitute for a first class aerial.

In order to split one signal to run several outlets and obtain maximum signal at each of the outlets, a star-splitter is used. This arrangement provides correct impedance matching throughout the system.

Figure 10 shows the circuit of a star-splitter. The value of the resistors R depends upon the impedance of the feeders (Z) usually 75Ω, and on the number of outlets (n) which can be as many as required.

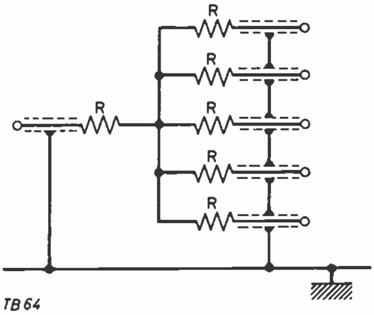


Fig. 10: Circuit of star-splitter enabling several outputs to be obtained from a single input.

The relationship is:— $R = Z(n-1)/n+1$. For example, for a splitter for a 75Ω system with two outputs the resistors to the nearest preferred value are 27Ω. Small ¼W resistors are suitable and indeed preferable to physically larger types.

All of these systems involve a loss of signal and this must be made up by amplification before the splitting. For a distribution system, splitting six or eight ways, two f.e.t.'s followed by three transistors should be adequate. One important point to note is that the outputs of the splitter must all be loaded by a 75Ω resistor when not in use, otherwise a loss of signal results and the splitter may form the node of standing waves in the feeder.

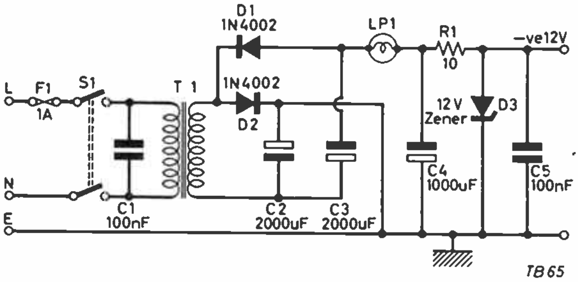


Fig. 11: Suggested power supply for the v.h.f. amplifiers.

If either of the amplifiers is built as a distribution system, it is perhaps a good idea to build a small mains unit to power the whole system. It is desirable that this supply be stabilised to guard against changes in the tuning of the f.e.t.'s if the supply voltage changes.

Fig. 11 gives a circuit of a simple power supply based on an 8V bell transformer with voltage doubling and zener stabilisation. The lamp, LP1, can be used to give on/off indication.

It is hoped that this article has given sufficient information for the home constructor to build an amplifier system to improve the performance of a tuner to reach the very high standards of the B.B.C. stereo transmisions. ■

EXPERIMENTERS CORNER

NOVEL TONE GENERATOR

N. NAUGHTON

WHENEVER home constructors and experimenters need to build a source of audio frequency, the choice nowadays is usually a transistor multivibrator. The reasons for this selection are easily understood. It requires few components, avoids the need for a transformer and gives a strong output signal. These virtues outweigh the fact that the square-wave output does not make for a particularly pleasing sound when amplified and fed to a loudspeaker.

In designing the a.f. tone generator to be described, the author set out to devise a circuit which would possess all the aforementioned merits of the multivibrator and at the same time give a better audio tone. In the circuit shown in Fig. 1—which, as a transistor circuit, is thought to be original—the writer believes these objectives have been largely achieved.

It will be noticed that the circuit is actually simpler than a multivibrator and basically it is a sawtooth generator. Like all sawtooth generators it depends upon the charge and discharge times of a

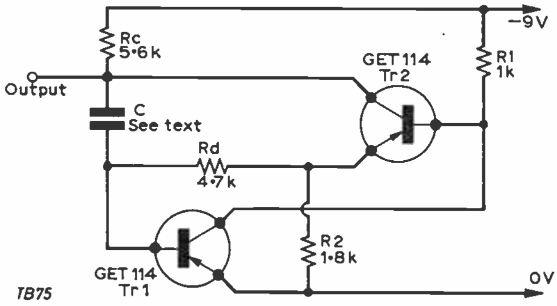


Fig. 1; Circuit of tone generator.

capacitor for its action. But as linearity of the sawtooth ramp is not important for the required purpose, the provision of constant current is omitted in the circuit shown.

In Fig. 1 the two transistors perform the function of switches and the circuit operates as follows:—capacitor C charges via the charging resistor Rc and the base-emitter junction of Tr1. The charging current flowing through the B-E junction turns on Tr1 and the flow of collector current causes a voltage drop across R1 which results in the potential on the base of Tr2 dropping to a level low enough to turn off Tr2. As the charge on C rises the charging current diminishes so that the potential on the base of Tr1 decreases to a point where Tr1 turns off. The base of Tr2 now goes strongly negative causing Tr2 to turn on and C now discharges via Tr2 into the discharge resistor Rd. While discharge current is flowing in Rd it maintains a positive potential on the base of Tr1 thus preventing further switching action during the period of discharge. When C has discharged, it again draws current through Tr1 once again turning off Tr2. The cycle then repeats.

The foregoing is a simplified description of the operation but many will find it interesting to measure the balance of currents and potentials which exist in the circuit under static conditions when C is removed.

The frequency of oscillation is not readily calculated since it is influenced by several factors one of which will be determined by the type of coupling employed to connect the output. However, for practical purposes values of C ranging between 2μF and 5000pF will cover the audio spectrum.

APPLICATIONS

A useful feature of the circuit is that it uses only one capacitor. With the values given, the generator should oscillate at any point within the a.f. range the actual point being determined by the value of C selected. Thus it becomes a simple matter to construct a signal generator giving a number of spot frequencies as desired; the only extra components needed being a multi-pole switch and a few capacitors. Many other audio applications will doubtless occur to readers.

For those interested, an interesting feature of the circuit is that because the charge and discharge paths of C are independent, the circuit can readily be made to produce right-handed or left-handed sawtooth waveforms. Moreover, by choice of p.n.p. or n.p.n. transistors, the polarity of either slope can be created as desired at source, thereby eliminating inverting stages. Although some value of Rd is essential for circuit function, in practice this can be less than 100Ω thus allowing fast flyback times. There is no reason why C can not be a very large value electrolytic so that the circuit can easily be adapted for timing application.

GENERAL

No constructional details are given since the generator will mostly be incorporated in some larger project. Experimenters can assemble the components on a length of Veroboard or tagboard.

As stated at the outset, the circuit is primarily intended as an a.f. generator and the values given have been chosen to give a roughly pyramid waveform at the collector of Tr2. A strong output signal is also available at the collector of Tr1 but this is a steep sided pulse and the "softer" toned signal at the Tr2 output can be readily appreciated. Coupling of the output is perhaps best determined to suit the individual case but too tight a coupling to the Tr2 output is best avoided. This is less important if the Tr1 output is used.

With the component values given, the circuit places no critical demands on the transistors' characteristics. Seven widely differing types, in various combinations, have been tried with success. However, experimenters using low values of Rd—especially with a high value of C—should note that Tr2 must then be a device capable of handling the heavier discharge current. Tr1 and Tr2 must both be either p.n.p.'s or n.p.n.'s, the −9V becoming +9V if n.p.n.'s are used. ■

IC POWER AMPLIFIER

D. SILVESTER

THE audio amplifier to be described was designed to deliver in excess of 10W r.m.s. into an 8Ω load, whilst being constructed in a 4½in. x 3½in. x 2in. diecast aluminium box. The size of the box is, in fact, limited not by the size of the i.c. but by the passive components, especially the output capacitor which must be included in the circuit. The use of the i.c. has added one inestimable advantage in that the current through (and the power dissipated by) the output stage under overload conditions can be limited. It is thus possible for the output to be short circuited without disastrous results.

The i.c., although capable of giving a 1 watt output without any other transistors, has been primarily designed for use as the driver stage of an amplifier capable of delivering up to 35 watts into an 8Ω load.

A description of the working of the i.c. has not been included as it is not necessary for the constructor to completely understand the operation of the device for it to be used successfully.

Two transistors in the i.c. are responsible for the current and power limiting facility. It was calculated that under maximum current limiting and with the normal current gain of a power transistor, the output stage of the i.c. would be overloaded. One way of curing this fault is to use a Darlington transistor. This in fact was done, the Darlington pair being contained in the TO3 metal case of the power transistor. The current gain of the complementary Darlington pairs is in excess of 1000.

CALCULATIONS

The final circuit used for the prototype amplifier is shown in Fig. 1 but since other constructors may wish to use different power supply voltages and load impedances from those used by the author, the method of calculation of the current and power limiting components is given. The basic circuit should be adhered to as it is only the values of R6, R8, R9 and R11 which need to be changed.

The following section shows the worked equations used to give the value of the components in Fig. 1.

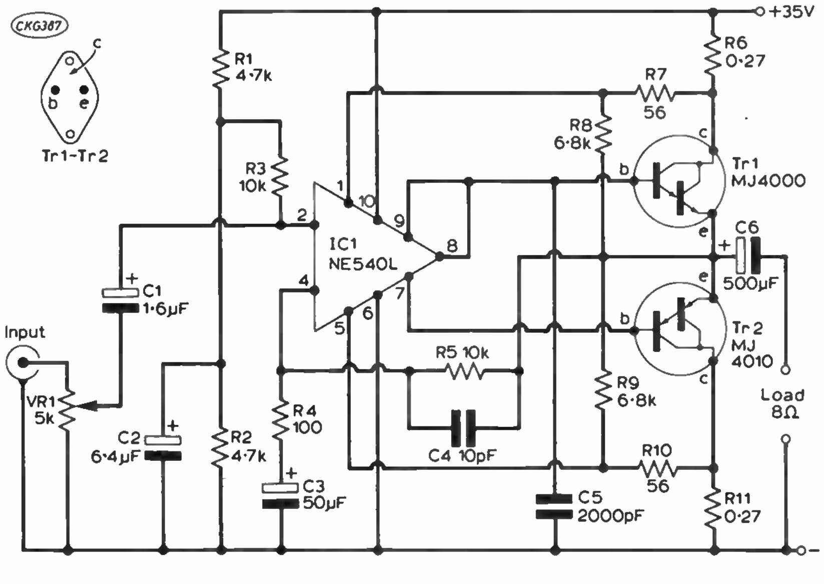


Fig. 1: Circuit diagram of the amplifier and pin connections for the output transistors.

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2G345B	0·25
2G371	0·15
2G374	0·15
2G381	0·22
2G417	0·20
2N109	0·49
2N174	1·40
2N176	0·75
2N274	0·75
2N335	0·75
2N351	0·95
2N376	1·00
2N384	0·98
2N388A	0·40
2N404	0·23
2N404	0·20
2N456	0·75
2N456A	0·75
2N457A	0·80
2N491	3·25
2N584	0·28
2N591	0·34
2N696	0·15
2N697	0·15
2N698	0·25
2N699	0·29
2N706	0·10
2N706A	0·12
2N708	0·13
2N709	0·38
2N711	0·30
2N718	0·21
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2N2193	0·40
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2N3703	0·10
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ACY40	0·17
ACY41	0·17
ACY44	0·31
AD136V	0·96
AD140	0·50
AD140	0·55
AD142	0·50
AD143	0·45
AD149V	0·66
AD149V	1·26
AD150	0·63
AD161	0·37
AD162	0·37
AD161 }	PR
AD162 }	0·69
ADZ11	1·50
ADZ12	1·75
AF106	0·27
AF109R	0·40
AF114	0·25
AF115	0·24

AF116	0·25
AF117	0·20
AF118	0·50
AF121	0·22
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AF127	0·20
AF139	0·38
AF170	0·25
AF172	0·25
AF178	0·55
AF179	0·65
AF180	0·50
AF186	0·40
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AF239	0·41
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AFY42	0·74
AF211	0·55
AL102	0·75
AL103	0·70
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ASZ21	0·55
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BC117	0·21
BC118	0·11
BC119	0·27
BC121	0·23
BC123	0·29
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BC126	0·20
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BC136	0·15
BC137	0·15
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BC205	0·10
BC206	0·11
BC207	0·10
BC208	0·09
BC209	0·10
BC211	0·30
BC212K	0·10
BC212L	0·12
BC214L	0·14
BC238	0·16
BC237	0·09
BC238	0·09
BC239	0·09
BC251	0·20
BC252	0·18
BC253	0·23
BC257	0·09
BC258	0·09
BC259	0·13
BC261	0·20
BC262	0·18
BC263	0·23
BC300	0·42
BC301	0·34
BC302	0·37
BC303	0·54
BC304	0·43

BC307	0·10
BC307A	0·10
BC307VI	0·10
BC308	0·09
BC308A	0·09
BC308B	0·09
BC309	0·10
BC309A	0·10
BC309B	0·10
BC313	0·30
BC327	0·24
BC328	0·22
BC337	0·19
BC338	0·19
BCY30	0·35
BCY31	0·40
BCY32	0·60
BCY32	0·75
BCY33	0·34
BCY34	0·35
BCY38	0·40
BCY39	1·05
BCY40	0·50
BCY42	0·15
BCY43	0·15
BCY58	0·21
BCY59	0·22
BCY66	0·66
BCY67	0·94
BCY70	0·17
BCY71	0·22
BCY72	0·13
BCY87	3·47
BCY88	2·40
BCY89	0·80
BCZ10	0·85
BCZ11	0·50
BD115	0·75
BD116	0·75
BD121	0·75
BD123	0·82
BD124	0·67
BD130	0·57
BD131	0·40
BD132	0·50
BD135	0·43
BD136	0·49
BD137	0·55
BD138	0·63
BD139	0·71
BD140	0·83
BDY10	1·25
BDY11	1·50
BDY17	1·50
BDY18	1·75
BDY19	1·97
BDY20	0·92
BDY38	0·65
BDY60	0·90
BDY61	0·85
BDY62	0·75
BF115	0·23
BF117	0·43
BF119	0·58
BF121	0·25
BF123	0·27
BF125	0·25
BF127	0·27
BF152	0·20
BF153	0·29
BF154	0·16
BF158	0·15
BF159	0·27
BF160	0·23
BF161	0·35
BF163	0·20
BF166	0·35
BF167	0·18
BF173	0·19
BF177	0·25
BF178	0·25
BF179	0·30
BF180	0·35
BF181	0·32
BF182	0·30
BF183	0·40
BF184	0·17
BF185	0·17
BF194	0·14
BF195	0·15
BF196	0·15
BF197	0·15
BF198	0·15
BF199	0·18
BF200	0·35
BF224J	0·14
BF225J	0·19
BF237	0·22
BF238	0·22
BF244	0·16
BF245	0·33
BF246	0·43
BF247	0·49
BF254	0·14
BF255	0·15
BF257	0·41
BF258	0·46
BF259	0·48
BF261	0·23
BF264	1·45
BF270	0·25

BF271	0·21
BF272	0·53
BF273	0·25
BF274	0·23
BF457	0·46
BF458	0·57
BF459	0·57
BFS21	2·10
BFS21A	2·30
BFS28	0·92
BFS61	0·27
BFS98	0·28
BFW10	0·61
BFW11	0·61
BFW15	0·35
BFX13	0·23
BFX29	0·25
BFX30	0·25
BFX37	0·30
BFX44	0·33
BFX63	2·48
BFX68	0·30
BFX84	0·24
BFX85	0·29
BFX86	0·24
BFX87	0·25
BFX88	0·20
BFX89	0·45
BFY10	0·35
BFY11	0·45
BFY17	0·90
BFY18	0·25
BFY19	0·25
BFY20	0·50
BFY29	0·40
BFY37	0·20
BFY41	0·43
BFY43	0·62
BFY50	0·16
BFY51	0·16
VFY52	0·16
BFY53	0·15
BFY56	0·34
BFY64	0·41
BFY75	0·40
BFY76	0·22
BFY77	0·24
BFY78	0·36
BFY90	0·60
BRY39	0·30
BSX19	0·13
BSX20	0·14
BSX21	0·30
BSX26	0·34
BSX27	0·34
BSX28	0·25
BSX29	0·47
BSX30	0·68
BSX59	0·78
BSX60	0·54
BSX61	0·42
BSX76	0·15
BSX77	0·20
ASX78	0·25
BSW70	0·28
BSY24	0·20
BSY25	0·15
BSY26	0·20
BSY27	0·15
BSY28	0·15
BSY38	0·15
BSY39	0·15
BSY51	0·25
BSY52	0·25
BSY53	0·25
BSY54	0·30
BSY56	0·79
BSY65	0·15
BSY78	0·40
BSY79	0·40
BSY790	0·45
BSY95A	0·09
BU104	1·42
BU105	2·25
C111	0·52
D40N3	0·62
GET111	0·45
GET113	0·20
GET114	0·20
GET115	0·50
GET119	0·35
GET120	0·25
GET535	0·20
GET536	0·30
GET538	0·20
GET873	0·12
GET880	0·30
GET883	0·20
GET887	0·20
GET890	0·22
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SN7404	0·20	0·18	SN7437	0·52	0·45	SN7474	0·40	0·34
SN7405	0·20	0·18	SN7438	0·52	0·45	SN7475	0·45	0·35
SN7406	0·30	0·24	SN7439	0·52	0·45	SN7476	0·44	0·39
SN7407	0·56	0·48	SN7440	0·20	0·18	SN7480	0·75	0·70
SN7408	0·20	0·18	SN7441AN	0·75	0·72	SN7481	1·25	1·07
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SN7410	0·20	0·18	SN7443	1·04	0·88	SN7483	1·00	0·82
SN7411	0·22	0·20	SN7444	1·04	0·88	SN7484	0·95	0·85
SN7412	0·42	0·36	SN7445	1·85	1·70	SN7485	2·50	2·30
SN7413	0·30	0·27	SN7446	2·00	1·60	SN7486	0·45	0·40
SN7416	0·45	0·40	SN7447	1·30	1·20	SN7488	12·40	11·80
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SN7421	0·22	0·20				SN7491	1·20	1·06
SN7422	0·48	0·42	SN7450	0·20	0·18	SN7492	0·75	0·70
SN7423	0·52	0·45	SN7451	0·20	0·18	SN7493	0·75	0·70
SN7425	0·48	0·42	SN7452	0·20	0·18	SN7494	0·84	0·80
SN7426	0·32	0·28	SN7453	0·20	0·18	SN7495	0·80	0·74
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1A	8p	9p	10p	11p	13p	15p	20p	—
3A	15p	17p	20p	22½p	25p	27p	30p	35p
6A	—	—	25p	30p	32½p	35p	—	—
10A	30p	35p	40p	47p	56p	66p	75p	—
15A	36p	45p	48p	55p	65p	75p	87p	—
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IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA82	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
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3¾ × 3¾in	25p	25p
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(As published in P.E. November 1971)

Complete kit £10·00

P. & P. 50p.

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58 mm. TRACK
SINGLE GANGED. LOG or LIN 1k to 1M. 40p each.
TWIN GANGED. LOG or LIN 1k to 500k 60p each

MULLARD C280 M/FOIL CAPACITORS

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0·068, 0·10	4p each
0·15, 0·22, 0·33	5p each
0·47	9p
0·68	11p
1μF	14p
1·5μF	21p
2.2μF	25p

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2·5 watt 5% (up to 270 ohms only), 7p
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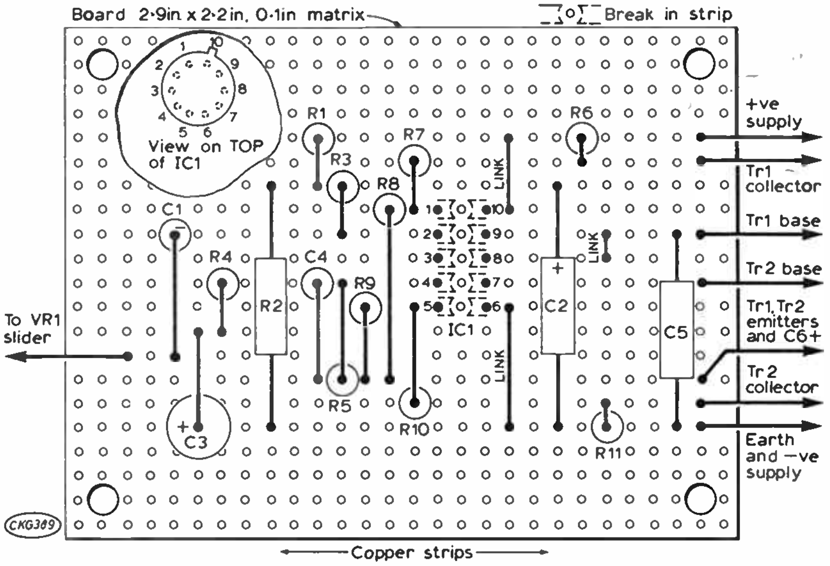


Fig. 3 Component layout on top of veroboard, the copper strips running horizontally underneath.

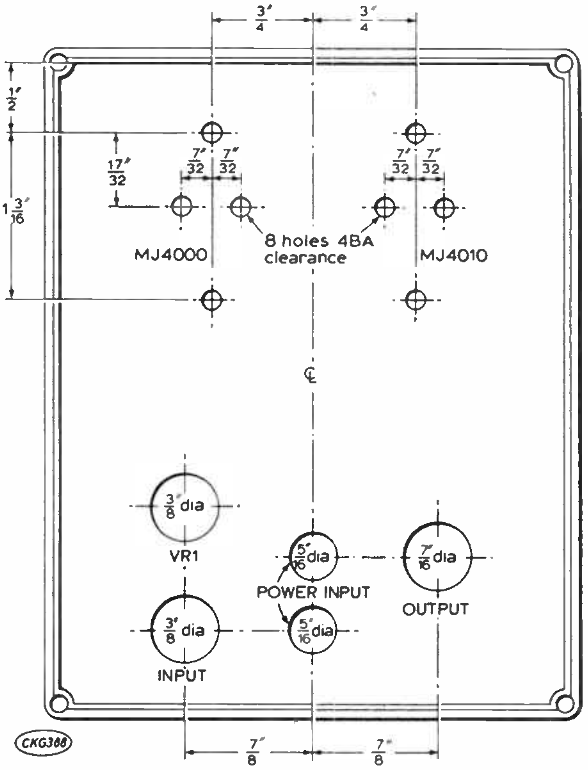
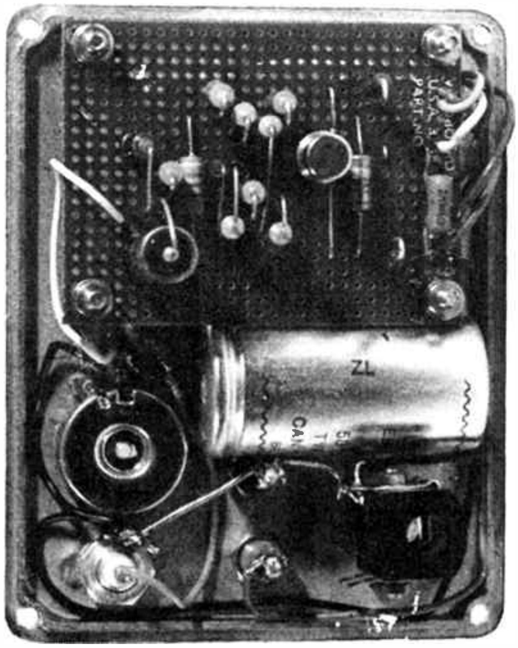


Fig. 2: Drilling details for the box lid on which components are mounted



This view of the completed amplifier emphasises the restrictions on the physical size of the output capacitor C6.

They are based on a supply voltage (Vcc) of 35V and a loudspeaker impedance of 8Ω (R_L). Before beginning the calculations it must be remembered that there are two limitations imposed by the active devices used; the supply voltage must be in the range 10 to 40V, and the maximum current through the transistors Tr1, Tr2 must not exceed 4A. We can calculate:

Peak current in transistors is:

$$\frac{V_{cc}}{2R_L} = 2{\cdot}2\text{A } (I_{pk})$$

If this value is above 4A we must use either a lower supply voltage or higher load impedance. To provide current limiting of this value and assuming no voltage drop across R7, R10 we calculate the values of R6 and R11 as:

$$R6 = R11 = \frac{650\text{mV}}{I_{pk}} = \frac{0{\cdot}65}{2{\cdot}2} = 0{\cdot}296\ \Omega$$

The nearest preferred value of resistor, which must be lower in value than the calculated value, is 0·27Ω. The basis of the working of the power limiting facility is difficult to explain in such a short article but works on the principle that both a high voltage across or a high current through a transistor and its network of resistors (Tr1, R6, R7 and R8) will tend to turn off the transistor. The resistor network acts to sense the power dissipation in the transistor and to limit this dissipation. The value of R7 and R10 is 56Ω. In all cases the value of R8 and R9 is:

$$R8 = R9 = \frac{V_{cc}}{6mA} = 5{\cdot}8k\Omega$$

The next highest preferred value, 6·2kΩ, is rather difficult to obtain and the value has been increased to 6·8kΩ. The voltage gain of the circuit is 100 and although this may be altered by changing the value of R4, the effect of such a change on the stability of the amplifier is difficult to predict. Under d.c. conditions the capacitor C3 represents an open circuit and the d.c. gain becomes zero, the voltage at the emitters of the two transistors, determined by the ratio of the values of R1 and R2, being at half the supply voltage.

★ components list

Resistors

R1 4·7kΩ	R5 10kΩ	R9 6·8kΩ
R2 4·7kΩ	R6 0·27Ω ± ·02	R10 56Ω
R3 10kΩ	R7 56Ω	R11 0·27Ω ± ·02
R4 100Ω	R8 6·8kΩ	VR1 5kΩ log

All ½W 5% except R6 and R11

Capacitors

C1 1·6μF 40V	C4 10pF
C2 6·4μF 25V	C5 2000pF
C3 50μF 35V	C6 500μF 50V

Note: C6 should not be over 2½" long and 1" dia.

Semiconductors

Tr1 MJ4000 Tr2 MJ4010
(both with mica washers and bushes)
IC1 NE540L
Available from SCS Components, POB 26, Wembley, Middlesex

Miscellaneous

Diecast box, 4½" x 3½" x 2". Veroboard 2·9" x 2·2", 0·1" matrix. Input socket, Output jack socket.

CONSTRUCTION

The complete circuit is constructed in a diecast aluminium box using the lid to hold all the components and the rest of the box as the cover. Fig. 2 shows the lid marked out for drilling, after which the power transistors are mounted (the NPN transistor Tr1, MJ4000 on the left as seen in Fig. 2) using mica washers with bushes. It is best at this stage to check whether the collectors of the transistors have been accidentally shorted to the box lid. The remainder of components should be fixed to the box lid, a tag washer under the input socket nut providing the main connection to the lid.

The component board is a 2·9in. x 2·2in. piece of 0·1 matrix veroboard, with the copper strips running along the 2·9in. length of the board, Fig. 3. After cutting the strips below the i.c., drilling the mounting holes and cleaning up the rough edges, a few moments should be spent with a meter checking that no lines are shorted together and that the strips below the i.c. are completely severed.

There should be no difficulty in constructing the board, but it is advisable to use different coloured wires for the flexible connections as this assists in the final wiring. The capacitor C6 is held in place by its wire leads, the positive end of the component being connected to the emitter of Tr1. The circuit board is held above the transistors on four 4BA screws with either two sets of nuts and washers or 1in. long spacers. The nut heads are stuck on the box lid with epoxy resin adhesive.

The final stage of wiring consists of connecting all the leads from the board to their respective terminations, wiring a negative supply earth lead to the earth end of the output socket, the negative supply socket, and the solder tag on the input socket. Lastly a wire is taken from the centre of the input socket to one side of VR1, the remaining potentiometer connection being taken to earth (the slider goes to the input on the board).

A power supply capable of delivering the maximum requirements of the amplifier must be used. In the author's case a supply of 35V at 2·5A. Under these conditions the amplifier was able to deliver nearly 15W r.m.s. into an 8Ω load. ■

CQ! CQ! CQ! CQ! CQ!

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...Television for March, April, May and June 1972.—R. T. McCoy 34, Karana Avenue Grovedale, Victoria 3221, Australia.

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...issues of P.W. that contained details of capacitive discharge systems:—J. Smith, 9 Amherst Avenue, Handsworth Wood, Birmingham. B20 2LH.

...P.W. Jan. 1972. April 1972, E.E. Nov. 1971. Feb. 1972, March 1972. Will pay face value plus postage and packing. All replies answered. Redwood, 45A Lulworth Avenue, Poole, Dorset, BH15 4DH.

...P.W. February and April 1972.—Ramesh Udyawar, C/O Post Box 610, Bombay 1. India.

...P.W. February 1972 issue containing details of the "Transistor Scope".—Mr. A. Chaplin. 26 Wakering Avenue, Shoeburyness, Nr. Southend-on-Sea, Essex.

...P.W. January 1972—T. Fresson, Fernilee, Churt, Farnham, Surrey.

...May 1972 edition of Television or a photostat of the second part of the colour television project.—C. A. Wilson, 23 Friars Oak Road, Hassocks, Sussex.

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EABC80	30p	EF95	35p	PCF805	80p
EAF42	52p	EF183	30p	PCF806	70p
EB91	18p	EF184	35p	PCF808	85p
EBC33	50p	EFL200	75p	PCH200	70p
EBC41	50p	EL34	50p	PCL81	47p
EBC81	31p	EL41	53p	PCL82	35p
EBF80	40p	EL84	24p	PCL83	60p
EBF83	40p	EL85	42p	PCL84	42p
EBF89	30p	EL86	40p	PCL85	42p
ECC81	30p	EL90	35p	PCL86	43p
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ECF801	82p	EZ41	50p	PY33	60p
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ECH35	90p	EZ81	27p	PY81	27p
ECH81	28p	GZ34	58p	PY82	35p
ECH83	40p	GZ37	70p	PY83	35p
		KT66	£2·05	PY88	37p
		KT88	£2·40	PY800	40p
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OA71	10p	OC75	25p	IZMT10	33p	12FR60	73p	BCY72	15p	NKT222	20p
OA73	7p	OC76	25p	IZT5	67p	40954	£1·25	BF115	25p	NKT304	50p
OA74	7p	OC81	20p	IZT10	63p	40595	£1·25	BF173	20p	RAS310AF	33p
OA79 (6D15	10p	OC81D	20p	2G385	51p	40636	£1·25	BFY51	20p	8D918	26p
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OA91	7p	OC82	25p	2N918	37p	40669	£1·40	B8	45p	8D938	32p
OA200	7p	OC82DM	30p	2N1304	22p	AC126	25p	B82	47p	8D94	21p
OA202	10p	OC83	25p	2N1306	25p	AC127	25p	BSY29	25p	8D988	46p
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OC22	50p	OC170	25p	2N3053	20p	AD161	35p	CR81/30	40p		
OC25	40p	OC171	30p	2N3054	50p	AD162	35p	CR81/35	43p		
OC26	25p	OC172	37p	2N3055	64p	AF118	50p	CR81/40	48p		
OC28	60p	OC200	40p	2N3730	50p	AF127	20p	CR83/05	30p		
OC29	60p	OC201	75p	2N3731	£2·75	AF139	30p	CR83/20	38p	**ZENER DIODES**	
OC35	50p	OC206	95p	2N4172	50p	AF178	48p	CR83/30	43p	All preferred voltage	
OC36	56p	1N21B	30p	82303	50p	AF186	40p	CR825/025	55p		
OC38	42p	IN25	60p	3F100	62p	ASY26	25p	CR83/40	50p	¼W	0·17
OC44	17p	IN43	10p	3FR5	32p	ASY28	25p	CS2A	65p	1W	0·37
OC45	12p	IN70	7p	3N128	87p	ASY67	48p	CV102	25p	1·5W	0·25
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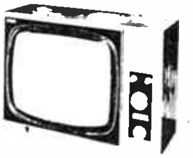

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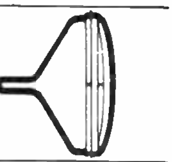

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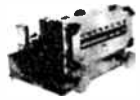

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STEREO AMPLIFIER 2 × 3W. Printed circuit. Valves EZ80 & 2 ECL82. Liquidated stock of well-known manufacturer. Front panel 12" × 2". Chassis 9" × 3". Controls on-off, balance, ganged vols., ganged tones; for 200-250v. a.c. Output transformers for 3-ohm speakers. With knobs. Also available for 110v. a.c. Only £6 (p. & p. 50p) 110v. type £5 plus post.

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HOTLINES ON RECENT DEVELOPMENTS

FOR some time now, weather satellites have been happily orbitting the earth some 800 miles up. These animals transmit a picture of the earth and a suitably equipped station below can receive these pictures. They show cloud distribution which is useful in helping to guess whether it will rain or not on the following washday.

3D RAIN?

Now comes news about a satellite built by the RCA. It is equipped with special sensors and boasts the distinction of being the very first operational satellite to provide a three-dimensional picture of the earth's weather. It is equipped with some very impressive sounding equipment; a scanning radiometer, a very high resolution radiometer and a vertical temperature profile radiometer.

The very high resolution radiometer (v.h.r.r.) has two channels and offers images from both the visible and infra-red regions. It can sense the thermal energy given off by objects below, down to half a mile in area.

Resolution is far better than the pictures provided by television cameras or the radiometers used in earlier satellites. The solar cells in the satellite, NOAA-2, generate some 500 watts and over 10,000 individual cells are used to achieve this power. Who knows—television announcers of the future may be forecasting that three dimensional rain is on the way.

LIQUID CRYSTALS

It now seems a certainty that liquid crystal displays will have a big impact on the electronics market. I reported these as being already built into a multi-digit display being marketed at the Electronica exhibition in Germany late last year. Now, the U.S. giant, North American Rockwell is reported to be mass-producing liquid crystal devices.

The liquid crystal phenomenon was first discovered way back, as long ago as 1888. The basic principle is that certain liquids become opaque when they are subjected to an electric field. With no field present, they are transparent. The North American Rockwell displays consist of two small plates of glass. Although these are bonded together, they are separated by a tiny gap—about a thousandth of an inch. This tiny gap is filled with the special liquid which is affected by an electric field. The cell is thus completely transparent.

However, when a small electric field is applied (this takes about 25V to achieve the desired effect) the cell becomes opaque. Without a field, the molecules in the liquid are uniformly and regularly oriented. The application of the electric field causes this molecular structure to become disoriented and the molecules thus scatter the light giving an opaque effect.

The voids or spaces into which the liquid is put can be formed into figures or letters for the purposes of forming a display. Conductors to the liquid are formed from tin oxide which is a transparent conductor. The liquid crystal display draws almost no power—about 10mW or one hundredth of a watt. Perhaps we will have windows some day which will be clear until we press a button?

OZONE SPEEDS UP RESIST REMOVAL

Integrated circuits (i.c.'s) are delicate little beasts especially during their manufacture. Part of this process is a photographic one. There is a particular stage in the printing of each mask where unwanted photo-resist has to be removed. Considering the size of elements on individual i.c.s this removal is a delicate business. The General Electric Company in the U.S.A. have come up with a new method of removing unwanted photo-resist. It consists of exposing the resist to ultra-violet rays in the presence of air. It takes about 40 minutes for a typical film of resist to be removed. The depolymerisation of the resist happens at a rate of about a thousand angstroms per minute. By injecting 2% ozone gas into the chamber with the specimen the process is speeded up some ten times.

Earlier, I talked of liquid crystals and many have leapt in claiming that the solid state flat tube television screen is here. One British manufacturer, however, is obviously unimpressed. Mullard has opened a new factory in County Durham. The sole purpose is to manufacture shadow mask colour television tubes.

Although only officially opened in December last year, pilot production was already said to be running at the rate of 100,000 tubes delivered from this plant. By the end of this year, production is estimated to be in the region of 500,000 tubes and by the end of this present decade, production will be running at some 900,000 tubes/annum. All this adds up to a lot of colour television receivers—have you got yours yet?

LASERS ARE BACK

Lasers are back in the news again, this time in America where the Optical Physics Division of the National Bureau of Standards is applying one to monitor pollution. A major contributor to atmospheric pollution is nitrous oxide. It is found lurking in such jolly jollop as flue gases and in the exhaust fumes from motor vehicles.

The laser beam is directed through a magnet whose coils are driven by an audio amplifier and is detected by an infra-red device. The amplifier generates a modulating magnetic field which has the effect of sweeping the absorption line through the laser line. The detector produces a signal which has a direct relationship to the amount of nitrous oxide in the sample being investigated.

Concentrations of nitrous oxide as low as 20 parts per million (p.p.m.) can be detected but workers believe that concentrations right down to 0·1 p.p.m. will be detectable as the method is improved.

FLYING SPOT

Useful things oscilloscopes. Have you ever wondered just how fast that tiny spot of light travels across the cathode ray tube? Before you start to make calculations, think of the latest fast writing oscilloscope, the HP 184A. The writing speed for this unit is so fast that the spot travels 400cm in one millionth of a second.

Ginsberg

IAN SINCLAIR

EVER since the day when Marconi equipped the yacht *Elettra* with radio to act as a mobile test-bed, electronics and boats have been closely associated. The first really extensive use of radio was at sea, and after the Titanic disaster all ships were required to keep radio watch continuously for distress signals. The requirement for ships to be fitted with radio and staffed with trained operators did not, however, extend to small boats at that time, and it is only fairly recently that radio and electronic aids for pleasure craft have become more of a necessity for serious boating.

MARINE HAZARDS

Electronic devices for use at sea present some design problems which do not appear in land-based equipment. The most obvious hazard is moisture, not the fresh water moisture of a foggy day on land but the salt-laden moisture which corrodes its way through soldered joints, cable terminations, plugs and sockets, and most other metal-to-metal joints in a remarkably short time. As well as the corrosion problem, which can be completely solved only by total encapsulation, there is the problem of insulation resistance.

Salt spray is quite a good conductor and in valve equipment in particular, operating at high voltages, protection of equipment from saline elements is a problem to designer and operator alike.

It was largely the water-spray problem, as well as the cost factor, which has kept electronics out of small craft for so long. In large vessels, the radio and radar equipment could at least be mounted in an enclosed space at a reasonable height above the deck, well away from the direct spray except in the most extreme conditions. In small boats, such spray-free havens cannot be found, and there is little chance of keeping the equipment free of water by heating coils, as were once used on bridge-mounted radio and radar.

The advent of solid state equipment has opened up a new dimension in marine applications, especially with the possibility of cutting down on interconnections by using integrated circuits. Vibration is one of the most pressing problems in small craft, where the rumble of even a small diesel engine is enough to loosen plugs from sockets or wires from soldered joints.

Some of the most up-to-date equipment used for pleasure craft can be seen at the annual Boat Show, held each year in London in January. This year you would have found amongst other more glamorous displays, several kinds of communications equipment.

One stand showed a "triple-standard" television receiver, complete with inverter for use with ship batteries, for use in most yachting centres in the world. But for those who insist on wind in their sails, there was a complete analogue computer, taking information on wind speed and direction, water speed, currents, intended course, and displaying the optimum trim on a model.

RADIO AIDS

Radio is still the mainstay of marine electronics, and it is hardly surprising that there should not be many advances in this direction as there are in instrumentation. The latest ranges of transmitter/receivers are geared to the most recent International regulations, which call for s.s.b. working in the marine bands between 250kHz and 4·1MHz and the use of all solid state equipment nas resulted in very compact apparatus.

A large number of v.h.f. and u.h.f. radiotelephones were also shown, and one interesting new development is the Marconi "Pocketphone" intended for communication on large vessels, such as tankers, and during docking and cargo handling operations.

The v.h.f. and u.h.f. equipment uses frequency modulation, and most make provision for the reduction of channel spacings to 25kHz, which will soon be a Post Office requirement. The bands used are within the range 148MHz to 174MHz in v.h.f. and 440MHz to 470MHz in u.h.f. Communications equipment was being shown by (among others) Marconi Marine, Electronic Laboratories (Marine), Ajax Electronics and S.P. Radio A/S of Denmark.

The latter firm was showing a receiver operating under the spray from a waterfall, whose salt content I did not sample, and also showed the "Dual-watch" facility on receivers. This enables the operator to fulfil the requirements of listening for distress signals along with normal working. The distress frequency is preset, so that the set is tuned permanently to that frequency in the watching circuits.

Working can be continued on other channels, and if a signal is received on the distress frequency (or any other being watched) the receiver output is instantly and automatically switched to the watched frequency. A lamp indicator also shows when a call is being received on the watched channel, and flashes during normal operation to show that the watch is being carried out.

DIRECTION INDICATOR

An interesting device for the small boat is the "Seafix", a hand-held radio direction indicator by Electronic Laboratories (Marine). This consisted of a t.r.f. transistor receiver with "autodyne" detection over the range 200 to 400kHz, with the calibration most accurate at 300kHz, the centre of the Marine Beacon band.

Switched to NAV, the autodyne circuit is used to receive beacon transmissions, and the highly directional ferrite rod aerial can be used for finding the bearing of the beacon within 2° (at half rated range). Switched to BC, the "Seafix" can be used to pick up the long-wave shipping forecasts broadcast on this band. A stethoscope headset was used in preference to loudspeakers or conventional phones, and water sealing was by the conventional compressed rubber gaskets.

RADAR

Radar has for a long time been one of the most important navigational aids for larger vessels, but is seldom seen on smaller craft. There are several reasons for this: the cost of any radar installation is high, since it must include the cost of modifications to the vessel as well as the provision of the apparatus.

Radar equipment is often unavoidably large, heavy and dependent on high voltages, since the cathode-ray tube and the magnetron must use high voltages, although it is now possible to replace the klystron local oscillator by Gunn diodes or other semiconductor devices.

The Hepplewhite Marine Check radar detector lets you know if you are on a collision course.

Manufacturers are not dragging their heels over these problems, but are commendably cautious, since they know only too well how much the readings of a radar receiver come to be relied on. Any compression of size or cost must therefore not be made at the expense of accuracy of plotting if we are not to have a rash of "radar-assisted" collisions. All the big names in marine radar (Decca, E.M.I., Marconi Marine) showed small radar outfits, but these were not really intended for the amateur.

The Hepplewhite "Marine Check" is a continuous scanning self-powered instrument designed to minimise risk of collision with other vessels whose radar may not pick up small boats in bad weather or low visibility—the "Marine Check" will however, detect the other vessel's radar transmission and allow you to take avoiding action.

The scanning head is a miniature, precision, solid-state detector and amplifier of continuous, pulsed and modulated X-band radar transmission (9,000 to 11,500MHz) with electronics mounted in a shock-proof case and will receive radar transmissions at sighting distance.

As the sensitivity is reduced, the directional power of the antenna is proportionately increased to a point where the bearing is located on a narrow sector. If this bearing, which is indicated on a compass scale, remains constant, you may be on a collision course, also as the pulse length increases as the distance decreases, it is possible, within limits to determine if the transmitting vessel is approaching or receding.

The "Seascan" radar by Electronic Laboratories (Marine) is designed for the amateur, and has a power consumption of only 48W from 12V, 24V or 48V battery supplies. The only vacuum devices used are the display tube and the magnetron, the local oscillator being a Gunn diode whilst the magnetron modulator uses a thyristor. Unfortunately no circuit details were available and all the units on the stand were dummies.

One interesting new development in radar for the small craft is a passive radar detector by Hepplewhite Marine. This picks up the X-band (9,000 to 11,500MHz) transmissions from other vessels, and has a small directional aerial consisting of a Perspex "horn" on which waves are guided (along the surface) by the effect of the permittivity of the material. The received radar signals are mixed with the output of a local oscillator, and the beat note amplified. The point of strongest signal can be identified by altering the mixer bias so that only a signal of the maximum strength will produce a beat note; this enables the operator to find the bearing of the craft carrying the radar.

SPEED MEASUREMENT

Water and wind speed instruments have for a long time been a weak point in the instrumentation of boats. The traditional methods of measuring speed have depended on anemometers for wind speed and submersible "logs" for water speed. The anemometer is the device using three or four cups at the ends of radial rods pivoted so that the effect of wind is to revolve the assembly about its axis. The

The Electra Magnetic Log is an impellerless speed and distance indicator.

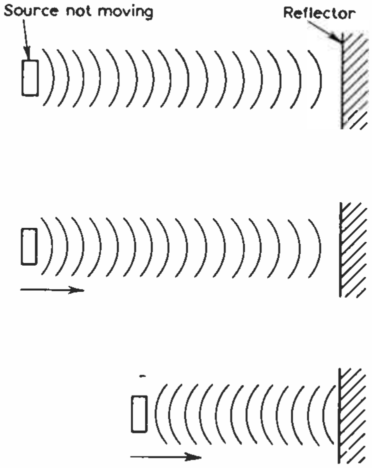


Fig. 1: The Doppler Principle.
Imagine a transducer giving out sound waves. These waves travel in water at a speed of about 1,000 metres per second. Speed equals frequency multiplied by wavelength.
If the transducer moves at a speed "V", the speed of the waves towards the reflector is now 1,000+V metres per second. We have not changed the frequency of transmission, so the wavelength must now be less.
($1{,}000+V=f\times$ new wavelength.)
The waves are now reflected to a moving object, so that more waves per second hit the receiving transducer. The frequency is now higher by a factor $\frac{c+V}{c}$ where c is the normal wave speed and V is the speed of the transducer and boat. The final effect is to receive waves of shorter wavelength and higher frequency.

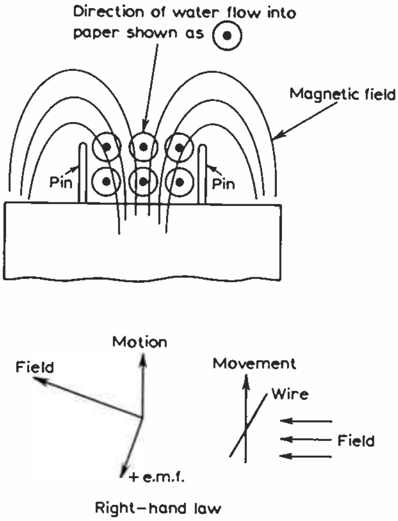


Fig. 2: An e.m.f. is produced between two metal contacts, providing the direction of flow is at right-angles to the line joining the contacts.

speed of rotation, which depends on the wind speed, is measured by counting the number of switching operations of a reed switch under the influence of a magnet on the rotating shaft. This count is converted into an analogue signal which drives a meter. Wind direction is found by using a vane coupled to a potentiometer to show the angular position by voltage detection on a meter.

The traditional submersible "log" consists of a small propeller whose shaft is held in a casing containing a reed switch. The rotation of the propeller as the "log" is towed behind then registers relative water speed just as the anemometer registers relative wind speed. The snag is that the propeller of the log is easily jammed by anything encountered in the water from jellyfish to seaweed, and this can have the effect of making calculation of speed and distance incorrect.

SPEED-LOGS

Two novel speed-logs were shown, each representing refreshingly different thinking about the problem. Space Age Electronics showed their Doppler speed log. This uses a ceramic transducer to project a 1MHz sound beam ahead of the ship. Most of the beam is dissipated in the water, but a small part is reflected from the layer of relatively still water (the boundary layer) close to the boat.

When the boat is moving, the reflected frequency is not the same as the transmitted frequency (Doppler Effect). If the boat is moving ahead, the reflected frequency is higher than the transmitted frequency; if the boat moves astern, the reflected frequency is lower.

Referring to Fig. 1, the transmitter, because of its movement, "packs in" more waves between itself and the still layer than it would if it were not moving. Because more waves are travelling, the wavelength seems shorter. Also, when the waves reflect from the boundary layer, the receiver has also moved towards them, making the frequency of the received waves seem higher.

When the reflected wave is detected, the shorter wavelength appears as a higher frequency (speed = frequency × wavelength), whose value depends on the difference between the speed of sound in water and the speed of the boat. By beating the transmitted frequency against the reflected frequency, a measure of speed can be obtained.

The method is dependent on obtaining a reflection from relatively still water, and so the transmitting/receiving head must be located where such a layer is within range. Precise location varies from boat to boat. To allow for variations in installation, the calibration is adjustable, so that the distance log can be checked against accurately known distances (between two land-marks, for example). The circuitry uses three integrated circuits, 17 transistors and eight diodes. A "log" accuracy of better than ± 1½% (typical) is claimed.

The "Electra" magnetic log, produced by E.M.I. marine uses the magnetohydrodynamic principle for its operation; this is the generation of a voltage by induction when a conducting liquid flows past a magnetic field.

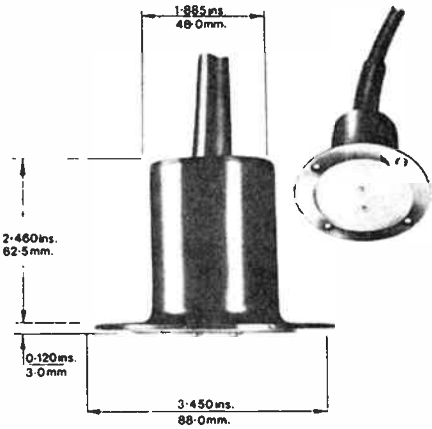
By arranging a magnetic field to cut the direction of water flow at right angles, an e.m.f. is induced between two metal contacts in the moving water, provided that the direction of flow is at right angles to the line joining the contacts (Fig. 2)

The Electra Magnetic Log operates on this principle, but with some ingenious modifications. The magnetic field used is an alternating field. In this way, the voltage generated is also alternating, which disposes of two problems at once. One problem is polarisation; when a steady voltage exists between two contacts in sea water, an electrolysis action takes place causing corrosion of the metal. The use of a.c. avoids polarisation problems and makes it easy to amplify and display the output from the contacts. As with the previous method, the positioning of the measuring head is critical.

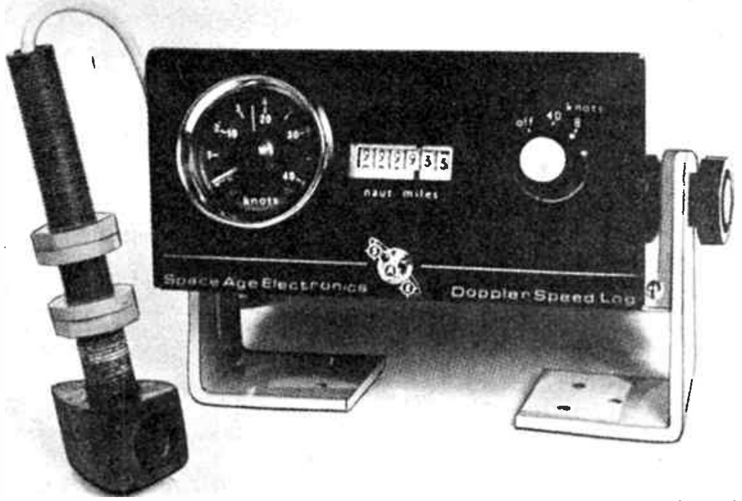
ECHOSOUNDERS

Echosounders have been used for a considerable time, and changes have been in detail rather than in concept. Basically, a marine echosounder consists of a pulse generator working at ultrasonic frequencies in the region 20kHz to 150kHz (the higher frequencies are used for inshore work). A transducer converts the electrical pulses into sound waves directed from the bottom of the boat into the sea, and a receiver, using the same transducer, detects the pulse reflected from the bottom of the sea.

The shape of the received pulse provides a guide to the nature of the sea bed, for example, a muddy



The electro-magnetic transducer for the magnetic log. As the boat moves along, a small e.m.f. is produced and sensed by two probes. This signal is then amplified and displayed in speed and distance units.



The Doppler speed-log does not rely on the flow of water to move a mechanical part like an impeller or paddle wheel. A small streamlined transducer, mounted flush with the underside of the hull, transmits a high frequency ultrasonic signal 70cms ahead. A small part of this signal is reflected back from the boundary layer between the hull and the water.

sea bed is indicated by a broad pulse, a sandy bed by a narrow pulse, a rocky bed gives multiple reflections. Pulses received from intermediate depths can indicate shoals of fish. The time delay between transmission and reception is proportional to the depth of sea.

Because the pulses are travelling in the water at the speed of sound (around 1,000 metres per second) rather than at the speed of radar waves in space (some 30 million metres per second), scanning rates have to be lower than the 1,000Hz commonly used in radar. Scanning rates of once per second are common, although this is rather too low for display on a long persistence cathode ray tube screen.

The display method traditionally used is a rotating wheel carrying, or illuminated by, a neon which flashes on transmission of the pulse and again when the echo is received. The stationary bezel round the wheel is then calibrated in metres of depth (now replacing fathoms on the latest charts).

The large number of echo sounders at the show demonstrated several novel points of design. Most interesting was the use of electro-luminescent diodes to replace neons, so avoiding the need to generate a high voltage supply (Brookes & Gatehouse). A common feature of all the echo sounders was the use of high scan rates for the shallow water ranges (up to six pulses per second) so giving better definition in critical conditions.

Lead zirconate titanate crystals were in evidence as transducers, encapsulated in various plastics. For professional use, chart recording echosounders were shown (these, of course, have been around for a long time). The Marconi Marine chart-maker used electrosensitive paper which changed colour when a small voltage was applied between the front of the paper and the back.

WATER-LEAK AND WATCH

In addition to the displays of electronics for communication and navigation, there were some interesting exhibits in the "miscellaneous" class. Space-Age Electronics were showing their water-leak and watch alarm, and judging by the sound which could be heard all over the first floor of Earls Court, almost every chandlery firm was demonstrating it.

The instrument is basically a conventional leakage detector using stainless steel pins as probes. If the pins are immersed in water for more than four seconds, an alarm is given, but only if the immersion is for longer than four seconds, a time carefully chosen to avoid continual false alarms in heavy seas. When there is no conductivity between the pins, all transistors are biased off, so ensuring practically no standby current. The sound given out is a rising frequency note which is most easily distinguished amongst other sounds.

The watch facility also provided on this instrument gives an alarm note of gradually increasing amplitude every three minutes. If an alarm button is pressed during the alarm, or before it, the instrument remains silent until another three minutes has passed. If the helmsman is asleep and does not press the alarm button, the alarm warning increases to maximum intensity.

GAS ALARM

The Electra gas alarm, from E.M.I. Marine, is of considerable interest. Unlike previous gas alarms, which used heat conduction from a hot wire to detect changes in the air composition, the Electra gas alarm uses semiconductor sensors. No details were given, but it is possible that the sensors consisted of infra-red electroluminescent diodes and detectors. Any change in the air composition caused by petrol vapour, butane or propane gas, carbon monoxide, smoke, paraffin fumes, diesel fumes is indicated by two visual warnings in the form of a meter reading and a red warning lamp.

In addition, a loudspeaker gives out a 2·5kHz note when the gas concentration exceeds the safe limit. In this way, no panic is caused by small concentrations of gases, since only the discreet visual warning is given, but dangerous amounts operate the audible alarm so that evacuation or other measures can be taken. Remote warnings can also be fitted.

All in all, the Boat Show is developing considerable interest from the point of view of electronic aids. It is unfortunate that so few exhibitors were able to cope with technical queries, but all of them were most helpful. ■

practically wireless commentary by HENRY

No. 98
First in the Field

I HAD a chap in the shop today, searching for an SP4. It is true: even in the glitter of a hi-fi establishment, where every prospect teases and only valves are vile, we still get enthusiasts with thirty-year-old equipment, hopeful of our being able to provide the missing link.

Which leads us, philosophically, to a contemplation of some of the 'firsts' we nowadays take for granted.

Example: the quasi-complementary transistor amplifier circuit, which has given us so much trouble since its inception. I have come across the September 1956 copy of *Electronics*, a McGraw-Hill publication, in which R. C. Lin, then of RCA, Princeton, first propounded his output circuit in which, to quote: '. . . the two upper transistors conduct during the negative half-cycle and the two lower transistors conduct during the positive half-cycle.'

In his summary, he gave amplifier distortion at 100cps (sic) and 400cps as below 1 per cent at six watts, and though he admitted that the distortion might be expected to rise at 5,000cps, he made no mention whatsoever of its fierce spikiness at a fraction of a watt, which is the mariner we've had wrapped around our necks ever since.

The mariner wrapped around our necks.

Inventions, especially world-shaking innovations such as the transistor proved to be, have a habit of spawning themselves much more prosaically than we would like to imagine. No technologist runs screaming through the corridors of the M.I.T. with 'Eureka' echoing behind him. More likely, something as laconic as the 12/29/39: 4.15 p.m. entry in William Shockley's notebook may be handed down to posterity: 'It has today occurred to me that an amplifier using semiconductors rather than vacuum tubes is in principle possible.'

In principle: hardly in practice. He was thinking of a Schottky-barrier FET kind of device, with copper-oxide as the semiconductor. And, as Henry could have told him*, it didn't work. Instead, the experiments of the team included covering metal points with wax and pushing them down on to p-type silicon treated to give an n-type surface. They surrounded the point with water and found they could obtain power amplification.

To quote Brattain: '. . . the group was jubilant that day.'

Trouble was that the water would evaporate. Maybe it was all that heavy breathing. So they switched to glycol borate to reduce evaporation. One trouble: amplification was obtainable only below 8Hz—hardly hi-fi yet.

There were lots more experiments, culminating in evaporated gold spots and germanium, and then, on Dec. 23rd 1947, two gold contacts less than two-thousandths of an inch apart were made to the same piece of germanium and the first transistor happened.

No sudden breakthrough—no inspirational brainchild—and no immediate christening, I may add. It was a month later that a chap called John R. Pierce of the Bell technical staff mooched into Brattain's office and pointed out that the 20dB point-contact amplifier they had made was the

Runs screaming through the corridors.

'. . . dual of a vacuum-tube, circuit-wise.' He mentioned the important valve parameter, transconductance. Then he went on to talk about its electrical dual, transresistance. To quote Brattain once more: '. . . then he said 'transistor', and I said, 'Pierce, that is it!!'

What about a few more firsts in our field? Who developed the first p-n junction? Bet you can't even say his name, let alone remember it. Well Henry can, with the benefit of some help from Edward A. Torrero, who is Associate Editor of *Electronic Design*. He was William Pfann (with the aid of a chap called Jack Schaff; let's give credit where it is due). They also worked for Bell Laboratories.

But Bell eschewed silicon for germanium, because the impurities, back in the early 1940's, were easier to control. It was left to Texas Instruments to develop silicon types of transistor, and to Motorola to introduce the diffused base transistor.

So I could continue. Henry hasn't the space to name those to blame.

But the "first" we are all concerned with is that original all-transistor radio. And who made that? A firm called Regency, in 1954. How's that for a significant 'first'?

* With the benefit of hindsight. Ed.

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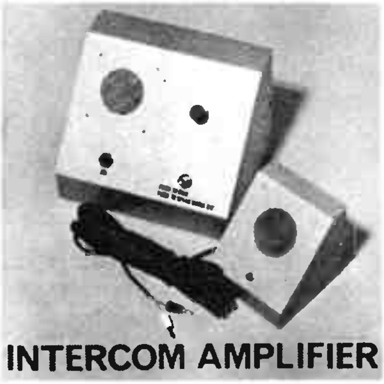

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TRI

Following the success of the Texan amplifier published in this magazine during May to August 1972, the applications laboratory of Texas Instruments Ltd. have developed exclusively for *P.W.*, a compatible unit for the control of Psychedelic lights from a sound source. The initial design features zero voltage control. A more sophisticated design incorporating lamp dimming facilities will also be covered in this series of articles. For stereo operation two *P.W. Tricolour* units are required.

MONO/STEREO CAPABILITY

ZERO VOLTAGE SWITCHING

NEGLIGIBLE RADIO INTERFERENCE

LAMP OVER-RIDE CONTROL

OPTIONAL LAMP DIMMING

Mood

PART ONE

IF I had been asked, a couple of years ago, what 'psychedelic lights' were, I could only have made a wild guess: was it perhaps a medical term referring to some sort of ultra-violet treatment for disorders of the mind? Or, possibly, the latest in pet food, some extra tantalising form of offal? The truth, however, dawned slowly. What my "trendy" young friends were talking about was the latest innovation, the offspring of a marriage between light and music. It was not simply a question of a 'pop' version of 'son et lumière' but a more intimate relationship between the two media. Light could be made to respond directly to sound; flashing furiously for a fanfare, discreetly dimmed for Debussy. It is, however, unlikely that psychedelic lights will be installed in the Royal Festival Hall, but those of our readers who occasionally frequent the discotheque or dance hall will be familiar with this innovation. It is probable, too, that many have given thought to the incorporation of this feature into their own domestic lighting systems. What, it might be asked, does this involve?

In essence a 'psychedelic' light system works like this: sound controlled modulators convert bass, middle and treble frequencies into corresponding bursts of light thus adding a new "visual" dimension to the beat of the music. This is achieved by taking a signal from across the loudspeaker terminals and feeding it into a filter circuit whose output provides pulses which correspond to the sound spectrum—bass, middle and treble and any combinations of these three channels. These pulses then pass through an interface circuit and energise appropriate triacs. The latter, as will be seen, act as electronic switches and turn on the lamps.

This article will attempt to explain fully the construction of psychedelic light control units for both mono and stereo equipment. It is aimed at the home constructor who possesses nothing more than an average amount of skill.

Zero Voltage Switching

As stated, the lights are turned *on* and *off* by utilising a device called a triac, i.e. a semiconductor bidirectional switch (Fig. 1). This replaces two thyristors connected back to back, thus controlling the positive and negative cycle of the supply voltage. Whereas the thyristor requires a positive gate to cathode voltage and will turn *on* only when the anode voltage is positive with respect to the cathode, triacs will turn *on* when the gate voltage polarity is the same as voltage between mt2 and mt1 (main terminal 2 and 1), i.e. positive for the positive half cycle and negative for the negative half cycle. In addition a triac will turn *on* with the gate negative with respect

* TEXAS INSTRUMENTS LIMITED.

COLOUR

Lighting System

JURE K BUDEK*

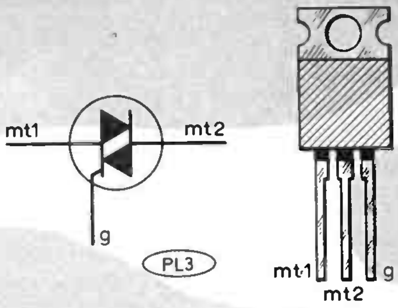


Fig. 1: The TIC226D bidirectional switch

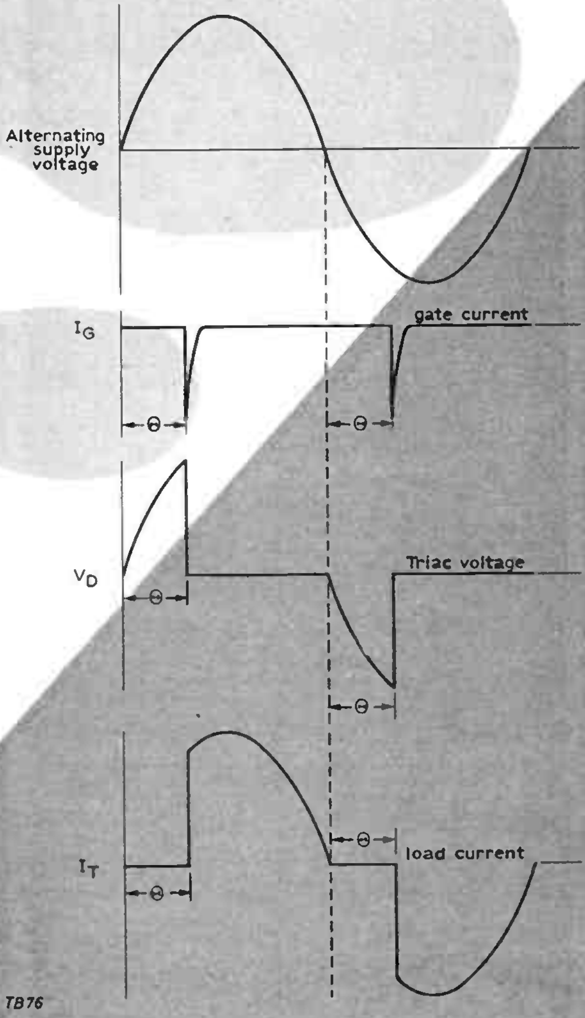


Fig. 2: Waveforms associated with triac switching. Refer to the text for clarification

to the mt1 terminal for either polarity of mt2. It is the latter factor which accounts for the techniques used in the circuits to be discussed in this article.

A further point about the triac is that there is only 2-3 volts between the gate and terminal 1, whereas there may be many hundreds or even a thousand volts between terminal mt2 and mt1.

Triacs used in a phase control mode, as shown in Fig. 2, produce considerable radio frequency interference (r.f.i.) due to the step change in current. The noise thus generated is spread by means of conduction through the wiring system or by radiation. Suppressing r.f.i. becomes more difficult and expensive as the load increases. Uncontrolled switching of "psychedelic" lamps *on* and *off* will have a similar effect and will also introduce additional noise in the loudspeakers. A simple solution to this problem is to arrange the switching so that it always takes place at the point where the mains supply voltage crosses zero, as shown in Fig. 3.

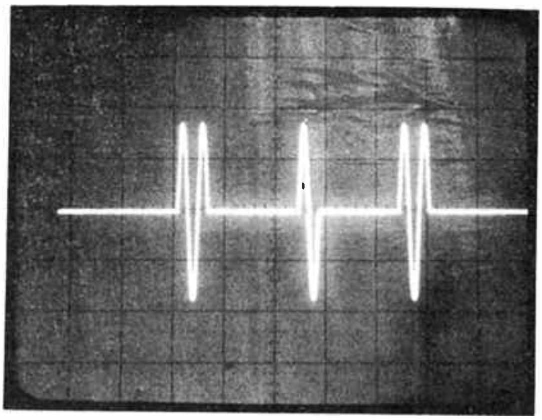


Fig. 3: Waveform depicting zero voltage switching.

This technique is called 'zero voltage switching' or 'burst firing.' In this way isolated numbers of half or full cycles will pass through the lamps and thus avoid step change in currents, which also has the additional advantage of increasing the life of the lamp.

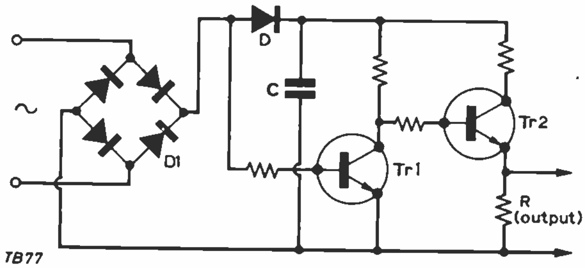


Fig. 4: Basic circuit which generates the pulses at the point of zero voltage crossing.

Fig. 4 shows the circuit used to generate the pulses at the point of zero voltage crossing. Transistor Tr1, whose base is connected to the unsmoothed supply from the bridge rectifier D1 is *on* most of the time.

However, each time the mains voltage crosses zero, its base voltage is taken below the holding on voltage and it thus turns *off*, giving positive pulses on its collector. In order to reduce the loading on transistor Tr1, transistor Tr2 has been added. Positive pulses appear as an output across resistor R each time the mains voltage crosses the zero point.

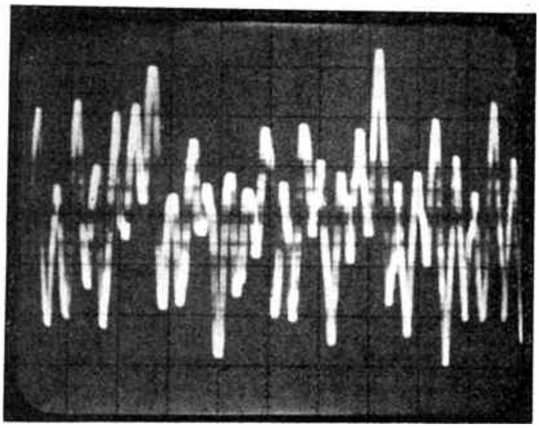


Fig. 5: Typical music voltage waveform at the terminals of a loudspeaker.

In order to control the lamp switching with respect to the frequency bands, we need a circuit which will separate out the low, middle and high frequencies from the voltage waveform appearing at the terminals of a loudspeaker. A typical voltage waveform appearing at this point is shown in Fig. 5.

Filter

A circuit which separates frequencies into bands is called a filter. There are various types of filters which could be employed; e.g. one commonly used is a resistor/capacitor (r.c.) network for high and low pass filters and an inductor/capacitor (l.c.) network for middle frequencies. The elegant way, however, specially developed for the *P.W. Tricolour* is to employ integrated circuit (i.c.) operational amplifiers, in a positive fixed-gain configuration, as the active filter element and resistors and capacitors as passive elements. By choosing suitable component values a sharp separation between bass, middle and treble frequencies can be obtained.

The shape of the filter response is determined by a factor known as the damping ratio (ζ). The lower this ratio, the sharper the cut-off and there is a *peaking* effect. This *peaking* effect is of no importance in our application. As approximately 1·5 volts is required to turn *on* the interface circuit, and thus to switch on the appropriate lamps, the filter characteristics are expressed in volts against frequency and not in the more usual decibels against frequency.

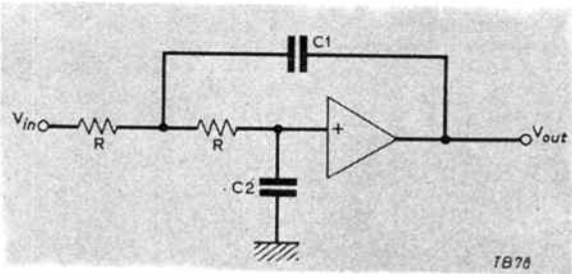


Fig. 6: Basic low pass filter as used in the P.W. Tricolour.

The theory of filter design is quite extensive and complex. We will however only outline the necessary basic concepts and give some simplified formulae.

Let us first look at a basic low pass filter (i.e. one which will stop all frequencies except those below a chosen frequency). The circuit of such a filter is shown in Fig. 6.

Here the angular cut off frequency, $\omega 0 = \dfrac{1}{R\sqrt{C1\ C2}}$

and the damping factor $\zeta = \sqrt{\dfrac{C2}{C1}}$

Critical damping occurs when $\zeta = \dfrac{1}{\sqrt{2}}$

and, for the reason explained before, i.e. to improve the sharpness, this value is reduced to 0·5. From these equations, the filter component values can be established.

The high pass filter (passing all frequencies above a chosen one) is shown in Fig. 7 and again requires only one operational amplifier, two resistors and two capacitors.

Here the angular cut-off frequency, $\omega 0 = \dfrac{1}{C\sqrt{R1\ R2}}$

and the damping factor $\zeta = \sqrt{\dfrac{R1}{R2}}$

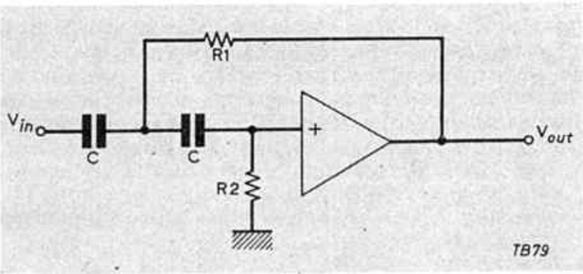


Fig. 7. Basic high pass filter. ▲

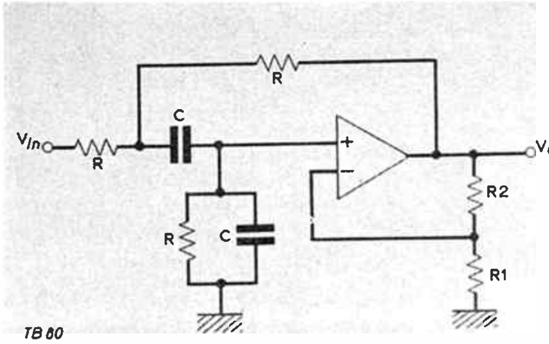


Fig. 8: Basic band pass filter.

Once more from these equations, the filter components values can be established. Finally, the band pass filter; which, of course, as its name suggests, passes a band of frequencies. This, as can be seen from Fig. 8, is a little more complicated than the other two.

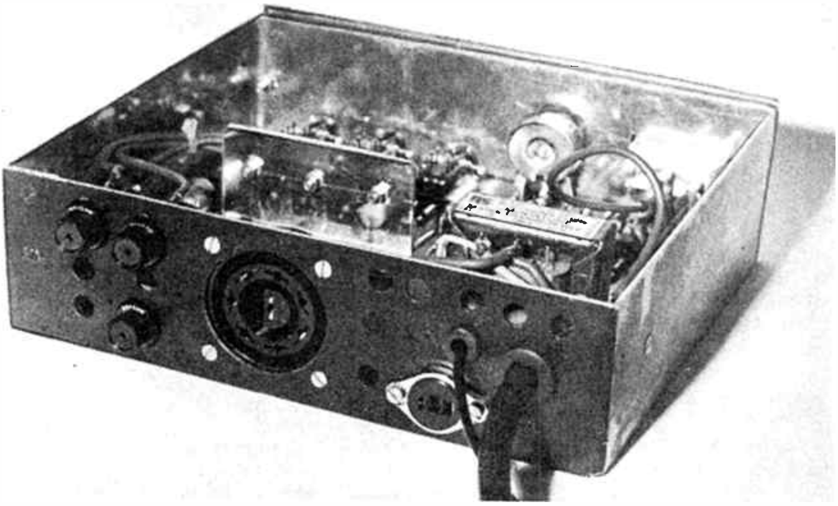
The centre angular frequency $\omega 0 = \dfrac{\sqrt{2}}{RC}$

and the quality factor $Q = \dfrac{\sqrt{2}}{4 - \dfrac{R2}{R1}}$

$Q = \dfrac{2\Delta f}{fo}$, where $2\Delta f$ is the difference between two frequencies at which the voltage output of the filter is $\dfrac{1}{\sqrt{2}}$ of its maximum value. From the above formulae, relevant component values can be obtained.

Musically oriented readers will recall the 'unisono' note played on the oboe during the orchestra's tuning-up time, just before the concert begins. This note is middle 'A' with a frequency of 440Hz; a frequency which has been chosen as the centre frequency for the middle band-pass filter in

Rear view of the P.W. Tricolour. ▶



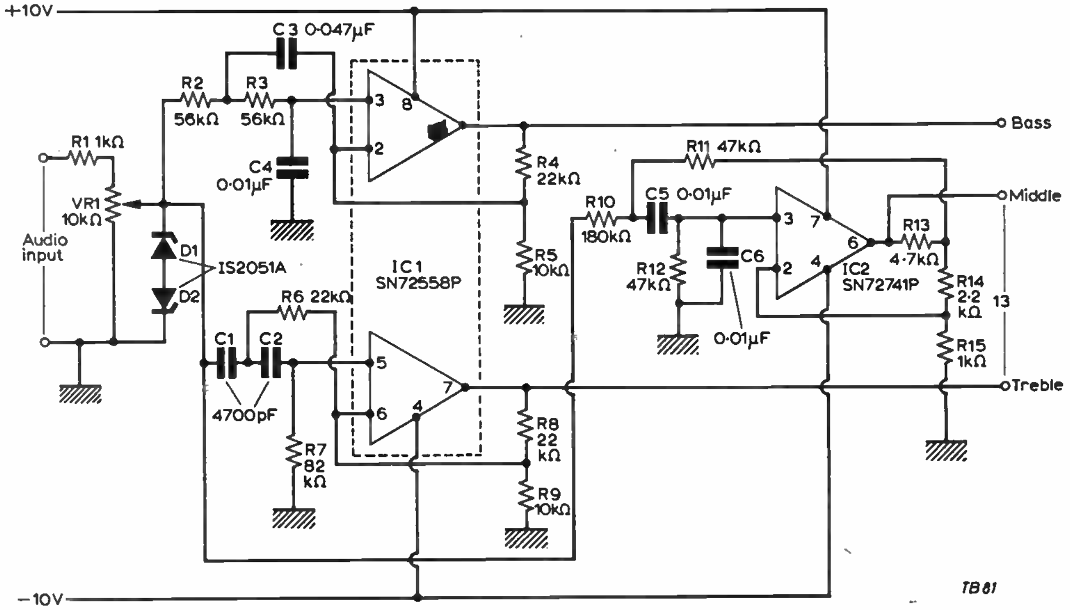


Fig. 9: Complete P.W. Tricolour filter circuit. This unit is used without modification, with either the zero voltage switching unit (Fig. 12) or with the lamp dimming unit, to be described later in this series.

this design. Cut-off frequency for the low pass filter has been chosen to be around 200Hz and that of the high pass filter (treble) about 1kHz.

Based on the above assumptions, a complete filter has been developed with the component values as shown in Fig. 9. The alert reader will notice that some of the component values differ from the figures obtained using the formulae. This has been done intentionally in order to improve the separation between the various frequency ranges.

The input to the filter circuit has been limited to 5 volts peak to peak by using two 5 volt zener diodes connected back to back. Three i.c. operational amplifiers are used. Two of which are contained in one 8 pin package, SN72558P and the other i.c. is contained in a second 8 pin package, SN72741P.

Fig. 10 shows output voltage response of the three filters plotted against frequency for a peak input signal of 0·5 volts. The effectiveness of the filters are obvious. The solid state switches—triacs—turn on their corresponding lamps at filter output voltages equal to and higher than 1·5 volts.

Figs. 11a to 11d show four oscilloscope photographs. These show traces with the vertical axes representing voltages and the horizontal one time. In each instance the four traces were taken simultaneously (i.e. they have a common time axes). In the oscillograms the top trace corresponds to the voltage at the loudspeaker terminal. The other three traces were taken at the outputs of the respective filters.

Fig. 11a was taken at a time when the treble

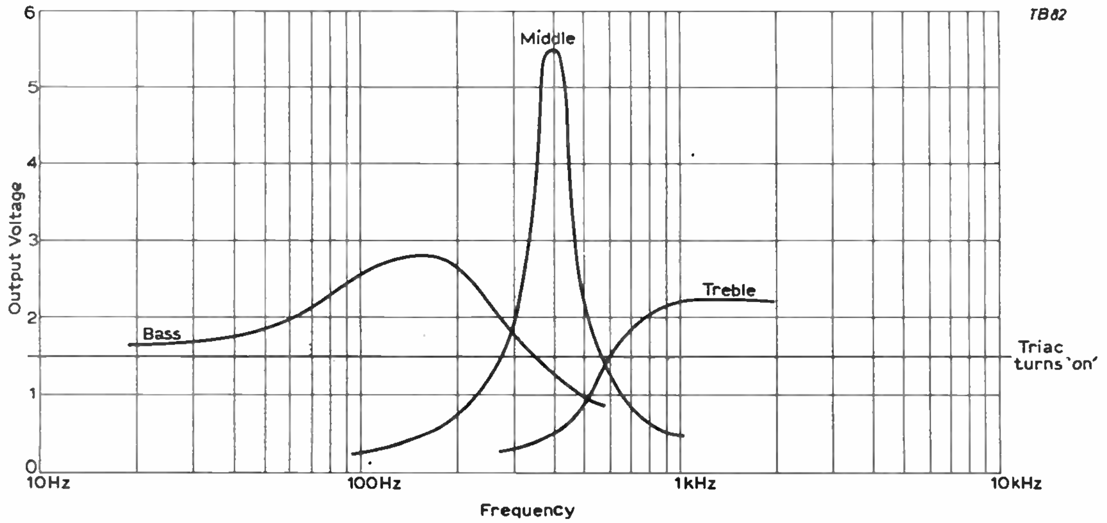


Fig. 10: Output voltage/frequency response of the filter circuit shown in Fig. 9.

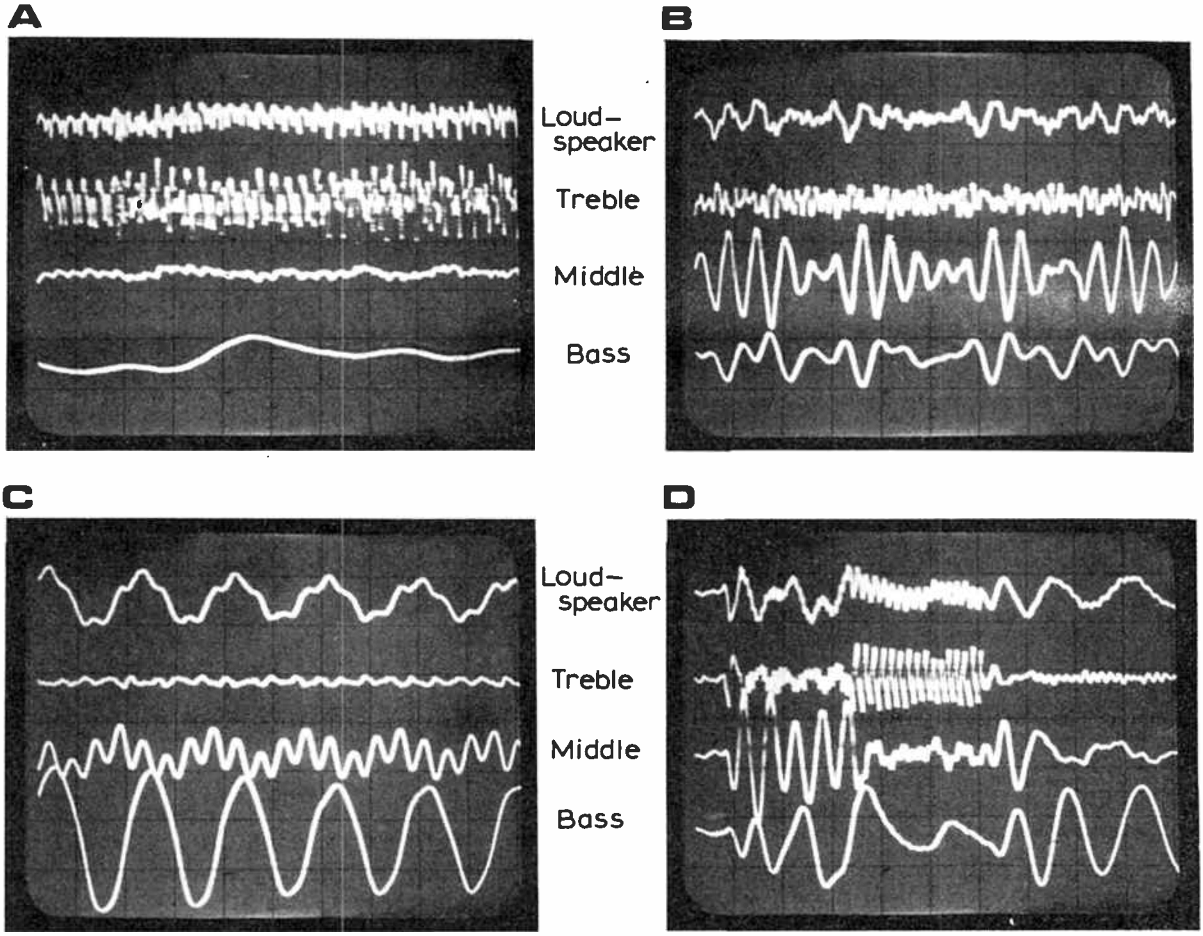


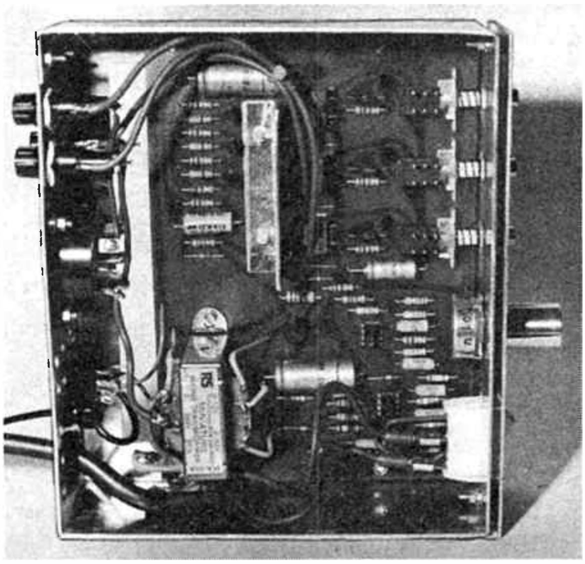
Fig. 11 : (a–d) A full explanation of these waveforms is given in the accompanying text.

frequency was predominant. In Fig. 11b the middle frequency is the strongest signal, while in Fig. 11c it is the bass. Fig. 11d shows some interesting combinations of all three frequencies. The middle frequencies predominate at the beginning of the trace, then the treble takes over at the centre of oscillogram and towards the end of the trace it is the turn of the bass to predominate.

A 10kΩ potentiometer has been added at the input to the filter circuit to allow the voltage level at which the lamps are switched to be controlled. In this way it is possible to establish the best effect for 'soft' or 'party' type music.

The *P.W. Tricolour* is suitable for use with 4 to 15Ω loudspeakers. The load represented by the filters is negligible compared to the loudspeaker impedance.

It should be noted that the simple filter circuits illustrated at the beginning of this article used operational amplifiers. An operational amplifier has high input impedance, very high gain, and low output impedance, enabling the filter component values to be determined independent of the amplifier parameters. The amplifiers used were shown having a voltage gain of unity. This means that the output voltage of the high and low pass filters can never



Underside view of the P.W. Tricolour *with zero voltage switching.*

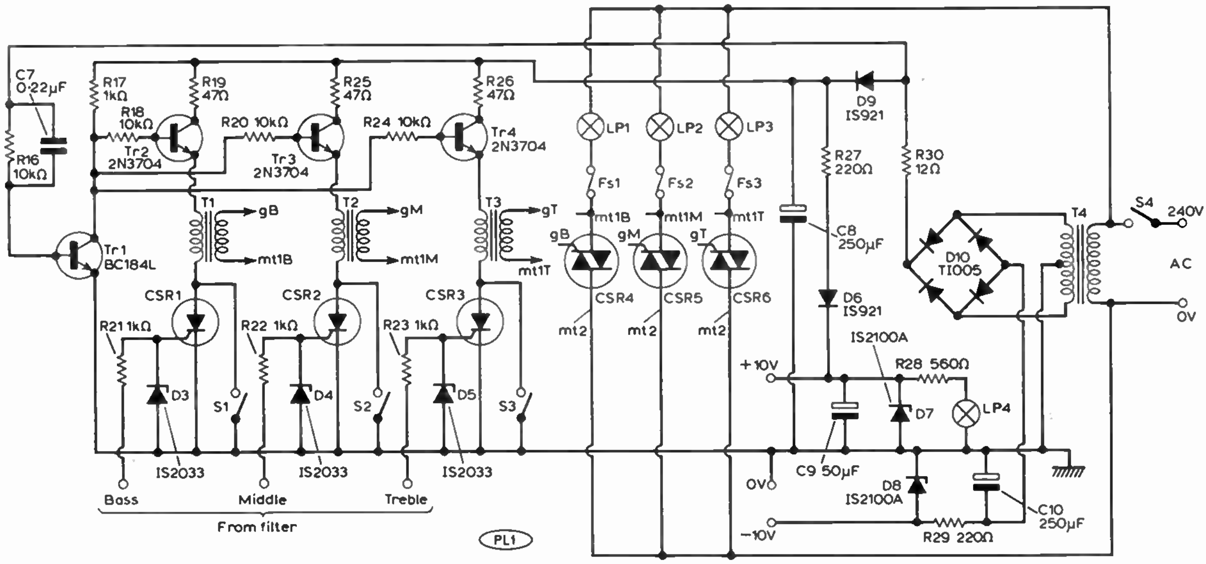


Fig. 12: Zero voltage switching control unit. The positive and negative 10V supply lines are the d.c. supplies to the filter unit (Fig. 9).

be more than the input voltage. In order to achieve voltage gain so that sufficient output can be obtained to drive the interface circuit at low volume levels, the basic circuit must be modified. This involves reducing the proportion of output voltage from the amplifier that is used as feedback to the filter capacitors and resistors. This is achieved by the use of a resistive potential divider at the output of the amplifier. This is shown in Fig. 9. The resistor ratio determines the gain of the filter in the pass-band.

The *P.W. Tricolour* is suitable for either mono or stereo record playing. In the case of the stereo system, the lights will flash in accordance with the signals appearing at the terminals of one of the speakers. However, for stereo enthusiasts who wish to use two units, the interconnecting arrangement will

★ components list

Resistors:

R1	1kΩ	R16	10kΩ
R2	56kΩ	R17	1kΩ
R3	56kΩ	R18	10kΩ
R4	22kΩ	R19	47Ω
R5	10kΩ	R20	10kΩ
R6	22kΩ	R21	1kΩ
R7	82kΩ	R22	1kΩ
R8	22kΩ	R23	1kΩ
R9	10kΩ	R24	10kΩ
R10	180kΩ	R25	47Ω
R11	47kΩ	R26	47Ω
R12	47kΩ	R27	220Ω
R13	4·7kΩ	R28	560Ω
R14	2·2kΩ	R29	220Ω
R15	1kΩ	R30	12Ω ¼W

All 10% ¼W unless otherwise specified

Capacitors:

C1	4700pF
C2	4700pF
C3	0·047μF
C4	0·01μF
C5	0·01μF
C6	0·01μF
C7	0·22μF
C8	250μF 25V
C9	50μF 25V
C10	250μF 25V

Transformers:

T1, T2, T3 — Pulse transformer, type PT-ATA ITT Ltd.
T4 — Miniature mains transformer 240V primary 0-12V, 0-12V r.m.s. 6VA, type 12V R.S. Components

Integrated Circuits

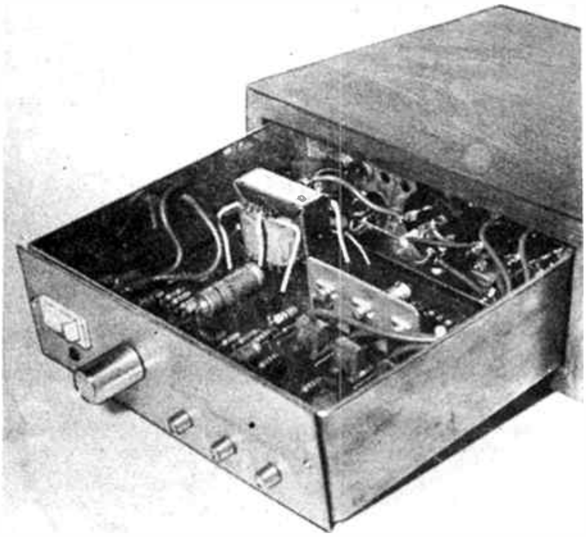
IC1 SN72558P
IC2 SN72741P
} Texas Instruments Ltd.

Semiconductors: (Texas Instruments Ltd.)

Tr1	BC184L	
Tr2	2N3704	
Tr3	2N3704	
Tr4	2N3704	
D1	IS2051A	
D2	IS2051A	
D3	IS2033	
D4	IS2033	
D5	IS2033	
D6	IS921	
D7	IS2100A	
D8	IS2100A	
D9	IS921	
D10	TI005	Bridge rectifier
CSR1	TIC44	
CSR2	TIC44	
CSR3	TIC44	
CSR4	TIC226D	
CSR5	TIC226D	
CSR6	TIC226D	

Miscellaneous:

VR1 10kΩ linear potentiometer
FS1, FS2, FS3 — 5A fuses and panel mounting holders
LP1, LP2, LP3 — Colour flood lamps, 240V 100W
LP4 — TIL 209 Indicator lamp Texas
S1, S2, S3 — Push on-push off
S4 — Single pole mains on-off rocker



Internal view of the P.W. Tricolour.

be explained later.

Fig. 12 shows the circuit which operates the flashing lights according to the frequency ranges.

Switch S4 controls the mains supply to the unit from a 13A domestic socket. When the a.c. mains power is on the gallium arsenide device LP4 lights. A smoothed d.c. supply for transistors Tr1-Tr4 is obtained from a single phase bridge D10, resistor R30, diode D9 and capacitor C8. The ±10V power supply for the filter circuit is taken from zener diodes D7, D8 and capacitors C9 and C10.

As described previously, the zero voltage crossing pulses are generated at the collector terminal of transistor Tr1. These pulses turn *on* transistors Tr2, Tr3 and Tr4 via base resistors R18, R20 and R24. When a voltage signal from the filter circuit appears at the input terminals, the corresponding thyristors CSR1, CSR2 or CSR3 will turn *on* allowing pulses to be present at the respective gate of CSR4, CSR5 or CSR6 which turn them and thus their lamps *on*. Pulse transformers T1, T2 and T3 are used only for electrical isolation.

Zener diodes D3, D4 and D5 limit the thyristors gate voltages to 3·3V in the positive direction and to under 1 volt during the negative half cycles.

Facilities are provided for 'by-passing' the psychedelic control by closing switches S1, S2 or S3 to allow the lamps to be used as normal lights. The centre tap of the 12-0-12V mains transformer is connected to the chassis and is earthed. Note that the three triacs are mounted on a common heat-sink, which is at the supply line voltage, i.e. 240V.

The author has made arrangements for the supply of all components for the *P.W. Tricolour* with Henry's Radio Ltd. We understand that a detailed price list will be available from them upon receipt of a stamped addressed envelope.

TO BE CONTINUED

CHARLES MOLLOY

THE Medium Wave Column

J. KING (Edinburgh) asks for the times and frequencies of English speaking foreign stations on the medium waves. Among the stronger there are Radio Sweden which is on 1178kHz every night at 2245hrs; Radio Portugal on 755kHz and 1161kHz, also at 2345hrs and the Vatican Radio on 1529kHz at 2100hrs. There are also the American Forces Network (AFN) outlets on 872kHz, 935kHz and 1142kHz. Try for CJON St John's, Newfoundland on 930kHz—it can be found on the low frequency side of AFN on 935kHz after 2330hrs. CJON has been a strong and consistent signal all winter and it has even been heard when conditions have been poor and no other North American could be heard.

Harold Emblem (Mirfield, Yorkshire) has received a QSL card (verification) from Radio Zagreb Yugoslavia which transmits on 1133kHz. The address is Radio Televizija Zagreb, PO Box 818, Zagreb Yugoslavia and reports in English are answered. Harold mentions hearing PJA6 Radio Victoria on 925kHz, which is located in the Netherlands Antilles in the Caribbean. It broadcasts religious programmes in English and other languages and is usually heard in this country after midnight.

Harry Kenyon (Leeds) has been looking for a published list of medium wave stations. "Broadcasting Stations of the World" published by Iliffe is available in many bookshops price 50p. It covers medium wave stations in Europe and North Africa plus a number of more powerful outlets in other parts of the world, that are usually heard in Europe. There is also a comprehensive list of short wave stations.

Karl Ritz (Bicester) sends a programme schedule of BBC Radio Oxford which is now on 1484kHz. Frequencies in use by BBC local radio are 850kHz R. Blackburn, 998kHz R. Solent, 1034kHz R. Medway, R. Sheffield; 1106kHz R. Leeds; 1457kHz R. London, R. Birmingham, R. Newcastle, R. Manchester; 1484kHz R. Brighton, R. Humberside, R. Merseyside, R. Oxford; 1502kHz R. Stoke; 1546kHz R. Bristol, R. Teeside; 1594kHz R. Leicester.

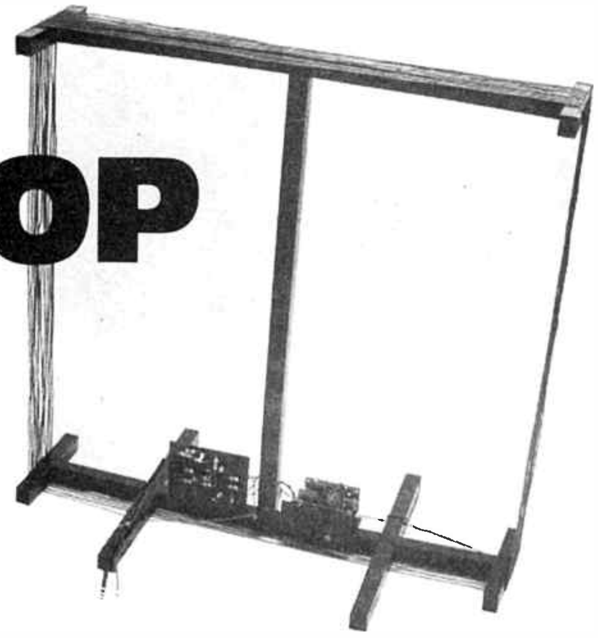
Kenneth Turner (Edinburgh) has logged R. Birmingham, R. Stoke and R. Bristol and he reports hearing Manx Radio (Britain's only commercial radio) on 1295kHz and 1594kHz.

G. H. Esmail (Bradford) enquires about a suitable receiver for use on the MWs. Serious DXers prefer a communications receiver such as the Trio 9R59DS or the Lafayette HA600 but an ordinary transistor portable will pull-in Europeans and North Africans and if the receiver is rotated to make use of its internal directional aerial, it will be possible to reduce quite a lot of interference.

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

DXers MW LOOP aerial

S. A. MONEY G3FZX



DURING the next two years the minimum of the current sunspot cycle should occur. Although short wave reception usually suffers at the period of the sunspot minimum the conditions will become very favourable for the reception of DX signals on the medium wave broadcast band. Unfortunately, the interference from European stations, many of which now remain on the air all night, is likely to be much worse than it was during the last sunspot minimum. In order to winkle out the weaker DX signals from the QRM it will be important to choose an effective aerial system as well as a good receiver.

In the late 1950's the writer, in collaboration with Reg Dunkley of Havant, Hampshire, carried out a series of tests to investigate the possibility of using a tuned loop aerial for the reception of DX signals on the medium wave band. These tests showed that although the loop aerial is somewhat less sensitive than the usual outdoor wire type aerial it has several advantages which make it attractive for DX work.

Pick-up of background noise and static seems to be rather less on the loop aerial than it is on a wire aerial so that although giving less signal the loop does usually give a better signal to noise ratio.

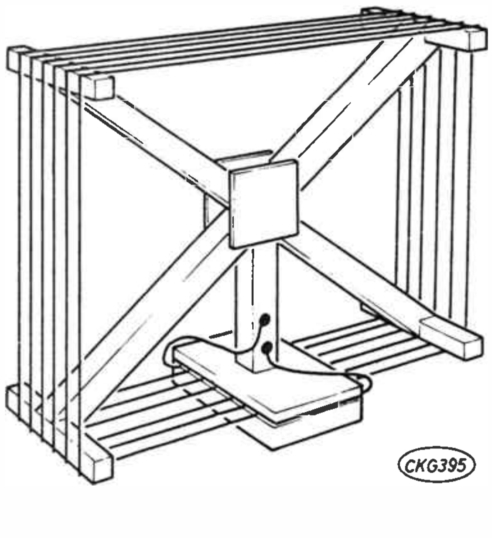


Fig. 1: Configuration of a typical m.w. loop aerial.

By rotating the loop aerial its directional properties can be used very effectively to cut down adjacent channel interference from strong European signals. A further advantage of the loop aerial is that it is very compact and hence attractive to the listener who is unable to use a large outdoor aerial system.

The advantages of the loop aerial have, in the past ten years, made it very popular among the medium wave DX enthusiasts in Britain.

Although the basic loop aerial as used by most of these DX'ers is quite effective it is not the optimum arrangement.

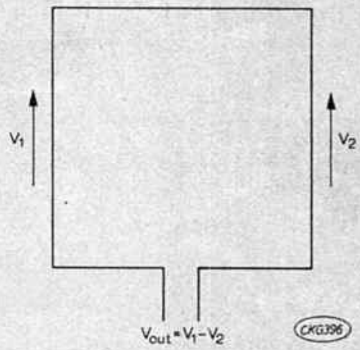
In the past year the writer has experimented with methods of improving the performance of this type of aerial. In this article a system is described consisting of a loop aerial and a matching amplifier capable of giving a performance superior to that of the basic loop aerial.

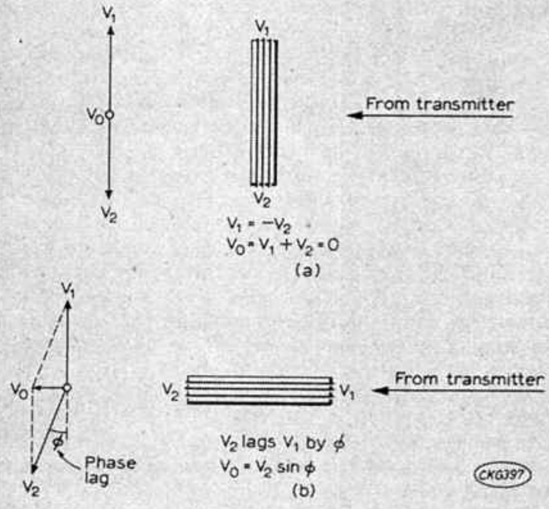
HOW THE LOOP WORKS

Before going on to describe the improved aerial system it would be as well to consider the make up of the basic loop aerial and the way in which it works. This type of aerial used to be a standard fitting in portable radios before the arrival of the ferrite rod aerial.

The loop aerial usually consists of a number of turns of wire wound in the form of a short coil on a large wooden frame. Typical aerials are square in shape as shown in Fig. 1 although circular or diamond shaped loops will also work. The length of the sides may be from 12in. up to about 4ft. In general, the larger size aerials give greater signal output and rather better directional properties.

Normally the turns of the winding are spaced apart from one another to reduce self capacitance. The whole aerial is then tuned to resonance by a variable capacitor connected across the ends of the loop.





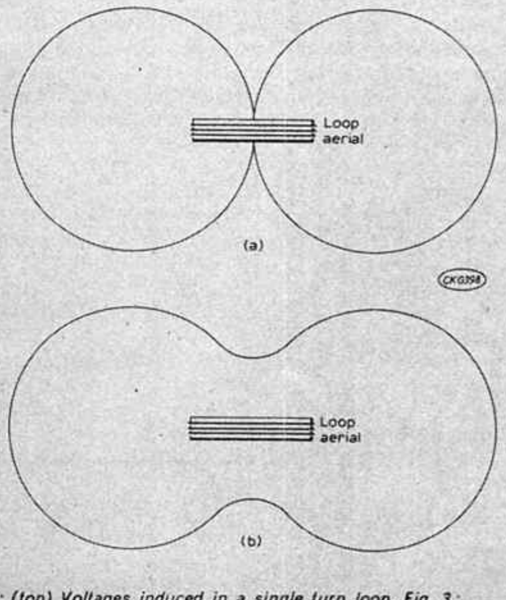


Fig. 2: (top) Voltages induced in a single turn loop. Fig. 3: (centre) indicates how the output of the loop depends on its position relative to the signal source. Fig. 4: (bottom) illustrates the modified pick-up pattern of a loop due to "antenna" effect.

To see how the loop works let us assume that there is only one turn as shown in Fig. 2. When radio waves pass through the loop a voltage will be induced in each of the vertical sides. These voltages are shown as V1 and V2. The relative polarity of the two voltages is indicated by the arrows. It will be seen that the voltage at the terminals of the loop will be made up of V1 and V2 connected in series. When the two voltages are connected in this way they will be effectively in opposition to one another so that the resultant output voltage at the loop terminals will be the difference between V1 and V2. In practice the two voltages are alternating and therefore the difference voltage will depend not only upon amplitude but also upon the phase of V1 relative to V2.

Suppose the loop is set up so that it is broadside on to the direction from which the received signal is coming. This is shown in Fig. 3(a) which shows a view looking down on to the aerial. Both vertical sides of the loop will be at exactly the same distance from the transmitter aerial so the induced signal voltages V1 and V2 will be of the same amplitude and in phase with one another. At the output terminals the difference voltage produced will be zero since V1 and V2 will cancel out exactly. This is known as the 'null' position for the loop since there will be no signal output.

Now let us see what happens when the loop is turned so that it is in line with the direction of the signal being received as shown in Fig. 3(b). In this case one side of the loop is closer to the transmitter than the other. Since the width of the loop is very small compared with the distance to the transmitter the amplitudes of the induced voltages V1 and V2 will still be virtually equal. The radio wave will, however, take a finite time to travel from the near side of the loop to the far side so that V2 will lag behind in phase relative to V1. This phase shift of V2 will produce a difference signal output at the loop terminals. In fact at this position the loop will give its maximum output signal.

The resultant pick up pattern for a loop aerial will be as shown in Fig. 4(a). If extra turns are now added to the loop so that it forms a short coil the voltages produced by each of the turns will add together at the output terminals. As a result the output from the aerial will be proportional to the number of turns used. For a multi-turn aerial the pick up pattern will be the same as for a single turn. A further increase in output can be obtained if the aerial is tuned to resonance by connecting a variable capacitor across the ends of the loop winding.

"ANTENNA" EFFECT

One of the difficulties which occurs when using a loop aerial is known as the "antenna" or "vertical" effect. Unless the aerial is exactly balanced electrostatically with respect to earth it will act as a normal vertical aerial. A simple vertical aerial picks up the signal at equal strength from all directions in the horizontal plane. Now we get the condition that when the aerial is broadside on to the direction of the signal the voltages V1 and V2 cancel as before but the output due to "antenna" effect remains constant. This results in a pick-up pattern like that in Fig. 4(b) where the nulls are less marked and much broader than for a perfect loop.

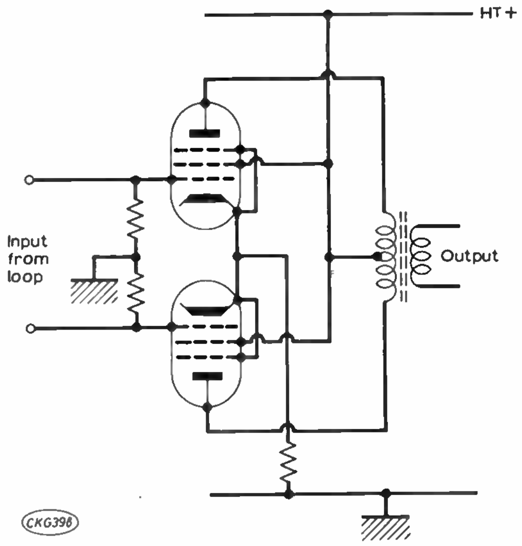


Fig. 5: Basic circuit of an early valve-type balanced input stage.

Perhaps the most obvious method of coupling the loop to the receiver would be to connect it directly across the aerial input terminals of the receiver. This method is rarely successful since the aerial will be unbalanced to earth and "antenna" effect is usually very bad.

For the basic loop aerial used by m.w. DX'ers the usual method of coupling is by means of a link winding. The link usually consists of one turn, or sometimes two, wound on the frame alongside the main winding. This link winding is then connected directly to the receiver input. With a link coupling of this type the aerial usually works quite well except that the link winding itself tends to produce some output due to "antenna" effect.

DIFFERENTIAL MATCHING AMPLIFIER

Wartime d.f. receivers, such as the R1155, made use of a differential or push-pull amplifier at the input. This type of amplifier uses two valves with

★ components list

Resistors

R1	47kΩ	R5	47kΩ	R9	10kΩ
R2	1kΩ	R6	2·2kΩ	R10	470Ω
R3	100Ω	R7	330Ω	R11	100Ω
R4	1kΩ	R8	330Ω	VR1	500Ω preset

All ¼W 5%

Capacitors

C1	4·7nF polyester	C3	4·7nF polyester
C2	0·1μF min. foil		

Semiconductors

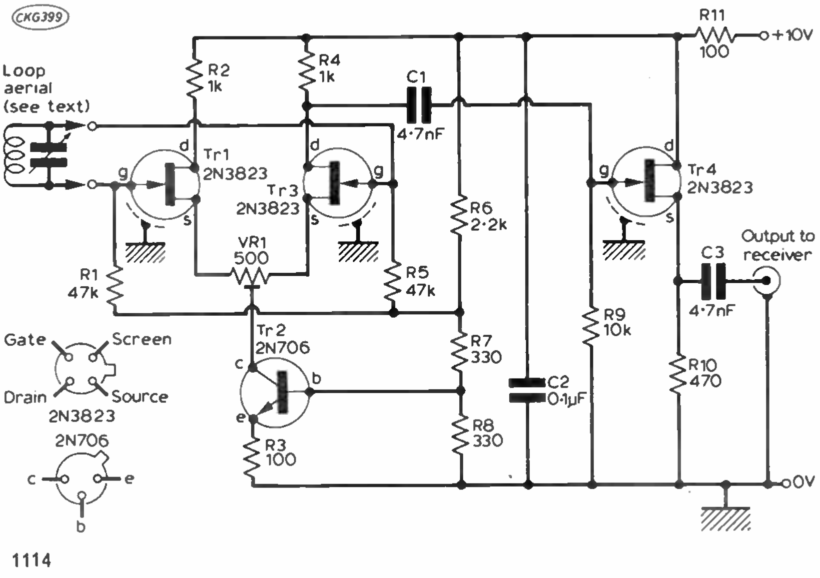
Tr1	2N3823	Tr3	2N3823
Tr2	2N706	Tr4	2N3823

their cathodes connected together as shown in Fig. 5. The resistor in the cathode circuit is made large enough so that it acts as a constant-current source. This type of amplifier responds only to differences in voltages between the two grids and will reject any signal common to both grids such as that produced by "antenna" effect in the loop aerial.

A balanced input amplifier using transistors instead of valves is shown in Fig. 6. In order to maintain a high value of Q in the aerial circuit a pair of field effect transistors is used for the differential input stage. This type of transistor has similar characteristics to a valve and gives a much higher input impedance than a normal bipolar type transistor. In this circuit 2N3823 'N' channel field effect transistors are used.

A differential amplifier works most effectively when the common-tail circuit of the input pair is fed from a constant-current source. In the valve version this is achieved by feeding the common cathode point through a large resistor from a negative supply voltage. In the circuit of Fig. 6 the transistor Tr2 is used to provide a constant current feed.

Characteristics of the 2N3823 may vary widely from one transistor to another. For optimum results the two transistors Tr1 and Tr3 in the input stage should either be matched or at least have similar characteristics. This can be checked by using the



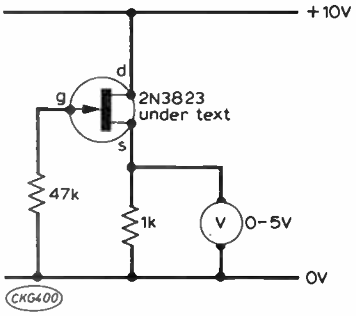


Fig. 6: (left) Complete circuit of the loop matching amplifier. Note that the 2N3823 transistor specified is preferable to the unscreened 2N3823E. Fig. 7: (above) is the circuit of the simple test set-up for checking the characteristics of the f.e.t.'s.

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AC128	24p
AC128/AC176	36p
AC151	12p
AC152	15p
AC153	19p
AC176	16p
AC153/176K	32p
AC187	17p
AC188	23p
AC187/188K	40p
ACY17	27p
ACY18	20p
ACY19	20p
ACY20	20p
ACY21	19p
ACY22	10p
AD140	55p
AD149	50p
AD161	35p
AD162	38p
AD161/162	70p
AF106	24p
AF114	25p
AF115	25p
AF116	25p
AF117	25p
AF118	44p
AF124	25p
AF125	24p
AF126	17p
AF139	30p
AF186	40p
AF239	36p
AF279	47p
ASY26	25p
ASY27	30p
ASY28	22p
ASY29	30p
BA138	15p
BAX16	8p
BB103	16p
BB104	28p
BB105	32p
BC107	10p
BC107/BC177	24p
BC108	10p
BC108/BC178	23p
BC109	10p
BC109/BC179	24p
BC109C	11p
BC140	30p
BC147	10p
BC148	9p
BC149	10p
BC157	12p
BC158	11p
BC159	12p
BC147/157	22p
BC148/158	20p
BC149/159	22p
BC167	11p
BC168	10p
BC169	11p
BC169C	12p
BC177	14p
BC178	13p
BC179	14p
BC182	10p
BC182L	10p
BC183	9p
BC183L	10p
BC184	13p
BC184L	12p
BC212	12p
BC212L	12p
BC238	10p
BC238/308	20p
BC257	9p
BC258	8p
BC259	9p
BC307	12p
BC308	10p
BCY30	25p
BCY31	48p
BCY32	50p
BCY33	20p
BCY34	25p
BCY38	30p

BCY58	18p
BCY70	15p
BCY71	30p
BCY72	15p
BD124	75p
BD131	75p
BD132	75p
BD131/132	£1·50
BDY20	92p
BF115	23p
BF163	35p
BF167	18p
BF173	19p
BF177	25p
BF178	31p
BF180	35p
BF194	15p
BF195	15p
BF196	15p
BF200	35p
BF254	14p
BF255	15p
BFX13	25p
BFX29	25p
BFX84	25p
BFX85	34p
BFX86	25p
BFX87	30p
BFX88	24p
BFY50	15p
BFY51	15p
BFY52	15p
BFY53	17p
BFY90	£1·05
BP101	75p
BPX66	£1·35
BRY39	40p
BSX19	16p
BSX20	16p
BSX21	20p
BSY27	20p
BSY29	25p
BSY95A	12p
BY100	20p
BY127	22p
BTY79/400R	92p
BT106	£1·20
BZY88C3V3	13p
BZY88C3V6	13p
BZY88C3V9	13p
BZY88C4V3	13p
BZY88C4V7	13p
BZY88C5V1	13p
BZY88C5V6	13p
BZY88C6V2	13p
BZY88C6V8	13p
BZY88C7V5	13p
BZY88C8V2	13p
BZY88C9V1	13p
BZY88C10V	13p
BZY88C11V	13p
BZY88C12V	13p
BZY88C13V	13p
BZY88C15V	13p
BZY88C16V	13p
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BZX61C22V	23p
BZX61C24V	23p
BZX61C27V	23p
BZX61C30V	23p
CA3004	£2·25
CA3005	£1·50
CA3011	92p
CA3013	£1·30
CA3014	£1·52
CA3018	88p
CA3018A	£1·19
CA3020	£1·55
CA3028A	88p
CA3035	£1·52

CA3043	£1·73
CA3044	£1·42
CA3046	86p
CA3048	£2·34
CA3052	£1·80
CA3065	£1·80
CA3088E	£1·38
CA3090Q	£4·70
CD4001AE	72p
CD4009AE	£1·56
CD4011AE	72p
CD4012AE	£1·16
CD4013AE	£1·48
CD4015AE	£3·90
CD4017AE	£3·90
CD4018AE	£3·90
CD4020AE	£4·34
CD4024AE	£2·78
CR1/051C	45p
CR1/401C	60p
CRS3/05AF	£1·08
CRS3/40AF	£1·53
CZ6	15p
D10 (NTGD10)	40p
IRT84	£2·00
LIC709C/5	42p
LIC709C/8	42p
LIC723C/5	£1·02
LIC723C/14	£1·00
LIC741C/5	45p
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MC1303L	£1·75
MC1305P	£2·80
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MFC6030	£1·63
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MFC8010	£1·38
MFC8040	£1·24
MFC9020	£2·12
MJE371	68p
MJE520	85p
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MJE2955	£1·06
MJE3055	66p
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NKT211	25p
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NKT216	46p
NKT217	50p
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NKT271	18p
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NKT401	71p
NKT402	77p
NKT403	65p
NKT404	60p
NKT405	79p
NKT406	82p
NKT713	29p
NKT773	25p
NKT781	29p
NTGD10	40p
OA47	8p
OA79	8p

OA81	8p
OA90	8p
OA91	5p
OA95	5p
OA200	6p
OA202	7p
OC20	97p
OC25	37p
OC28	70p
OC29	76p
OC35	60p
OC36	63p
OC41	40p
OC42	40p
OC44	20p
OC45	20p
OC71	20p
OC72	20p
OC75	25p
OC76	25p
OC77	40p
OC81	20p
OC81D	20p
OC83	23p
OC84	25p
OC139	75p
OC140	35p
OC170	25p
OC171	30p
OCP71M	42p
ORP12	50p
ORP60	40p
ORP61	40p
ORP69	50p
PN70	9p
PN71	9p
PN107	7p
PN108	7p
PN109	7p
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TIS43	30p
VA1066s	15p
VA1039	15p
VA1040	15p
VA1077	15p
W005	30p
W01	31p
W02	32p
W04	33p
W06	35p
W08	44p
ZTX107	12p
ZTX108	11p
ZTX300	13p
ZTX302	18p
ZTX303	15p
ZTX304	23p
ZTX314	11p
ZTX320	30p
ZTX330	18p
ZTX500	14p
ZTX501	15p
ZTX502	18p
ZTX503	17p
ZTX504	45p
1N914	4p
1N3754	20p
1N4001	7p
1N4002	7p
1N4003	10p
1N4004	10p
1N4005	12p
1N4006	15p

1N4007	19p
1N4148	4p
1N5400	14p
1N5404	18p
1N5408	25p
1S44	4p
1S920	7p
1S940	6p
1S5009	80p
1S5012	80p
1S5015	75p
1S5018	75p
1S5024	75p
1S5047	75p
2N404	23p
2N696	15p
2N697	17p
2N698	30p
2N706	10p
2N706A	12p
2N708	16p
2N911	50p
2N914	20p
2N918	42p
2N929	25p
2N930	28p
2N1131	24p
2N1132	24p
2N1302	17p
2N1303	17p
2N1304	24p
2N1305	24p
2N1306	30p
2N1307	30p
2N1308	34p
2N1309	34p
2N1559 (CR1/401C)	60p
2N1613	15p
2N1711	15p
2N1893	54p
2N2218	33p
2N2218A	44p
2N2219	38p
2N2219A	53p
2N2368	17p
2N2369	17p
2N2369A	17p
2N2484	42p
2N2646	45p
2N2904	44p
2N2904A	49p
2N2905	65p
2N2905A	75p
2N2924	18p
2N2925	20p
2N2926	10p
2N3053	27p
2N3054	50p
2N3055	50p
2N3391A	29p
2N3525	£1·04
2N3702	9p
2N3703	9p
2N3704	9p
2N3705	9p
2N3706	9p
2N3707	9p
2N3708	7p
2N3709	9p
2N3710	9p
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2N4058	13p
2N4060	11p
2N4061	11p
2N4062	11p
2N4444	£2·20
2N4871	40p
2N5245	45p
2N5457(MPF103)	49p
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3N152	£1·05
3015F	£2·00
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7402	20p
7403	20p
7404	25p
7405	25p
7408	25p
7409	25p
7410	20p
7413	30p
7420	20p
7425	30p
7430	20p
7440	24p
7442	£1·16
7443	£1·45
7444	£1·45
7445	£2·06
7446	£1·45
7447	£1·25
7450	20p
7451	20p
7453	20p
7454	20p
7460	20p
7470	45p
7472	32p
7473	45p
7474	46p
7475	45p
7476	45p
7480	67p
7482	87p
7483	£1·32
7486	33p
7490	60p
7491A	£1·28
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7493	75p
7494	£1·13
7495	80p
7496	£1·48
74100	£1·64
74107	52p
74121	43p
74141	£1·00
74150	£3·35
74151	£1·10
74153	£1·35
74154	£2·00
74155	£1·55
74156	£1·55
74190	£1·80
74191	£1·80
74192	£1·74
74193	£1·74
74196	£1·50
74197	£1·50
40250	66p
40309	40p
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40311	42p
40312	62p
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40603	70p
40669	£1·20
40673	68p
40739	£1·50

ELECTROLYTIC AXIAL LEADS

Mfd.	Working Voltage	Price	Mfd.	Working Voltage	Price
1 0	40v	7p	100	16v	6p
1 0	100v	5p	100	25v	6p
2 2	25v	7p	100	40v	7p
2 2	63v	5p	100	63v	10p
4 7	40v	5p	220	25v	8p
10	25v	5p	220	40v	9p
10	63v	6p	470	25v	12p
22	25v	6p	1000	25v	16p
22	40v	6p	2200	25v	30p
47	25v	6p	4700	16v	33p
47	40v	6p			

CAPACITORS—METALLISED POLYESTER

Stock values: MFD	Price each
0·01, 0 015, 0 022, 0·033	3p
0 047, 0·068, 0 10	4p
0·150, 0 220	5p
0 33	7p
0 47	8p
0·68	11p
1·0	14p
1 5	20p
2·2	24p

Order as "Polyesters" + Capacitance.

CAPACITORS—POLYSTYRENE

Axial leads, Clear encapsulation, 5% Tolerance. 160 volt working.

Stock values	Price each
100pF, 150pF, 220pF, 330pF, 470pF, 560pF, 680pF, 820pF, 1000pF, 1500pF, 2200pF, 3300pF, 4700pF, 5600pF, 6800pF,	3p

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Cheese head screw bolts. Nuts with integral washer. Moulded in high density nylon. Ideal for mounting "live" assemblies, power transistors, etc.
Each pack consists of four nuts and four screw bolts.

Pack No.	Thread	Length	Quantity	Pack Price
HSN1	6BA	½"	4	10p
HSN3	6BA	¾"	4	10p

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A range of miniature high stability resistors with very low noise characteristics and long life. Tolerances, ranges and wattages as indicated. (Wattage ratings are at max. limiting voltage).

Type No.	Wattage	Tol.	Range	Series	Price
UPM050	0·5	5%	10E-1M	E12	1p each
UPM050	0·5	10%	1M -4·7M	E12	1p each
UPM075	0 75	5%	10E-1M	E12	1p each
UPM075	0 75	10%	1M -4·7M	E12	1p each
UPM100	1 00	10%	10E-1M	E12	2½p each

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OVERLOAD PROTECTION INCORPORATED. SOLID STATE CIRCUITRY

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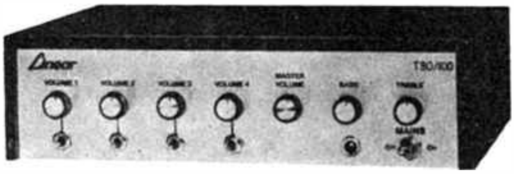
The Amplifier cover is made of rigid plastic, bonded metal on top and two sides. Finished in Black to suitably contrast with anodised metal control panel. Size approx. 14" x 4½" x 9½".

From April 1st prices are subject to VAT.



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

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

Rec. Retail Price **£69·75**

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Three individually controlled inputs plus Master volume control. Bass and Treble Controls providing both 'lift' and 'cut'.
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13	6	4	2	59p
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SPECIAL NOTICE—BETWEEN FEB. 22nd AND MARCH 14th SOME DELAY IN DESPATCH OR ORDERS AND REPLIES TO CORRESPONDENCE MAY OCCUR DUE TO RECONSTRUCTION. ALL ABOVE PRICES HAVE BEEN ADJUSTED TO INCLUDE V.A.T. BUT FOR ALL ORDERS DESPATCHED BY US UP TO MARCH 31st, PRE-VAT PRICES AS PER LAST MONTHS ADVERTISEMENT WILL APPLY.

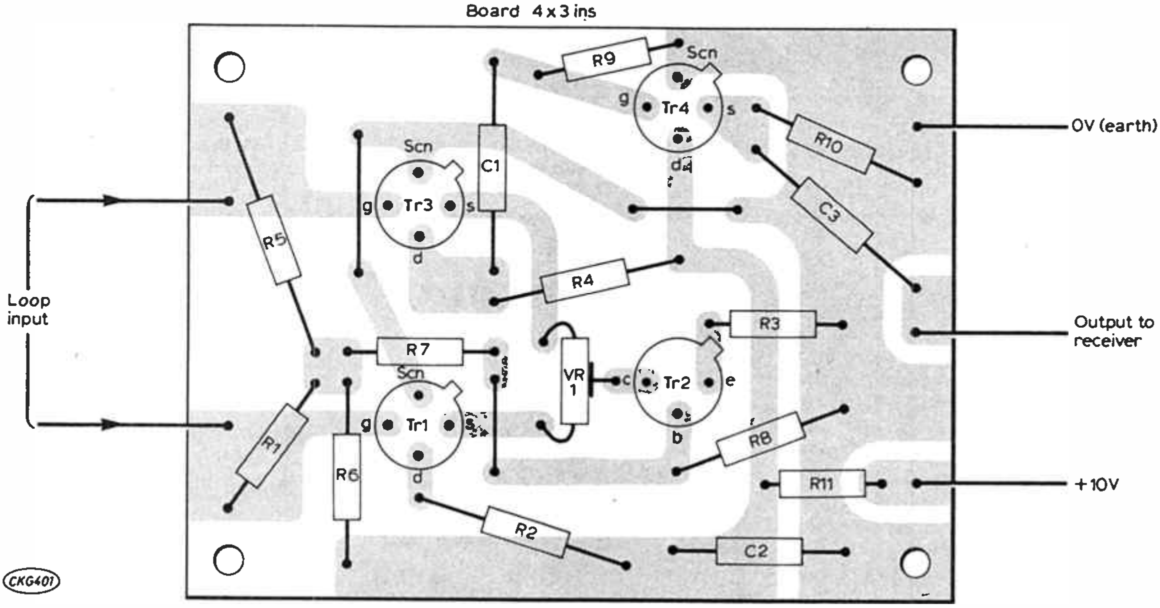


Fig. 8: Full size illustration of the printed circuit board, from the copper side. Small holes are drilled for component leads and the components mounted from the other side of the board.

circuit of Fig. 7 to select two 2N3823 transistors giving a similar voltage drop across the 1kΩ resistor in the test circuit. The balanced amplifier itself will tend to level out small differences between the transistors.

Transistor Tr4 acts as a source follower and is used to match the output from Tr3 into the low impedance of the cable and the receiver input circuit. Capacitive coupling is used to the output so that if the cable is accidentally short circuited the transistor Tr4 in the output stage will not be destroyed.

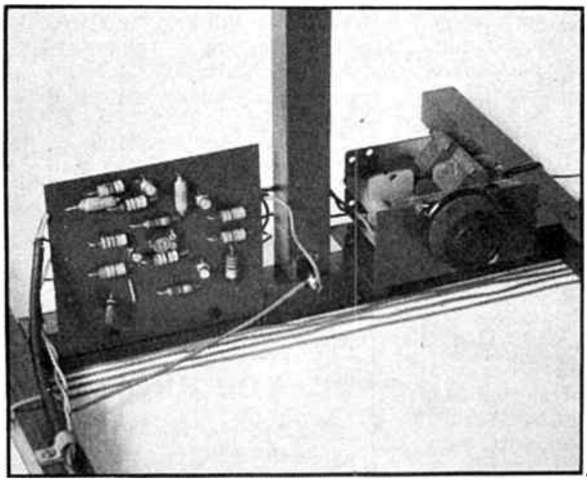
CONSTRUCTION

It is convenient to build the amplifier on a small circuit board and to mount it close to the tuning capacitor on the main loop frame. A suggested layout for a printed circuit board for the amplifier is given in Fig. 8. As an alternative the amplifier may be built on a piece of Veroboard. It should be noted that the screen leads of the 2N3823 transistors are connected to earth.

To test the aerial system the input amplifier stage should first of all be balanced. Connect a meter between the drains of transistors Tr1 and Tr3 and adjust the preset resistor VR1 until the voltage is zero. The two transistors will now be drawing equal currents.

Tune in a fairly strong signal from a known direction and rotate the aerial to obtain maximum pick up. At this point the loop should be tuned to resonance by means of the tuning capacitor as indicated by a further increase of signal when resonance is reached.

If the aerial is now rotated so that it is roughly broadside on to the direction of the station being heard a point should be found where the signal falls to a low level. A further small adjustment of VR1 may enable the signal to be reduced even lower.



Close-up of the matching amplifier and loop tuning capacitor.

THE LOOP

The loop aerial used by the writer has 12 turns on a 24in. square frame. To reduce self-capacitance and give more turns for the same inductance the turns are spaced 3/8in. apart. For the winding 14/0·0076 p.v.c. covered flexible wire is used. Tuning is by a 365pF air spaced variable capacitor across the ends of the loop winding.

Signal pick-up for this loop with its amplifier was found to be some 20dB up on the signal from a 30ft. outdoor wire aerial. Using a Lafayette HE30 receiver the signal reading on the 'S' meter varied from S9+60dB at the maximum pick up point to about S3 when the loop was rotated to the null position. The null point itself is sharp and extends over perhaps only two or three degrees. ■

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents

"Mobile" dog sledge

In the February 1973 issue of Practical Wireless on page 890 you have a little note about working amateur radio from a dog sledge, stating that this might have been the world's first QSO from a dog sledge mobile installation. I would like to point out to you that there have been a number of radio amateur contacts from dog sledges over the past years. My first contact from a dog sledge installation was made in 1938 and I am quite sure that that was not the first one in the world.

The UK expedition which some years ago tried to reach the North Pole from Alaska also carried amateur radio equipment and had a number of contacts with the outside world. A Norwegian expedition which also some years ago tried to reach the Pole from the northern part of Greenland had practically all their contacts with the outside world made by amateur radio. Both these expeditions relied on dog sledges for their transportation.

In Norway and no doubt also in other countries with similar snow conditions amateur operations from dog sledges are not infrequent, and I myself have done it many times. I thought you might be interested in knowing this. **Lars R. Heyerdahl**, LA6A. *(Oslo 2, Norway)*.

Don't get knotted!

A serious error was made by somebody when he knotted the mains input cable, as illustrated and described in the text on the battery eliminator (on pages 920 and 921).

This can be very dangerous and is specifically outlawed by the Institute of Electrical Engineers in their published regulations.

If a cable is rapidly bent from a straight to a highly twisted configuration, as often occurs when an item is knotted and the knot pulled tight rapidly, the core material may suffer from local fatigue causing cracking of the material. The cracking acts as a resistance to the current flowing through the appliances, hence local heating occurs.

The error, though dangerous is so common that M. Wallis could be excused it, provided the suggested warning is printed.

I would suggest that one of the plastic cable clamps, to secure mains leads, should be used. **S. A. East**, *(Enfield, Middlsex)*.

Midget radio phones

Over the Christmas holiday I assembled the *Practical Wireless* midget radio, lashed it to the head-band of some wartime crystal 'phones and got good listening for radios 2 and 4 and others between.

The hospital wards being quietish, I set off on some market research: men and women patients listened and all said that such lead-less headphones would be much appreciated, since they currently roll about and pull out the lead, and also cannot use 'phones when sitting out in the middle of the ward. They need to be lighter than my prototype, perhaps built onto a stethophone; and as not a few are hard of hearing, a bit more volume is needed. If we want Radio Humberside or television sound (the ward set provides vision only) we should need something more sophisticated I suppose. Also an experienced Charge Nurse said if 'phones are not on leads I shall need to put them on chains!

Incidentally, when walking home across the common in the fog the wireless 'phones directionality helps personal alignment!—Dr. H. F. Barnard, Pathologist *East Riding Group Laboratory, Westwood Hospital, Beverley, Yorks. HU17 8BU.*

25 years of transistors

I was especially interested in Mr. R. Collins's article, 25 Years of the Transistor, because he attributed the research and development that led to it to the Bell Company's need for a substitute for the valve in the telephone service, in the 1940's.

I think that there must have been a lot that went before because men were looking for a substitute for the valve as early as 1920, and soon after, in the "Amateur Wireless" of those days, an account was published of a Russian scientist who was experimenting in making *crystals* perform all the functions of valves.

I remember this well because, as a schoolboy, I put this down as my own scientific basis for an application for an Experimenter's Licence.

Unfortunately, I went to New Zealand afterwards, and lost touch with radio, but I wonder if any other reader can recall what, if any further developments there were in those experiments.—John Pinches (*London, N.W.7*).

[A semiconductor substitute for the valve is now in production. It has improved characteristics and longer life and uses field effect transistor principles. This device, called a FETRON, will be described in full in next month's Practical Wireless.]—Editor

CQ! Gambia

We have been asked by the General Manager of the RSGB to publicise the following letter received by him:—

Whilst on a visit to West Africa recently, I was able to visit the transmitting station of Radio Gambia. I was asked to make an appeal to British S. W. listeners to report to them any reception of Radio Gambia in Britain.

The point is that they have received reports and QSL cards from Australia and America, but would very much like to hear from any British listener. I understand that the transmissions are as follows:—

Radio Gambia, 4·82MHz in the 60metre short wave band.

They tell me the best time for a reception would be between 10.30 p.m. and 11.30 p.m. **George Wallace, M.P.** *(House of Commons)*.

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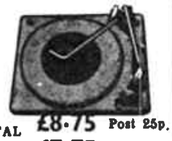

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ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

WE are running out of frequencies. I know we have certain "Amateur Bands," but some of these are on a shared basis, i.e. we can only use them provided we are not a nuisance to other non-amateur stations using the band.

Many will remember when 40 metres was 300kHz wide—it's now 100kHz wide and intruders still try to drive us off this remaining r.f. island. The only real answer to amateur radio survival is intelligent activity. With a band full of active enthusiasts, intruders will think twice about taking on our "QRM". Those that do would find a few hundred amateurs from dozens of different locations and countries, all suddenly doing tests on that particular frequency. Whether amateur radio loses any more of its r.f. spectrum or indeed a complete amateur band, is entirely up to the people who practise and enjoy our hobby.

A topical example is 4 metres or 70MHz. This band is greedily looked at by many people (non-amateurs) who would like to use the small piece of 4 metres which we still have. Activity on 70MHz is very low from an amateur's point of view, and if activity is not increased, then the authorities may well award the entire 4 metre band to "other services". The argument could well be (and it is a valid one) that since there is so very little amateur activity on 4 metres, then you do not really need that band. So how about some logs for 4 metres?

A 4 metre converter is not a difficult thing to build and would offer a very useful intermediate step in construction practice between the h.f. bands and 2 metres. Constructing a converter for 70MHz is not difficult but needs a little more care than units constructed for the lower frequencies. One excellent idea would be to use 70MHz as a local net band, which would avoid the interference suffered on 160 metres top band, would keep us clear of Loran, which plagues 160, and would increase the level of 4 metre activity dramatically. We have to start somewhere or we could well lose this band. So, 4 metre enthusiasts forward. Let's hear what you hear.

A letter from **Paul Petty** (Canterbury) tells of a useful information service for European stations which transmits on 80 metres between 2100 and 2200 GMT. There is a controller station which is changed daily. Monday's controller is DA1LA. On Wednesdays it is DK8FZ. The purpose of the net is to assemble and disseminate information on DX stations, i.e. future skeds.

Top band enthusiasts will be delighted to hear that G3SZA has been heard on 160 metres in Australia by a VK3 station. Alas callsigns are still changing. MP4 stations have been heard using a new call sign—A4FA. When will we have some callsign stability? And why change from MP4M to A4FA?

Another strange change is that CT1 stations are to use the prefix CT4 during the CQWPX contest this month. Why is not made clear. First class licence holders in Japan now have two-letter suffix calls and second class licensees will use a JM suffix followed by three letters.

Old hands will be pleased to hear VR6TC on again from Pitcairn Island, and DX enthusiasts who enjoy hearing/working island stations should listen for VQ9HCS who radiates on 15 metres in the afternoons from Aldabra Island.

Robert Harpur (Shenfield) tells of two VP8 stations located in South Georgia which can be heard some evenings between 14·125kHz and 14·130kHz. This page commonly informs of stations heard by other short wave listeners and amateurs. The gear is quoted, i.e. receivers, a.t.u. preselectors etc., in this way readers can gauge how their own performance is by direct comparison especially if the report is from someone using similar equipment. It has been suggested it would be nice to actually see some of these stations. Photographs of individual set ups would be of interest to others. Anyone got any really good, sharp photographs of the gear plus themselves. Think of the satisfaction of seeing your trusty old CR100 smiling back at you from the pages of *PW*.

Peter Franklin (Skegness) received a UNR30 receiver for Christmas and is busily spoiling the brute with a diet of 100ft. end fed. A preliminary listen on eighty metres brought forth a high level of G activity. Peter queries the callsign G4GJ heard testing a transmitter on 3·8MHz one afternoon. Will the real G4GJ please stand up?

Another eighty metre enthusiast is **Peter Reed** (Brighton) who is the proud possessor of an FTDX401 receiver which apparently has a Japtick UFP. Sorry Peter, I know of no ointment which can cure that. Perhaps you could scrape it off with a bent screw-driver. Peter's log for eighty reads; FL8OM, HS4AGM, I5FLN, JW9QH, M1C, M1I, VE1AIH, VE1IE, VS6DO, VQ9R, W1AA, W1KET, W2APU, W2PV, W3WJD, YA1AH, ZL4KE, ZS1MH, ZS3GH, 5X5N, 9G1DY, 9H1C, 9H5D, all on s.s.b.

Stephen Mayer (Poole) has a CR70A receiver fed with a 90ft. wire. This set up brought in stations from most European countries. From further afield; PY2ZAT, W4AG, W5QGZ, all on eighty metres.

Great rejoicing in South Yardley where **David Sharred** has found that his blood pressure and country score have increased in direct proportion to the arrival of a new CR150/2. This, together with sharp ears (no, he's not Mr. Spock) and a 140ft. end fed raised these on 3·8MHz; CT2BG, FP8CT, K1DQV, VE1ADV, VE3CDP/W9, VE7SV, W1CF, W4CC, W5SR, W5SW, WA9PRO, ZL3GS, 4X4UF, 5X5NK, 5X5XM, 9HIC.

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

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE first topic for this month is that of aerial wire. In the February column I asked if anyone knew of a good source for. aerial wire. The number of replies was very pleasing and I must apologise for not being able to answer them all personally.

In general, your answers seem to bear out my opinion that it is becoming more difficult to find supplies of good quality aerial wire. The wire which I have always used in the past is that manufactured by a firm called 'Aerialite'. This wire consists of seven strands of copper with very strong insulation which is ideal for the purpose.

Mr. **A. E. Halladay** informs me that this is still available from a shop called 'A1 Radio Components' of 14 The Borough, Canterbury, Kent. The wire is available in lengths of 25, 50 or 75 feet and is very reasonably priced at 14p, 22½p and 29p respectively. A charge of 6p is made for post and packing.

Mr. **David Porter** writes to say that a firm called Chas. H. Young Ltd of 170-172 Corporation Street, Birmingham, B4 6UD sells Stranded 7/·029 and 32/0·2mm Insulated wire in 140 foot lengths for £1·87. This firm is also a good source for aerial insulators and dipole centre pieces.

Mr. **A. A. Smith** of Preston in Lancashire suggested the use of a particular type of G.P.O. Telephone wire. This consists of a single strand of steel wire which is covered with a film of copper and then a layer of insulation. It is usually supplied as a twin cable, similar to lighting flex, but this is easily split into two separate wires. The advantage of this wire is the superior strength of the steel core. No supplier is known but the wire should be available from Surplus Stores.

A preselector is basically an r.f. amplifier and, as such, it will improve the performance of almost any receiver. Many receivers do not have an r.f. amplifier stage, the first stage being the mixer and it is with these sets that the most significant improvement in performance will be obtained. If the receiver has one or more r.f. stages incorporated the improvement will not be so marked.

The preselector usually provides a gain of 30dB, which in simple terms is a gain of 32 times, this gain being very useful in the reception of weak signals.

It is worth noting that the most common source of lost efficiency in a receiving system is a mismatch between components of the system. The three common components are the aerial, the preselector and the receiver. In the simplest case of aerial and receiver it is essential to have a good match between the two. If a preselector is added there must be a good match between the aerial and the preselector and also between the preselector and receiver.

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz ● Times in GMT

READERS' LOGS

The first log comes from **Raymond Mowll,** who enquired about preselectors, his equipment is a Trio 9R59DS and 100 feet of wire. The lack of a preselector did not prevent him from hearing:

5047 *Togo*, French news and music at 2250.
7120 *Kiev*, with Mailbag programme at 0045.
7180 *BBC, Tebrau, Malaysia* relay at 1720.
9655 *R. Damascus, Syria*, in English at 2040.
11710 *RAE, Argentina* with music at 2330.
11955 *FEBA, Seychelles* in English at 1745.
15140 *R. Havana, Cuba*, commentary at 2100.
15375 *R. Nederland, Bonaire*, English at 1830.

R. M. Witney of Braintree has been active again with his Skywood CX-203 receiver and 110 foot long-wire hearing the following stations:

11730 *Radio Ceylon* at 0140.
11815 *Trans World Radio, Bonaire* at 0055.
15165 *Radio Denmark* at 2000.
15448 *Radio Nacional de Brazilia* in Spanish at 0225.

Peter North of Southport has sent in his first report to the column using his Heathkit RG-1 receiver and 24 foot long-wire to hear:

4979 *R. Rumbos, Venezuela* in Spanish at 0430.
4995 *R. Brazil Central* in Portuguese at 0030.
5075 *R. Sutatenza, Colombia*, Spanish at 0130.
9550 *RTB, Belgium* in English at 0050.
9730 *ETLF, Ethiopia* in English at 0400.
9745 *R. Baghdad, Iraq* in English at 1930.
11710 *RAE, Argentina* in English at 2300.
11720 *R. Nacional de Brazilia* in English at 2230.
11805 *R. Globo, Brazil* in Portuguese at 0030.
11860 *R. Canada International*, English at 2115.
11880 *R. Ankara, Turkey* in English at 2200.
11930 *WIBS, Grenada* in English at 2030.
11955 *FEBA, Seychelles* in English at 1730.
15300 *HCJB, Quito, Ecuador* in English at 1900.
15345 *R. Kuwait* in English at 0500.

Reports should arrive by the 15th of the month and be addressed to me at 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

NEXT MONTH

ON THE AIR

Our specialist team will present news, views, comment and of course YOUR LOGS on the Broadcast Bands (Short Wave and Medium Wave). The Amateur Bands (Short Wave) and

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ROAMER 10 WITH VHF INCLUDING AIRCRAFT

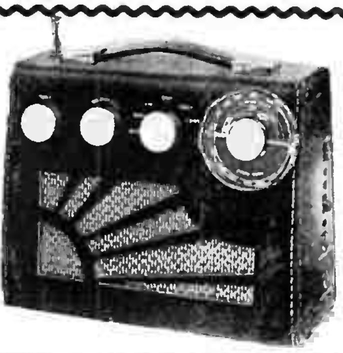
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS ALSO AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Fine tone moving coil speaker. Ganged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

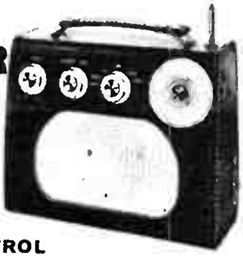
Total building cost **£8·50**

P. P. & Ins. 50p

(Overseas P. & P. £1)



ROAMER EIGHT Mk I

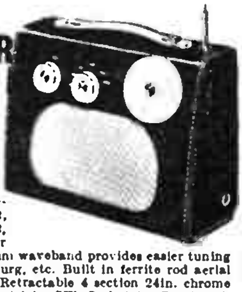


NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car Aerial and Tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building cost **£6·98** P. P. & Ins. 45p.
(Overseas P. & P. £1)

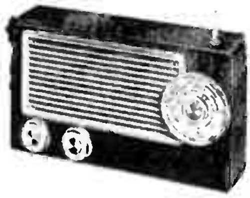
ROAMER SEVEN MK IV



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes, fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£5·98** P. P. & Ins. 45p.
(Overseas P. & P. £1)

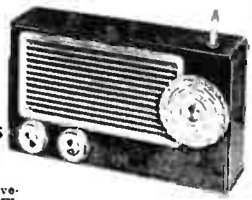
ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 Trawler band plus an extra Medium waveband for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 25p (FREE with parts).

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

TRANS EIGHT

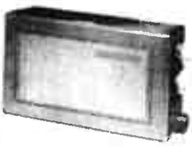


8 TRANSISTORS and 3 DIODES

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

Total building costs **£4·48** P. P. & Ins. 32p
(Overseas P. & P. £1)

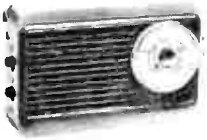
POCKET FIVE



3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1¼ × 3½in. Easy build plans and parts price list 10p (FREE with parts).

Total building costs **£2·29** P. P. & Ins. 23p
(Overseas P. & P. 63p)

TRANSONA FIVE



5 TRANSISTORS AND 2 DIODES

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

Total building costs **£2·50** P. P. & Ins. 24p
(Overseas P. & P. 63p)

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POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

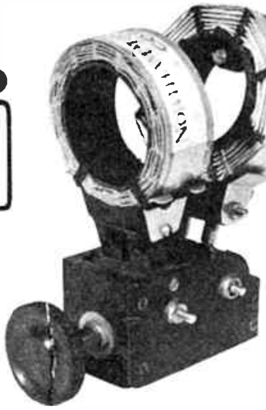
Name ....

Address ....

.... PW52

GOING BACK...

1970 60 50 40 30 20



COLIN RICHES
ARTHUR DOW

THE other month we received a letter from one of our New Zealand readers who informed us that he is an ardent vintage radio equipment collector. He told us that he decided one day to cart all his gear out on to his back lawn (it's baking hot over there at this time of the year) and take some pictures for us to show in the Going Back column.

The reader, **George A. Weston**, says that he would be grateful if anyone could supply him with the exact dates of the British-made sets, so, if anyone wants to contact him, the address is 179 Rosebank Road, Avondale, Auckland, New Zealand.

The items we show in our pictures have all been fully restored by Mr. Weston and where components had to be substituted, he used parts of the same vintage. Likewise, any valves used were of the same period and not later replacement types.

Picture No. (1) is a set made by McMichael. It has MH on the panel and is an all-wave superhet. There are five valves inside the unit and one outside. Date is about 1927.

Next, in picture (2) is a Philips 2516 with valves 506, E415, B443 and date of manufacture is about 1930. The matching speaker is a Baby Grand model 2028 balanced armature cone type that can either hang on the wall or sit on the table as shown.

Set No. (3) is an American "Radiola" model 12/20. Dated about 1925 it has UX199's in all stages except a UX120 as output valve. Case is walnut veneer.

The Gecophone shown in photograph (4) is a 1924 model containing 2 valves and working from batteries. There is one r.f. stage with variometer and a detector stage with condenser-controlled reaction. The valves used are "R" types and the receiver is shown sitting on top of a 2-valve amplifier.

Picture (5) shows a 1924 "B.T.H." crystal set with matching phones. The "driving instructions" are shown in the lid. Also shown is a "Polar Twin" 2-valve battery receiver about 1924 vintage and a Gecophone crystal set c1924 in mahogany case.

The "B.T.H." is called "Radiola"—a name generally associated with RCA in America, indicating a tie-up between manufacturers.

An "Atwater-Kent" model 30 c1926 6-valve set is shown in picture (6). It uses grid stoppers (Cossor system) in lieu of neutralizing. This was the first single-dial model made by this company. Valves are UX201A's in all stages.

No. (7) is an American 1926 "Grebe" MV1 synchrophase 5-valve neutrodyne battery set. Valves used are UX201A's. The cabinet is mahogany.

A Philips Dutch 2510 1930 vintage 5-valve mains t.r.f. is shown in picture (8). Valves 2 x E442 screen grid, detector E415, output C443 with a 506 rectifier. The case is a metal frame enamelled black with insert panels mottled rich deep red.

Picture (9) shows an American "Gilfillan GN1 c1926 5-valve neutrodyne battery set. This is a de-luxe model with walnut veneer case. It is 3ft long to accommodate "B" batteries. There is a meter for battery checking and three covers on the front drop down. In 1926, this set cost £35.

No. (10) shows a "Claritone" re-entry horn speaker (rear left) made by Automatic Telephone Co., England. It has a heavy cast-iron case and was made in 1924. A B.T.H. horn speaker (rear right) can be seen (c1926). This model has a brown flare with a transfer in black and gold.

Also shown are a "Brown" H4 (front left) (c 1926) a Burndept "Peter Pan" (c 192??) and a "True Music Minor" (front left)—date not known and no information available.

Photograph No. (11) shows an American cone speaker with a balanced armature. It is made from pressed steel and painted gilt. No. (12) is a cone speaker with a reed unit. It is called a "Mellotone" and the cone is made entirely of cardboard. The stem and base are wooden and the date is April 1926.

In some future Going Back articles we hope to show some more of our readers' collections of vintage radio gear.

A reader remembers

R. J. Hall, 7 Darlington Road, Longrock, Penzance, Cornwall, comments on his early days in radio . . .

"In those days the enthusiast enjoyed winding his own solenoid coils and basket coils, building up variable capacitors from threaded brass rod, brass or aluminium plates and nuts and bolts, and even winding transformers, both r.f. and a.f. I myself have wound more than one mains transformer by hand at 7 turns per volt on a sq. inch core and made speech coil formers and wound them.

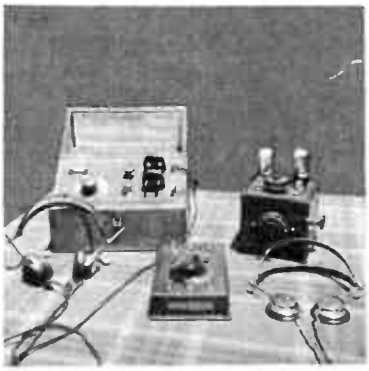
It was common practice in the early days to plan a set and build it on a 'breadboard' layout when it usually worked perfectly but on being tidied up and put into a cabinet it invariably refused to function. In those days radio was a fascinating hobby but since it has become an exact science half the fun has gone".

1 McMichael "MH" receiver dated about 1927.

2 The Philips 2516 dated about 1930 and Philips 'Baby Grand" speaker

3 R.C.A. model 20 Radiola of 1925.

4 Gecophone 1924 vintage sitting on a 2-valve amplifier



5 B.T.H. crystal set (1924) with Polar Twin and Gecophone set

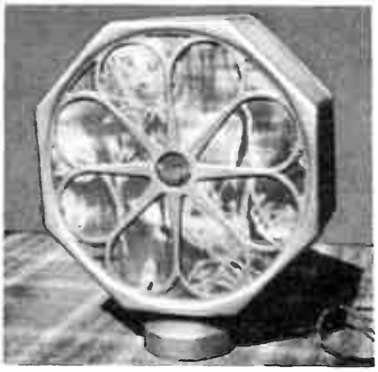
6 The Atwater-Kent model 30.

7 American Grebe MV1 (1926).

8 Philips 2510 receiver (1930).

9 American Gilfillan GN1 c1926.

10 A selection of vintage speakers.



11 American cone speaker with balanced armature.

12 Cone speaker with a reed unit.

TAKE 20

JULIAN ANDERSON

No. 47
VARICAP TUNED B.F.O.

WHEN a diode is reverse biased it becomes a low value capacitor. Integrated circuits make use of this effect as in this technology it is far easier to incorporate this than a more conventional component. What is more, the actual value of the capacitance depends on the voltage applied. Special diodes are made to make the best use of this effect and are known as *Varicaps* but as we have mentioned, all diodes exhibit this affect, the higher the current rating, the better the affect. We can make use of this effect where a small capacity change is sufficient such as in a b.f.o. and it is this which forms the subject of our project this month. Instead of using a variable capacitor, which would be expensive, we are using a simple potentiometer to alter the tuning.

The complete circuit is shown in Fig. 1. The tuned circuit, which operates round about 465kHz, is made up from C4 and L1. This is coupled to Tr1 to form an oscillator, C2 providing the feedback to maintain oscillation.

L1 is the Repanco DRX1 crystal set coil which has both long and medium wave windings, we only use the medium wave winding in our circuit and the connections should run to the common connection of both windings and to the tag that goes to the start of the smaller winding. In the normal state this would be tuned somewhere in the medium wave band and to increase the inductance (and also to give some control over the operating frequency) we fit a dust core into the centre of the coil.

The tuning side is accomplished by VR1, R1, D1 and C1. If a low value capacitor is connected from the collector of the transistor to the negative line this will alter the frequency. We cannot connect the diode directly here as we would affect the d.c. operating conditions of the transistor and so we have to d.c. block this; C1 performs this function.

To alter the capacity of the diode we have to apply d.c. bias to it and this has to be varied. VR1 can be almost any potentiometer from 5kΩ to 500kΩ; all we need is a variable voltage at the slider. R1 has to be included to prevent funny things happening at the extremes of the track.

As regular readers of this column will know, we often use Veroboard but this is of less use at r.f. frequencies and straightforward drilled s.r.b.p. board is better and a layout is shown in Fig. 2. This should cause few problems; the wiring on the reverse side is shown dotted.

When the unit is switched on, the slider of VR1 should be at the centre of the track and then, with the unit near a receiver, the core in L1 should be turned until a whistle is heard on *all* stations. Whistles may well be heard on one or two stations but this will mean that the frequency, or an harmonic of it, are on top of that station and not on the i.f. When the correct setting has been found VR1 can be adjusted to get the right sort of beat note, it has a fair range both sides of the centre frequency. On the layout a wire is shown marked "To Rx". It will not normally be necessary to make a connection and this wire may not be needed but if the beat note is a bit weak this wire may be dangled among the components of the receiver's i.f. strip. ■

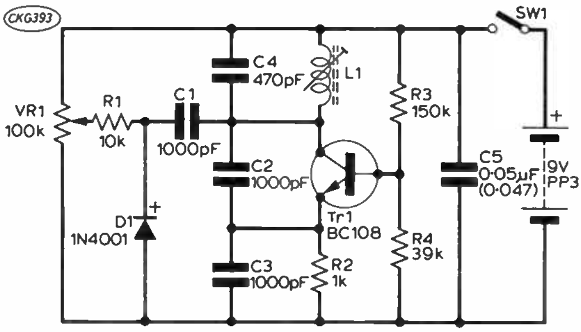


Fig. 1 The circuit: instead of using a conventional variable capacitor, D1 tunes the circuit

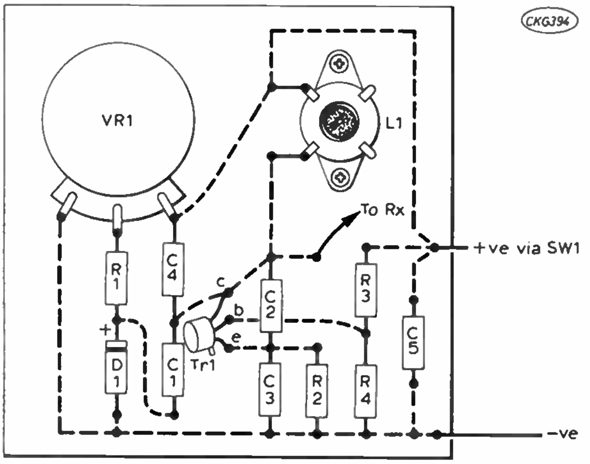


Fig. 2: A suggested component layout on drilled s.r.b.p. board.

★ components list

R1	10kΩ ¼W, 5 per cent	1p
R2	1kΩ ,,	1p
R3	150kΩ ,,	1p
R4	39kΩ ,,	1p
VR1	100kΩ linear pot	12p
C1	1000pF polystyrene	4p
C2	1000pF polystyrene	4p
C3	1000pF polystyrene	4p
C4	470pF polystyrene	4p
C5	0·05μF Mylar etc.	4p
Tr1	BC108	10p
D1	1N4001	6p
L1	DRX1 crystal set coil	18p
Dust core to fit L1		3p
SW1 On-off toggle switch		5p
		78p

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

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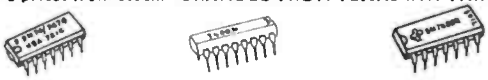

Type	1/11 p	12/24 p	25/99 p	Type	1/11 p	12/24 p	25/99 p	Type	1/11 p	12/24 p	25/99 p
SN7400	0·20	0·18	0·16	SN7450	0·20	0·18	0·16	SN74145	1·50	1·40	1·30
SN7401	0·20	0·18	0·16	SN7451	0·20	0·18	0·16	SN74150	3·35	2·95	2·15
SN7402	0·20	0·18	0·16	SN7453	0·20	0·18	0·16	SN74151	1·10	0·95	0·90
SN7403	0·20	0·18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

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AC187	25p	BCY43	25p	GET880	45p	OC140	55p	ZTX503	17p	2N3705	10p
AC188	25p	BCY55	2·50	LM309K (T03)	1·87	OC170	25p	2G301	30p	2N3714	1·80
ACY17	30p	BCY70	15p	MAT121	25p	OC171	30p	2N404	20p	2N3771	1·75
ACY20	20p	BCY71	20p	MJE340	50p	OC200	45p	2N527	35p	2N3773	2·00
ACY21	20p	BCY72	15p	MJE370	70p	OC201	75p	2N696	15p	2N3790	2·25
ACY39	55p	BCY87	2·99	MJE520	75p	OC202	80p	2N697	15p	2N3819	35p
AD140	50p	BCZ11	50p	MJE2955	1·10	OC203	50p	2N706	10p	2N3820	50p
AD149	50p	BD124	80p	MJE3055	75p	OCP71	1·25	2N930	20p	2N3866	85p
AD161	35p	BD131	75p	MPF105	40p	ORP12	50p	2N987	45p	2N3903	15p
AD162	35p	BD132	80p	NKT214	20p	ORP60	40p	2N1131	25p	2N3906	12p
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AF118	50p	BF167	25p	NKT217	40p	RAS310AF	45p	2N1302	18p	2N4062	12p
AF124	25p	BF173	25p	NKT403	70p	RAS508AF	55p	2N1304	22p	2N4126	15p
AF139	30p	BF179	30p	NKT404	50p	TAA263	75p	2N1305	22p	2N4871	35p
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AF239	40p	BF194	15p	OA10	35p	TIP29A	50p	2N1308	25p	2N5777	55p
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IN4004	400	8
IN4005	600	10
IN4006	800	12
IN4007	1000	15
1·5 amp miniature		
PL4001	50	8
PL4002	100	9
PL4003	200	10
PL4004	400	10
PL4005	600	12
PL4006	800	15
PL4007	1000	16

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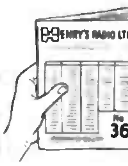

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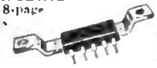

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3 Amp T048

15 Amp T048

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B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
ONE AMP (G.I.) TUBULAR		
W005	50	30p
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W02	200	40p
W06	600	45p
TWO AMPS [illegible]		
B2/05	50	35p
B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
B2/1000	1000	60p
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B4/200	200	65p
B4/400	400	70p
B4/600	600	75p
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CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
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1 Amp T05

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DARKROOM EXPOSURE METER

A.P. DONLEAVY

THIS instrument was designed for use with a photographic enlarger, to determine the exposure required for any particular print. It is cheap to build and easy to use, with a range up to about 40 seconds.

THE CIRCUIT

This is shown in Fig. 1. LDR is a light dependent resistor whose resistance varies with the amount of light falling on its face. LDR and VR1 form a potential divider. The potential at point A is determined by the setting on VR1 and on the resistance of the LDR, hence on the light incident on its surface. Tr1 and Tr2 form a Schmitt trigger. The potential at A determines which of these transistors is on and which is off.

Tr2 has a light emitting diode D1 in its collector circuit, which lights when Tr2 is conducting.

To measure the amount of light incident on the meter, VR1 is altered until the extinguishing (i.e. on-off) point of the diode is found. The setting of VR1 is thus a measure of the exposure time required. A knob with a linear calibration around the outside is used to alter VR1.

The unit is sensitive to voltage supply change, hence a zenor diode D2 is used to regulate the power supply.

SW1 is a push button switch which is depressed only when making the exposure, hence eliminating the possibility of forgetting to turn the unit off.

COMPONENTS

Other transistors could be used for Tr1 and Tr2 e.g. 2N2926. VR1 is 50kΩ. Increasing the value increases the range of the instrument but decreases its sensitivity.

D1 does not have its positive lead marked. This must be found by trial and error or by using a meter.

CONSTRUCTIONAL DETAILS

The whole unit can be fitted into a small plastic box 4½in. x 3in. as shown in Fig. 2. Veroboard is used to mount the transistors and resistors. Two small holes can be drilled to take the LDR leads, a dab of glue will hold it in place. Further constructional details are not given since the layout is not critical and most constructors will find it is a simple job to assemble the instrument.

The instrument is now ready for calibrating.

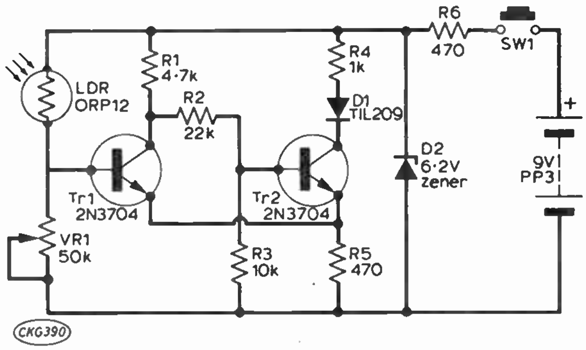

Fig. 1: The complete circuit which is basically a Schmitt trigger.

★ components list

Resistors
R1 4·7kΩ
R2 22kΩ
R3 10kΩ
R4 1kΩ
R5 470Ω
R6 470Ω
All ¼W, 5% types
VR1 50kΩ lin. pot.
LDR ORP12.

Transistors
TR1 2N3704
TR2 2N3704
D1 TIL209 (light emitting diode)
D2 6·2V zener diode.

Miscellaneous
9V battery; Battery connector; Veroboard; On-off switch, push button type; Plastic box; Calibrated knob or dial.

CALIBRATION

The scale is calibrated in terms of exposure as follows: a piece of clear blank film is put into the

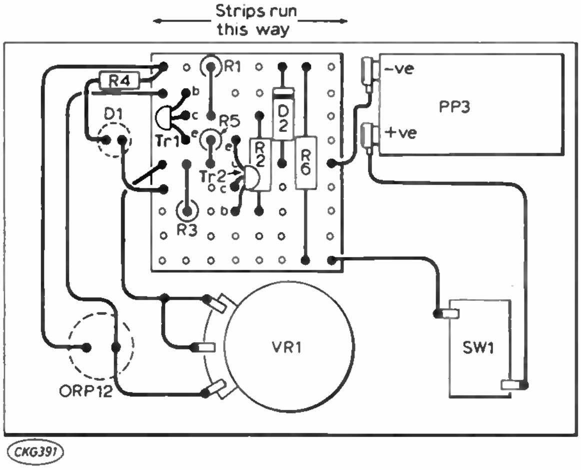

Fig. 2: Constructional details.

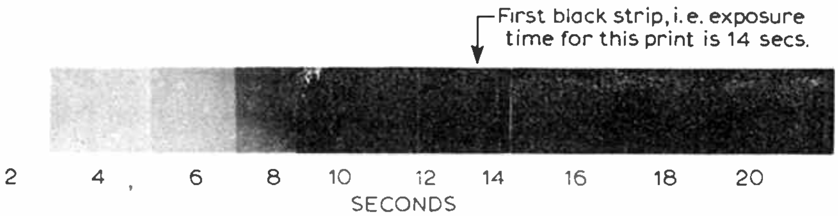

Fig. 3: An example of the gradiations which will appear on the printing paper; the time of each exposure is marked below.

enlarger; all lights in the darkroom are put out except for the enlarger light; the instrument is placed on the easel, SW1 is depressed and VR1 is adjusted so that the diode light just goes from on to off. The reading on the scale is noted. (It is important that the scale reading is always taken from on-to-off since the off-to-on reading is different, owing to hysteresis in the Schmitt trigger.)

A narrow strip of paper is then used for a test strip. Parts of the paper are exposed in multiples of two seconds. The developed strip will look like Fig. 3. There is a gradual transition from light to black. The first black stripe can be judged and the corresponding exposure time also. The scale reading and exposure time are then noted.

The procedure is then repeated for different light readings (scale readings) and a graph of scale reading against exposure time is plotted, Fig. 4.

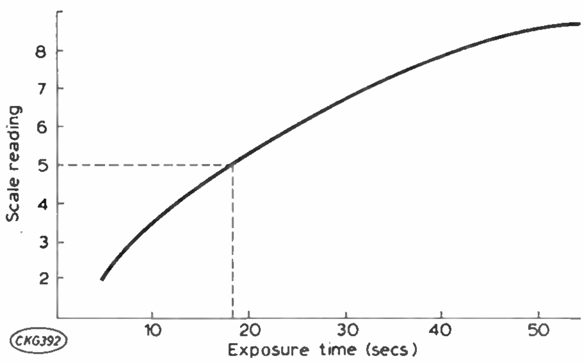

Fig. 4: A calibrated graph relating the knob markings of 1-10 to the time.

For scale readings between 20 and 40 seconds it will be easier if the strips are exposed in multiples of 4 seconds.

A similar calibration graph must be obtained for each different type of printing paper used.

USING THE INSTRUMENT

Having obtained the graphs, the instrument is simple to use. Place it on the easel such that a clear part of the film e.g. the margin between the frames or an unexposed frame, shines onto the LDR. Find the on-off point of the diode DI and note the scale reading. From the graph, read off the required exposure time, if the scale reading is 5 then the exposure time is 19 secs. This will give the correct exposure time for all normal negatives with full tonal reproduction.

CONCLUSION

The instrument is cheap and easy to make, and is reasonably accurate. Its great advantage is the saving in time, since after initial calibration there is no need to make a test strip for every exposure. ■

25 YEARS MARCH 1973 page 993. At the foot of column three: The I.E.R.E. is publishing a collection of 20 *papers* in their journal on semiconductor subjects.

DIGITRONIC SOLID STATE DIGITAL CLOCK MARCH 1973 page 1009. The sentence—There is no need . . . harm a LED is to pass too high a *current* through it (most LEDS work operate on *10–15mA*).

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** or **Television**.

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.

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ZENER DIODES full range E24 values: 400mW: 2·7V to 36V, 14p each; 1W: 6·8V to 82V, 27p each; 1·5W: 4·7V to 75V, 48p each. Clip to increase 1·5W rating to 3 watts (type 266F) 4p.

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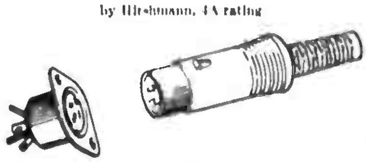
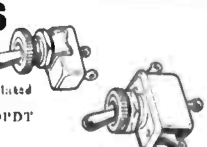


2 way L8—socket 10p; plug 12p. 3 way ser. socket 10p; plug 12p. 5 way ser. socket 12p; plug 15p.

TRANSISTOR ACCESSORIES

To3 cover 7p
Heat sinks 1°c/w, type 6W1, undrilled 60p

SWITCHES



1011C SPST toggle 19p; 409 DPDT toggle 28p. (These are chrome plated 2·5A rating)
7201 Sub-miniature DPDT 250V a.c/2A 48p

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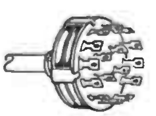
Radiospares Miniature Maka-switch (In assembly kit form) Shaft 48p.
Wafers, MBB-2P5W, 1P11W: BBM-1P12W, 2P6W, 3P4W, 4P3W, 6P2W, each, 6p.

WAVECHANGE SWITCHES



1P12W, 2P6W, 3P4W, 4P3W, each 24p

ELECTROLYTIC CAPACITORS

AXIAL LEAD

Rated voltage: Capacity μF	3V	6·3V	10V	16V	25V	35V	50V	63V	100V
0 47								7p	5p
1·0						7p			5p
2·2					7p			5p	5p
4·7				7p		5p		5p	6p
10			7p		5p	5p		6p	6p
22			5p	5p		6p	6p	6p	7p
47	5p		5p	5p	5p	6p	6p	6p	7p
100	5p	5p	5p	6p	6p	7p	9p	10p	15p
220	5p	6p	6p	6p	8p	9p	14p	14p	21p
470	6p	7p	7p	8p	10p	14p	19p	19p	34p
1000	8p	10p	10p	14p	16p	19p		33p	
2200	12p	14p	18p	20p	30p	33p			
4700	19p	22p	30p	33p					
10,000	31p	33p							

Polycarbonate —5% Tolerance

250V up to 0·1μF: 100V/0·1μF and above.
0·01; 0·012; 0·015; 0·018; 0·022; 0·027; 0·033; 0·047; 0·056; each 4p. 0·068; 0·082; 0·1; 0·12; 0·15 each 4p. 0·18; 0·22; each 5p. 0·27; 0·33; 6p. 0·39 7p. 0·47 8p. 0·56 10p. 0·68 11p. 1μF 13p.

RESISTORS 10%, 5%, 2%

Code	*Power*	*Tolerance*	*Range*	*Values available*	1 *to* 9	10 *to* 99 (see note below)	100 *up*
C	1/20W	5%	82 Ω–220K Ω	E12	9	8	7
C	1/8W	5%	4·7 Ω–470K Ω	E24	1	0·8	0·7
C	1/4W	10%	4·7 Ω–10M Ω	E12	1	0·8	0·7
C	1/2W	5%	4·7 Ω–10M Ω	E24	1·2	1	0·9
C	1W	10%	4·7 Ω–10M Ω	E12	2·5	2	1·9
MO	1/2W	2%	10 Ω–1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12	7	7	6
WW	3W	5%	1 Ω–10K Ω	E12	7	7	6
WW	7W	5%	1 Ω–10K Ω	E12	9	9	8

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MO—metal oxide, Electrosil TR5, ultra low noise.
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Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
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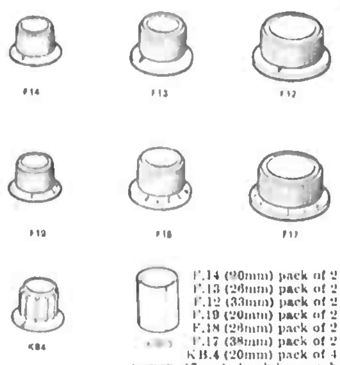

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F.13 (26mm) pack of 2 38p
F.12 (33mm) pack of 2 40p
F.19 (20mm) pack of 2 32p
F.18 (26mm) pack of 2 38p
F.17 (38mm) pack of 2 40p
KB.4 (20mm) pack of 4 40p
K 30/3 (17mm) aluminium, each 24p

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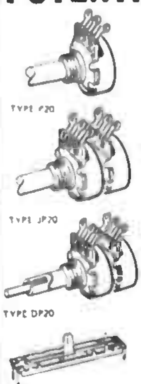

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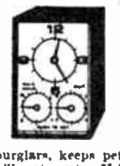

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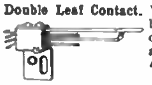

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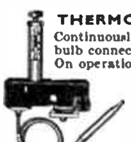

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2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
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8 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
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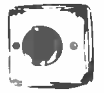

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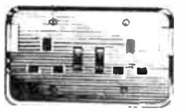

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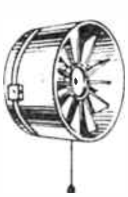

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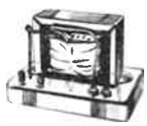

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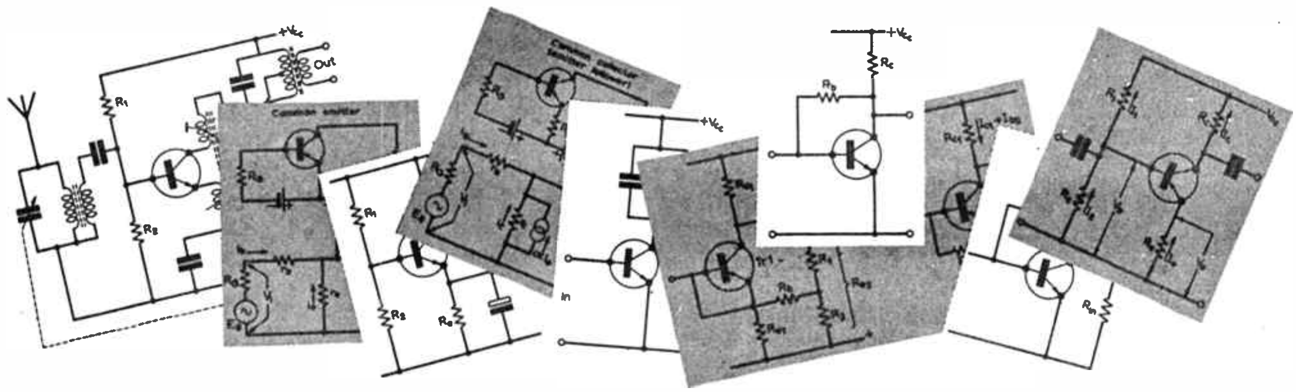

TRANSISTOR CIRCUITRY for beginners

PART 15

H.W. HELLYER & MICHAEL HOLLIER

Tone control circuitry

Toward the end of the last part of this series of articles that was published, we were concerned with frequency-dependent feedback. Without being intentionally devious, we skated over some of the finer points and here shall try to keep our promise of digging more deeply into the matter of tone controls, their design and their limitations.

The utter purist will not deign to acknowledge the need for tone controls! Everything should be flat, he says. There should be, he further asserts, no need to alter the frequency response of an amplifier if all the other parts of the audio system are in order. True, but Utopia has not yet arrived, whatever the politicians promise, and there will be nasty pops and crackles from our records, hiss from our tape, peaks and troughs from many a cartridge and even worse deviations by the time the sound escapes from the loudspeakers.

Even then, we are not finished. If the little woman insists on foot-deep rugs and wall-to-wall drapes, or if your pad is scoured to its functional austerity, man, you will need same trimming of the ideally flat response to compensate for—in the first case, the premature absorption of treble, and in the second, the 'hardness' of the sound. Tone controls may be regarded as necessary evil, but as long as we are obliged to have them, let's make sure they do not detract from the best possible performance. And in so many commercial designs, they do.

First steps

Before delving into the tone control circuit as a whole, we must take a look at the effect of the passive components with a change in frequency. Back in the days when Poppa bought his radiogram because it sounded 'mellow', the tone control was simply a network of passive components, usually across the output stage, with variation of the resistive part of a series capacitor-resistor shunt that drained away progressively more and more of the upper frequencies. It was, in other words, a variable treble-cut device. One or two more enterprising makers

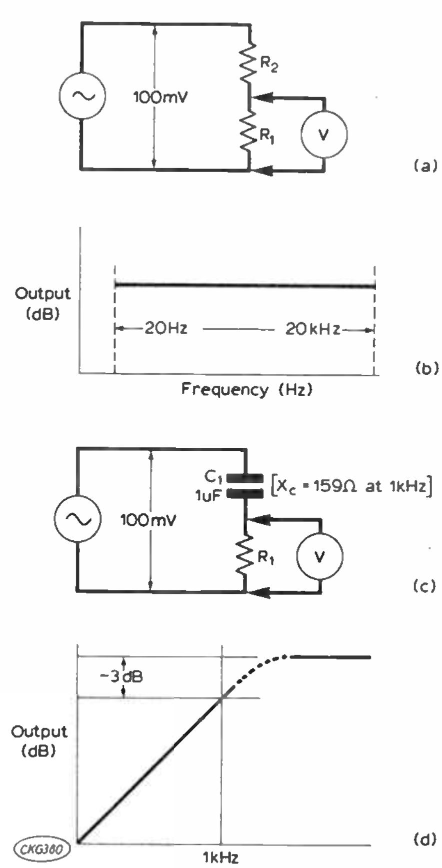

Fig. 74: (a) For a simple resistive network the output shown by the voltmeter is in proportion of the ratio of the resistors to the applied input voltage. In (b) theoretically, the output should not change with frequency, giving a "straight-line" graph. (c) Substituting a capacitor for R2 makes the output frequency dependent while (d) shows an example of the curve we might expect from a simple network such as (c) having a "slope" of 6dB per octave.

fitted alternative resistor-capacitor combinations in the grid circuit of output valves, and others even went so far as to label these Bass or Treble Boost and Cut, but all such passive networks, i.e., those which do not have inbuilt amplification, must attenuate the overall signal.

The point about the passive tone controls is that the attenuation varies the frequency. Take the case of a simple resistive network, as in Fig. 74(a). If we have two resistors of equal value, fed by a signal generator, the output across the measured one will be half the input signal in amplitude, but will not change in frequency. A graph of the situation would be a straight line, as Fig. 74(b).

But if we now substitute the upper resistor with a capacitor, C1 in Fig. 74(c), we find that the measured output will be exactly half the input at **only one frequency.** Reactance $X_c = \frac{1}{2\pi fC}$ where X_c is in ohms, C in farads and f is the frequency at which the test is made, in hertz.

Working out the reactance of a 1μF capacitor at 1kHz, we get $\frac{10^6}{6{\cdot}28 \times 1000 \times 1} = 159$ ohms.

But if we now measure the voltage across a similar-value resistor, we find that instead of half the signal input, we have slightly more. Instead of our attenuator dropping the output by 6dB (to half voltage) at 1kHz, it will have dropped the output only 3dB. This is because the voltage across the capacitor is 90° out of phase with the voltage across the resistor. The output voltage ratio is 0·707:1, not 0·5:1. In fact, if we alter the frequency of the generator, we will find that the measured output drops as the frequency falls. The rate of 'slope', as shown in Fig. 74(d), is 6dB per octave, an octave being a frequency change of 2:1.

This 3dB drop has a further significance when we tackle power output stages, for if the drive voltage to the amplifier fell sufficiently for the power output to drop 3dB, this would be the well-known 'half-power-point'. This is the figure normally quoted in amplifier specifications—a point to which we shall return later. Below this −3dB point in Fig. 74(d), the slope of the curve falls away regularly by 6dB per octave, i.e., a ratio of 2:1, a reduction of output by a half each time the frequency is halved.

Making it active

It helps to regard tone control as a method of frequency correction. The introductory remarks we have made, and references to frequency-dependent

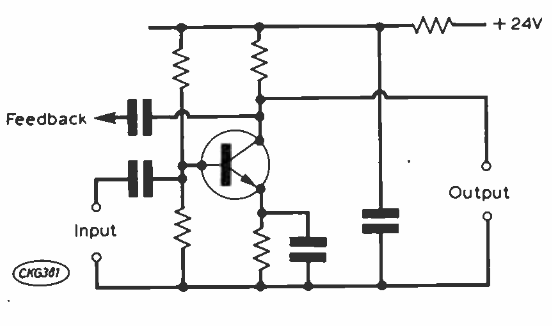

Fig. 75: A collector-follower amplifier arranged so that its output can be measured with and without feedback.

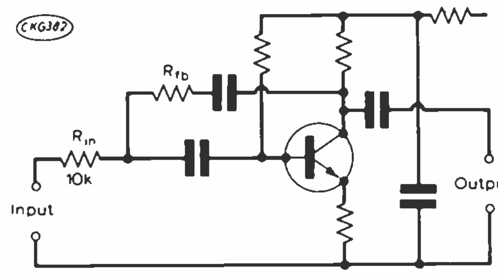

Fig 76. The basic circuit used for tests.

feed-back in previous articles, should have prepared the regular reader for this approach. Simple tone controls are types of filters. We shall deal thoroughly with filter circuitry later, but at the moment it is necessary to observe that the 'filter' of Fig. 74(c), for example, is called a 'first order filter', having a 'slope' of 6dB per octave. Second order filters have slopes of 12dB/octave and third-order filters, 18dB/octave. As we shall see, real filters, used in well-designed audio amplifiers, should ideally have a third-order slope to be effective.

These filters are passive devices. They contain no amplifying stage or stages to put back the signal attenuated by their action. If we make a marriage of the virtual earth circuitry we talked about in Parts 12 and 13 of this series and the fundamentals of tone control circuitry touched upon in Part 11, we get an amplifier with frequency-dependent feedback, which becomes, if we correctly design it, a better tone control circuit.

First, we need what is known as an 'inverting amplifier'. If you take a look at Fig. 75, you will see that this can be a collector-follower circuit, so arranged that we can measure its gain with or without the feedback. In practice, this is a useful circuit, and the component calculation will be discussed as we go along. It is convenient to use the 24-volt supply described in Part 13, December PW. Fig. 76 shows the circuit devised by Mike and used for tests on the prototype.

With an input from the audio generator, and an output measured with a millivoltmeter, we can measure the open-loop gain. This is the gain of the amplifier with no feedback connected. Here, a word of warning is required: in many erudite theoretical articles, 'open-loop gain' is bandied about freely, but an inspection of the circuit will often show that it would be virtually impossible to measure it in practice. Our aim in this case is to show what we mean by the term, then, by applying the feedback we need, to modify the gain and achieve our controlled response, i.e., effect a tone control.

In our prototype, the open-loop gain, (G_0) was 260. It is absolutely essential when carrying out these measurements to mount the circuit in a screened box, use screened input and output leads and make sure our construction is 'solid'. We use Veroboard for convenience: it allows connection of additional components while retaining the versatility of wired circuitry. We use the very convenient Norman Rose aluminium boxes, because they are inexpensive, easily worked for outlet holes, tag-strip mountings, etc., and have a simple lid which not only completes the screening but also affords an easy access for modifications.

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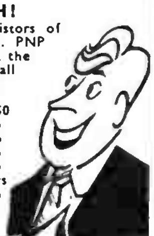

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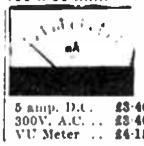

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500μA	£3·50		
1mA	£3·40		
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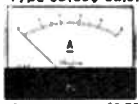
1 amp. D.C.	£3·40		

Type SD.830 82.5mm x 110mm Fronts



50μA	£2·75	10mA	£2·50
50-0-50μA	£2·70	50mA	£2·50
100μA	£2·70	100mA	£2·50
100-0-100μA	£2·70	500mA	£2·50
200μA	£2·70	1 amp.	£2·50
500μA	£2·55	5 amp.	£2·50
1mA	£2·50	10 amp.	£2·50
5mA	£2·50	5V. D.C.	£2·50
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		20V. D.C.	£2·50
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		15V. A.C.	£2·75
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Type SD.640 63.5mm x 85mm Fronts

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50-0-50μA	£2·55	1 amp.	£2·35
100μA	£2·55	5 amp.	£2·35
100-0-100μA	£2·55	10 amp	£2·35
200μA	£2·55	5V. D.C.	£2·35
500μA	£2·35	20V. D.C.	£2·35
1mA	£2·35	50V. D.C.	£2·35
5mA	£2·35	300V. D.C.	£2·35
10mA	£2·35	15V. A.C.	£2·40
50mA	£2·35	300V. A.C.	£2·40
100mA	£2·35	VU Meter	£2·70

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100μA	£2·35	10 amp.	£2·15
100-0-100μA	£2·35	5V. D.C.	£2·15
200μA	£2·35	10V. D.C.	£2·15
500μA	£2·20	20V. D.C.	£2·15
1mA	£2·15	50V. D.C.	£2·15
5mA	£2·15	300V. D.C.	£2·15
10mA	£2·15	15V. A.C.	£2·30
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100-0-100μA	£3·30	1 amp.	£3·10
200μA	£3·30	5 amp.	£3·10
500μA	£3·20	15 amp.	£3·10
500-0-500μA	£3·10	30 amp	£3·20
1mA	£3·10	20V. D.C.	£3·10
1-0-1mA	£3·10	50V. D.C.	£3·10
5mA	£3·10	150V. D.C.	£3·10
10mA	£3·10	300V. D.C.	£3·10
		15V. A.C.	£3·10
		300V. A.C.	£3·10
		S Meter 1mA	£3·15
		VU Meter	£3·95
		1 amp. A.C.*	£3·10
		5 amp A.C.*	£3·10
		10 amp. A.C.*	£3·10
		20 amp. A.C.*	£3·10
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Type MR.52P. 2¼in. square fronts

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

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

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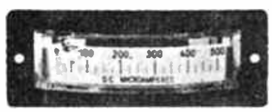
100μA	£2·10	500mA	£1·75
100-0-100μA	£1·95	750mA	£1·75
200μA	£1 95	1 amp.	£1·75
500μA	£1·80	2 amp.	£1·75
500-0-500μA	£1 75	5 amp.	£1·75
1mA	£1·75	10 amp	£1 75
1-0-1mA	£1 75	3V. D.C.	£1·75
2mA	£1·75	10V. D.C.	£1 75
5mA	£1·75	15V. D.C.	£1 75
10mA	£1·75	20V. D.C.	£1 75
20mA	£1 75	50V. D.C.	£1·75
50mA	£1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

Type MR.45P. 2in. square fronts

50μA	£2 50	5 amp.	£1 85
50-0-50μA	£2·30	10V. D.C.	£1 85
100μA	£2·30	20V. D.C.	£1·85
100-0-100μA	£2·05	50V. D.C.	£1·85
200μA	£2 05	300V. D.C.	£1·85
500μA	£1·95	15V. A.C.	£2 00
500-0-500μA	£1·85	300V. A.C.	£2 00
1mA	£1 85	8 Meter 1mA	£2 05
5mA	£1 85	VU Meter	£2·50
10mA	£1 85	1 amp. A.C.*	£1 85
50mA	£1·85	5 amp. A.C.*	£1·85
100mA	£1 85	10 amp. A.C.*	£1 85
500mA	£1 85	20 amp. A.C.*	£1·85
1 amp.	£1 85	30 amp. A.C.*	£1·85



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

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

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50μA	£3 50	5 amp. D.C.	£2 85
50-0-50μA	£3·40	300V. A.C.	£2 85
100μA	£3·40	VU Meter	£3·70
100-0-100μA	£3·30		
500μA	£3·05		
1mA	£2·85		
20V. D.C.	£2·85		
50V. D.C.	£2·85		
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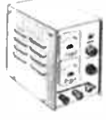

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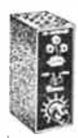

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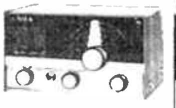
Ideal for home, office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.

2 Station, £2 97, 3 Station £5 25, P. & P. 15p
4 Station £8 62, P. & P. 17p.

SEND SAE FOR LIST OF SEMI CONDUCTORS & VALVES

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

UNR-30 RECEIVER



4 Bands covering 550Kc/s – 30Mc/s. B.F.O. Built-in Speaker 220/240v A.C. Brand new with instructions. £15 75. Carr. 37p

UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 550Kc/s-30Mc/s. FET S Meter. Variable BFO for SSB. Built-in Speaker. Bandspread. Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12¼" × 4¼" × 7" Brand new with instructions. £25. Carr. 37p.

SKYWOOD CX203 COMMUNICATION RECEIVER

Solid state. Coverage on 5 bands 200-420 KHz and ·55 to 30 MHz. Illuminated slide rule dial. Bandspread. Aerial tuning BFO. AVC, ANL, 'S' meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240v AC or 12v DC. Size 325 × 266 × 150 mm. Complete with instructions and circuit. £38·50. Carr. 50p.

LAFAYETTE HA-600 SOLID STATE RECEIVER

General coverage 150–400Kc/s. 550 Kc/s–30Mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter. S. Meter, Bandspread, RF Gain. 15" × 9½" × 8¼". 18 lbs. 220/240v. A.C. or 12v. D.C. Brand new with instructions. £50, Carr. 50p.

TRIO 9R59DS COMMUNICATION RECEIVER

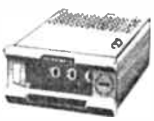
4 band covering 550Kc/s. to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW. ANL. Variable BFO. S meter. Sep. bandspread dial. IF frequency 455 Kc/s. audio output 1·5w. Variable RF and AF gain controls 115/250v. A.C. Size: 7" × 13" × 10" with instruction manual. £49 50. Carr. Paid.

EMI LOUDSPEAKERS

Model 350. 13" × 8" with single tweeter/crossover. 20-20,000 Hz. 15 watt RMS. Available 8 or 15 ohms. £7 25 each P. & P. 37p.

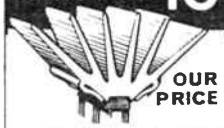
Model 450. 13" × 8" with twin tweeter/crossover. 55–13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. £3·62 each. P. & P. 25p.

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: 5¼in. × 2 13/16in. × 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. £35·50. Carr. 50p.

SINCLAIR IC-12

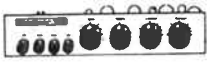


List Price £2·98

OUR PRICE £1·80

P. & P. 10p

SINCLAIR EQUIPMENT



Project 60 Package offers.

2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. £15·95 Carr. 37p. Or with PZ6 power supply £18·00 Carr. 37p. 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. £20·25. Carr. 37p.

Transformer for PZ8. £2·97 extra.

Add to any of the above £4·45 for active filter unit and £13·00 for pair of Q16 speakers.

All other Sinclair products in stock.

2000 Amp £21·95 Carr. 37½p.; 3000 Amp £28·50 Carr. 37p.; Neoteric Amp £43·95. Carr. 37p IC12 £1·80 p. & p. 10p.

NEW PROJECT 605 — £20·97. Carr. 37p.

SPECIAL OFFER! GOODMANS AXIOM 301

Hi Fi 12" 20 watt twin cone full range speaker. 30–16,000 Hz. 16,500 gauss. 8 ohm impedance. Brand new and boxed.

(List price £21.72) OUR PRICE £12·50 each. Carr. 50p.

EA.41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7½ × 3 × 4½in. £5·97. P. & P. 15p.

SPECIAL OFFER! STEREO SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14½" × 9" × 7½". 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead. £19·95 pr. Carr. 50p.

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.

SPECIAL PURCHASE! NEAT G30J STATIC BALANCE PICK-UP ARMS

Identical specification to NEAT G30 arm but with two-tone chrome and black finish. Complete with head shell, pick up rest and plug in phono leads.

BRAND NEW—
FULLY GUARANTEED
ONLY £8·95. P. & P. 25p.

ARF-300 AF/RF Signal Generator

All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output 'sine / square 10v. P-P. RF 100KHz to 200 MHz. Output 1v. maximum. Operation 220/240v. AC. Complete with instructions and leads. £29·95. Post 50p.

AKAI BARGAINS

SUPER MONEY SAVING OFFERS—
BUY NOW WHILE STOCKS LAST!
BRAND NEW AND FULLY GUARANTEED

1721 Tape Rec.	£73·95		
X5000 Tape Rec.	£99·95		
GX370 Tape Deck	£259·95		
4000DS Tape Deck	£73·95		
4000DS Dust Cover	£4·75	GXC40 Cassette Rec.	£82·95
X200 Tape Deck	£99·95	GXC40D Cassette Deck	£67·95
X201D Tape Deck	£132·95	GXC40T Cassette/Receiver	£123·95
X221D Tape Deck	£169·95	GXC45D Cassette Deck	£89·95
GX220D Tape Deck	£148·50	GXC46D Cassette Deck	£103·50
GX280D Tape Deck	£249·40	GXC46 Cassette Recorder	£115·95
X1810D Tape/8 track Deck	£169·95	GXC60D Cassette Deck	£111·25
GX1900D Tape/Cass Deck	£177·95	GXC65D Cassette Deck	£110·25
X2000SD Tape/Cas/8 Track Rec	£223·30	CS35D Cassette Deck	£59·50
CR81 8 track Rec.	£80·95	AA6300 Receiver	£79·95
CR81D 8 track Rec.	£65·95	AA8030 Receiver	£106·95
CR81T 8 track/Receiver	£118·90	AA8080 Receiver	£144·95
CR80DSS 8-track	£121·95	AA8500 Receiver	£175·00
CR80SS 8 track system	£145·00	ADM11 Microphones (Pair)	£7·50

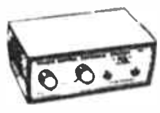
Carriage 50p extra. (Recorders & Decks 75p)

DOLBY SYSTEM NOISE REDUCTION UNIT

Improves the performance of cassette and semi-professional recorders. Reduces tape bias by 3dB at 600Hz, 6dB at 1200Hz and 10dB for all frequencies above 3000Hz. Controls for input levels and noise reduction on record and replay. 2 meters for Dolby level. Off tape monitoring. Frequency response: 20Hz to 15kHz ± 1dB 19kHz −35dB. Size 15¾" × 9" × 3¼". AC 200/250V.

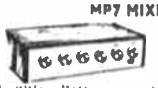
OUR PRICE **£32·50** Carr. 50p.

1021 STEREO LISTENING STATION



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6" × 4" × 2½". £8·25. P. & P. 15p.

MP7 MIXER PREAMPLIFIER

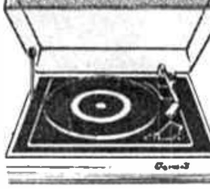


6 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9¼" × 5" × 3" Inputs Mics: 3 × 3mV 50K: 2 × 3mV 600 ohm. Phono mag. 4mV 50K. Phono ceramic 100mV 1 meg. Output 250mV 100K. £8·97. P. & P. 20p.

TE-1035 STEREO HEADPHONES

Low cost high performance stereo headphones. Foam rubber ear cups Adjustable head-band. 8 ohm impedance 25–18,000 Hz, With lead and stereo jack plug. ONLY £1·97. P. & P. 12p.

NEW GARRARD MODULES



Popular range of Garrard decks with Shure cartridge fitted in deluxe plinth with hinged lid.

SP25 III Module/M75-6	£23·50
AP76 Module/M75-6	£33·80
AP96 Module/M75-6	£38·75
Zero 100S Module/M93E	£52·60

Carr. 50p extra any item.

HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES

Features unique mechanical 2 way units and fitted adjustable level, controls. 8 ohm impedance 20–20,000cps. Complete with spring lead & stereo jack plug £7·97. P. & P. 12p.

GENUINE BARGAIN!

KOSS SP.3XC STEREO HEADPHONES

Response 10–15,000Hz. Impedance 4–6 ohms. Brand new, Boxed & fully guaranteed (List £9.50). OUR PRICE £6·50. P. & P. 25p.

HOSIDEN DH-02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head-band. 8 ohm impedance. 20-12,000 cps. Complete with lead and plug. ONLY £2·37. P. & P. 12p.

TAPE CASSETTES

Top quality Hi-Fi Low Noise in Library cases.

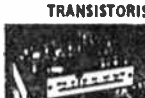
C60	3 for 75p.	10 for £2·35
C90	3 for £1·05	10 for £3·30
C120	3 for £1·35	10 for £4·30

Tape Head Cleaner 30p each.
P. & P. 10p extra.

SPECIAL OFFER! ROTEL RH700 STEREO HEADPHONES

20–20,000Hz. 8–16 ohm. (List £9·95). OUR PRICE £6·75. P. & P. 25p.

TRANSISTORISED FM TUNER



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 9V battery. Coverage 88–108Mc/s. Ready built ready for use. Fantastic value for money. £6·87½. P. & P. 12½p. Stereo multiplex adaptors £4·97½.

TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms. £1·97. P. & P. 15p.

HAND HELD 2-WAY WALKIE TALKIES

Industrial quality in robust metal cases. Battery operation. Volume and squelch controls. Call button and press to talk button. Telescopic aerial. Complete carrying cases.

2 channel 300 mW	£52·50	Pair. Post 50p.
3 channel 2 watt.	£79·50	Pair. Post 50p.

G. W. SMITH & CO (RADIO) LTD.
Also see previous pages and opposite page

FANTASTIC OFFER!

NIKKO TRM 50 STEREO AMPLIFIER

17 + 17 watts rms stereo amplifier with inputs for Magnetic and Crystal phono, Tuner, Tape, Aux and Tape Monitor. Outputs for two pairs of stereo speakers and Tape. Stereo headphone socket. Full range of controls including loudness control, scratch filter, etc. Size 13" × 9½" × 3½". Unrepeatable offer—limited stocks!

List price £59·50
OUR PRICE **£39·95**
Carriage 50p

HI-FI EQUIPMENT

SAVE UP TO 33⅓% OR MORE

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NIKKO TRM.50 SYSTEM

NIKKO TRM50 17 + 17 watt rms. stereo amplifier, BSR MP60, plinth & cover, Goldring G800 cartridge, pair of Linton 2 speakers and all leads.

OUR PRICE **£104·90** Carr. and Ins. £1·50

LEAK DELTA 30 SYSTEM

Leak Delta 30 stereo amplifier, Goldring GL75, plinth, cover and G800 cartridge. Pair of Leak 150 speakers and all leads.

OUR PRICE **£123·50** Carr. and Ins. £1·50

TELETON SAQ206B SYSTEM

Teleton SAQ206B 8 + 8 watt Amplifier, BSR MP60, plinth & cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.

OUR PRICE **£54·40** Carr. £1·50

Amplifier only, £22·95. Carr. 50p.

AUDIOTRONIC ACR.3500 MW/LW CAR RADIO

Fully transistorised, dual waveband. Size 6¾" × 4¼" × 2". 12v. D.C. Neg. or Pos. earth. Complete with fixing kit, speaker and leads. ONLY £7·50. Post 20p.

SUPER BARGAIN! AUDIOTRONIC ACP.8 8-TRACK CAR STEREO TAPE PLAYER

Tone, volume and balance controls. Track selector. Complete with matched pair of stereo speakers, connections and fittings. ONLY £15·95. Post 30p. (Illus is example only).

BH.001 HEAD SET AND BOOM MICROPHONE

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

WHARFEDALE LINTON SYSTEM

Wharfedale Linton Amplifier, Linton Turntable, pair of Linton 2 speakers and all leads.

OUR PRICE **£106·00** Carr. and Ins. £1·25

LINTON RECEIVER SYSTEM £155·00. Carr. & Ins. £1·25.

AMSTRAD 8000 II SYSTEM

Amstrad 8000 II 7 + 7 watt amplifier. BSR MP60, plinth and cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.

OUR PRICE **£48·25** Carr. £1·00

Amplifier only, £16·95. Carr. 50p.

B.S.R. TD8S 8-TRACK STEREO TAPE PLAYER DECK

Integrated preamps (output 125 mV) to feed into any stereo amplifier. Automatic and manual programme selector. 4 pole synchronous motor. 210/240 V.

OUR PRICE **£16·25** Post 50p

SPECIAL PURCHASE!

FERGUSON 3414 STEREO TUNER AMPLIFIER TURNTABLE UNIT

10+10 watts rms.
Five push buttons with separate scales for pre-tuning to desired FM station. Housed in a handsome walnut finished cabinet with BSR P128/MP60 record deck with Goldring G800H stereo magnetic cartridge. Offered complete with cover and a pair of matching Medway Speakers, size 18"×11"×8". TODAY'S VALUE AT LEAST £125!

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Carr. & Ins. £1·50.

SAVE £££'s PHILIPS GA308 TRANSCRIPTION TURNTABLE

2 speeds 33⅓ and 45 rpm. Lightweight tubular counterbalanced arm. Belt driven low speed synchronous motor. Viscous damped pick up lift/lower device. Complete with teak plinth and hinged cover. GA308 less cartridge (List £36·55).
OUR PRICE £24·50. P. & P. 50p.
GA308 PU with GP400 stereo magnetic cartridge (List Price £47·65)
OUR PRICE £29·95 P. & P. 50p.
LIMITED NUMBER ONLY!

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All brand new and guaranteed

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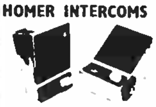
RA310 Amp ...	£34·95
RA610 Amp ...	£48·25
RX150 Receiver	£45·95
RX200 Receiver	£57·50
RX400 Receiver	£70·95

P. & P. 50p extra any item.

WHARFEDALE MID-RANGE HI-FI UNITS

As used in world famous system. 5" dia. Impedance 4/8 ohms. High flux ceramic magnet, 20 watts rms. Brand new £1·50. Carr. 37p.

HOMER INTERCOMS



Ideal for home office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.
2 Station, £2·97, 3 Station £5·25, P. & P. 15p
4 Station £6·62, P. & P. 17p.

CREDIT TERMS FOR CALLERS ACCESS & BARCLAYCARD WELCOME

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THIS MUST BE ADDED TO THE TOTAL VALUE OF GOODS ORDERED (INCLUDING POSTAGE/CARRIAGE) AND ENCLOSED WITH ORDER.

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C129 Mono	£6·50
C137	£8·35
MP60	£9·50
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810	£31·25
210/TPD3	£8·75
MP60/G800	£12·95
MP60/TPD1	£16·05
MP60/TPD1/G800	£19·50
MP60/TPD2	£14·35
610/TPD1	£18·95
510/TPD1	£17·95
HT70	£13·99
HT70/G800	£17·25
HT70/TPD1	£20·35
HT70/TPD1/G800	£23·90
810 Plinth/Cover	£9·25

CONNOISSEUR

BD1 Kit	£10·90
BD1 Chassis	£13·60
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BD2/SAU2/Chassis	£25·95
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GARRARD

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SP25 III/Acos GP104 Ceramic	£10·25
SP25 III	£10·25
SP25 III/M75-6	£15·95
SP25 III Module/ M75-6	£23·50
SL65B	£13·75
AP76	£17·95
AP76 Module/ M75-6	£33·80
SL72B	£21·95
SL95B	£32·25
401	£25·95
ZERO 100A	£38·95
ZERO 100S	£38·95
ZERO 100S Mod/ M93-E	£52·60
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GL72/P	£27·50
Plinth 69/72	£7·02
LID 72	£3·25
GL75	£26·95
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LID 75	£3·60
G99	£19·25
GL85P/C	£56·95
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T45 Table	£4·95

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Delta Turntable	£52·50

MICRO-SEIKI

MR111	£29·50
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PHILIPS

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GA308 Teak	£24·50
GA308PU Teak	£29·95
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PL15C	£51·35
PLA35	£82·65
PL50	£111·85
PL41D	£118·50
PL61	£119·95

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TD160C	£56·95
TD150A II	£35·95
TD150AB II	£39·95

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Linton Turntable	£26·95

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Budget SP25, etc.	£3·20
Budget AP76/Zero 100S	£4·50
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SME 2000 System	£34·50

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Decks supplied with stereo cartridge ready wired in plinth with cover.

GARRARD

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SP25 III/M44-7	£19·75
SP25 III/M44-E	£20·95
SP25 III/M55E	£22·40
AP76/G800	£27·95
AP76/M75-6	£30·25
AP76/M55E	£30·50
AP76/M75EJ	£32·50
AP76/G800E	£30·75
AP76/M44E	£30·50
AP76/M75ED	£38·95

B.S.R. McDONALD

MP60/G800	£17·50
MP60/M44-7	£18·95
MP60/M44-E	£19·95

GOLDRING

GL75/G800	£39·50
GL75/G800E	£42·50

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The Space Age WORLD RECORD award winning 7′ 6″ long All Band JOYSTICK VFA Antenna—JOYMATCH A.T.U.—TRIO RECEIVER or TRANSCEIVER—Matching HEADPHONES—A COMPLETE STATION IN ONE COMPACT PACKAGE—THE FLAT DWELLER'S DREAM!

★ 1972 JOYSTICK VFA £11·40 (A); JOYMATCH ATU 111 or 111A £11·40 (B); JOYMATCH ATU LO-Z500 £16·45 (C).

COMMUNICATIONS HEADPHONES £2·60 (D)

(All including postage, packing, accessories & insurance.)

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9R59DS receiver	£49·50
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Complete Gen. Coverage Station	£60·50

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JR310 receiver	£75·00
• Items (A); (B); (D) above	£7·00
Complete Amateur RX Station	£82·00

PARTRIDGE PACKAGE No. 3

JR599 receiver	£185·00
• Items (A); (B); (D) above	FREE
Complete Amateur RX Station	£185·00

PARTRIDGE PACKAGE No. 4

TS/PS515 Transceiver 180W	£210·00
• Items (A); (C); (D) above	FREE
Complete TX-RX Station	£210·00

BARCLAYCARD—ACCESS—PERSONAL LOANS!!

ALSO: SP5D SPKR. **£4·50**; 2M CAR TRANSCEIVER TR7100 **£99·50**; 2M PERSONAL TRANSCEIVER TR2200 **£62·50**; OA2 MAINS STABILISER **67p.**

NEW: World-wide reception on the amazing "DX—CRYSTAL SET" **£1·75** (+ 25p) including unique aerial.

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ARTIFICIAL EARTH—SOLVES YOUR EARTH PROBLEMS **£4·80**; **AERIAL BANDSWITCH**—TUNED AERIAL **£4·80**; **A.T.U. KIT**—FULL COVERAGE TX/RECEIVER **£4·80**; ASSEMBLED **£5·80.**

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BROADSTAIRS, KENT

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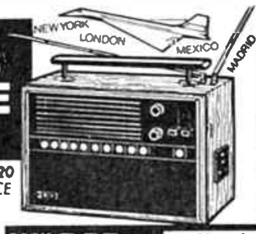
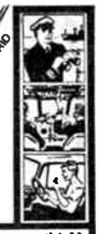
BATTERY/MAINS PORTABLE RECEIVER





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COMPLETE SYSTEM £64

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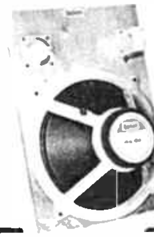

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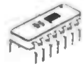

	1–24	25 plus
7400	15p	14p
7401	15p	14p
7402	15p	14p
7403	15p	14p
7404	15p	14p
7405	15p	14p
7408	18p	17p
7410	15p	14p
7411	15p	14p
7413	29p	26p
7420	15p	14p
7430	15p	14p
7440	15p	14p
7441	67p	64p
7442	67p	64p
7446	97p	94p
7447	97p	94p
7448	97p	94p

	1–24	25 plus
7450	15p	14p
7451	15p	14p
7453	15p	14p
7454	15p	14p
7460	15p	14p
7470	29p	26p
7472	29p	26p
7473	37p	35p
7474	37p	35p
7475	47p	45p
7476	43p	40p
7480	67p	64p
7481	97p	94p
7482	97p	94p
7483	1·10p	1·05p
7486	32p	30p
7490	67p	64p
7491	37p	34p

	1–24	25 plus
7492	67p	64p
7493	67p	64p
7494	77p	74p
7495	77p	74p
7496	77p	74p
74100	1·75p	1·65p
74104	97p	94p
74105	97p	94p
74107	40p	33p
74110	1·25p	1·25p
74111	1·00p	95p
74118	1·00p	95p
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741c	TO99	38p
741c	DIL	36p
741c	8 Pin DIL	34p
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748c	TO99	38p
1437		1·10p
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47µF	6p
100µF	6p
220µF	6p
330µF	6p
1000µF	12p
4700µF	26p

6·3 VOLT	
33µF	6p
68µF	6p
150µF	6p
470µF	10p
680µF	12p
1500µF	16p
2200µF	16p
3300µF	24p

10 VOLT	
22µF	6p
47µF	6p
100µF	6p
220µF	7p
330µF	9p
470µF	9p
1000µF	12p
1500µF	23p
2000µF	39p

16 VOLT	
15µF	6p
33µF	6p
68µF	6p
150µF	7p
220µF	8p
680µF	15p
1000µF	15p
1500µF	23p
2000µF	39p

25 VOLT	
10µF	6p
22µF	6p
47µF	6p
100µF	7p
150µF	7p
220µF	9p
470µF	12p
680µF	18p
1000µF	20p
2200µF	36p
5000µF	62p

40 VOLT	
6·8µF	6p
15µF	6p
33µF	6p

40 VOLT	
47µF	6p
100µF	8p
150µF	9p
220µF	10p
470µF	17p
680µF	23p
1000µF	23p
2200µF	40p

63 VOLT	
1µF	6p
2·2µF	6p
4·7µF	6p
6·8µF	6p
10µF	6p
22µF	6p
68µF	9p
100µF	10p
150µF	12p
220µF	17p
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470µF	24p
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50p

Pack of 10
BC108 50p
BC107 50p
(Plastic can)

Pack of 10
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AC128	12p
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AC141K	18p
AC176	14p
AC187	12p
AC187K	18p
AC188	12p
AC188K	18p
ACY17	21p
ACY18	19p
ACY19	23p
ACY20	20p
ACY21	21p
ACY22	16p
ACY39	62p
AD140	36p
AD142	40p
AD143	35p
AD149	34p
AD150	55p
AD161	27p
AD162	27p
AD M/P	50p
AF114	14p
AF115	14p
AF116	14p
AF117	14p
AF118	82p
AF124	24p
AF139	36p
AF239	37p
AL100	68p
AL102	60p
AL103	49p
ASY26	27p
ASY27	36p
AU103	90p
AU110	97p
AU111	67p
BC107	8p
BC108	8p
BC109	8p
BC113	14p
BC116	15p
BC125	15p
BC126	22p
BC132	14p
BC134	14p
BC135	14p
BC137	14p

BC138	24p
BC142	30p
BC143	30p
BC144	26p
BC145	24p
BC147	8p
BC148	8p
BC149	8p
BC153	15p
BC154	16p
BC157	12p
BC158	11p
BC159	12p
BC167	11p
BC168	10p
BC169	10p
BC177	14p
BC179	14p
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BF330	16p
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BFX84	25p
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BFX86	22p
BFX87	25p
BFX88	24p
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BFY52	15p
BFY64	35p
BFY90	65p
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NKT677G	22p
NKT713	29p
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OC20	50p
OC23	30p
OC25	25p
OC28	30p
OC29	30p
OC35	25p
OC36	35p
OC41	13p

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OC45	13p
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2N2924	16p
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2N3053	24p
2N3054	50p
2N3055	48p
2N3405	40p
2N3663	52p
2N3702	8p
2N3703	8p
2N3704	8p
2N3705	8p
2N3706	8p
2N3707	8p
2N3708	8p
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1S131	10p
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1S920	7p
1S922	8p
1S923	12p
1S940	5p
AA119	10p
AA129	10p
AAZ13	10p
AAZ15	12½p
AAZ17	12½p
BA100	15p
BA102	22½p
BA115	7½p
BA144	12½p
BA145	20p
BA154	12½p
BAX13	12½p
BAX16	12½p
BAY18	17½p
BAY31	7½p
BY100	17½p
BY126	15p
BY127	17½p
BYX10	22½p
OA5	17½p
OA9	10p
OA10	22½p
OA47	8p
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OA73	10p
OA79	7p
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1R5	·28	30C17	·76	EAF42	·60	EM80	·36	PCF808	·68	U801	·75
185	·22	30C18	·72	EB91	·12	EM81	·36	PCL82	·30	UABC80	·31
1T4	·16	30F5	·64	EBC33	·40	EM84	·32	PCL83	·55	UAF42	·50
384	·26	30FL1	·65	EBC41	·49	EM87	·50	PCL84	·33	UBC41	·45
3V4	·47	30FL12	·69	EBC81	·30	EY51	·36	PCL85	·38	UBF80	·34
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5Y3GT	·30	30L15	·70	EBF83	·39	EZ40	·39	PCL800	·89	UCC85	·35
5Z4G	·35	30L17	·70	EBF89	·29	EZ41	·39	PCL805	·38	UCF80	·30
6/30L2	·54	30P4	·65	ECC81	·17	EZ80	·21	PENA4	·77	UCH42	·58
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6AQ5	·22	30P19	·65	ECC83	·35	EZ90	·25	PFL200	·51	UCL82	·33
6AT6	·20	30PL1	·60	ECC85	·34	GZ30	·34	PL36	·48	UCL83	·55
6AU6	·20	30PL13	·89	ECC804	·54	GZ32	·40	PL81	·43	UF41	·52
6LA6	·20	30PL14	·80	ECF80	·30	KT41	·77	PL81A	·47	UF89	·30
6BE6	·21	35L6GT	·45	ECF82	·26	KT61	·55	PL82	·31	UL41	·53
6BJ6	·41	35W4	·25	ECH35	·55	KT66	·78	PL83	·33	UL84	·30
6BW7	·50	35Z4GT	·25	ECH42	·59	LN319	·63	PL84	·30	UM84	·23
6F14	·35	50CD6G	·68	ECH81	·29	LN329	·80	PL500	·63	UY41	·39
6F23	·68	807	·49	ECH83	·38	LN339	·65	PL504	·63	UY85	·25
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6J7G	·24	B729	·54	ECL82	·29	PABC80	·31	PY32	·52	Z77	·23
6K7G	·12	CCH35	·67	ECL86	·35	PC86	·47	PY33	·52	Transistors	
6K8G	·36	CY31	·28	EF39	·38	PC88	·47	PY81	·25	AC107	·17
6Q7G	·35	DAF91	·22	EF41	·57	PC96	·42	PY82	·25	AC127	·18
6SL7GT	·32	DAF96	·36	EF80	·23	PC97	·38	PY83	·26	AD140	·37
6SN7GT	·32	DF91	·16	EF85	·28	PC900	·29	PY88	·33	AF115	·29
6V6G	·28	DF96	·36	EF86	·30	PCC84	·29	PY800	·31	AF116	·20
6V6GT	·28	DH77	·20	EF89	·26	PCC85	·23	PY801	·31	AF117	·20
6X4	·23	DK32	·33	EF91	·13	PCC88	·38	R19	·30	AF125	·17
6X5GT	·28	DK91	·28	EF92	·27	PCC89	·43	R20	·70	AF127	·17
10P13	·53	DK92	·50	EF98	·65	PCC189	·48	U25	·73	OC26	·25
12AT7	·17	DK96	·45	EF183	·27	PCC805	·70	U26	·65	OC44	·13
12AU7	·20	DL35	·40	EF184	·29	PCF80	·26	U47	·73	OC45	·13
12AX7	·22	DL92	·26	EH90	·36	PCF82	·33	U49	·70	OC71	·13
19BG6G	·75	DL94	·47	EL33	·55	PCF86	·46	U52	·31	OC72	·13
20F2	·67	DL96	·38	EL34	·48	PCF800	·58	U78	·24	OC75	·13
20P3	·75	DY86	·24	EL41	·54	PCF801	·28	U191	·68	OC81	·13
25L6GT	·19	DY87	·24	EL84	·23	PCF802	·39	U193	·31	OC81D	·13
25U4GT	·57	DY802	·33	EL90	·28	PCF805	·72	U251	·61	OC82	·13
30C1	·28	EABC80	·32	EL95	·33	PCF806	·56	U301	·38	OC82D	·13
30C15	·58			EL500	·62			U329	·66	OC170	·23

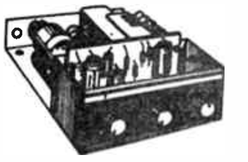
READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441.

Minimum post/packing on 1 valve 7p., on each additional valve, (3p. per. valve extra)

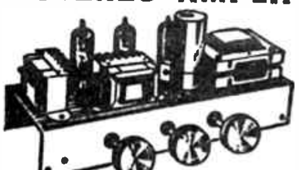
Any parcel insured against damage in transit 3p extra.

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz—30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high x 6" wide x 7½" deep. AC 200/250V.
PRICE £10·50. P. & P. 25p.

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.

POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp continuous (1½amp intermittent).
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3¼" × 2¼".
Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. etc. Ready built and tested. **PRICE £4.50 P. & P. 35p.**

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2¾" × 3" approx. 25p pair. P. & P. 5p.

HIGH GRADE COPPER LAMINATE BOARDS 8" × 6" 5 for 50p P. and p. 13p.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £1·85 P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri 200/240v. Sec. 9-0-9 at 500mA. 85p. P. & P. 13p. Pri. 200/240v. Sec. 12-0-12 at 1 amp. 95p. P. & P 13p. Pri. 200/240v. Sec. 10-0-10 at 2 amp. £1·45. P. & P. 30p.

SPECIAL OFFER MAINS TRANSFORMER 200/240v. A.C. Input 35v at 1½ amp A.C. output overall size 2¾" × 2¼" × 3" approx. Suitable drop through or vertical mounting 90p. P. & P. 30p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100μA. For balance or tuning. Approx. size 1" x 1" x ¾" deep. Limited number. 75p. P. & P. 10p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER
For P.U. Tape, Mike, Guitar, etc. and suitable for use with valve or transistor equipment. 9-18v. battery or from H.T. line 200/300v. Frequency response 15Hz—25KHz. Gain 26dB. Solid encapsulation size 1¾" x 1½" x ¾". Brand new complete with instructions. Price 88p. P. & P. 13p.

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

VAT. Prices in this advertisement (incl. p. and p.) will be subject to VAT as from 1st April, 1973.

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER. With latest mono compatible cartridge £6·97 Carr. 50p. With stereo cartridge £7·97 Carr. 50p.
GARRARD SP25 Mk III with heavy precision machined die cast turntable £10·95, carr. 50p.

SPECIAL BARGAIN OFFER!

PRECISION ENGINEERED PLINTHS
Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60 etc. or B.S.R. C109, C129, A21 etc. Black leatherette finish. Size 12¼" × 14¾" × 3¼" high (approx. 7¼" high, including rigid smoked acrylic cover).
NOW ONLY £4·50, P. & P. 35p.

LATEST ACOS GP91/1SC mono compatible cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. £1·50 P. & P. 8p.

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78.
ONLY £2·50 P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3. P. & P. 10p.

LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. £1·63 P. & P. 10p.

LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £1·50 P. & P. 10p.

QUALITY RECORD PLAYER AMPLIFIER MK II
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE £3·95 P. & P. 40p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE £5·25 P. & P. 50p.

DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE £4·75, P. & P. 50p.

SPECIAL OFFER !
HI-FI LOUDSPEAKER SYSTEMS

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½" high x 10½" wide x 5½" deep. Fitted with E.M.I. Ceramic Magnet 13" x 8" bass unit, two H.F. tweeter units and crossover. Power handling 10 watts. Available 3 or 8 or 15 ohms impedance.
OUR PRICE £8.40 Carr. 65p
Cabinet Available Separately £4·50 Carr 60p
Also available in 8 ohms with EMI 13" x 8" bass speaker with parasitic tweeter £6·50 Carr. 65p

LOUDSPEAKER BARGAINS
5in. 3 ohm £1·05, P. & P. 15p. 7 × 4in. 3 ohm £1·15, P. & P. 20p, 10 × 6in. 3 or 15 ohm £1·90, P & P. 30p, E.M.I. 8 × 5in. 3 ohm with high flux magnet £1·62, P. & P. 20p
E.M.I. 13½ × 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm £3·20, P. & P. 30p. E.M.I. 13 × 8in. 3, 8 or 15 ohm with two inbuilt tweeters and crossover network £4·20, P. & P. 30p.

BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly £6·75. Guitar models: 25w. £6·75, 35w. £8·50. P. & P. 38p

SPECIAL OFFER!
LIMITED NUMBER OF BRAND NEW ELAC 10" TWIN CONE LOUDSPEAKERS
With large ceramic magnet and plasticised cone surround.
8 ohm impedance. £2·75. P. & P. 25p.

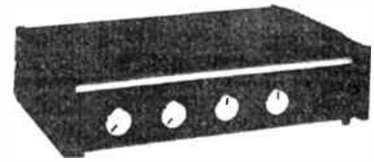
12in. **"RA" TWIN CONE LOUDSPEAKER.** 10 watts peak handling. 3, 8 or 15 ohm £2·20, P. & P. 30p.
35 ohm **SPEAKERS** 3in. only 63p P. & P. 13p.
"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" x 14¾" x 1⅛" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only £5·95 each. P. & P. 25p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Usually £1·75 yd., our price 75p yd. length. P. & P. 15p per yd (min 1 yd.) S.A.E. for samples.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30-15,000Hz. Matching impedance 8-16 ohms. Easily converted for Mono. PRICE £2·95, P. & P. 15p.
HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE £1·05, P. & P. 8p

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



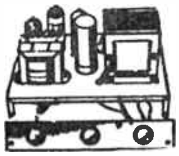
NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED FIBRE GLASS PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EVEN EASIER CONSTRUCTION

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled fibreglass printed circuit board, smart brushed anodised aluminium front panel with matching knob, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ±3dB 12-30,000 Hz Sensitivity: better than 80mV into 1M Ω. Full power bandwidth: ±3dB 12-15,000 Hz. Bass boost approx. to +12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1.0 amp. Overall Size 12"w. x 8"d. x 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 18p plus large S.A.E.

AMPLIFIER KIT	£10·50	P. & P. 15p
(Magnetic input components 30p extra)		
POWER PACK KIT ..	£3·00	P. & P. 30p
CABINET	£3·00	P. & P. 30p

(Post Free if all units purchased at same time)
Full after sales service

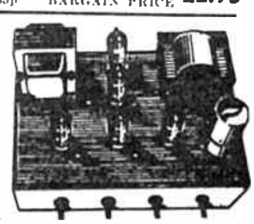
Also available ready built and tested £21·00. Post Free.
Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi Fi Discotheque use, etc.



3-VALVE AUDIO AMPLIFIER HA34 MK II.
Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4·95. P. & P. 35p.
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £4·10. P. & P. 40p.

HARVERSON'S SUPER MONO AMPLIFIER
A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
P. & P. 35p BARGAIN PRICE **£2.95**

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 13p (Free with parts). All parts sold separately. ONLY £7·97 P. & P. 55p. Also available ready built and tested £10·97 P. & P. 60p.

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

HARVERSON SURPLUS CO. LTD.

(Dept. P.W.) 170 HIGH ST., MERTON, LONDON, S.W.19 Tel.: 01-540 3985

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PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

Sinclair Project 60

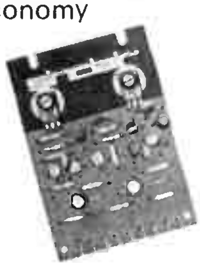
Now–the Z.50 Mk.2

with built-in automatic transient overload protection

with free manual
£5.48

When originally introduced, the Sinclair Z 50 proved now it was possible to design and produce a popularly priced modular power amplifier having characteristics to challenge the world's costliest amplifiers. Many thousands of Z.50's are now giving excellent service day in, day out. But we have also learned that constructors do not always use their Z.50's ideally. That is why we have introduced modifications whereby risk of damage through mis-use is greatly reduced and performance further enhanced. The Z 50 Mk 2 has improved thermal stability, more accurately regulated D C limiting to ensure more symetrical output voltage swing and clipping and still less distortion at lower power. Z.50 Mk.2 is compatible with all other Project 60 modules, and may be incorporated to advantage in existing systems. Eleven silicon epitaxial planar transistors are now used, two more than in the original Z.50, circuitry has been re designed making this versatile high performance amplifier better than ever.

Z.30 the power amplifier for quality and economy

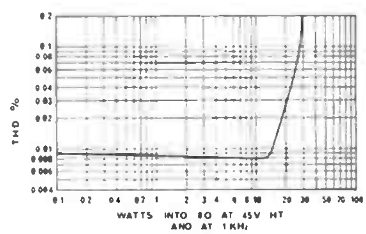


with free manual
£4.48

The Z 30 provides excellent facilities for the constructor requiring a high fidelity audio system of less power than that available from Z 50 s. Using a power supply of 35 volts, Z 30 will deliver 15 watts RMS into 8 ohms, or 20 watts RMS into 3 ohms using 30 volts. Total harmonic distortion is a fantastically low 0 02% at 15 watts into 8 ohms with signal to noise ratio better than 70 dB unweighted. Input sensitivity 250mV into 100K ohms. Size 80 x 57 x 13 mm (3⅛ x 2¼ x ½) Z 30, Z 50 and Z 50 MK 2 modules are compatible and interchangeable

Brilliant new technical specifications

Input impedance 100 KΩ
Input (for 30w into 8Ω) 400mV
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better
Distortion 0.02% up to 20W at 8Ω. See curve
Frequency response 10Hz to more than 200 KHz ± 1dB
Max. supply voltage 45v (4Ω to 8Ω speakers) (50v 15Ω speakers only)
Min. supply voltage 9v
Load impedance – minimum : 4Ω at 45v HT
Load impedance – maximum : safe on open circuit



Typical Project 60 applications

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

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

Guarantee

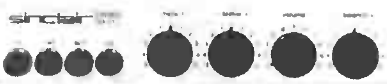
If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1 00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

sinclair

the world's most advanced high fidelity modules

Stereo 60 Pre-amp/control unit



Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

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

Built, tested and guaranteed **£9.98**

Project 60 Stereo F.M. Tuner

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

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SPECIFICATIONS

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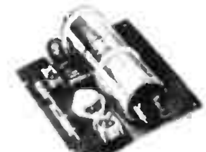

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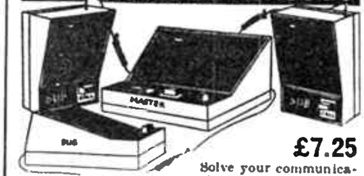

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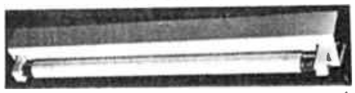

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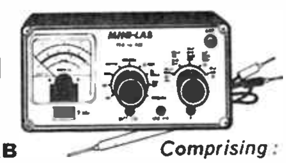

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Distributed over approx. 16,500 dial diversions, each meter (same as the Bc221) contains its own book of Calibration charts, plus circuits and Instruction Book. Contained in Metal Shockproof Transit case, with Supply Cable. Supply 115 volts ± 10% 50 c/s. Output on headphones or meter in the front panel. Accuracy is 0·01%, 0·002% on the Crystal Calibrator check points. Sensitivity for R/F signal input 500 Micro Volts to 1 volt. A plug is also provided for V1010 output for connection to an Oscilloscope, RF input connection is via coaxial cable or standard Wave Guide. Limited number available £18·50, carr £1·50.

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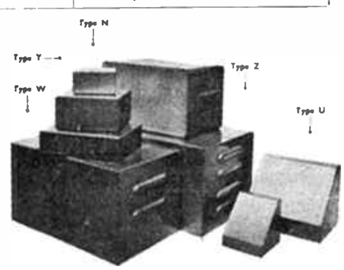
N	8x6x2"	£1·00	W	12x7x7"	£2·50
N	6x6x3"	£1·05	W	15x9x8"	£3·15
N	4x4x2"	80p	Y	8x6x6"	£2·25
U	4x4x4"	95p	Y	12x7x7"	£2·80
U	5½x4½x4½"	£1·15	Y	13x7x9"	£3·15
U	8x6x6"	£1·45	Y	15x9x7"	£3·35
U	9½x7½x3½"	£1·55	Z	17x10x9"	£4·15
U	15x9x9"	£3·00	Z	19x10x8½"	£4·35
W	8x6x6"	£1·90		*Plus p.& p. *Height*	

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



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7x5x2"	40p	19p	12x9x2½"	76p	38p
8x4x2"	38p	19p	13x8x2½"	76p	38p
8½x5½x2"	44p	21p	14x7x3"	80p	36p
9x7x2"	50p	26p	14x10x2½"	88p	47p
10x4x2½"	50p	21p	15x10x2½"	92p	50p
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OD3	0.40
1B3GT	0.45
1L4	0.25
1R4	0.50
1R5	0.45
1S4	0.30
1S5	0.30
1T4	0.30
1U4	0.40
1U5	0.75
1V2	0.55
1X2B	0.55
2D21	0.40
3A4	0.45
3A5	0.75
3BP1	3.50
3S4	0.40
3V4	0.65
5R4GY	0.75
5U4G	0.40
5V4G	0.50
5Y3GT	0.45
5Z3	0.75
5Z4G	0.45
6/30L2	0.90
6AB4	0.45
6AF4A	0.60
6AG5	0.25
6AG7	0.45
6AH6	0.60
6AJ8	0.30
6AK5	0.40
6AK6	0.60
6AL3	0.43
6AL5	0.22
6AM5	0.40
6AM6	0.37
6AQ5	0.42
6AQ6	0.70
6AR5	0.55

6AR8	0.65
6AR11	1.25
6AS5	0.50
6AS7G	0.65
6AT6	0.38
6AU6	0.30
6AV6	0.40
6AW8A	0.65
6BA6	0.28
6BE6	0.32
6BF6	0.55
6BH6	0.75
6BJ6	0.55
6BK7A	0.75
6BN5	0.43
6BN6	0.60
6BQ5	0.25
6BR8	0.75
6BS7	1.35
6BW6	0.90
6BW7	0.90
6BX6	0.25
6BZ6	0.45
6C4	0.35
6C5GT	0.55
6CB6	0.40
6CD6GA	1.30
6CG7	0.60
6CH6	0.60
6CL6	0.60
6CU6	0.80
6CW4	0.70
6CY5	0.50
6CY7	0.75
6D3	0.55
6DC6	0.60
6DK6	0.60
6DQ6B	0.75
6DS4	1.25
6EA8	0.65
6EH7	0.30
6EJ7	0.35
6EW6	0.70
6F1	0.75

6F5	0.75
6F6G	0.45
6F11	0.50
6F13	0.50
6F14	0.70
6F15	0.65
6F18	0.50
6F23	0.90
6F24	0.80
6F25	1.00
6F26	0.35
6F28	0.70
6GK6	0.60
6J4	0.80
6J5GT	0.40
6J6	0.30
6J7	0.45
6K4/7	0.60
6K8GT	0.75
6K7	0.43
6K8G	0.45
6K25	0.75
6L6GT	0.55
6L7	0.45
6L18	0.50
6LD20	0.50
6N7GT	0.55
6P28	0.65
6Q7	0.50
6SA7	0.45
6SG7	0.45
6SK7	0.50
6SL7GT	0.45
6SN7GT	0.45
6SQ7	0.50
6SR7	0.50
6T8	0.38
6U4GT	0.70
6U5G	0.75
6U8A	0.48
6V6GT	0.45
6X4	0.40
6X5GT	0.45
6X8	0.65
6Y6G	0.80

7Y4	0.75
9BW6	0.70
10C2	0.60
10D1	0.65
10D2	0.55
10F1	0.75
10F9	0.65
10F18	0.60
10L1	0.60
10LD11	0.70
10P13	0.75
12AB5	0.70
12AC6	0.60
12AE6	0.60
12AL5	0.55
12AQ5	0.50
12AT6	0.40
12AT7	0.40
12AU6	0.45
12AU7	0.33
12AV6	0.45
12AV7	0.70
12AX7	0.33
12AY7	0.75
12B4A	0.65
12BA6	0.45
12BA7	0.50
12BE6	0.50
12BH7	0.50
12BY7	0.65
12K5	1.00
12K7GT	0.50
12Q7GT	0.45
12SR7	0.50
20D1	0.60
20L1	1.10
20P1	0.50
20P4	1.10
20P5	1.20
25C5	0.60
25L6GT	0.50
25Z4G	0.35
25Z6GT	0.75
30A5	0.60
30AE3	0.40

30C1	0.30
30C15	1.00
30C17	1.10
30C18	0.90
30F5	1.00
30FL1	0.60
30FL12	1.10
30FL14	0.90
30L1	0.40
30L15	0.95
30L17	0.95
30P12	1.00
30P19	0.95
30PL1	0.95
30PL13	1.10
30PL14	1.25
35A3	0.60
35A5	0.75
35B5	0.65
35C5	0.60
35D5	0.75
35L6GT	0.75
35W4	0.40
35Z3	0.75
35Z4G	0.40
35Z5GT	0.70
50A5	0.80
50B5	0.70
50C5	0.60
50CD6G	1.20
50EH5	0.65

50L6GT	0.60
85A2	0.55
90AG	2.40
90AV	2.50
90C1	0.75
90CV	2.40
807	0.50
813	4.00
866A	0.65
5642	0.70
6080	1.75
6146	1.60
6146B	2.50
6360	1.25
6939	2.25
7199	0.85
7586	1.50
7895	1.50
A2293	2.20
AZ1	0.60
AZ31	0.55
CBL1	0.99
CBL31	1.00
CY1	0.50
CY31	0.50
DAF96	0.50
DF96	0.50
DK92	0.70
DK96	0.60
DL96	0.55
DM70	0.60

DM160	0.68
DY51	0.55
DY86	0.35
DY87	0.36
DY802	0.37
E80F	1.10
E88CC	0.70
E180F	1.00
E810F	2.90
EABC80	0.38
EAF42	0.60
EBC33	0.60
EBC41	0.65
EBC81	0.33
EBF80	0.40
EBF83	0.40
EBF89	0.32
EBL31	1.50
EC53	0.50
EC86	0.60
EC88	0.60
EC90	0.35
EC92	0.45
EC93	0.60
ECC35	1.00
ECC40	0.70
ECC81	0.40
ECC82	0.33
ECC83	0.33
ECC84	0.30

ECC88	0.40
ECC89	0.50
ECC91	0.30
ECC189	0.65
ECC807	1.00
ECF80	0.35
ECF82	0.35
ECF804	1.65
ECH42	0.75
ECH81	0.30
ECH83	0.45
ECH84	0.45
ECL80	0.50
ECL81	0.50
ECL82	0.35
ECL83	0.70
ECL84	0.55
ECL85	0.55
ECL86	0.40
EF37A	1.00
EF40	0.50
EF41	0.65
EF42	0.70
EF80	0.30
EF85	0.35
EF86	0.30
EF89	0.28
EF91	0.37
EF92	0.35

EF95	0.40
EF97	0.65
EF98	0.75
EF183	0.30
EF184	0.35
EF804	1.25
EK90	0.32
EL34	0.50
EL36	0.50
EL37	1.70
EL41	0.75
EL81	0.55
EL83	0.50
EL84	0.25
EL85	0.43
EL86	0.40
EL90	0.42
EL360	1.15
EL821	0.60
EL822	1.40
ELL80	0.75
EM34	1.00
EM71	0.80
EM80	0.45
EM81	0.60
EM83	0.50
EM84	0.35
EM85	1.00
EM87	0.70
EN91	0.40
EY51	0.40
EY80	0.75
EY81	0.40
EY83	0.55
EY86	0.40
EY87	0.43
EY88	0.43
EZ40	0.50
EZ41	0.75
EZ80	0.28
EZ81	0.29
GT1C	3.00
GY501	0.70
GZ30	0.45
GZ31	0.40

GZ32	0.50
GZ33	0.75
GZ34	0.60
HABC80	0.55
HK90	0.50
KT66	2.35
KT88	2.25
N78	1.60
PABC80	0.40
PC86	0.60
PC88	0.60
PC92	0.05
PC97	0.50
PC900	0.48
PCC84	0.40
PCC85	0.40
PCC88	0.55
PCC89	0.55
PCC189	0.60
PCC805	0.95
PCC806	0.95
PCF80	0.30
PCF82	0.35
PCF84	0.60
PCF86	0.60
PCF87	1.10
PCF801	0.50
PCF802	0.50
PCF805	0.90
PCF806	0.75
PCF808	0.90
PCH200	0.70
PCL81	0.50
PCL82	0.35
PCL83	0.65
PCL84	0.45
PCL86	0.45
PCL88	1.25
PCL200	0.75
PCL800	1.10
PCL801	0.95
PCL805	0.50
PD500	1.30
PF86	0.70

PF818	1.00
PFL200	0.65
PL33	0.40
PL36	0.55
PL81	0.50
PL82	0.45
PL83	0.45
PL84	0.40
PL302	0.65
PL504	0.75
PL508	0.90
PL509	1.10
PL801	1.00
PL802	0.95
PM84	0.60
PY31	0.35
PY33	0.63
PY80	0.40
PY81	0.30
PY82	0.35
PY83	0.38
PY88	0.40
PY800	0.47
PY801	0.50
PZ30	0.88
QQVO2-6	2.25
QQVO3-10	1.25
QQV03-20A	5.25
TT21	3.40
TT22	3.50
U18/20	0.75
U25	0.65
U26	0.65
U31	0.70
U37	8.50
U52	0.40
U76	0.40
U78	0.40
U191	0.75
U201	0.50
U281	0.55
U282	0.55

U301	0.55
U403	0.70
U404	0.70
U801	0.80
UABC80	0.40
UAF41	0.70
UAF42	0.60
UB41	0.65
UBC41	0.55
UBC81	0.45
UBF80	0.40
UBF89	0.40
UBL1	0.70
UBL21	0.70
UC92	0.45
UCC85	0.45
UCF80	0.70
UCH21	0.60
UCH42	0.70
UCH81	0.40
UCL81	0.60
UCL82	0.35
UCL83	0.65
UF9	0.65
UF11	0.60
UF41	0.65
UF42	0.65
UF43	0.65
UF80	0.35
UF85	0.40
UF89	0.40
UL41	0.65
UL84	0.43
UM84	0.30
UY1N	0.50
UY11	1.00
UY41	0.48
UY82	0.50
UY85	0.40
W729	0.75
Y63	0.75
Z759	3.00
Z803U	1.35

TRANSISTORS

2N696	0.15
2N697	0.15
2N698	0.30
2N705	0.70
2N706	0.10
2N708	0.15
2N753	0.25
2N929	0.20
2N930	0.20
2N987	0.80
2N1131	0.25
2N1132	0.25
2N1164	1.25
2N1302	0.17
2N1303	0.17
2N1304	0.20
2N1305	0.20
2N1306	0.25
2N1307	0.25
2N1308	0.25
2N1309	0.25
2N1613	0.17
2N1711	0.20
2N1756	0.75
2N2147	0.75
2N2160	0.60
2N2217	0.25
2N2218	0.20
2N2219	0.20
2N2369A	0.15
2N2477	0.65
2N2646	0.40
2N2905	0.25
2N2923	0.12
2N2924	0.13
2N2926	0.10
2N3053	0.20
2N3054	0.50
2N3055	0.60
2N3133	0.25
2N3134	0.25
2N3391	0.17
2N3392	0.17
2N3393	0.15
2N3394	0.15
2N3395	0.20
2N3402	0.15
2N3403	0.15
2N3404	0.32
2N3414	0.20
2N3415	0.15
2N3417	0.25
2N3702	0.10
2N3703	0.10
2N3704	0.12
2N3707	0.12
2N3709	0.10
2N3710	0.10
2N3819	0.35
2N3906	0.25
2S702	0.50
2S746	0.25
AC113	0.15
AC125	0.30
AC126	0.20
AC127	0.17

AC128	0.15
AC132	0.35
AC153	0.20
AC154	0.15
AC157	0.17
AC169	0.10
AC176	0.17
AC187	0.25
AC188	0.25
ACY17	0.25
ACY18	0.20
ACY19	0.25
ACY20	0.20
ACY21	0.20
ACY22	0.10
AD140	0.50
AD149	0.45
AD161	0.35
AD162	0.35
ADZ11	1.25
ADZ12	1.25
AF114	0.17
AF115	0.17
AF116	0.17
AF117	0.17
AF118	0.30
AF125	0.20
AF127	0.20
AF180	0.35
AF181	0.35
AF186	0.40
AF239	0.36
AFZ11	0.45
AFZ12	1.00
ASY26	0.25
ASY27	0.30
ASY28	0.25
ASY29	0.30
ASY54	0.25
ASZ15	0.70
ASZ16	0.70
ASZ17	0.75
ASZ18	0.75
ASZ20	0.25
ASZ21	0.40
AUY10	1.00
BC107	0.10
BC108	0.10
BC109	0.10
BC113	0.10
BC118	0.20
BC134	0.20
BC147	0.10
BC148	0.10
BC149	0.12
BC152	0.15
BC158	0.15
BC175	0.20
BC186	0.25
BCY30	0.25
BCY31	0.30
BCY33	0.25
BCY34	0.30
BCY72	0.15
BCZ10	0.30
BCZ11	0.40

BD121	0.65
BD123	0.80
BD124	0.60
BD131	0.75
BD132	0.80
BF115	0.20
BF167	0.18
BF173	0.20
BF179	0.30
BF180	0.30
BF181	0.30
BF184	0.20
BF185	0.20
BF194	0.14
BF195	0.14
BF196	0.12
BF197	0.12
BF200	0.35
BFW87	0.25
BFW88	0.20
BFW89	0.20
BFW91	0.20
BFX86	0.20
BFY17	0.40
BFY19	0.25
BFY50	0.20
BFY51	0.20
BFY52	0.20
BSY26	0.17
BSY27	0.15
BSY28	0.17
BSY65	0.20
BSY95A	0.12
OC16	0.50
OC22	0.50
OC23	0.60
OC24	0.60
OC25	0.35
OC26	0.25
OC28	0.50
OC29	0.60
OC35	0.50
OC36	0.45
OC42	0.20
OC44	0.15
OC45	0.12
OC70	0.10
OC71	0.12
OC72	0.12
OC73	0.30
OC75	0.15
OC76	0.15
OC78	0.25
OC78D	0.20
OC81	0.20
OC81D	0.20
OC83	0.20
OC139	0.30
OC140	0.35
OC141	0.60
OC170	0.25
OC171	0.25
OC200	0.30
OC201	0.60
OC202	0.65
OC203	0.40
OC204	0.40

MULTIMETERS MADE IN USSR

Prices of these exceptionally well made instruments range from £4·95 to £10·50. Please write for illustrated catalogue.

SYNCHROSCOPE TYPE C1-5

Made in USSR

3-in tube fitted with telescopic viewing hood, giving bright display in full daylight. Sensitivity 10mV/mm (narrow band) to 30mV/mm (wide band).
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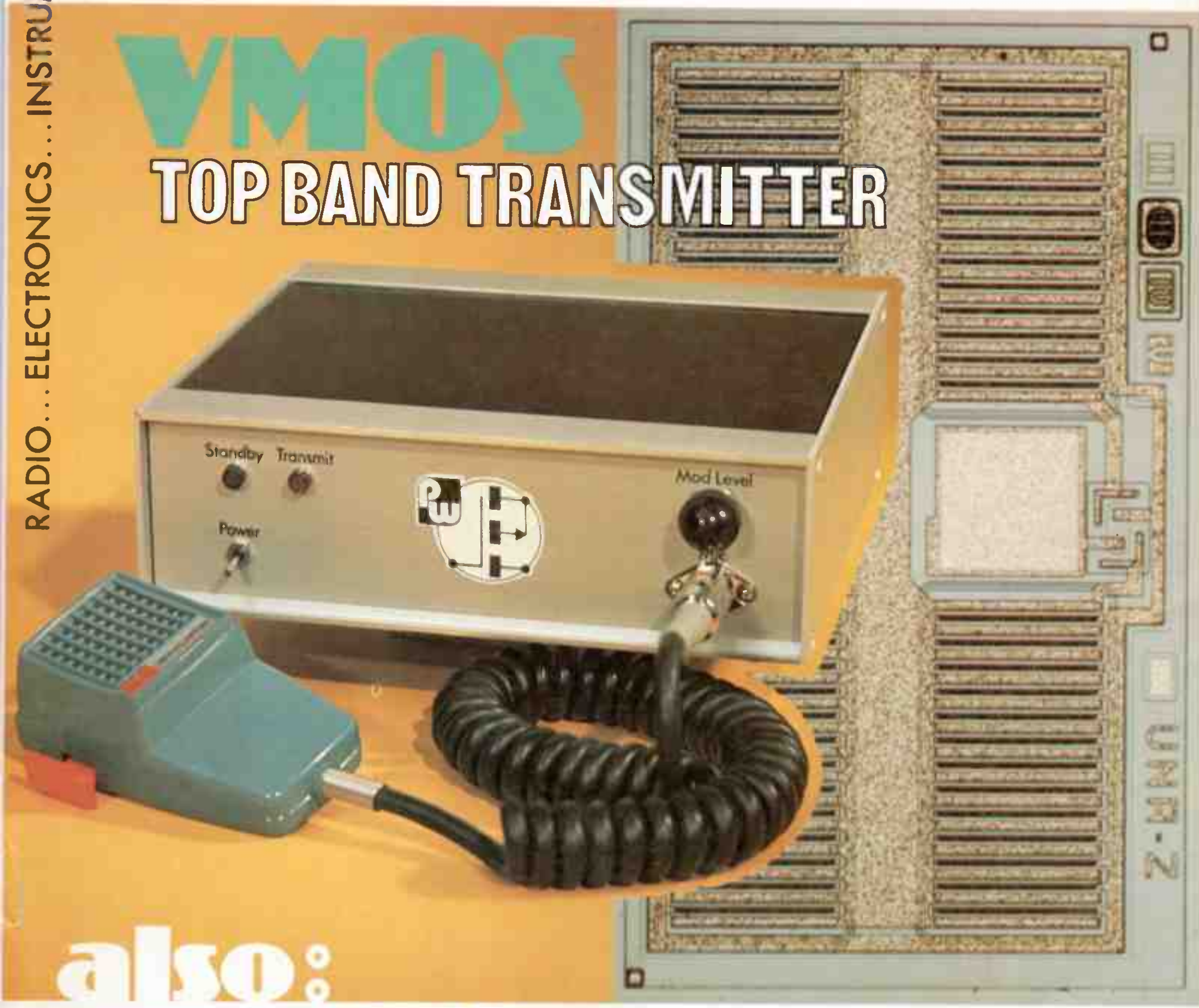

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4018	55p	4072	12p
4019	40p	4081	12p
4020	50p	4082	12p
4022	50p	4093	70p
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6 8/25	7p	220/25	14p
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10/16	7p	330/25	17p
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10/50	7p	330/50	20p
22/6V3	7p	470/10	14p
22/10	7p	470/25	19p
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BC126	20p	BD135	35p	BFX85	30p	2N1308	50p
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BC136	16p	BD137	40p	BFX88	25p	2N2219A	25p
BC137	16p	BD139	40p	BFY10	30p	2N2483	30p
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BC140	30p	BD144	160p	BFY19	100p	2N2907	20p
BC141	30p	BD181	100p	BFY50	20p	2N3053	20p
BC142	30p	BD182	100p	BFY51	20p	2N3054	50p
BC143	30p	BD188	130p	BFY52	20p	2N3055	60p
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BC148	10p	BD220	65p	BFY90	125p	2N3703	12p
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QUERIES
While we will always try to assist readers in difficulties with a *Practical Wireless* project, we cannot offer advice on modifications to our designs, nor on commercial radio, TV or electronic equipment. Please address your letters to the Editor, Practical Wireless, at the above address, giving a clear description of the problem and enclosing a stamped self-addressed envelope. Only one project per letter please.

Components are usually available from advertisers. A source will be suggested for difficult items.

SUBSCRIPTIONS
Subscriptions are available to both home and overseas addresses at £10·60 per annum, from **"Practical Wireless" Subscription Department, Oakfield House, Perrymount Road, Haywards Heath, West Sussex RH16 3DH.**

BACK NUMBERS AND BINDERS
Limited stocks of some recent issues of *PW* are available at 75p each, including post and packing to addresses at home and overseas.

Binders are available (Price £2·85 to UK addresses or £3·45 overseas, including post and packing) each accommodating one volume of *PW*. Please state year and volume number for which the binder is required.

Send your orders to **Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.**

All prices include VAT where appropriate. Please make cheques, postal orders, etc., payable to IPC Magazines Limited.

NEWS & VIEWS

FOR OUR CONSTRUCTORS

GENERAL INTEREST

We regret that Part 2 of the PW "Trent" has had to be held over, due to production difficulties

OUR COVER
The object looking rather like a ventilation grille is in fact a much-enlarged view of the "works" of a power f.e.t. Photograph courtesy Siliconix Ltd.

Our August issue will be published on 6 July
(for details see page 43)

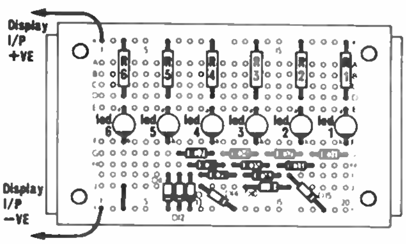
THREE FOR FREE FROM CSC

ELECTRONICS BY NUMBERS FREE PROJECTS No 1, No 2, & No 3.

ELECTRONICS BY NUMBERS

LED BAR GRAPH UNIVERSAL INDICATOR

Now using **EXPERIMENTOR BREAD-BOARDS** and following the instructions in "Electronics by numbers" **ANYBODY** can build electronic projects.
Look at the diagram and select R1, this is a resistor with a value between 120 to 270 ohm. Plug it into holes X20 and D20, now take LED 1 and plug it into holes E20 and F20. Do the same with the Diodes e.g. plug D7 into holes G7 and G10.



YOU WILL NEED

EXP- ANY EXPERIMENTOR BREAD-BOARD
D1 to D15 – Silicon Diodes (such as 1N914)
R1 to R6 – From 120-270 ohm resistors ¼ watt.
LED1 to LED6 – Light emitting diodes.

LED BAR GRAPHS are replacing analogue meters as voltage-level indicators in many instances.
This circuit uses the forward voltage drop of diodes to determine how many LEDs light up. Any type of diode can be used but you must use all the same type. For full working details of this circuit fill in the coupon.
If you have already built the Two-transistor Radio and the Fish'n'cliks projects you will find that you can reuse the components from these projects to build other projects in the series.

FILL IN THE COUPON AND WE WILL SEND YOU FREE OF CHARGE FULL COPIES OF "ELECTRONICS BY NUMBERS" PROJECTS No 1, No 2 and No 3.

PROTO-CLIP TEST CLIPS.

Brings IC leads up from crowded PC boards. Available plain or with cable with clips at one or both ends.

PC – 16 pin. £2.75.
PC – 16 pin with cable. £6.00.
PC – 16 with cable and 16 pin clips at both ends. £10.25.

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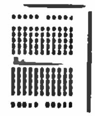
Telephone: SAFFRON WALDEN 21682.
Telex: 817477.

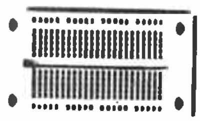
EXPERIMENTOR BREADBOARDS.

No soldering modular breadboards, simply plug components in and out of letter number identified nickel-silver contact holes. Start small and simply snap-lock boards together to build breadboard of any size.
All EXP Breadboards have two bus-bars as an integral part of the board, if you need more than 2 buses simply snap on 4 more bus-bars with the aid of an EXP.4B.

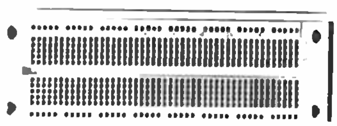
EXP.325. The ideal breadboard for 1 chip circuits.
Accepts 8,14,16 and up to 22 pin IC's.
ONLY £1.60.



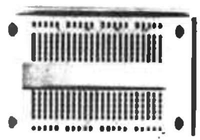
EXP.350. £3.15.
270 contact points with two 20-point bus-bars.



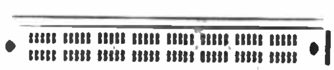
EXP. 300.
550 contacts with two 40-point bus-bars.
£5.75.



EXP. 650 for Micro-processors. **£3.60.**



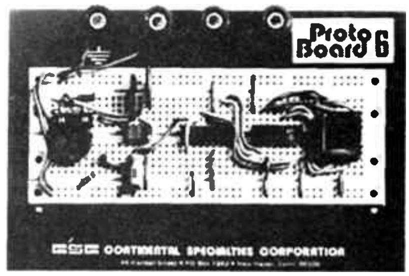
EXP 4B.
More bus-bars.
£2.30.



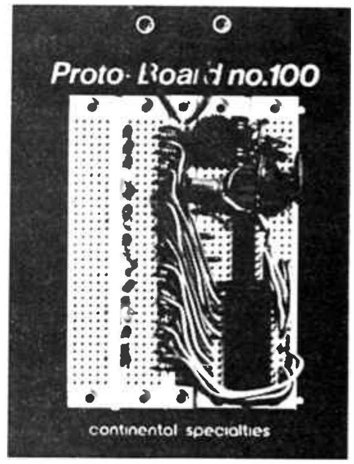
ALL EXP.300 Breadboards mix and match with 600 series.

PROTO-BOARDS.

THE ULTIMATE IN BREADBOARDS FOR THE MINIMUM COST.
TWO EASILY ASSEMBLED KITS.



PB.6 Kit, 630 contacts, four 5-way binding posts accepts up to six 14-pin Dips.
PROTO-BOARD 6 KIT. £9.20.



PB.100 Kit complete with 760 contacts accepts up to ten 14-pin Dips, with two binding posts and sturdy base. Large capacity with Kit economy.
PROTO-BOARD 100 KIT £11.80.

HOW TO ORDER AND RECEIVE FREE COPY OF TWO-TRANSISTOR RADIO PROJECT, FISH'N'CLIKS AND LED BAR GRAPH.

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It's easy. Give us your name and full postal address, in block capitals. Enclose cheque, postal order or credit card number and expiry date. OR telephone 0799 21682 and give us your Access, American Express or Barclaycard number and your order will be in the post that night.

EXPERIMENTOR. BREADBOARDS.	CONTACT HOLES.	IC CAPACITY 14 PIN.DIP.	UNIT PRICE INCLUDING POSTAGE AND V.A.T.
EXP. 325	130	1	£ 2.53
EXP. 350	270	3	£ 4.21
EXP. 300	550	6	£ 7.29
EXP. 650	270	use with 0.6 pitch Dip's	£ 4.69
EXP. 4B.	Four 40 Point Bus-Bars	Bus-Bar Strip	£ 3.29
TEST CLIPS			
PC. 16.			£ 3.78
PC.16-1B.			£ 7.56
PC. 16-1B Dual Clip			£12.15
PROTO-BOARDS.			
PB. 6.	630	6	£11.01
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FILL IN COUPON & RECEIVE FREE COPY OF ELECTRONICS BY NUMBERS PROJECTS Nos 1, 2 AND 3

Tecknowledgey for sale.

The Mark III FM Tuner

DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically & visually superior to all others. Some options available, but the illustrated version with reference series modules: £149.00 + £18.62 VAT

With Hyperfi Series modules £185.00 + £23.12

ALL TUNER KITS £3 carriage

Features of the system:

- Precision construction & design of all parts
- Time frequency display
- State of the art performance with facilities for updates, using modular plug in systems
- Deviation level calibrator for recording
- All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

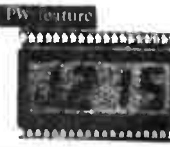
A multiband superhet tuner constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon)	£33.00 + £4.12 VAT
Complete with digital frequency readout/clock-timer hardware	£99.00 + £12.37 VAT
Complete with MA1023 clock/timer module with dial scale	£66.00 + £8.25 VAT

Hardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW MW FM LCD Digital Frequency Display - July PW feature

...ate your old radio, or build this into a new design. Or use it as a servicing aid - this low power unit with LCD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM 1kHz. Sensitivities better than 10mV



Complete kit £19.50 +*£1.56 VAT. Built and tested version £24.00 +*£1.92 VAT

Various other DFM systems described in our catalogue part 2 - including a one chip solution to providing digital display of FRG7 kHz dial, combined with clock/timers etc.

PW SANDBANKS PI METAL LOCATOR

Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved enviromental sealing. £37.00+ *£2.96vat.

VHF MONITOR RX WITH PLESSEY IC

4/9 channel version of the PW design - but using standard 3rd OT crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31 25 +£3.90vat.

ETI - REMCON RADIO CONTROL

A tried and tested RC system with a full set of supporting hardware from a well known manufacturer. Please send for details - and watch our ads for further news of developments in RC products.

Radio and Audio Modules : The biggest range/ best specs:

EF5801/3/4 6 stage varicap tunerheads with LO feed and various levels of sophistication. New 5804 include pin AGC loop 'on board'. 5801 £17.45+£2.18vat - 5803:£19.75+£2.47vat 5804:£24.95 +£3.18vat. *Frequencies in 40-180MHz on appcn.*

EF5402 4 stage varicap with TDA1062, compound FET/Bipolar input stage, low noise, balanced mixer, pin agc, osc output. A worthy successor to the 5400. £10.75+£1.34vat

The 5402 is available centred on a wide range of frequencies from 30MHz to 180MHz. Non standard units £14.75+£1.84 - 3 weeks.

8319 4 stage varicap tunerhead from Larsholt using MOSFET RF and mixer stages. New temperature compensated oscillator for wide ranges of ambient temperature £13.45+£1.68vat

7252 Complete Larsholt FM tuner less stereo decoder. £26.50+£3.31vat

7253 Stereo FM tunerset from Larsholt with FET head. (as 7252)

944378 Hyperfi stereo decoder. The very best. £19.95+£2.49vat

911223 Pilot cancel stereo decoder, priced to make the MC1310 as obsolete as it now deserves to be.£12.50+£1.56vat

Inotec 1-A fully DC tuned and switched LW/MW/FM stereo tuner to interface with synthesiser control etc.A first! Details OA

COMPONENTS for Radio and Audio ICs, HMOS etc.

The list is too long to attempt here, but AMBIT specializes in all types of semiconductor for radio reception, including devices operating from DC to 5GHz. New low cost SBL1 diode ring mixers (equiv case MD108 etc) - first with HMOS fets, now with a PCB for DC amplifier, and offset sense and protection relay for speakers. See catalogue and updates for most info, pse send an SAE for information on anything you cannot find in catalogues.

Radio ICs	cost + vat		Stereo ICs	cost + vat		AF power ICs	cost + vat	
CA3089E	1.94	24	MC1310P	1.50	19	LM380N	1.00	12
CA3189E	2.45	30	uA758	2.20	27	TBA810AS	1.09	14
HA1137W	2.20	27	CA3090A	2.75	34	TDA2002	1.95	24
SN76660	0.75	9	HA1196	3.95	49	TBA820M	0.75	9
TDA1090	3.35	42	HA11223	4.35	54	from the general list:		
TDA1083	1.95	24	KB4437	4.35	54	LEDs: all colours and low prices		
TDA1220	1.40	17	KB2224	2.75	34			
SL6640	2.75	34	Preamp ICs/switches			2SJ48/2SK134 HMOS		
MC3357	3.12	39	TDA1028	3.50	44	9.90 +£0.80 vat(Pair)		
HA1197W	1.40	17	TDA1029	3.50	44	Signal fets/transistors and		
MC1496	1.25	16	TDA1074	4.14	52	TOKO COILS & FILTERS!		
LM373/4	3.75	49	KB4438	2.22	28			

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - your assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering

IMPORTANT: ALL OSTS PRICES EXCLUDE VAT - CURRENTLY 8% - BUT MAY BE CHANGED BY THE TIME YOU READ THIS. PLEASE REMEMBER TO ADD VAT, and 25p POSTAGE

TTL: Standard AND LP SchottkY

All prices listed in pence *

	'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		'LSN'
7400	13	20	7455	35	24	74126	57	44	74185	134		74377	124
7401	13	20	7460	17		74128	74		74188	275		74378	93
7402	14	20	7463		124	74132	73	78	74190	115	92	74379	130
7403	14	20	7470	28		74133		29	74191			74368	37
7404	14	24	7472	28		74136		40	74192	105	180	74390	140
7405	18	26	7473	32	38	74138		60	74193	105	180	74393	140
7406	38		7474	27	38	74139		60	74194	105	187	74395	139
7407	38		7475	38	40	74141	56		74195	95	137	74396	133
7408	17	24	7476	37	38	74142	265		74196	99	110	74398	180
7409	17	24	7478		38	74143	312		74197	85	110	74399	150
7410	15	24	7480	48		74144	317		74198	150		74445	92
7411	20	24	7481	86		74145	65	97	74199	160		74447	90
7412	17		7482	69		74147	175		74247		90	74490	140
7413	30		7483A		110	74148	109	191	74248		90	74668	110
7414	51		7484	97		74150	99		74249		93	74670	249
7415		24	7485	104	99	74151	64	84	74251		90		
7416	30		7486		40	74153	64	54	74253		105		
7417	30		7489	205		74154	96		74257		108		
7420	16	24	7490	33	90	74155	54	110	74258		153		
7421	29	24	7491	76	110	74156	80	110	74259		420		
7422	24	24	7492	38	78	74157	67	55	74260		153		
7423	27		7493	32	99	74158		60	74261		353		
7425	27		7494	78		74159	210		74266		40		
7426	36	27	7495A	65	99	74160	82	130	74273		124		
7427	27	29	7496	58	120	74161	92	78	74275		312		
7428	35	32	7497	185		74162	92	130	74279		52		
7430	17	24	74100	119		74163	92	78	74283		120		
7432	25	24	74104	63		74164	104	130	74290		90		
7433	40	32	74105	62		74165	105		74293		95		
7437	40	24	74107	32	38	74166			74295		120		
7438	33	24	74109	63	38	74167	20		74298		100		
7440	17	24	74110	54	54	74168			74324		157		
7441	74		74111	68		74169		200	74325		242		
7442	70	99	74112		38	74170	230	200	74326		247		
7443	115		74113		38	74172	625		74327		237		
7444	112		74114		38	74173	170		74352		100		
7445	94		74116	198		74174	87	120	74353		100		
7446	94		74118	83		74175	87	110	74362		715		
7447	82	89	74119	119		74176	75		74365		49		
7448	56	99	74120	115		74177	78		74366		49		
7449		99	74121	25		74180	85		74367		43		
7450	17		74122	46	57	74181	165	350	74368		49		
7451	17	24	74123	48	73	74182	160		74373		77		
7453	17		74124		137	74183		210	74374		77		
7454	17	24	74125	38	44	74184	135		74375		60		

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1Amp IEC	4 83
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5A wirein	3 87

All BS approved

Requests for the next issue of the catalogue now being "booked" for despatch immediately it is ready (about November) Please send 50p to reserve a copy (Part 3)

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
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4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4014	95p	4075	20p	4541	141p
4016	52p	4076	90p	4543	174p
4017	80p	4077	20p	4549	399p
4018	80p	4078	20p	4553	440p
4019	60p	4081	20p	4554	153p
4020	93p	4082	20p	4556	77p
4021	82p	4085	82p	4557	386p
4022	90p	4086	82p	4558	117p
4023	17p	4089	150p	4559	388p
4024	76p	4093	50p	4560	218p
4025	17p	4094	190p	4561	65p
4026	180p	4096	105p	4562	530p
4027	55p	4097	372p	4566	159p
4028	72p	4098	110p	4568	281p
4029	100p	4099	122p	4569	303p
4030	58p	4160	90p	4572	25p
4031	250p	4161	90p	4580	600p
4032	100p	4162	90p	4581	319p
4033	145p	4163	90p	4582	164p
4034	200p	4174	104p	4583	84p
4035	120p	4175	95p	4584	63p
4036	250p	4194	95p	4585	100p
4037	100p	4501	23p		
4038	105p	4502	91p		
4039	250p	4503	69p		
4040	83p	4506	51p		
4041	90p	4507	55p		
4042	85p	4508	248p		
4043	85p	4510	99p		
4044	80p	4511	149p		
4045	160p	4512	98p		
4046	130p	4513	206p		
4047	99p	4514	260p		
4048	60p	4515	300p		
4049	65p	4516	125p		
4050	55p	4517	382p		
4051	65p	4518	103p		
4052	65p	4519	57p		
4053	65p	4520	109p		
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4055	135p				

Micromarket

6800 series				2114	£10
6800P	6.50	8216	1.95	2708	£
6820P	£6	8224	3 50	**Development**	
6850P	2 75	8228	4.78	MEK6800	£220
6810P	£4	8251	6.25	TK80	£306
6852	3.65	8255	5.40	AMI Signetics TI Intersil, Harris etc	OA
8080 series		**MEMORIES**			
8080	6.30	2102	£1 70		
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		2513	£7 54		
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ICM7107CP LEO OVM IC	£9 55
ICM7107CPK LEO DVM KIT	£20 65
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MSL2318 divide by 100 to 175MHz min divide by 10 to 45MHz min	£4 20

PLEASE REMEMBER TO ADD 8% VAT TO ITEMS LISTED UNDER OSTS

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CA3140T	72p	LM3900N	60p
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CA3160T	99p	709PC dil	36p
Op amps		710HC tob	65p
LM301AH	67p	710PC dil	59p
LM301AN	30p	723CN	65p
LM308H	121p	741CH tob	66p
LM308N	97p	741CN 8dil	27p
LM318H	279p	747CN	70p
LM318N	224p	748CN	36p
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OPTO 7 seg displays

0.43" High Efficiency HP

5082 7650 red CA	233p
5082 7653 red CC	
5082 7660 yellow CA	
5082 7663 yellow CC	
5082 7670 green CA	
5032 7673 green CC	

0.3" Standard HP

5082 7730 red CA	147p
5082 7740 red CC	

0 5" Fairchild

FND500 red CC	150p
FND507 red CA	150p

Current news: Work continues apace on our HMOS PA kit, and by the time this is published - we expect to be about to launch the product in a style that matches the Mark III system. The unit uses separate transformers and power supplies, and includes a DC offset sensing circuit combined with slow switch on using a relay. We introduce the HyperFi FM IF with this advert - and a separate leaflet is available on request with an SAE. All new pricelist revision also available with an SAE. The Mullard DC controlled tone/volume and switch ICs with a 'more than HiFi' specification are in stock at last - together with reams of data (over 50 pages now). Also, RC enthusiasts will be interested to learn that we are supplying parts for various kits now.

Terms: CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Access facilities for credit purchases.

Catalogues: Ambit. Part 1 45p Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p All inc PP etc. Full data service described in pricelist supplements.

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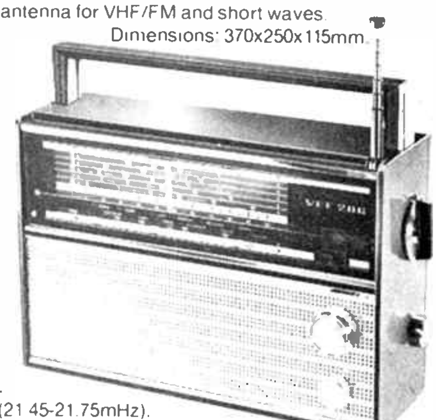

Vega 206 Superhet portable receiving long and medium waves plus 6 short-wave bands: 150-60m (2-5mHz), 60-40m (5-7.5mHz), 32.35-24.8m (9.3-12.1mHz); 19.85-19.4m (15.1-15.45mHz); 16.95-16.75m (17.7-17.9mHz), 14-13.8m (21.45-21.75mHz). Intermediate frequency 465kHz. Rated Output 150mW. Circuitry comprises 12 semi-conductors including voltage stabilising diode, plus turret waveband selector, treble control, inbuilt ferrite rod aerial for med and long waves. 7-section telescopic antenna for short waves. Sockets for line aerial, 9v DC external power source, tape-recorder, earphone or extension loudspeaker. Dimensions: 229x297x105mm. Weight 2.7kg (5lb) without batteries. **Price: £24.15 inc VAT.**

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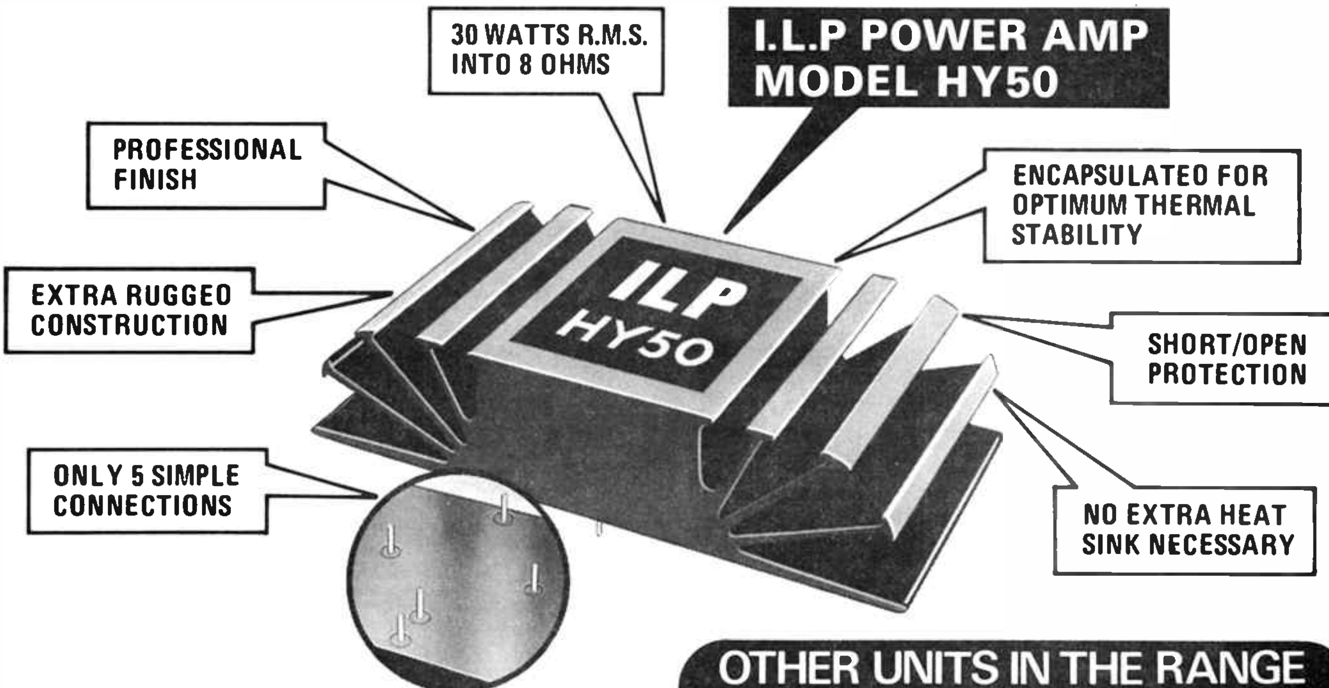

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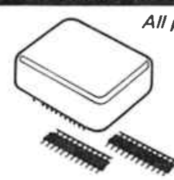

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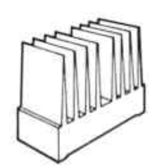

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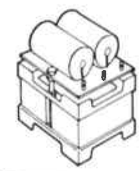

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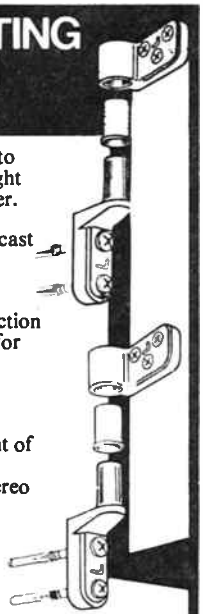

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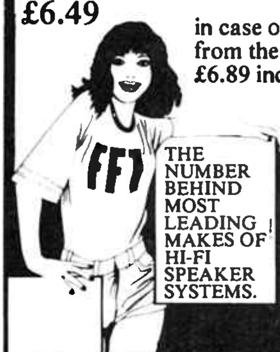

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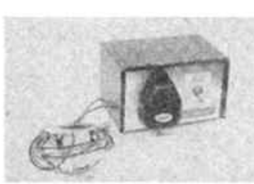

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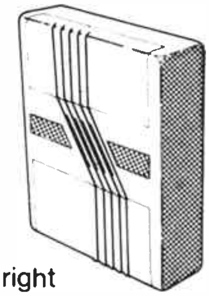

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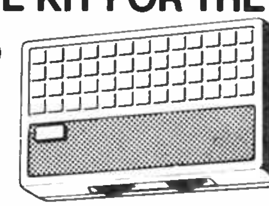

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2N760	N70	.35	AC176K	N54	.70	BC114	N54	.22
2N869	P70	.35	AC176	N54	.56	BCY70	P70	.21
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2N916	N70	.33	AC187K	P54	.86	BCY72	P70	.18
2N917	N65	.38	AC188	P54	.54	BCY77	P70	.70
2N918	N65	.45	AC188K	P54	.56	BCY78	P70	.43
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Z50—V.H.F./F.M. TWIN RIBBON FEEDER 300 OHMS 10 p/m

MAINS CABLE

Z31—2-CORE OVAL—2½ AMPS

Z25—FIGURE 8—RIB POLARISED 10 p/m

POTENTIOMETERS-VOLUME CONTROLS

ROTARY POTENTIOMETERS. All standard ¼" spindles

35p 1) SINGLE LESS SWITCH Long spindle double wiper, available in following values

75p 2) SINGLE SWITCHED As above but with 2 Pole Switch 2 Amp 250V AC

95p 3) DUAL GANGED STEREO As above but dual *No Switch* All Log or Lin available in the following values

5k, 10k, 25k, 50k, 100k, 250k, 500k, 1Meg, 2Meg, except type 1 not available in 1Meg value

---

TRANSFORMERS

EX-STOCK—
SAME DAY DESPATCH
VAT 8%

30 VOLT RANGE

Pri 220/240 sec 0-12-15-20-24-30V Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V and 15V-0-15V.

Ref	Amps	Price	P & P
112	0 5	2·64	0 78
79	1 0	3·57	0 96
3	2 0	5·77	0 96
20	3 0	6·20	1 14
21	4 0	7·99	1 14
51	5 0	9·87	1 32
117	6 0	11·17	1 45
88	8 0	14·95	1 64
89	10 0	17·25	1 64
90	12 0	19·17	1 95
91	15 0	21·96	2 08
92	2 0	20·45	O.A.

50 VOLT RANGE

Pri 220/240V Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V 0-20V and 25V-0-25V.

Ref	Amps	Price	P & P
102	0 5	3·41	0 78
103	1 0	4·57	0 96
104	2 0	7·16	1 14
105	3 0	8·66	1 32
106	4 0	11·41	1 50
107	6 0	15·06	1 64
118	8 0	20·26	2 08
119	10 0	24·98	O.A.
109	12 0	28·90	O.A.

MAINS ISOLATORS (SCREENED)

PM 120/240 Sec 120/240V CT

Ref	VA	Price	P & P
*07	20	4·40	0 79
149	60	6·70	0 96
150	100	7·62	1 14
151	200	11·16	1 14
152	250	13·28	1 50
153	350	16·43	1 84
154	500	20·47	2 15
155	750	29·06	O.A
156	1000	37·20	O.A
157	1500	51·38	O.A
158	2000	61·81	O.A.
159	3000	86·66	O.A.

*Pri 0-220/240V Sec 115 or 240V. State sec. volts required.

CASED AUTO TRANSFORMERS

240V cable in 115V USA flat pin outlet

VA	Price	P & P	Ref
20	5·95	0 90	56W
75	7·73	1 14	64W
150	10·01	1 14	4W
200	10·92	1 45	65W
250	11·59	1 45	69W
500	19·17	1 64	67W
1K	27·88	2 30	84W
1 5K	26·02	O.A.	93W
2K	49·97	O.A.	95W

12 OR 24V OR 12-0-12V

Pri 220-240 volts

Ref	12V Amps	24V Amps	Price	P&P
111	0 5	0 25	2·20	0 45
213	1 0	0 5	2·64	0 78
71	2	1	3·51	0 78
18	4	2	4·03	0 96
85	0 5	2 5	5·00	0 96
70	6	3	6·35	0 96
108	8	4	7·42	1 14
72	10	5	8·12	1 14
116	12	6	8·99	1 32
17	16	8	10·72	1 32
115	20	10	13·98	2 08
187	30	15	17·93	2 08
226	60	30	36·74	U.C.

TRANSFORMERS END OF LINE OFFERS

Ref

30-Isolator 240V:240V 200VA **£4·54** P&P £1 04
62-Isolator 240V:240V 250VA **£5·62** P&P £1 04
63-Isolator 240V:240V 500VA **£11·50** P&P £2 15
6-250-0-250 • 100ma 1) Sec 6 3V • 3 5A 2) Sec 0-5V, 6 3V • 2/1 amp **£3·20** P&P 78p
7-350-0-350V • 100ma 1) Sec 6 3V • 3 5A 2) Sec 0-5V, 6 3V • 2/1 amp **£4·10** P&P 96p
218-250-0-250V • 150ma 1) Sec 6 3V • 4A 2) 0-5V, 6 3V • 2/1 amp **£3·50** P&P 78p
27-250-0-250 • 60ma 1) Sec 6 3V • 2 5A 2) Sec 6 3V • 1 amp **£3·00** P&P 78p
220-410-0-410V • 180ma 1) Sec 6 3V • 4 amp CT 2) Sec 6 3V • 2A 5V • 2 amp **£5·30** P&P 96p
82-4 amp lead acid Battery Charger (transformer only) **£4·81** P&P £1 04
86-6 amp lead acid Battery Charger (transformer only) **£5·80** P&P £1 04
59-0-240V, 25-0-25 • 4A **£6·32** P&P £1 62
M184 – To match EL84 15W **£1·62** P&P 32p
M616 – 0-240V: Screen 1) 13-0-13 1A. 2) 12V 150ma **£2·10** P&P 60p
M489 – 0-240V: 1400V • 150ma, 6 3V • 4A **£5·50** P&P £1 04
M708 – 6K to 3KΩ matching transformer 5 watt **90p** P&P 40p
M679 – 120V x 2: 36V 1 6A **£3·00** P&P 78p
M865 – 100V Line to 4Ω 10 watts **£1·90** P&P 60p
M973 – 100V Line to 8Ω 40 watts **£2·90** P&P 60p
M1015 – Choke 8A • 5 watt 150A Serge **£1·50** P&P 45p
M1020 – 0-240V 12-0-12V • 50ma **97p** P&P 41p
M1126 – 0-120 x 2: 9-0-9 1A **£2·40** P&P 71p
M1130 – 0-240 4500V • 10ma **£4·86** P&P £1 08
M1165 – 0-115-240V: 14V 50ma **75p** P&P 30p
M624 – 0-380V: 110V • 13 6A **£12·70** P&P £1·40

COMPONENT PACKS

65 ½W Metal Oxide Resistors
65 1W Metal Oxide Resistors
150 Mixed Value Capacitors
10 Reed Switches
50 Wire Wound Resistors
10 3000mf 30V Capacitors
25 Assorted presets
50 3 tag terminal strips
Hardware BA nuts bolts
200 Mixed Resistors
10 mixed valve electrolitic caps 32 mf to 2000 mf.

70p + 12½% VAT
P&P 40p + 8% VAT

BRIDGE RECTIFIERS

100V	25A*	£2·36
200V	2A	£0·51
400V	4A	£0·96
400V	6A	£1·41
500V PM7A6	12A*	£3·08

VAT 12½% P & P 15p VAT 8%*

AMPLIFIER MODULES

10W	(AL30)	£3·75
25W	(AL60)	£4·95
35W	(AL80)	£7·79
125W	**(AL250)**	**£18·74**
Power Supply PS12		£2·05
Power Supply SPM80		£4·25
VAT 12½%	PA12	£6·70
P & P 35p	PA100	£13·88

TEST METERS

AVO 8 MK5	£88·10
AVO 71	£36·00
AVO 73	£48·70
AVO MM5 minor	£32·95
Wee Megger	£74·25
TT169 in circuit transistor tester	£39·53
EM272	£57·80
DA116	£108·90
BM7 Megger	£51·76

All accessories available.
P&P £1 15 8% VAT

MINI-MULTIMETER

DC 1000V AC 1000V DC 100mA Res 150kΩ 1000Ω/V Bargain **£7·20** P&P 62p VAT 8%

20,000 ohm/V Multimeter, mirror scale Ranges AC DC to 1000V DC current to 250mA Resistance to 3 Mohms 5" x 3½" x 1¼" **£14·36** P&P £1 05 VAT 8%

NEW RANGE TRANSFORMER

Pri 120V or 220 240V Sec 0 36 48 twice to give 36 0 36V 48 0 48V 72V or 92V

Ref		P & P
3A	14·70	1 48
4A	18·77	1 84
5A	26·64	2 15

VAT 8%

PANEL METERS

43mm · 43mm		82mm · 78mm	
0 50μA	6·20	0 50μA	6·70
0 500μA	5·95	0 500μA	6·70
0 1mA	5·95	0 1mA	6·70
0 30V	5·95	0 30V	6·70

VU ind. Panel 48mm · 45mm 3·36
VU ind Edge 90mm 250μa 54mm · 14mm 250μa FSD 2·60
VU Ind Edge 54 · 14mm 250μA F S D **2·60**
Carriage 65p VAT 8%

15V RANGE

O C T 15V

Ref			P & P
171	500 mA	2·09	0 45
172	1A	2·96	0 78
173	2A	3·59	0 78
174	3A	3·75	0 86
175	4A	5·73	0 96

VAT 8%

S-DECS

Solderless breadboarding

S Dec 70 contacts	£3·56
T Dec 208 contacts	£4·35
U Dec A for I C s etc	£4·50
U Dec B for I C s etc	£6·99

P & P 40p VAT 8%

Electronic Construction Kit

Home electronic starter Start simply and progress to a TRF radio or electronic organ No soldering All parts included in presentation box. Full instructions. **£8·29.** P & P 96p VAT 8%

ABS PLASTIC BOXES

inset brass nuts, internal slots to take P C cards, flush fitting lid

PB1 180mm · 62 · 40	65p
PB2 100mm · 75 · 40	73p
PB3 120mm · 100 · 45	87p
*PB4 215mm · 130 · 85	£2·54*

P & P 29p. VAT 8% (*P & P 40p)

ANTEX SOLDERING IRONS

15W 3·95
25W 3·95
Stand **£1·52** VAT 12½%
P & P 46p VAT 8%

Send 15p for Catalogue

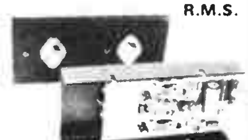
Barrie Electronics Ltd.
3, THE MINORIES, LONDON EC3N 1BJ
TELEPHONE: 01-488 3316/7/8
NEAREST TUBE STATIONS: ALDGATE & LIVERPOOL ST

Professionals and Enthusiasts from BI-PAK

AL120

50W R.M.S.

AUDIO AMPLIFIER
(With integral heat sink and short-circuit protection).



OUTPUT POWER	50 Watts R.M.S.
SUPPLY	70 Watts
LOAD IMPEDANCE	8-16 ohms
TOTAL HARMONIC DISTORTION	05% Max. (Typically 02%)
FREQUENCY RESPONSE ±1dB	25Hz-20kHz
SENSITIVITY	500mV
MAX HEAT SINK TEMP.	45 deg C
DIMENSIONS	192 x 89 x 49 mm

£12·91
+ P. & P. 35p

Introduced to fulfill the demand for a fully protected power amp., capable of driving high quality speaker systems at up to 50w., with distortion levels below 05%. Ideal for domestic use, Discos, P.A. systems, electronic organs etc. The generously rated components ensure continuous operation at high output levels.

SPM120

STABILISED POWER SUPPLIES

SPM120/45
SMP120/55
SMP120/65

AC INPUTS	
SPM120/45	40-48v
SPM120/55	50-55v
SPM120/65	60-65v
OUTPUT CURRENT	2.5A
RIPPLE	1A 100mV 2A 150mV

£6·52
+ P. & P. 35p

SPM120 is a fixed voltage stabiliser available with an o/p v/ge of either 45v, 55v, or 65v. Designed primarily for use in audio applications, the stabiliser which provides output currents up to 2.5A., operates direct from a mains transformer requiring only the addition of 2 Electrolytic capacitors to complete the s/c protection.

GE100 Mk2.

10 CHANNEL MONOGRAPHIC EQUALISER

Control Range	±12dB
Dynamic Range	110dB
Maximum Output	+15dB
Frequency Response	30Hz-20KHz (±1dB)
Power Supply	15-0-15v
Voltage Handling Input	3v R.M.S
T.H.O.	005%

£22·50
+ P. & P. 35p

Only 155mm x 65mm x 50mm including the 10 x 10K 1in slider potentiometers and knobs which are mounted on a board positioned above the circuitry. In the frequency range of 31Hz to 20KHz you can cut and boost ±12dB with the 10 sliders each of which has its frequency marked on the circuit board. The GE100 has numerous uses including mixers P.A. systems and discos It will also greatly improve the sound reproduction of your existing audio equipment. Power Supply for GE100 o/d SG30 £3 80

VPS30

REGULATED VARIABLE STABILISED POWER SUPPLY

AC Input Maximum	25v
Voltage Regulation	2-30v
Regulated Current	0-2A
Incorporating short circuit protection	

£8·20 + P. & P. 35p

This NEW versatile Regulated Variable Stabilised Power Supply with short circuit protection and current limiting is a must for all electronics enthusiasts. It incorporates adjustable voltage from 2v–30v, with a current limiting range of 0-2A. With this module there is no need to build a separate power supply for each of your projects, with the simple addition of a transformer (o/d 2033), 0–1ma (o/d 1310 or 1305), plus a suitable shunt, a voltmeter (o/d 1311 or 1306), a 470ohm pot (o/d 1896) a 4K7 pot (o/d 1899), it can be used again and again as a self-contained bench, power supply, eliminating the use of batteries and thus saving ££'s!

PA200

STEREO PRE-AMPLIFIER

FREQUENCY RESPONSE	20Hz to 20kHz x 1dB	
TOTAL HARMONIC DISTORTION	Less than 1% (Typically 70%)	
SENSITIVITY INPUTS 1 TAPE 2 RADIO TUNER 3 MAGNETIC P U	100mV/100 K ohms 100mV/100 K ohms 3.5mV/50 K ohms	For an output 500mV
EQUALISATION	Within + 1dB from 20Hz to 20kHz	
BASS CONTROL RANGE	+ 15dBs at 75Hz	
TREBLE CONTROL RANGE	+ 10 20dBs at 15kHz	
SIGNAL NOISE RATIO	Better than 65dBs (All inputs)	
INPUT OVERLOAD	Better than 2dBs (All inputs)	
SUPPLY	35 to 706v	
DIMENSIONS	300 x 90 x 33mm (less controls)	

£16.55
+12½% V.A.T.
P. & P. 40p

The PA200 is basically our popular PA100 Modifications have been made to make it compatible with the higher output AL120 and AL250 amplifiers

HEADPHONES

A top quality headphone with cushioned earpads and headband Separate balance/volume controls Stereo or Mono switch Impedance 8 ohms Frequency 30-18,000Hz. **o/n 884. £9·78.** p&p 70p.

A brilliant compromise between price and performance Superb stereo reproduction for the newcomer to Hi-Fi. Impedance 8 ohms. Frequency 30-15,000Hz. **o/n 885. £4·95.** p&p 50p.

BIB HI-FI ACCESSORIES

Parallel Tracking GROOV KLEEN
The very latest in automatic record cleaning. Designed to suit all modern single play decks Simple to fit, it is extremely efficient Complete with two types of base and three height extensions. **o/n 8101. £3·97.** p&p 35p.

Cassette Tape Editing Kit
Enables cassette tapes to be edited and joined easily, quickly and accurately Kit comprises Tape Splicer ⅛" (3 2mm) 2 Precision Tape Cutters Tape Piercer 9 Self-adhesive Labels Reel of Splicing Tape 3 Winders and removers and instructions, all in a handy wallet. **o/n 811. £2·59.** p&p 35p.

GROOV-STAT
The BIB Groov Stat static reducer neutralises the static charge on records and other plastic surfaces **o/n 8103. £5·89.** p&p 35p.

Cassette Head Cleaner
Essential for cleaning of tape heads, capstans and rollers Pack contains Tape Head Applicator and tape head polisher tools Plus bottle of special formula cleaning fluid and full instructions. **o/n 832. £0·72.** p&p 35p.

METERS

Miniature Balance & Tuning Meter
Miniature moving-coil meter for stereo balance indicator tuning indicator for FM or similar application Pointer at centre indicates zero or null position Robust construction Sensitivity 100 0 100MA Dimensions 23 x 22 x 26mm **o/n 1318. £2·11.** p&p 35p.

Balance and Tuning Meter
Clear view edgewise meter Centre zero application Sensitivity 100 0 100UA Dimensions 45 x 22 x 34mm **o/n 1319. £2·16.** p&p 35p.

Miniature Level Meter
Moving coil, for accurate level indication for tape recorders amplifiers etc Neat design rugged construction will withstand five times rated value Sensitivity FSD 200UA OdB 130UA Dimensions: 23 x 22 x 26mm. **o/n 1320. £3·02.** p&p 35p.

Vu Meter
Calibrated 20 to +3 and 0 100%, making it suitable for use as a recording level meter or as a power output indicator Sensitivity 130uA Dimensions: 40 x 29mm. **o/n 1321. £2·16.** p&p 35p.

ADAPTORS

AC-DC enables a large range of battery powered radios, recorders, calculators to be run off the mains. (220-240v AC). Switchable for 3-6-9-12 volts. Current rating 300mA. Polarity reversing switch. Universal plug incorporated. **o/n 137. £4·05.** p&p 35p.

DC-DC for use in all cars, boats etc., with pos. or neg. earth for a regulated output of 6, 7·5 or 9 volts DC at 300mA. For radios, recorders etc. **o/n 138. £3·15.** p&p 35p.

CROSSOVER NETWORKS

2-WAY channels for high and low frequencies to correct speakers – high to tweeters, low to woofers. Complete with instructions. Frequency: 3,000Hz. **o/n 1904. £1·24.** p&p 35p.

2-WAY for 8 ohm speakers up to 30 watts. Frequency: .3KHz. **o/n 1905. £1·81.** p&p 35p.

3-WAY for 8 ohms speakers up to 30 watts. Frequency: 800Hz and 4.5KHz. **o/n 1906. £3·32.** p&p 35p.

MICROPHONES

DYNAMIC CASSETTE
For equipment requiring a high quality microphone. Sturdy, solid moulded body in black with neat chrome surround Pick-up pattern is omnidirectional On/Off switch, 1 metre of tough lead with floating 2.5 and 3 5mm plugs Matching moulded strut. Impedance: 200 ohms. Sensitivity 90dB Frequency 90-10,000Hz Size: 20mm dia x 120mm. **o/n 1326. £1·80.** p&p 35p.

DYNAMIC MICROPHONE
Superior quality portable cassette recorder mike with built-in remote control switch and lead fitted with 5-pin 240° DIN plug (remote switch) and 3-pin DIN plug (microphone). Provides a direct replacement for those supplied with recorders With detachable stand. Omnidirectional Impedance 200 ohms. Freq response: 100 to 10,000Hz. Sensitivity: 79dB at 1,000Hz. **o/n 1327. £2·98.** p&p 35p.

RE – 317: DYNAMIC MICROPHONE
Highly sensitive, high-grade desk or hand mike suitable for use with many popular cassette decks Incorporates On/Off switch and 1 metre lead with moulded standard jack plug Complete with desk stand. Omnidirectional Impedance 5,000 ohms Freq response: 100 at 12,000Hz. Sensitivity: (–7dB at 1,000Hz). **o/n 1336. £4·48.** p&p 35p.

OMNIDIRECTIONAL CARDIOID
Powered by a 1½v battery located within the aluminium body. Satin silver finish with front disk protection to the diaphragm housing. On/Off switch Also with Busby type windshield, "U" bracket and stem and extremely supple cable Consumption 0 2mA from 1½v battery providing approx., 8-10,000 hours continuous life. Impedance: 600 ohms. Sensitivity 70dB Frequency 30-16,000Hz Size: 23mm dia + 267mm. **o/n 1329. £14·40.** p&p 35p.

UNIDIRECTIONAL CARDIOID
Dual imp 600 and 50,000 ohms Response 50 to 14,000Hz. Sensitivity 54dB at 50K/ohms Size 1¼" dia x 6½" long Weight approx., 190gm. **o/n 1328. £12·32.** p&p 35p.

STANDS

GOOSENECK CHROME FLEXIBLE HOLDERS
Length 320mm. **o/n 1333. £2·70.** p&p 35p.
Length 515mm. **o/n 1334. £3·83.** p&p 35p.

FLOOR STAND Heavy chrome Stow-away feet with rubber ends for maximum stability Draws to a height of 5' maximum. o/n 1335. + **£10·69.** p&p 85p.

BOOM ARM for use with the above stand Heavy chromed metal, it gives 30" reach from the stand. **o/n 1337. £10·35.** p&p 70p.

WINDSHIELD COVERS
o/n 1331 Medium per pair **£1·35.** p&p 35p. **o/n 1332** Large per pair **£2·03.** p&p 35p.

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0·68
113	3 5mm Jack plug to 3 5mm jack plug Length 1 5m	£0·84
114	5 pin DIN plug to 3 5mm. Jack connected to pins 3&5 Length 1 5m	£0·95
115	5 pin DIN plug to 3 5mm. Jack connected to pins 1&4 Length 1.5m	£0·96
116	Car aerial extension Screened insulated lead Fitted plug & skt	£1·24
117	AC mains connecting lead for cassette recorders & radios 2 metres	£0·76
118	5 pin DIN phono plug to stereo headphone jack socket	£1·18
119	2 + 2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones Length 0 2m	£1·01
120	Car stereo connector Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions.	£0·68
123	6 6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1·62
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0·84
125	5 pin DIN plug to 5 pin OIN plug Length 1.5m	£0·84
126	5 pin DIN plug to Tinned open end Length 1.5m	£0·84
127	5 pin DIN plug to 4 Phono Plugs. All colour coded Length 1.5m	£1·46
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0·90
129	5 pin DIN plug to 5 pin DIN plug mirror image Length 1 5m	£1·18
130	2 pin DIN plug to 2 pin OIN inline socket Length 5m	£0·76
131	5 pin DIN plug to 3 pin DIN plug 1&4 and 3&5 Length 1 5m	£0·93
132	2 pin DIN plug to 2 pin DIN socket Length 10m	£1·10
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	£0·84
134	5 pin DIN plug to 2 phono sockets Connected pins 3&5 Length 23cm	£0·76
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5 Length 23cm	£0·76
136	Coiled stereo headphone extension lead. Black Length 6m	£1·97
178	AC mains lead for calculators etc	£0·54

ALL PRICES INCLUDE V.A.T.

BI-PAK

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Opinion

ALTHOUGH we have, over the years, reviewed quite a number of kits, for items ranging from intruder alarms to ignition systems, it has long been editorial policy that reviews of ready-built equipment were confined to pieces of test equipment which were likely to appeal to the electronics or radio enthusiast. This was considered to be the right approach for a magazine which was aimed principally at constructors.

We have recently been receiving a growing stream of letters from readers, asking for advice and comment on currently-available communications receivers and other radio equipment for the short-wave listener and amateur, and it is to meet this demand that we are now embarking on a series of reviews. You may rest assured, however, that this change in policy does not mean that we shall be devoting less attention to designs for home-constructed equipment.

It is not our intention to carry out any *Which*-style comparative tests, nor to suggest a "Best Buy". Neither shall we be carrying out full-scale specification testing, in the way that the hi-fi magazines do on tuners, amplifiers and the like. We shall simply try to convey the feel of the equipment as gained from user tests, to give an idea of how good the instruction manual, etc. is, and to say what accessories or options may be available.

In choosing items for review, we have selected what seem to be the most popular, plus any others available within roughly the same price bracket. This month it is the turn of the Yaesu FRG-7 receiver—future plans include several more receivers, transmitters, transceivers, aerials and various pieces of ancillary equipment. We also hope to comment on some professional receivers now available on the second-hand market. We hope that you will find the reviews interesting and useful, and would be glad to receive suggestions for items to include in the future.

PW PERSONALITY

Charles Molloy G8BUS—"On the Air" Contributor

Trained as a telecommunications engineer, Charles worked abroad for several years and became an associate member of the IEE. He is now a technical author in electronics.

Interest in the medium waves began when a schoolboy in the mid-1930s, after constructing a receiver for domestic use. He later turned to the short waves after building a one-valve receiver from a design by F. J. Camm in *Practical Wireless*, and became a regular SWL while living in the Middle East.

Although a holder of a class B amateur licence, appearances on 70cm and 2m are infrequent as the main interest in radio these days is in broadcast band DXing.

Charles collects books on the early days of radio, and enjoys messing about in boats. Other interests include classical music, opera and attending ballet with wife Mary, who is a devotee. He is looking forward to retirement and the opportunity to catch up with a number of outstanding radio projects.

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

Marshall's Bristol move

Subsequent to the recent publishing of Marshall's 1979 product range catalogue their Bristol retail shop has moved.

From 24 April 1979, the new shop will be in larger premises at 108A Stoke's Croft, Bristol. This new location is approximately 5 minutes walk from the main shopping centre of Bristol.

At the same time they announce that they have been appointed sole specialist distributors to the constructor market for the new Mullard 'Teletext' chips—SAA 5000, 5010, 5012, 5020, 5030, 5040 and 5050. These will be available shortly.

Further information from: *Mardata, Kingsgate House, Kingsgate Place, London NW6 4TA. Tel: 01-624 0805.*

Conferences

An IERE/RSGB colloquium is to be held on Tuesday, 5 June 1979 starting at 2 pm at The Royal Institution, Albemarle Street, London W1.

The subject for discussion will be amateur work on microwave propogation and techniques over the last five years, which have made the professionals look hard.

There has been some fascinating work, particularly in the UK, e.g. "s.s.b. at 10GHz" and the colloquium will describe these great developments which are currently going on.

Further details from: *The Conference Secretariat, IERE, 99 Gower Street, London WC1. Tel: 01-388 3071.*

The programme for the Consumer Electronics Symposium, announced by the Society of Electronic and Radio Technicians (SERT) last autumn, has now been finalised, and is to be held at the University of Essex between 8 and 10 July 1979.

Copies of the programme/registration form are being widely distributed and applications from nearly 100 potential delegates have already been received.

As can be seen from the programme, there is a wide representation of authors from industry, broadcasting authorities and servicing organisations who are providing an extremely varied programme of lectures and discussion covering all aspects of electronics in the consumer field.

Further details from: *SERT, Faraday House, 8–10 Charing Cross Road, London WC2H 0HP. Tel: 01-240 1152.*

Club News

The North England Radio Club has a national and European membership, with the heart of the club on Merseyside.

They publish a monthly magazine called 'Spectrum' and meet monthly, usually at The Sports Centre, Grange Road West, Birkenhead.

New members from anywhere in the world would be very welcome. A copy of 'Spectrum' and club information may be obtained for two 9½p stamps, in the UK, or two IRC's from abroad.

The man to contact is: *Norman Monti, 66 Chesnut Grove, Birkenhead, Merseyside L42 0MZ.*

TI 9900 data book

A self-teaching microprocessor design manual—written for beginners and experts alike—is now available from Texas Instruments.

The soft-cover "9900 Family Systems Design and Data Book", will offer in more than 1000 pages a comprehensive selection of educational and applications information that can help users develop a deeper understanding of the complex technology and tremendous potential available in microprocessors.

Combining hardware and software information, the data book should assist both the engineer doing advanced m.p.u. design work and "interested" people who simply want to know more about the subject. It is a complete reference book containing the basic knowledge and data a novice might need to become better acquainted with m.p.u.s—and it carries that knowledge through into complete technical and systems design data needed to use TI's 9900 family of 16-bit microprocessor and microcomputer circuit boards.

The "9900 Family Systems Design and Data Book" costs £8.00 plus P&P, and is available from: *The Modern Book Co., 19–21 Praed Street, London.*

SERT

The Society of Electronics and Radio Technicians is pleased to announce that Mr T. Bryce McCrirrick has become a Vice-President of the Society.

Mr McCrirrick has recently been appointed Director of Engineering to the British Broadcasting Corporation in succession to Sir James Redmond.

The current President of SERT is Air Vice Marshal Alec Morris and the other Vice-Presidents are Mr Michael Clark (Deputy Group Chairman of the Plessey Company) and Sir Edward Fennessey.

Rally Dates

The Royal Naval Amateur Radio Society's Mobile Rally, will take place at HMS Mercury, Petersfield, Hampshire, on Sunday, 17 June 1979. It will be open to the general public between 1000 and 1700 hours.

The rally is intended as an outing for the whole family, with stands, arena events and displays of interest to all ages. There will also be the usual trade stands.

Further details from: *Wally Walker G4DIU, 9 Woodstock Road, Bedhampton, Havant, Hants PO9 3HX.*

The "East Suffolk Wireless Revival" Amateur Radio Mobile Rally will take place on Sunday, 3 June, 1979, at the I.A.C.S.S.A. Sports ground, Bucklesham, near Ipswich. Commencing at 1100hrs and admission will be 40p, which includes a free raffle ticket.

In addition to talk-in stations on 2m, 70cm f.m. and 80m s.s.b., there will be trade stands, technical displays (featuring Prestel, RTTY and m.p.u.s), refreshments and a licensed bar.

Further details from: *C. P. Ranson G8LBS, 67 Tranmere Grove, Ipswich, Suffolk IP1 6DU.*

"Nunsfield House Community Association Amateur Radio Group" of Derby, hold their 10th Rally, at Elvaston Castle Country Park, on Sunday, 10 June 1979.

It is expected to be their largest rally yet, with over 50 trade stands, along with many other attractions of interest to all the family.

Talk-in stations will be available on callsign GB2ECR, on 2m f.m. Ch. 22, and 70cm f.m. Ch.s SU8, SU20.

Further details from: *Chris Wallace G8PTW, QTHR. Tel: Derby 752358.*

"Bangor & District Amateur Radio Society" hold their mobile rally on 24 June 1979, at the Castlewellan Forest Park. There will be all the usual events including trade stands and a "bring and buy" stall.

Further details from: *W. H. Langtry GI4AMM, QTHR. Tel: Bangor 65394.*

am/fm frequency readout

William POEL

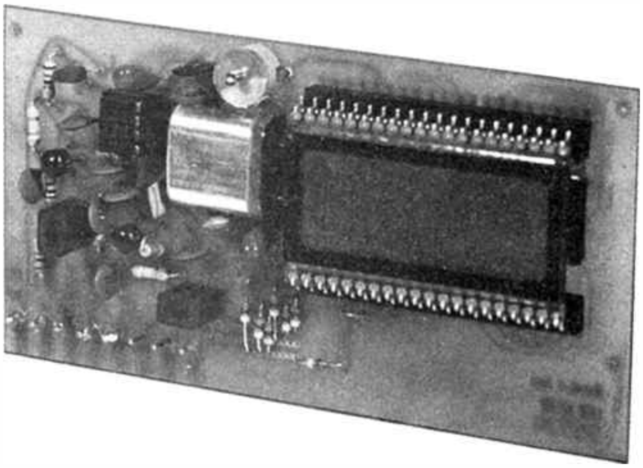
If you can think of an application for an arrangement of c.m.o.s. logic with a potential sale of a million plus, then the chances are that some enterprising manufacturer of l.s.i. has got a dedicated chip either on the drawing board, or in the market place. The application described here is an ideal candidate, since it is yet another instance of age-old analogue technology being swept aside with digital technology. For a long time past, an accurate readout of a radio receiver's tuned frequency has only been available with large amounts of logic, and large amounts of patience to work out the various i.f. offset programming steps. Such systems have also cost considerably more than the best analogue arrangements, and have consequently been restricted to the very expensive exotica in both consumer and communications applications.

Just as Intersil have revolutionised the concept of the instrument type counter with their ICM7216, OKI Electric of Japan have introduced a family of c.m.o.s. for consumer and communications digital frequency readouts which render all other approaches now quite simply obsolete. For in a 40-pin l.s.i. the counter gives both a.m. and f.m. frequency readout, plus straight kHz frequency count (no offset); drives an l.c.d. directly with no r.f.i. to the radio in question and all this with a current consumption of 4mA with the prescaler off, or 15mA with it on. The unit described here is conceived and designed as a universal readout for long wave through medium wave to a maximum a.m. count of 2·999MHz, including the popular marine DF band where digital readout is almost essential for reasonable operation in congested waters. The f.m. range operates from about 20MHz to 200MHz (with SP8629 prescaler) with a resolution of 100kHz—e.g. a typical readout is 88·1MHz. In the direct mode, the display shows kHz from the a.m. input, and 100s of kHz from the prescaled input.

Purists will complain that 100kHz is insufficient for f.m. resolution—but the display flicker brought about by further resolution is very tedious, and the small number of stations not on 100kHz channels makes the exercise rather pointless for the nuisance involved. And not many f.m. receivers would show up too well from the point of view of oscillator drift.

The Circuit

The full circuit (Fig. 1) reveals a remarkably simple overall approach compared to previous endeavours to produce this type of unit. Nearly all functions are carried



on within the MSM5526 i.c.—and the few remaining peripheral components are included as an extra for maximum flexibility. On f.m. the divide-by-100 prescaler is an obvious essential, but the input sensitivity of both the SP8629 and the MSM5526 is such that, if the unit is wired into many receivers directly, the pre-amps are not required. However, with these pre-amps using the high f_t BF274 type of transistor, typical sensitivities of 800µV on a.m. and 10–15mV on f.m. can be achieved—thus permitting connection of the digital display with the barest minimum of coupling. In the case of one portable radio tried by the author, it is sufficient simply to couple in via a single-ended wire loosely draped around the relevant oscillator section for either a.m. or f.m. So, even if your set doesn't possess specific local oscillator drive, a small piece of wire poked into the oscillator section will work in almost all applications.

The SP8629 has a very useful 6·3V Zener on-chip, permitting a simple but adequate 5·5V stabiliser stage to be built with an external pass transistor. The National Semiconductor equivalent DS8629 does not incorporate this facility, and a separate external Zener must be used. The stabiliser stage has an 82Ω resistor in the output—and this is the result of a mistake when assembling the prototype, since 8·2Ω should have been used. However, the whole circuit worked perfectly when switched on—and it was only when a check was made on the current drain, that this error was discovered, since the unit took a sur-

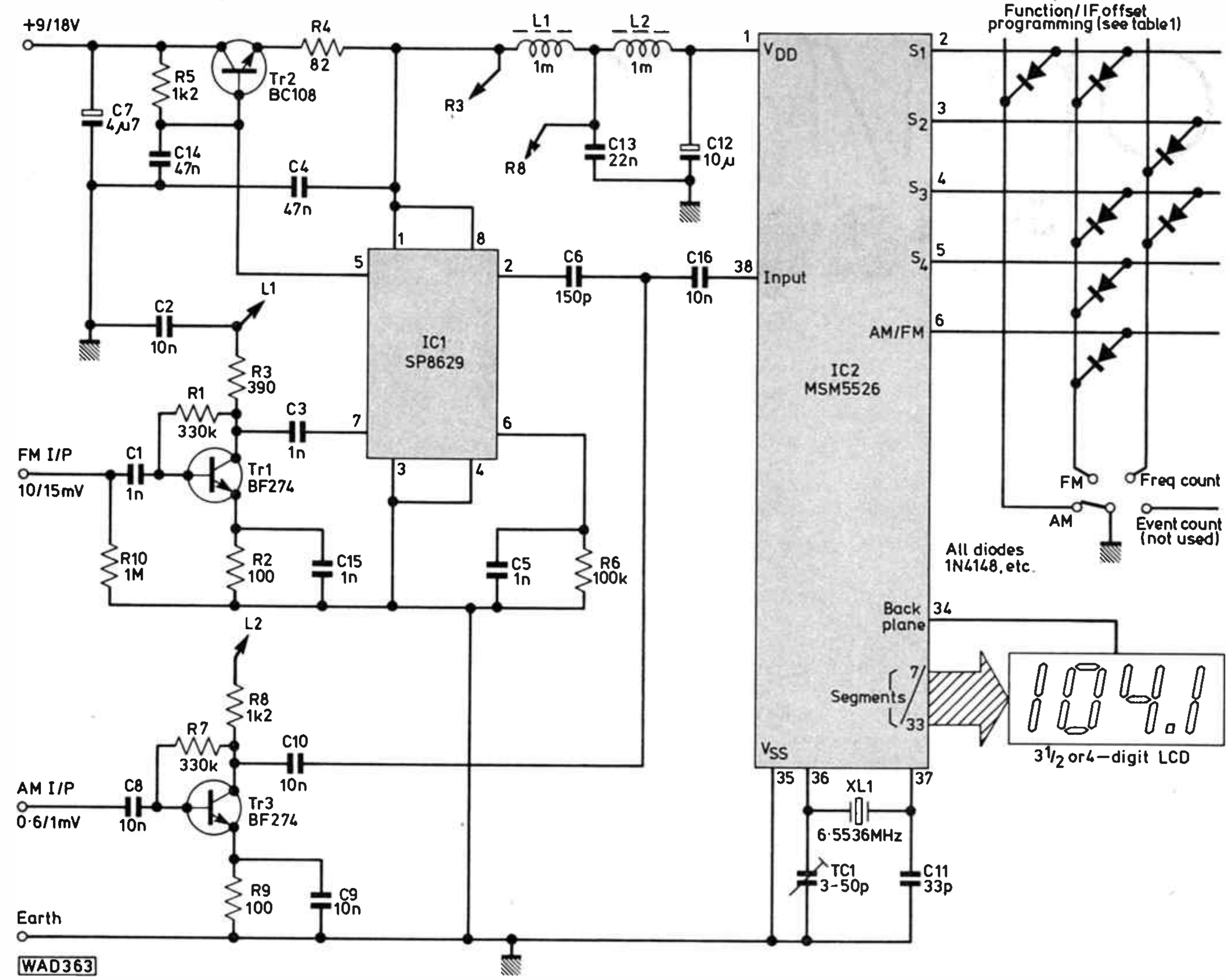


Fig. 1: Complete circuit diagram of the a.m./f.m. frequency readout based on the OKI MSM5526 i.c.

LCD 3½ Digit				LCD 4 Digit			
PIN		PIN		PIN		PIN	
1	Back Plane	40	Back Plane	1	Back Plane	40	Back Plane
2	– Bar	39	|Bar	2	nc	39	nc
3	b_4, c_4	38	Over Range	3	nc	38	nc
4	nc	37	nc	4	nc	37	g_4
5	nc	36	nc	5	e_4	36	f_4
6	nc	35	nc	6	d_4	35	a_4
7	nc	34	nc	7	c_4	34	b_4
8	DP3	33	nc	8	DP3	33	nc
9	e_3	32	g_3	9	e_3	32	g_3
10	d_3	31	f_3	10	d_3	31	f_3
11	c_3	30	a_3	11	c_3	30	a_3
12	DP2	29	b_3	12	DP2	29	b_3
13	e_2	28	DP4 (colon)	13	e_2	28	DP4 (colon)
14	d_2	27	g_2	14	d_2	27	g_2
15	c_2	26	f_2	15	c_2	26	f_2
16	DP1	25	a_2	16	DP1	25	a_2
17	e_1	24	b_2	17	e_1	24	b_2
18	d_1	23	g_1	18	d_1	23	g_1
19	c_1	22	f_1	19	c_1	22	f_1
20	b_1	21	a_1	20	b_1	21	a_1

Table 1

Display Select	Input conditions AM/FM	S1	S2	S3	S4	IF offset value
AM	H	H	H	H	X	−452·5kHz
	H	L	H	H	X	−454·5
	H	H	L	H	X	−456·5
	H	L	L	H	X	−465·5
	H	H	H	L	X	−467·5
	H	L	H	L	X	−469·5
FM	L	H	H	H	H	+10·68
	L	L	H	H	H	+10·71
	L	H	L	H	H	+10·75
	L	L	L	H	H	+10·79
	L	H	H	L	H	+10·82
	L	L	H	L	H	−10·58
	L	H	L	L	H	−10·60
	L	L	L	L	H	−10·61
	L	H	H	H	L	−10·62
	L	L	H	H	L	−10·63
	L	H	L	H	L	−10·65
	L	L	L	H	L	−10·66
	L	H	H	L	L	−10·69
	L	L	H	L	L	−10·70
	L	H	L	L	L	−10·72
	L	L	L	L	L	−10·73
direct	H	H	L	L	X	none
event counter	H	L	L	L	X	impulses

"H" = open (or Vdd)
"L" = ground (Vss)
"X" = either

prisingly low 15mA from a 9V source. The SP8629 is rated at a typical 30mA—so investigation with a voltmeter revealed that both prescaler and display i.c. were happily clocking away with only a 3·8V rail—as a result of the 82Ω mistake. A second unit was built with the same values, and worked just as well—and so it is assumed that most others will too—but if faulty counting is experienced, this 82Ω should be gradually reduced until the circuit settles.

The input to the counter i.c. is common for both a.m. and f.m. count, and the drives from the f.m. prescaler and a.m. pre-amp may be simply paralleled. The output of the SP8629 settles either high or low, depending where the last count cycle left it—and so whilst the outputs were originally paralleled via 10nF capacitors, the f.m. coupling capacitor has to be reduced to 150pF—otherwise the a.m. signal can easily be shunted through the prescaler output stage when it has settled to the low state. A value of 150pF is still quite enough to pass the very fast edges of the logic output of the prescaler, since counting of the l.s.i. occurs on edges, the actual waveform (which looks quite distorted) is immaterial.

The input to the 8629 must be disabled when reading a.m., and it is important to follow Plessey's application advice, and tie the unused differential input down via a 100kΩ resistor to ground, to prevent spurious oscillation occurring under no-input conditions.

The i.f. offsets are all pre-programmed via a diode matrix, set according to Table 1. Just about every standard offset is available, although occasional 500Hz compromises are called for, e.g. 454·5kHz not 455kHz. With an a.m. resolution of 1kHz, and an average i.f. filter tolerance of 1kHz, this sort of error is unlikely to be at all significant.

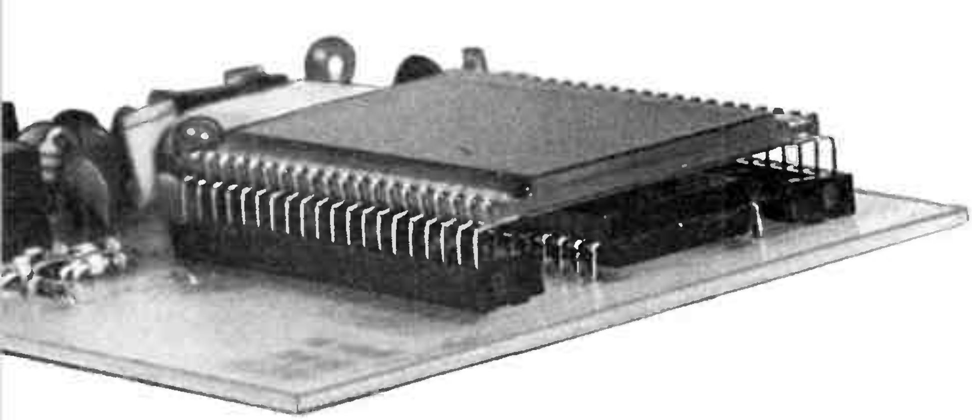
The functional setting is likewise matrix controlled, enabling selection via the simplest of all devices, a ground-to-operate switch. As well as the three modes available on this board, a straightforward event counter is also available for batch counting to a maximum of 2999 units, but this feature is not used in this instance.

Had this been a description of a "discrete" approach c.m.o.s. unit, the circuit description would have just about reached the oscillator stage, but instead, there is nothing more to say!

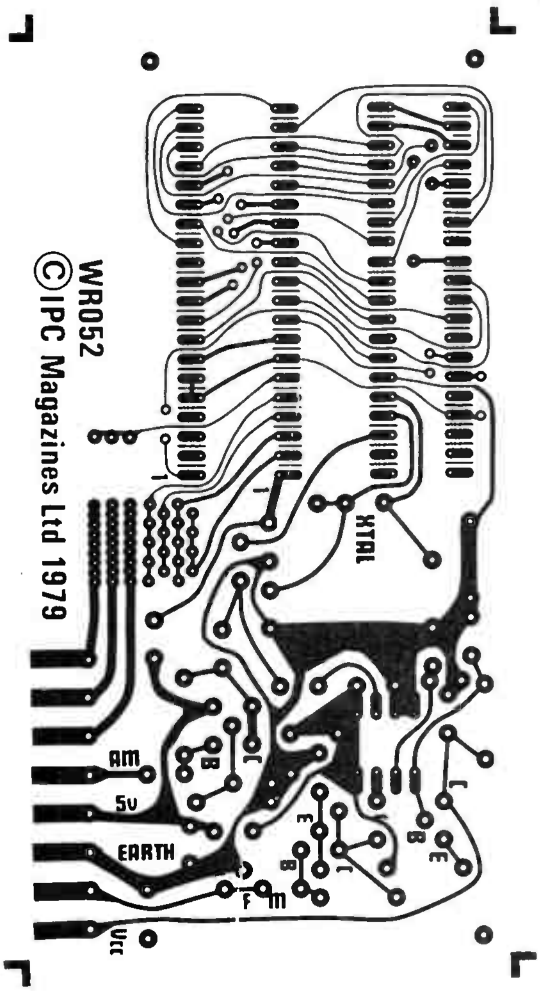
Construction method

The printed circuit board layout, Figs. 2 and 3, employs a useful technique when using direct drive to l.c.d.s from l.s.i., namely placing the i.c. under the display. This technique saves space—and cuts the only marginal area of possible interference (from the l.c.d. backplane strobe) to a bare minimum. Construction on anything but the properly made p.c.b. is not really feasible. Fixing holes for mounting are provided so that the unit may be fitted directly behind the receiver front panel. The c.m.o.s. MSM5526 is not a particularly fragile device, but the usual care should be taken when soldering, to avoid static damage, caused by poorly earthed soldering implements, or earth leakage currents. The p.c.b. is laid out for either HC13 or HC18 style crystals, and since 6·5536MHz is a standard binary frequency, the supply is not generally a problem.

Great care must be taken when mounting liquid crystal displays, since these are not only costly, but very fragile if pressure is applied unevenly. A socket must be used to raise the l.c.d. above the rest of the components, and either socket strip or a 40-pin d.i.l. socket cut in half is suitable for the purpose. Molex i.c. pins are not a good idea since in strips of 20, it is very difficult to accurately locate the pins of the display. The electrical contact is also somewhat more chancy at this sort of length, since a small displacement of one pin can cause a lot of trouble.



The MSM5526 is mounted directly on the board and the liquid crystal display is mounted over it, using i.c. sockets to space it from the p.c.b. (see text)



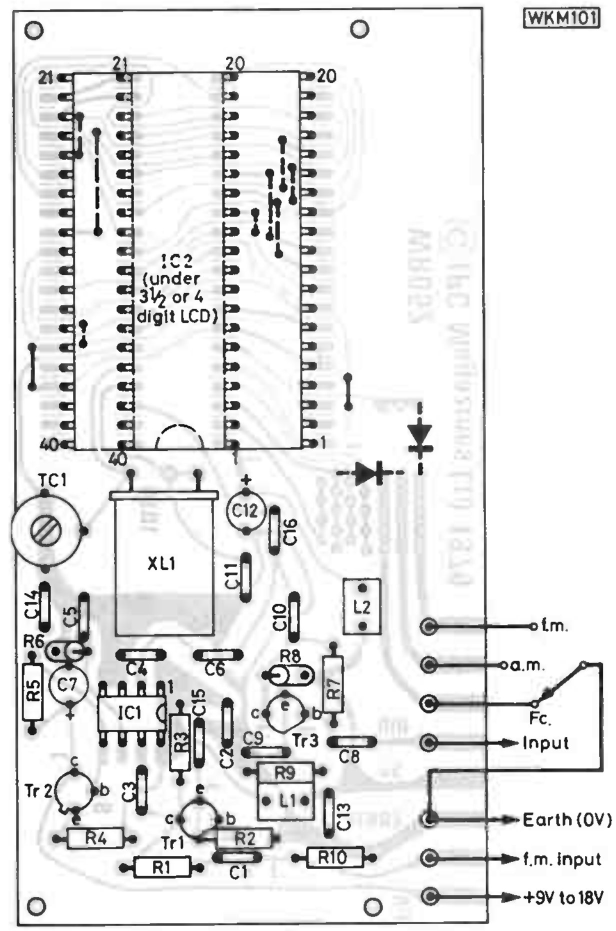
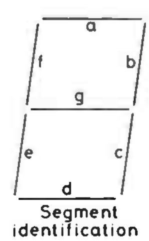
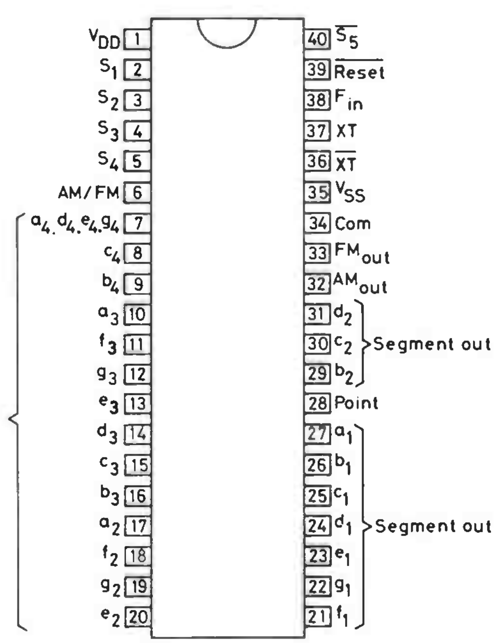


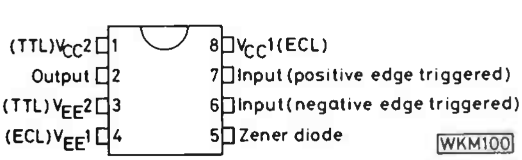
Fig. 2 (above): Full-size track layout of the p.c.b.

Fig. 3 (above right): Component layout and details of external connections to the p.c.b. The switch will normally be part of the wave-change switch of the associated receiver. When using a 3½-digit l.c.d., two "U"-links of insulated wire should be soldered to the track side of the p.c.b., linking pins 2 and 5/6, and pins 3 and 7 of the display

Fig. 4: Pin-outs of the SP8629 (below) and the MSM5526 (right)







★ components

Resistors		
0·25W 5%		
82Ω	1	R4
100Ω	2	R2, 9
390Ω	1	R3
1·2kΩ	2	R5, 8
100kΩ	1	R6
330kΩ	2	R1, 7
1MΩ	1	R10
Capacitors		
Ceramic disc or plate (lead spacing 5mm max.)		
33pF	1	C11
150pF	1	C6
1nF	4	C1, 3, 5, 15
10nF	4	C2, 8, 9, 10, 16
22nF	1	C13
47nF	2	C4, 14
Tantalum bead		
4·7μF	1	C7
10μF	1	C12
Sub-min trimmer		
3–50pF	1	TC1

Semiconductors		
Transistors		
BF274	2	Tr1, 3
BC108	1	Tr2
Diodes		
1N4148	as required for programming (see Table 1)	
Integrated circuits		
MSM5526	1	IC2 (OKI Electric)*
SP8629	1	IC1
Inductors		
1mH	2	L1, 2 (Toko 7BA 144LY–102)*

Miscellaneous
XL1 6·5536MHz Crystal, Style HC13 or HC18 wire-ended*
4-digit (or 3½-digit) liquid crystal display
Socket for l.c.d. (see text)
Printed circuit board Ref. WR052
Terminal pins (8 off)

*Available from Ambit International and Watford Electronics

Switch-on and test

Provided the components are located correctly, then there is nothing to go wrong apart from your soldering. Check the very fine tracks for splashes, and clean the board with flux remover if available. Using a current-limited power supply (for extra security), apply 5 volts at first, gradually turning up to 12V if the current drain is not excessive—indicating a short circuit somewhere. Switch to the desired input, and place a finger on the relevant pre-amp input, when some stray counting should occur from the pickup thus provided. Remember, this is very sensitive.

With a suitable radio to hand, place a pickup coil near the oscillator, and feed this to the counter input via r.f. coaxial cable. Something is almost certain to happen, and usually no more trouble than this is necessary. In fact, a single-ended pickup is frequently enough, though not suitable if more than 150mm long. If you don't know the exact i.f. offset, assume 10·7MHz high for f.m., and in the f.m. mode, tune to a station of known frequency. If the display reads incorrectly—say 89·2 instead of 89·1 with the tuning indicator zeroed—then the i.f. offset should be adjusted to 10·79MHZ (the closest to 10·8MHz available) by diode programming. Many of the finer variations of offset will not be apparent unless you have a very accurately calibrated signal source handy.

To set the internal clock accurately, switch to Direct Count and with a signal generator and reference counter, tune to 999kHz so that the generator output reads 999·4999kHz. Tuning to 999·501 should cause the counter to change over to 1000kHz, and the trimmer capacitor on the crystal input to the MSM5526 may then be adjusted to provide this threshold point. With the trimmer approx 30 per cent enmeshed, the whole unit is sufficiently accurate to be self calibrating anyway, so do not worry too much about these very fine adjustments if you cannot get access to appropriate equipment. Another way is simply to count the crystal oscillator frequency on a separate counter so that it is trimmed for exactly 6·5536MHz (take care not to load the crystal—try to use inductive coupling if possible).

To set the a.m. offset, tune to a known frequency with the offset pre-programmed for 469·5kHz (nearest available to 470kHz) for most UK- and European-made sets, and 455kHz for most Japanese sets, and check the error. Simple maths will tell you what to do—e.g. if the station is known to be on 910kHz, and the counter says 905 when the i.f. is set for 470kHz, then reprogramme the offset for 465·5 and all will be well.

Applications

Apart from new equipment, there is obviously a large retrofit application for improving existing equipment—since the accuracy of frequency display has let down many otherwise good designs. Varicap diode designs can occasionally put strains on analogue scale design, since the end-point capacitance can vary widely, although the diodes themselves remain well matched. This display takes away those problems, and does away with the last remaining mechanical headaches of the set designer.

One point which is very important about the MSM5526 is the fact the display is totally static. This means that there is no multiplexing interference—and the only potential source is in the shape of the backplane strobe, which is very, very low power for an l.c.d. Thus without screening, this device can readily be used without problems in any radio environment, from supplies ranging from 8V to 20V d.c. (thanks to the regulator on board). So next time the drive cord snaps, forget about a replacement and fit a digitally accurate alternative. ●

SPECIAL PRODUCT REPORT

CONTINENTAL SPECIALTIES CORPORATION

LOGIC PROBE KIT

If you are involved in digital electronics it is essential that you have some means of detecting pulses and logic states. Without this necessary equipment you will be totally in the dark when trying to find out why your latest creation does not work.

There are many logic probes on the market but for the amateur they tend to come a touch on the pricey side. Continental Specialties Corporation, who also make a range of logic probes, have recently introduced a kit for a probe which will detect and display logic levels, pulses and voltage transients.

The kit is complete down to the last piece of wire and even includes a length of solder. All the components appeared to be of good quality and fitted the holes drilled in the glass fibre printed circuit board without any problems.

The instruction manual is very comprehensive and covers not only the building of the probe but also notes on how to use it.

★ specifications

Input impedance: 300kΩ
Threshold: Logic 1 (Hi-l.e.d.) 70% Vcc
Logic 0 (Lo-l.e.d.) 30% Vcc
Detectable pulse width: 300 nanoseconds min.
Input signal frequency: 1·5MHz max.
Pulse detector: High-speed pulse train or single events (positive or negative transitions), active 0·1 second pulse stretcher
Input voltage: ± 50V continuous, 120V a.c. for less than 15 seconds
Power requirements: 5 volt Vcc at 30mA
15 volt Vcc at 40mA
25 volts max., with power lead reversal protection
Physical size: 147 x 25·4 x 17·8mm
Weight: 85 grams

Construction proved to be very simple and straightforward, the step-by-step assembly instructions proving easy to follow. Unlike traditional British component placement drawings however this one did not show the copper track pattern of the p.c.b. and no holes are shown so that it is very important to check twice that the components are correctly placed.

No problems were encountered and the probe worked first time, but if you are unfortunate a page is devoted to trouble-shooting and two pages to testing the probe following construction.

The plastics case, which is available separately and has been used for the *PW* Car Test Probe, is very neat and the two labels supplied with the kit are self-adhesive giving the finished probe a professional look.

The probe is simple to use, requiring the power leads to be clipped to suitable voltage rails on the circuit under test and the probe tip to be held against the test point.

Indication of the status of the point is by a combination of three l.e.d.s which light, or pulse, depending upon the logic state being investigated.

As a simple means of determining logic states this kit is very good value for money.

Dick Ganderton

SEE NEXT MONTH'S ISSUE OF PRACTICAL WIRELESS FOR DETAILS OF A SPECIAL INTRODUCTORY OFFER FEATURING THIS KIT

Ideas DEPARTMENT

Some original circuit ideas provided by our readers. These designs have not been proved by us, and we cannot therefore guarantee their effectiveness. They should at least provide a basis for experimentation.

Why not send us your idea? If it is published, you will receive payment according to its merits. Articles submitted should follow the usual style of PW in circuit diagrams and the use of abbreviations. Diagrams should be clearly drawn on separate sheets, not included in the text.

Each idea should be accompanied by a declaration that it is the original work of the person submitting it, and that it has not been accepted for publication elsewhere.

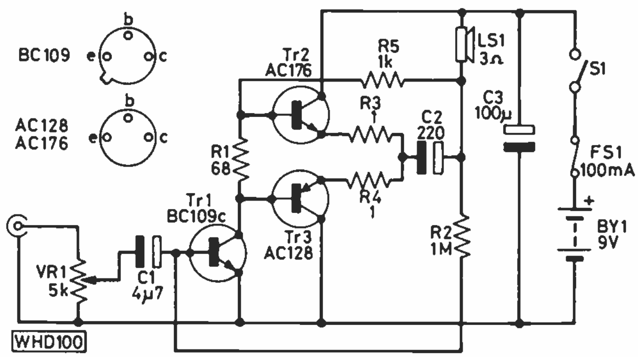
WORKBENCH AMPLIFIER

Although there are plenty of amplifier i.c.s and modules available, there are many applications where discrete circuitry can hold its own on cost and simplicity. One of these is a battery-powered audio amplifier for workbench use.

The input signal goes via the volume control VR1 to Tr1, which is a high-gain voltage amplifier. Its output is applied to the bases of Tr2/Tr3, the complementary output pair, with R1 providing the necessary standing bias. For reasons of simplicity and cost, no form of temperature compensation has been included.

Two negative feedback paths are included. Resistor R5, which is basically the collector load for Tr1, also provides bootstrapping for the output stage. Resistor R2 provides base bias for Tr1 and also overall negative feedback. Audio quality may be improved at the expense of reduced output by lowering the value of R2. Capacitor C3 decouples the supply, and helps to maintain audio quality when the battery approaches the end of its life.

Transistors Tr2 and Tr3 should be purchased as a matched pair, and must be fitted with heat-sinks—the push-on, finned type should suffice. With no signal applied, the total consumption of the amplifier should be less than 35mA.



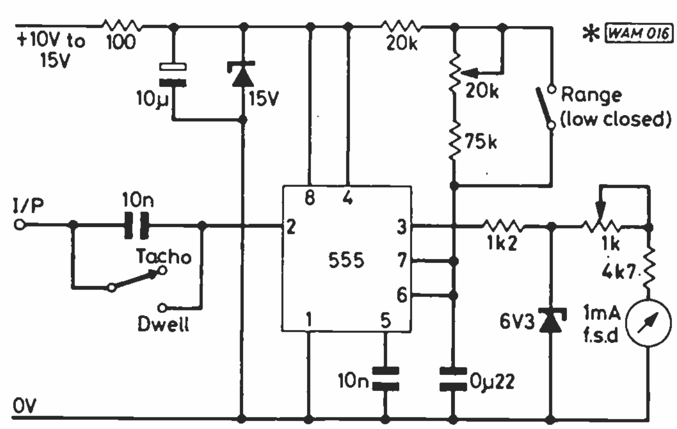
D. L. Jones,
Denbigh,
Clwyd.

TACHOMETER/DWELL METER

This circuit utilises a 555 timer chip in a dual function as a tachometer or dwell meter. In the tachometer mode, the input signal is taken from the car's contact breaker as a square-wave and fed via a capacitor to pin 2 of the timer, realising a high mark/space ratio. The two switched ranges, 0 to 1000 r.p.m. and 0 to 5000 r.p.m., are calibrated by a 20kΩ and a 1kΩ potentiometer.

In the "dwell" mode, the input capacitor is by-passed, maintaining a square-wave at the input of the device, which means that the output at pin 3 is an inverted version of the input waveform. In the "dwell" mode, only the lower of the two tacho ranges should be switched in.

The circuit requires a minimum supply of 12V for consistent operation.



R. J. Jenkins & M. E. Taylor,
Knebworth,
Herts.

Hey, Good Looking!

PW

'WINTON'

Beautiful innit?, but a swish exterior can often be an eye catching cover for some very ordinary "guts", so what's so different about the WINTON?

Well, for a start we have discarded Bi-Polar output devices in favour of the far superior performance of the Hitachi Power MOS-FETS, which until now have only been available in some of the most expensive Hi-Fi Amplifiers around, (and we consider £700 to be expensive with a capital E!). Secondly, our extremely low distortion figures are obtained at FULL RATED OUTPUT with both channels driven, across the entire audio spectrum.

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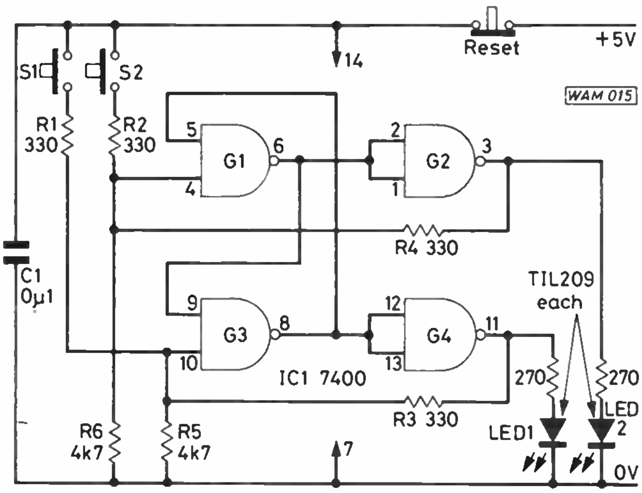


TTL "SNAP" INDICATOR

At switch-on R6 holds the input to gate 1 low, making the output high. This is coupled to inverter gate 2, the output of which is low and is coupled back to pin 4 by a 330 ohm resistor. These gates remain in this state as do gates 3 and 4 and in this condition no l.e.d.s are lit.

Note that the high at pins 6 and 8 are cross-coupled to the inputs of gates 1 and 3. Suppose S2 is pressed: pin 4 is connected to a high via R2. As pin 5 is also high the output of gate 1 goes low causing gate 2 to change state at pin 3, which goes high causing l.e.d. 2 to be lit.

Pin 4 is kept high via R4 so that the l.e.d. is "latched" on when S2 is released. Since pin 9 of gate 3 is held low by the output of gate 1, closing of S1 cannot change the state of gate 3 and l.e.d. 1 cannot be lit.

A complementary sequence occurs if S1 is pressed first. The power supply must be broken by the reset button to restore the circuit to its original state. C1 decouples the supply lines and prevents random triggering of the l.e.d.s at switch-on.

J. Bloxham,
Stratford-on-Avon,
Warwickshire.

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

UNICOM 21

To celebrate the 21st anniversary of the birth of their company, South Midlands Communications Ltd. are holding an Exposition and Symposium on Communications, called Unicom 21, on 22/23 June at Kempton Manor, Sunbury-on-Thames. Opening hours for the general public are 6pm–10pm on the Friday and 10am–8pm on the Saturday. Kempton Manor is adjacent to the M3 and A305, alongside Kempton Park Race Course.

There will be demonstrations of equipment by SMC, Strumech, Ascot Antennas and Microwave Modules, with experts on hand to answer all your questions. *Practical Wireless* will be there too, showing a selection of recent projects for the radio enthusiast.

The programme of lectures includes such subjects as: "A Single-chip Frequency Synthesiser", "FM vs SSB Bandwidths", "WARC 79", "Direct Conversion Receivers" and "Working more DX".

There will be a talk-in station operating on channel S22 with the special call-sign GB3SMC. Full bar and buffet facilities will be available.

Exhibitions

"The Great British Electronics Bazaar" is to be held at Alexandra Palace between 28 and 30 June 1979. The Bazaar is aimed at attracting the amateur, hobbyist and small professional buyer.

Among the stands booked by both large and small companies and organisations, will be demonstrations of building electronic circuits and home computer systems, to suit virtually everyone.

It is hoped that the event may be televised and application has been made for an amateur radio station with its own callsign.

Free tickets for the exhibition are available (send s.a.e.) from: *The Great British Electronics Bazaar, 34–36 High Street, Saffron Walden, Essex CB10 1EP.*

Computer shop

Since Friday, 16 March 1979, London's West End shoppers have been able to walk up to a counter and say "Can I have a computer, please?" And that's precisely what they can do at The Byte Shop, located in the capital's home electronics heartland, Tottenham Court Road.

At The Byte Shop, the fascinating world of computers is only a counter's width from the man in the street. For the first time, businessmen in Central London will be able to nip out at lunchtime for an impromptu demonstration. Everything needed to computerise a small to medium sized business is now on show—from the smaller self-contained systems costing a few hundred pounds to the most professionally-configured systems incorporating external printers and visual display units priced up to around £15 000.

The Byte Shop also offers a broad selection of advanced computer games, with shoppers being invited to pit their skills against chess, poker and backgammon programs compiled by experts. Further information from: *The Byte Shop, 48 Tottenham Court Road, London WC1.*

Cartoon computer

A unique computerised system to expedite the production and lower the costs of making animated films is now being used by the Swedish Broadcasting Corporation (SBC) for its television services.

Conventional methods of preparing animated films are enormously time-consuming. Most of the work is very repetitive since each second of finished film requires from 20 to 25 almost similar drawings.

Under the new system, utilising a Sperry Univac 1100/11 computer, SBC uses a technique developed by Alan Kitching, an animation and data processing specialist, who manages Grove Park Studios in Camberwell.

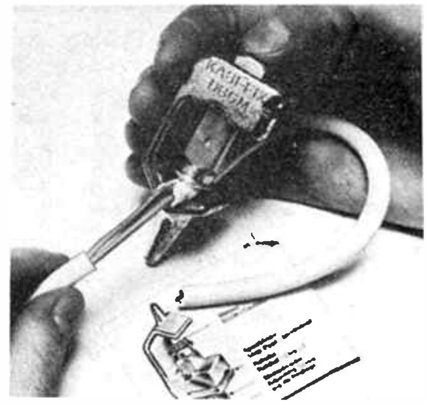
The technique, known as ANTICS, begins with a basic drawing being prepared and entered into the computer using a special light pen. By means of special command words and codes, direction, speed and position specifications are also fed into the computer. The basic drawing can then be modified in different ways, for example, it can be shrunk, enlarged, panned, skewed, shaken or reversed. It can also be induced to rotate, jump, rock, etc. The system now contains some 40 commands, but Alan Kitching is working on further expansion.

One of the latest concepts within ANTICS is the Skeleton command. In response to a Skeleton command, a part of the basic drawing—such as a human character—will move in a natural manner. Using single skeletal figures the operator can specify a pattern of movements based on key positions. The computer then automatically creates all the intervening pictures needed to complete the overall sequence of movements and the final result appears as a smooth natural motion which matches the position of the skeletal figures entered into the computer.

With the new ANTICS system, sophisticated films that would have taken more than six months to produce by conventional means can be made in a few man-weeks. *Sperry Univac, 65 Holborn Viaduct, London EC1.*

PRODUCTION LINES

alan martin



Mighty Midget

Toolrange, distributors of the Panavise range, announce availability of the Model 502 Precision Panapress. This small but tough arbor press, less than 178mm high, is ideal for pressing bearings, forming and assembling small parts, staking rivetting and broaching. Built to stand the rigours of daily production line usage, the press has a rated capacity of 500psi.

The arbor and table plate are pressure die cast in high strength Zamak III alloy. The operating mechanism and operating lever are hardened ground steel, leverage ratio 13·25:1. Throat depth is 64mm and vertical capacity is 89mm. Ram ends are supplied unfinished for custom tooling by the user and the operating ram is fully reversible. A unique feature of the Panapress 502 is the four self lubricating adjustment gibs which give fine directional control of the ram/plate alignment.

The Panapress 502 is available at £36 plus VAT, from *Toolrange Ltd., Upton Road, Reading RG3 4JA. Tel: (0734) 29446 or 22245.*

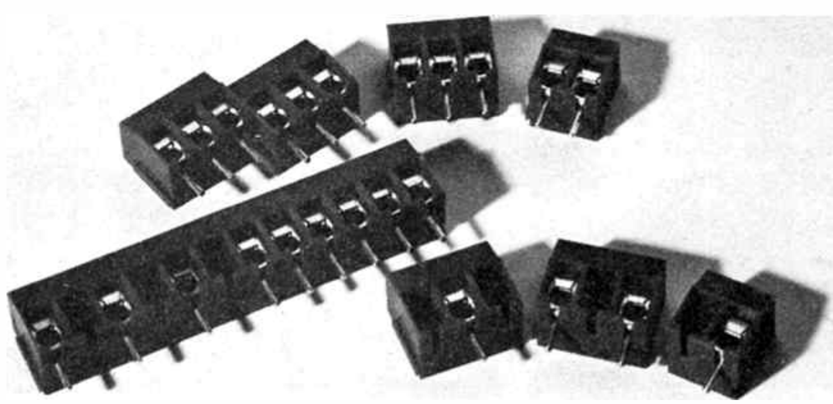
Test prod connector

The new Kaffka range of connectors being imported from Germany by West Hyde consists of six types, made in 5mm or 10mm spacing. They dovetail together to form a connector of any desired configuration.

They are of high-quality precision manufacture in red Nylon 66. The connector bodies are of zinc-plated brass with leaf springs to avoid conductor damage from the chromed nickel plated clamping screws.

Behind each screw there is a hole for a 2mm test prod. Current rating is 13 amps and accept cables of 2·5mm², with temperature range of from −30°C to +120°C.

Prices range from 7p to 23p each and are available from: *West Hyde Developments, Unit 9, Park Street Industrial Estate, Aylesbury, Bucks HP20 1ET. Tel: (0296) 20441.*



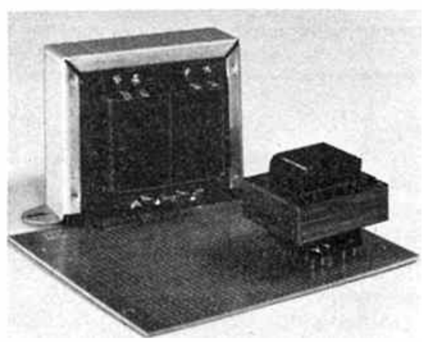
Handy Stripper

Recently introduced into the Carel Components catalogue, is the "Kabifix" DBP cable stripper which can effectively and accurately end or centre strip cables up to 25mm diameter.

Complete with a blade which easily adjusts to the insulation thickness and swivels automatically, the tool can be snapped closed over the cable, rotated round the insulation or pulled longitudinally to expose the cable.

Durable and easy to operate, this handy stripping tool supplied with an instruction leaflet and plastic pouch, costs £8·25 plus VAT.

Carel Components, 40–44 The Broadway, Wimbledon, London SW19. Tel: 01-540 7186.



Transformers

A new range of high quality competitively priced transformers, designed to conform generally to BS2214, is now being stocked by Verospeed.

All the transformers are fitted with full shrouds and are varnish protected. Two 120V windings are provided for the primary and they may be connected in series or parallel for operation at 50 and 60Hz. Two secondary windings are provided for series or parallel connection. Various output voltages from 0–3V to 0–20V are available within a range from 1·2VA to 50VA.

Further details are contained in the new Verospeed catalogue, available direct from: *Verospeed, Barton Park Industrial Estate, Eastleigh, Hampshire SO5 5RR. Tel: (0703) 618525.*

Learning to spell

The latest learning aid from Texas Instruments, known as "Spelling B", uses proven word/picture association techniques to help children progress in spelling regardless of their basic writing skills. Using an alphabetical calculator-type keyboard and display, combined with a picture book containing 264 carefully selected, colourful pictures of familiar objects, "Spelling B" is designed to provide an early introduction to word recognition, and also incorporates a series of simple and entertaining word games to improve basic reading skills.

In operation, the "Spelling B" selects and displays a picture number, the child finds the numbered picture in the book, and then spells the name of the picture by pressing the letter keys. As the letters are keyed they appear in the display, and at the end of each word the display signals "right or wrong". If the word is misspelled, the child is given a second attempt, and if this is wrong the correct answer is displayed. The number of correct answers is displayed as a "score" at the end of each set of five words.

"Spelling B" is programmed so that one of three different levels of difficulty can be selected. In addition, a variety of pre-spelling activities for younger children plus word games for all ages are available.

Among the games which add fun and variety to "Spelling B" are: "Starts with", a pre-spelling exercise in which the child only has to enter the first letter of the displayed word; "Missing letter", in which a word is selected at random and displayed with letters missing; "Mystery word", a variation of "Hangman" in which players have to guess words one letter at a time; and "Scramble", in which up to five words can be put into a memory in anagram form and recalled for "unscrambling" at a later stage.

The "Spelling B" costs £19·95 (r.r.p. including VAT), and is available through the usual distributors.

Texas Instruments Ltd., European Consumer Division, Manton Lane, Bedford MK41 7PA.

Portable 'scope

The new Model SB15M lightweight portable oscilloscope from Albol Electronic is claimed by the makers to break all records for cost-effectiveness for a professional/amateur instrument.

Albol say that the bandwidth goes up to 15MHz within 3dB limits and nine ranges cover, with an accuracy of 5% 10mV to 20V/cm on the 45 by 60mm measuring area of the c.r.t. Input impedance is 1MΩ±3% in parallel with 30pF, and the maximum input voltage is 400V.

The timebase can be freely running or triggered, and is displayed on 19 calibrated ranges from 0·5s/cm to 0·5μs/cm. Synchronisation can be either internal or external, with the a.c. mode giving 20Hz to 1MHz, and the h.f. mode 1 to 15MHz. Trigger sensitivity is said to be 0·5cm of the display on "internal", or 0·5V p–p on "external".

Bandwidth of the X amplifier, within 3dB, goes from d.c. to 3MHz, with an input impedance of 1MΩ in parallel with 45pF. The X deflection coefficient varies from 0·3 to 1·5V/cm. An attractive feature of this truly portable scope is that it can operate from 220 to 240V mains (using the optional adaptor) at 50 to 400Hz, with a power consumption of 40VA, or else from internal 1·5V cells giving 12V d.c. (rated then at 27W).

The width of the SB15M is 150mm, depth 340mm, and height 280mm, and it weighs only 7·6kg. Price is £150 plus VAT.

Available from: *Albol Electronic & Mechanical Products Ltd., 3 Crown Buildings, Crown Street, London SE5 0JR. Tel: 01-703 2311.*

New Sinclair DFM

Latest from Sinclair's new instrument product range, is a high specification, low cost, digital frequency meter, called the PFM200.

Designed to provide the performance of high quality bench-style instruments with the portability of a 158 × 76 × 45mm unit in a light (6oz) but rugged case, the PFM200 is priced at only £49·80 plus VAT, which should permit most laboratory engineers, service technicians, students and hobbyists to possess their own personal digital frequency meter.

Its bright, sharp 8-digit display with variable accumulation period gives high resolution coverage from low audio frequencies right up to v.h.f. without the need for complex range changing and with exceptional sensitivity of 10mV. Guaranteed range is 20Hz to 200MHz, typically higher, with a frequency resolution down to 0·1Hz. Power is from a 9V battery or approved a.c. adaptor.

Supplied complete with test leads and probes, protective wallet and operator's manual, optional extras are a.c. adaptors for 117V, 220V or 240V; de-luxe padded carrying case with lead storage compartment; and a connector pack comprising BNC, coaxial, DIN and phono adaptors plus telescopic aerial for direct signal pick-up from nearby transmitter.

A technical information leaflet on the PFM200 is also available from: *Instrument Sales, Sinclair Radionics Ltd., London Road, St Ives, Huntingdon, Cambs PE17 4HJ. Tel: (0480) 64646.*

numbers without tears

Dr G. BROWN

The aim of this design was to produce an educational toy capable of teaching rapid number recognition to children of $2\frac{1}{2}$ years and upwards. The absolute minimum of instruction should be necessary, the idea being that the child learns as he plays, without external influence. The toy should thus be interesting to play with.

To a young child this means: (a) visual stimulation—things should be seen to happen; (b) tactile stimulation—the instrument should respond to touch, to pressure—there should be something to turn, something to switch.

This simple unit has all these facilities and can hold a child's attention for remarkably long periods. It can also double as a single die for use with other games.

General Features

Fig. 1 shows the basic design blocks. A swept-frequency clock generator feeds the first decade counter, the digit outputs of which are used to drive ten light-emitting diodes (l.e.d.s) arranged in a circle. A second decade counter, fed from the same clock source, drives a single 7-segment l.e.d. numeric display. As the clock frequency rises from zero, the circular l.e.d. display assumes a rotating motion with a visible acceleration. As the clock frequency then falls to zero, the "flywheel" effects slows and stops at a random position.

The l.e.d.s are labelled 0 to 9, as are the positions on the manual number selector, which is a rotary switch. Provided that both decade counters are reset to zero initially, they will always remain synchronised, i.e., if the flywheel stops at position "4", then the 7-segment outputs will correspond to the figure 4 also.

The number selector is wired such that the 7-segment display is only illuminated when this switch is turned to the same number at which the flywheel has stopped. The normal fixed-frequency clock is used when the device is employed as a die.

Some simple logic is included to make the toy more interactive with the child, and will be described in the appropriate sections.

The Swept-frequency Clock Generator

For this particular application, a manually-initiated frequency sweep was required from zero up to about 100Hz and back again to zero. The circuit is shown in Fig. 2.

The clock is designed around the ubiquitous NE555V integrated circuit connected in the astable mode.

If the circuit to the left of the dashed line is studied, the timing components R1 and C1 are easily recognised. C1 is charged up through R1, and IC1 will discharge C1 when the voltage at point A reaches 0·67Vdd. The negative-going edge corresponding to the discharge of C1 retriggers the cycle and the system becomes astable, the frequency of oscillation being given by:

$$f = \frac{1{\cdot}44}{R1 \times C1}\text{Hz}$$

In the circuit to the right of the dashed line Tr1 and Tr2 are connected as a Darlington pair controlled by the touch plate connected to the base of Tr2. The quiescent-state voltage at point A is controlled by resistors R1, R2, and R3, the two transistors being effectively open-circuit. A simple Ohm's Law calculation shows that point A is held at 0·65Vdd and, because IC1 will not discharge C1 until point A reaches 0·67Vdd, the clock oscillator is biased off, its output being a logic "1" in this condition.

When a finger is applied to the touch plate, charge flows into the electrolytic capacitor, C2. As this charges up, the potential at point B rises. With C2 fully charged (after about one second), both transistors are turned fully on and point B is taken almost to Vdd. Thus the Darlington pair may be regarded as a variable resistance, Rt, between point B and Vdd, this resistance varying from infinity to near zero. As soon as Rt becomes finite, point A is lifted above the threshold value of 0·67Vdd and oscillation begins.

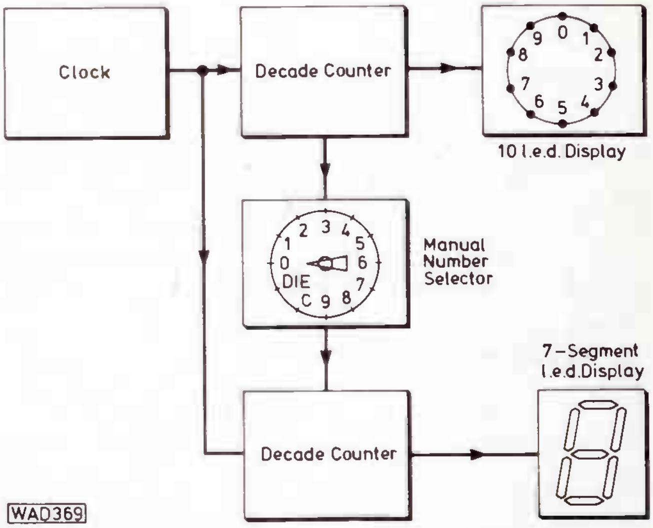


Fig. 1: The basic block diagram of the numbers toy

The frequency of oscillation is still given by the above equation, except that R1 must be replaced by the effective instantaneous value of R1, R2 and Rt. In the limit, with Tr1 and Tr2 turned fully on, R1 and R2 are virtually in parallel between Vdd and point A, and have an effective resistance of 24·8kΩ. This gives a theoretical upper frequency limit of:

$$f = \frac{1{\cdot}44}{2{\cdot}48 \times 10^4 \times 3{\cdot}3 \times 10^{-7}} = 176\text{Hz}$$

This figure is not attained in practice because Rt never falls completely to zero.

When the finger is removed from the touch plate, C2 discharges slowly through Tr1 and R3, and Rt increases correspondingly. The frequency of oscillation falls and finally reaches zero when point A falls again below its threshold value. This decay time is of the order of 10 to 15 seconds.

Switching R4 into the biasing network by closing S1 holds point A just above threshold and a constant-frequency output of about 15Hz is produced. The use of this clock frequency is described in a later section.

The touch plate is very sensitive in its action, and this encourages the child to experiment as he watches the effects of his finger's pressure illustrated on the flywheel display.

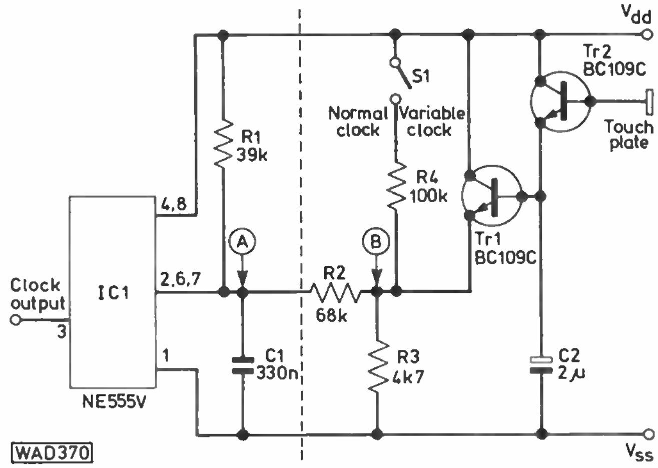


Fig. 2: Circuit diagram of the swept-frequency clock generator

The Decade Counters

Apart from the NE555V oscillator, this instrument employs c.m.o.s. devices which are relatively cheap and are ideal for this purpose. Fig. 3 shows the circuit diagram of the first decade counter and the transistor drivers for the 10–l.e.d. flywheel display. The 4017 decade counter is fed from the clock generator described above. In order to drive the flywheel l.e.d.s at 20mA, ten transistors operating as emitter followers are used. As only one l.e.d. is illuminated at any instant, only one current limiting resistor, R10, is necessary. It will be noted from Fig. 3 and Fig. 4 that the "reset" and "clock inhibit" functions are made common to both decade counters. This is to ensure complete synchronism of the two counters at all times. The combination of C3 and R5 resets both counters to zero when power is first applied.

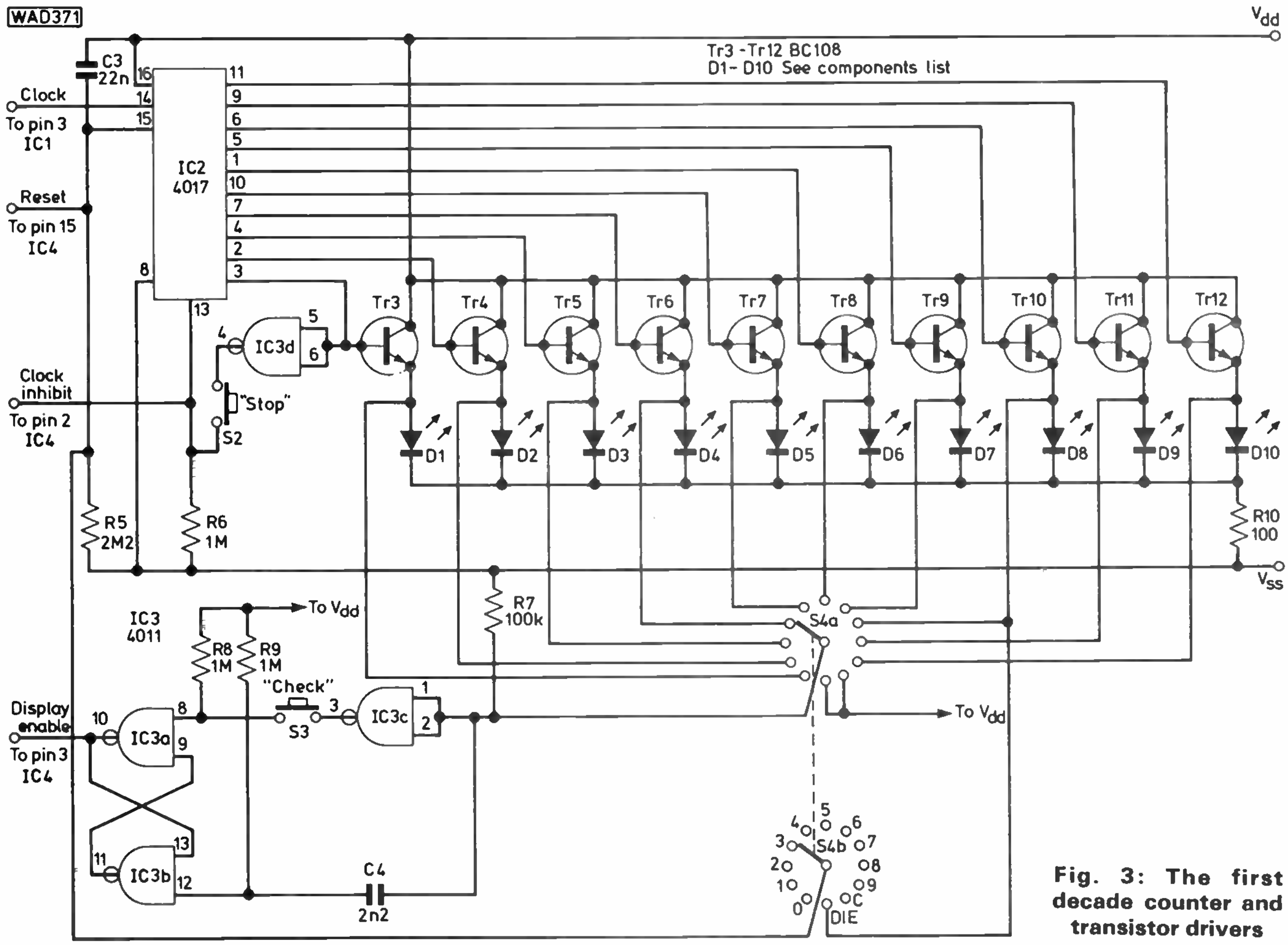


Fig. 3: The first decade counter and transistor drivers

Switching Logic

The switching logic provided by S3, S4 and IC3 has two important effects, which are now described.

Suppose the flywheel display has stopped at "4". It would be trivial to connect the pole of S4*a* to the "display enable" pin of the second counter (see Fig. 4) to illuminate the 7-segment display when S4*a* is turned to position "4". This operation would not require any numerical knowledge on the part of the child: he would just turn S4 until the 7-segment display came on. To avoid this, IC3*a*, *b* and *c* are interposed between S4*a* and the "display enable" pin of the second counter. IC3*a* and *b* form a toggle whose normally-off output is taken to the "display enable" input of the 4026 counter, thus keeping the 7-segment display off under normal conditions.

Taking pin 8 of IC3 to Vss will turn the toggle on and, with it, the 7-segment display. Similarly, taking pin 12 of IC3 to Vss will reset the toggle and extinguish the 7-segment display.

Signals to control the state of the toggle are taken from the pole of S4*a*. The "on" state of toggle and display is controlled by the position of S4*a*, by the inverter IC3*c*, and by the push switch S3. If S4*a* is turned to position "4" to match the flywheel display, then the pole is taken to logic "1"; logic "0" thus appears at pin 3 of IC3.

If S3 is momentarily pressed, the resulting logic "0" applied to pin 8 of the toggle will switch both itself and the 7-segment display on. Thus the child must not only select a number, but must press the CHECK button, S3, to see if his selection was correct.

What happens if the selector switch is turned after the 7-segment display has been illuminated? If the display were to remain illuminated with the electro-switch now showing a different number, the child would be confused, so provision is made to extinguish the display (a) when the selector switch is turned from the correct position, and (b) when the flywheel is started again. These requirements are simultaneously fulfilled by connecting the pole of S4*a* via C4 to the "reset" input of the toggle, pin 12.

Suppose the previous procedure has resulted in a "4" being indicated by both the displays. If S4*a* is turned away from "4" the pole is taken from logic "1" to logic "0", and the negative-going edge so produced is passed by C4 to reset the toggle and extinguish the display.

Similarly, if the flywheel is started, the negative-going edge produced as l.e.d. "4" goes out resets the toggle via C4 and the 7-segment display is extinguished.

Thus, in normal use, there can never be any ambiguity between the numbers on the displays and the number set on the selector switch.

The presence of R7 from the pole of S4*a* to Vss is worth nothing. There is no reason why the digit positions on the S4*a* wafer should not go direct to the digit outputs of the 4017 counter: in this case R7 would be unnecessary. However, there is a very good practical reason why this is not done. The ten l.e.d.s and the selector switch S4 are mounted on the front panel. The integrated circuits and transistors are on a single circuit board mounted on the base of the metal box. Thus there are ten flexible leads from the emitters of Tr3–Tr12 to the l.e.d.s on the front panel. Ten more flexible leads would be needed from the S4*a* wafer to the digit outputs of IC2, but these leads can be eliminated by simple wiring to S4*a* from the anodes of the l.e.d.s, which are on the same panel. When this is done, a pull-down resistor, R7, to Vss is needed for the inputs of IC3*c* to keep them at logic "0" except when a logic "1" is fed to the pole of S4*a* from the flywheel display.

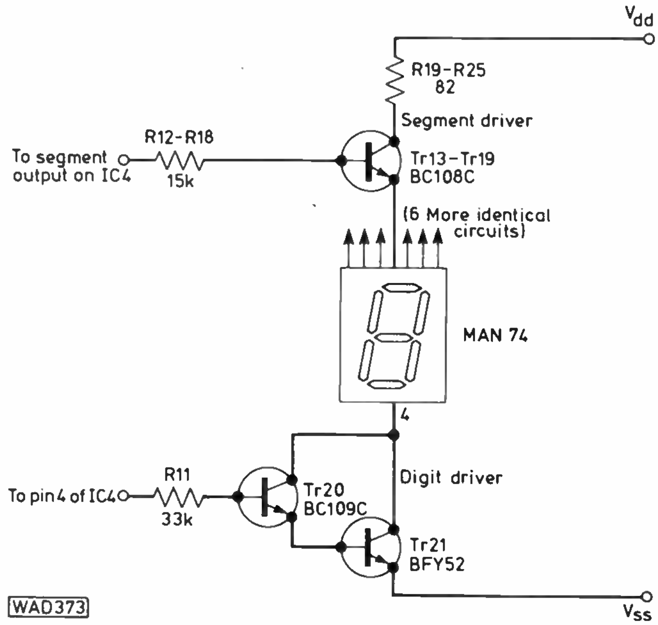


Fig. 5: Driver circuits for the second decade counter

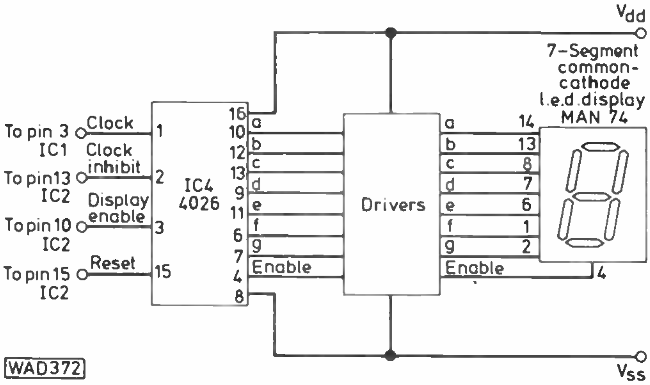


Fig. 4: The second decade counter

The second decade counter and its associated circuitry are shown in Figs. 4 and 5. The counter is a Type 4026 c.m.o.s. device which has outputs for a 7-segment display. These figures require very little explanation. The 4026 counter operates in parallel with the 4017 counter, and the 7-segment common-cathode display is fed by seven segment driver stages, Tr13–Tr19, and one digit driver stage, Tr20–Tr21. The current-limiting resistors, R19–R25, give segment currents of 19mA. To "enable" the display, the digit driver Darlington pair, Tr20–Tr21, is switched on by a logic "1" from pin 4 of the 4026 counter, thus providing a low-resistance path from the display cathodes to Vss. Tr21 must be capable of carrying $7 \times 19 = 133$mA, and the Darlington configuration has been used so that Tr21 can be very conservatively rated, ensuring high reliability.

Provision has been made to illuminate the 7-segment display while the flywheel is running. This adds to the visual appeal of the instrument before the child is ready to tackle number recognition and matching. This is the function of position "C" (continuous display) on the selector switch S4. When "C" is selected and S3 pressed, the display will remain on throughout the flywheel cycle.

A final word now about the use of the instrument as a die. On the "DIE" position of the selector switch, S4*a* provides a constant logic "1" on its pole (as in the "C" position), and when S3 is pressed the 7-segment display is constantly illuminated. S4*b* comes into operation at this point and connects the "7" digit of the l.e.d. flywheel to the "reset" pins of both counters. Thus both of the displays count repetitively from "0" to "6" when the clock runs. The swept-frequency clock can be used for this, but it has been found that the use of a constant 15Hz clock (selected by S1) is more satisfactory, in that the procedure is less involved for the child.

To "throw" the die, all that the child does is press S2: both displays stop immediately, showing a number between "1" and "6". On releasing S2, counting begins again. This function utilises the "clock inhibit" pins of both counters. When these pins are taken to logic "1", counting will cease, even though the clock is still running. The last NAND gate of IC3 is used for a rather devious purpose in this mode. Both IC2 and IC4 are counting from "0" to "6" yet it would clearly be incorrect to allow the die to stop at "0".

Instead, the die is slightly "weighted" such that it can never be stopped at "0"! The probability of throwing a given number on a die is 1 : 6. On this die, the probability of throwing a number between 2 and 6 is 1 : 7 and the probability of throwing a 1 is 2 : 7.

In use by young children, or even unsuspecting adults, this would never be noticed. To prevent a "0" being thrown, the signal to inhibit the clock is taken from the "0" digit output (pin 3) of the 4017 counter. If, at the moment S2 is pressed, a number from "1" to "6" is being displayed, pin 3 will be at logic "0". IC3*d* inverts this to logic "1" and inhibits the clock. However, if "0" is being displayed when S2 is pressed, pin 3 is at logic "1" and the logic "0" produced by IC3*d* will *not* inhibit the clock. Instead, it waits for the next clock pulse which increments both counters to the digit "1", at which instant pin 3 of the 4017 goes to logic "0" and IC3*d* then inhibits the clock with logic "1" at its output.

Power Supply

A single-polarity, stabilised 5 volt supply is used, employing an integrated circuit regulator. Stabilisation is to be preferred here, because the current taken from the supply varies between about 23mA with only the flywheel display on, to about 160mA with the 7-segment display showing an "8". Fig. 6 shows the circuit used. The regulator is mounted on the metal box to dissipate the small amount of heat generated. The use of 15V d.c. supply for the regulator may seem excessive. In fact, this supply rail will drop to 12 volts on full load and, as the regulator needs a supply of at least 8·5 volts, the supply is not too conservatively rated. A transformer with a 9–0–9 volt secondary could be used, provided that the supply rail for the regulator did not fall below 9 volts on full load.

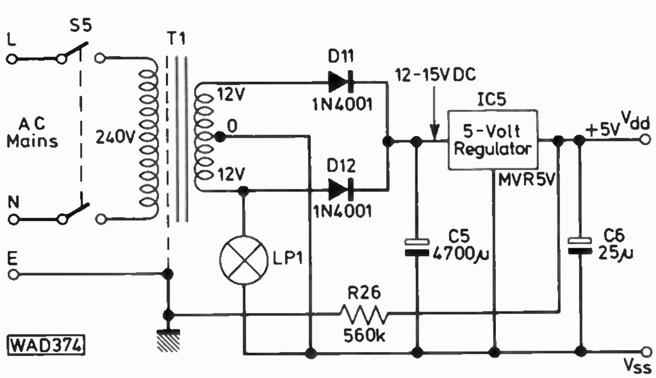


Fig. 6: Power Supply

★ components

Resistors
¼W 5% carbon film

82Ω	7	R19, 20, 21, 22, 23, 24, 25
100Ω	1	R10
4·7kΩ	1	R3
1·5kΩ	7	R12, 13, 14, 15, 16, 17, 18
33kΩ	1	R11
39kΩ	1	R1
68kΩ	1	R2
100kΩ	2	R4, 7
560kΩ	1	R26
1MΩ	3	R6, 8, 9
2·2MΩ	1	R5

Capacitors
Electrolytic

2μF 6V	1	C2
25μF 6V	1	C6
4700μF 25V	1	C5

Polycarbonate or polyester

2·2nF	1	C4
22nF	1	C3
0·33μF	1	C1

Semiconductors
Diodes

1N4001	2	D11, 12
LED	10	D1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Transistors

BC108C	17	Tr3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
BC109C	3	Tr1, 2, 20
BFY52	1	Tr21

Integrated circuits

MVR5 regulator	1	IC5
NE555V	1	IC1
4011	1	IC3
4017	1	IC2
4026	1	IC4

Switches

s.p.s.t.	1	S1
Push to make	2	S2, 3
2p 12w rotary	1	S4
s.p.d.t. slide	1	S5

Miscellaneous
12–0–12V 200mA transformer T1 (1); 12V panel lamp (1); 7-segment red l.e.d. display, common cathode MAN74 (1); Veroboard (see text), case.

Constructional Notes

Apart from the power supply, displays and switches, the entire circuit was constructed on a single piece of Veroboard measuring 95 × 63mm. The layout is not important, so no details are given, but it is advisable to take all Vss leads to a common point.

In general, this precaution is unnecessary, but in this circuit the emitter connection of the digit driver Tr21

Continued on page 60

Selective sound OPERATED switch

C.R.HARRIS

This unit was developed after I was asked by a friend to build a device with which he could turn a light on by clapping his hands.

Obviously this could be done by using a simple sound operated switch comprising a microphone, audio amplifier and trigger circuit, but such a simple circuit would respond to any sound of sufficient volume. Clearly something more sophisticated was required.

After a number of tests had been made, it was found that satisfactory operation could be obtained by making the circuit respond only after receiving two sounds with a fixed time interval between them of around one second. This achieves a good compromise between simplicity, spurious operation from background noise and ease of use. The human brain is very bad at estimating short time intervals and a sequence of more than two sounds becomes impossible to generate with any accuracy. The circuit also incorporates a filter and a level trigger so only sounds of the correct pitch and sufficient volume will be detected.

Circuit Operation

IC1 and associated components amplify the sound picked up from the microphone and include rough frequency filtering. VR1 is a gain control and VR2 adjusts the d.c. level of the output from this stage. This is fed to a Schmitt trigger comprising Tr1 and Tr2 and also has a time delay (C4, R2) to prevent multiple triggering. The components following (Tr3-Tr5) form a driver stage for the logic circuit, and the l.e.d. D2 indicates when a sound has been detected. The circuit gives a logical '0' on receiving an input above a preset threshold set by VR2.

The output from this stage is first fed to a monostable comprising G1 and associated components which in turn triggers two more monostables G3, G4 and associated components. Monostable G1 has a period of about 5 seconds and is included to prevent the other two monostables re-triggering before the circuit has finished its cycle. G3 has a period of about 1 second and G4 about 3 seconds.

The circuit comprising G6-G11 and FF1 looks for the state in which, after a pulse has triggered the monostables, a second pulse arrives during the period when G3 has turned off again and G4 is still on, i.e. 1-3 seconds after the first pulse. When this happens a logical '1' is sent to FF2 which then changes state and opens or closes the relay via Tr9 and Tr10. If the second pulse arrives before or after the allowed period it is ignored and will also work the latch G9, G11 to make the circuit ignore all further inputs until G1 has reset. Thus on receiving two sounds with a time interval of about 1 second between them the circuit will operate the relay, turning the load circuit on or off.

Construction

Construction is simplified by the use of printed circuit boards. Start by soldering in the smallest components, i.e., resistors and diodes and add the tallest components (capacitors and transistors) last. The c.m.o.s. integrated circuits (IC2-IC5) should be connected using i.c. sockets, installing them in after all the other components have been soldered. Standard c.m.o.s. handling precautions should be used. Sockets should also be used for the other integrated circuits. Take great care to connect all components such as diodes, transistors, i.c.s and electrolytics the correct way round as incorrect connection can cause a large range of puzzling faults.

At this point, something should be said about the microphone and the mains transformer. The microphone used is a high impedance balanced armature earpiece which is better than a crystal microphone in this application. There is also space on the circuit board for putting a resistor in series with C2 to adjust the low frequency characteristics (10-100Ω).

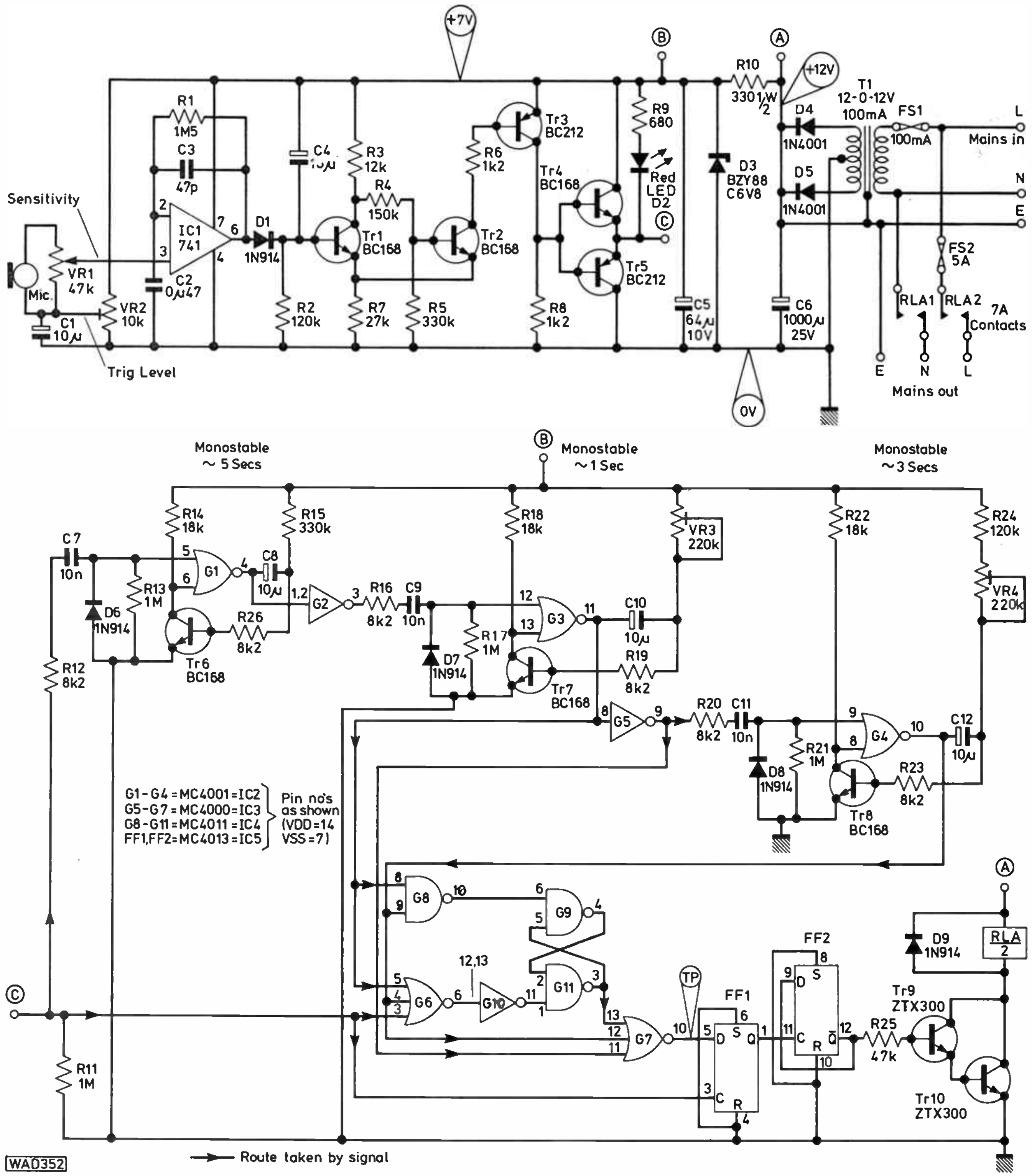
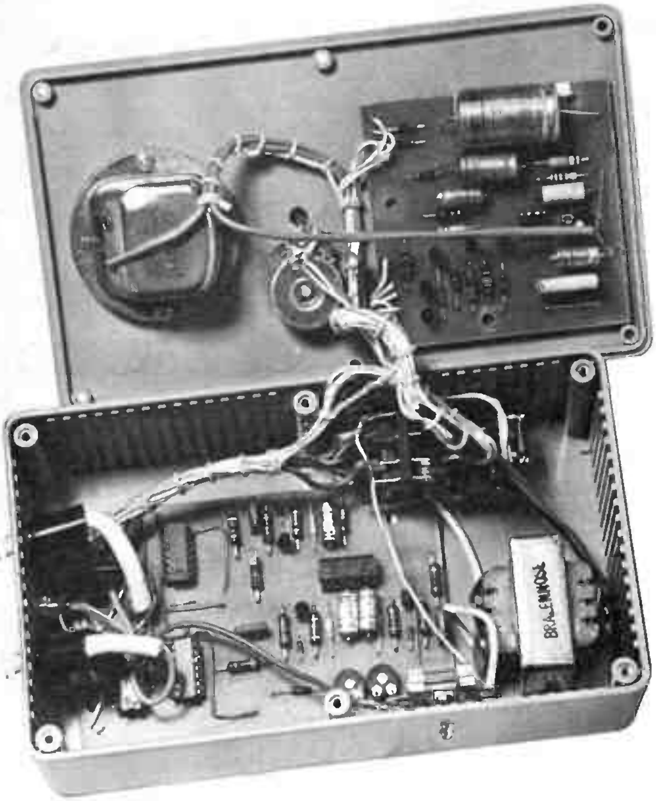


Fig. 1: Circuit diagram of the selective sound operated switch

The mains transformer is a 12-0-12V type designed to supply up to 100mA d.c. from a full-wave rectifier. Most of the current is drawn by the relay (60-80mA) with the rest taking less than 20mA. Thus if a relay is used which draws more than 80mA a larger transformer will be needed. A 100mA fuse is shown connected to the primary of the transformer and this is necessary for safety. If it is found that the fuse blows on switch-on an anti-surge fuse can be fitted. The other fuse supplying the appliance being controlled should be rated according to the relay contacts and mains cable used.

A suitable case for the unit can be made from a plastics Bimbox. When fitting components into the case, it is important to keep all the high voltage components (relay, transformer and fuse holders) well away from the other components so that there is no chance of any live connections touching any other part of the circuit. Holes are drilled in the case for the microphone, the l.e.d. and the gain control VR1. The circuit boards should be positioned within the case such that the presets VR2-VR4 can easily be reached to be adjusted. The boards are held in place using self-adhesive pads. When wiring up between the circuit boards, it is very important that all the supply rails are connected up correctly because the c.m.o.s. chips can be damaged if an input is fed to them before the power rails are connected.



The components and p.c.b.s are fitted into a plastics Bimbox. The two p.c.b.s are attached to the box base and lid using self-adhesive foam pads

Setting Up

First set VR3 and VR4 midway along their tracks. Set the gain control VR1 to minimum. It should be found that as VR2 is moved the l.e.d. will light at one end of the track and be extinguished at the other. Adjust VR2 until it is just extinguished. Then turn the gain control VR1 up a little. It should now be found that any loud sound near the microphone will cause the l.e.d. to flash on for just under a second. If it stays on or does not come on at all then adjust VR2 until the response is satisfactory. Next, connect a voltmeter between the 0V rail and pin 10 of IC3 (marked TP in the diagram) or, if no meter is available, disconnect R25 from IC5 and make a temporary connection from that end of the resistor to pin 10 of IC3.

It should now be found that if, after at least 5 seconds of silence, a sound is made near the unit loud enough to make the l.e.d. flash, then a short pulse of approximately +7V will be indicated on the meter, or the relay will close momentarily about one second after the sound. If this does not happen adjust VR3 and VR4 until it does. This is the period during which the device is sensitive and it will switch the load if a second sound is made during this period. Adjust VR3 and VR4 until the time period is satisfactory. Note, however, that if the values of the presets are made too low then the monostables will stop working, so that if a satisfactory time period cannot be achieved then it may be necessary to change C8 or C12. Do not make the "sensitive" period too short or it will be found very difficult to estimate the required time interval.

After R25 has been replaced in its correct position and the lid has been attached, then the unit is ready for use.

★ components

Resistors		
¼W 5%		
680Ω	1	R9
1·2kΩ	2	R6, R8
8·2kΩ	6	R12, 16, 19, 20, 23, 26
12kΩ	1	R3
18kΩ	3	R14, 18, 22
27kΩ	1	R7
47kΩ	1	R25
120kΩ	2	R2, 24
150kΩ	1	R4
330kΩ	2	R5, 15
1MΩ	4	R11, 13, 17, 21
1·5MΩ	1	R1
½W 5%		
330Ω	1	R10
Potentiometers		
Horiz. miniature preset		
10kΩ Lin.	1	VR2
220kΩ Lin.	2	VR3, 4
¼inch shaft		
47kΩ	1	VR1
Capacitors		
Disc ceramic		
47pF	1	C3
10nF	3	C7, 9, 11
Polyester		
0·47μF	1	C2
Electrolytic		
10μF 25V	5	C1, 4, 8, 10, 12
64μF 16V	1	C5
1000μF 16V	1	C6
Semiconductors		
Diodes		
1N4001	2	D4, 5
1N914	5	D1, 6, 7, 8, 9
Red l.e.d.	1	D2
BZY88 C6V8	1	D3
Transistors		
BC168	6	Tr1, 2, 4, 6, 7, 8
BC212	2	Tr3, 5
ZTX300	2	Tr9, 10
Integrated circuits		
741	1	IC1
4000	1	IC3
4001	1	IC2
4011	1	IC4
4013	1	IC5

Miscellaneous
Bimbox (190 x 110 x 60mm BIM 2006/16); Mains transformer 12-0-12V 100mA (1); Relay 12V 80mA max. 7A 240V d.p.c.o. (1); Fuse holder (2); Fuses 100mA and 5A; Balanced armature earpiece (see text) (1); Printed circuit board (2 in set); Sockets, 14 pin d.i.l. (4); 8 pin d.i.l. (1); Knob (1); Mains cable, socket and cable clamps.

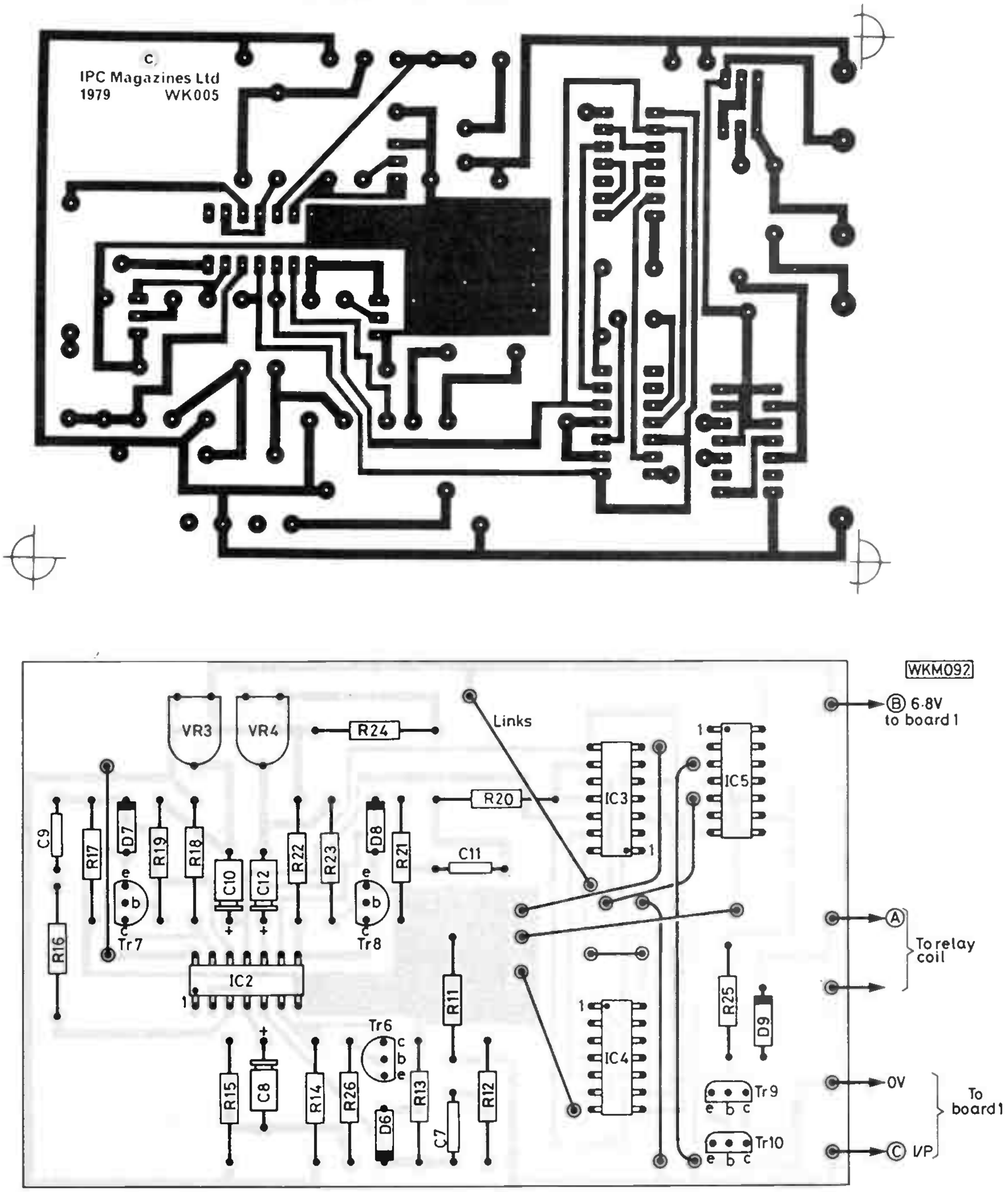


Fig. 2: The copper track pattern and component placement drawing for Board 2 shown full size.

Using the Switch

Adjust VR1 so that the l.e.d. will not flash from background noise in the room, but will reliably respond to a hand clap. The l.e.d. will be found very useful for indicating whether the unit has "heard" a sound or not, when setting the sensitivity.

Although originally intended purely as a gimmick, the device has been found to be extremely reliable and may well have more practical uses. The prototype was left in an average sitting room for a week without triggering spuriously, but would immediately respond on hearing the correct sound sequence.

There could be practical uses where it is necessary to operate equipment remotely, possibly by a disabled person, or in other cases where it is not possible to operate a switch directly.

Fault-finding

Once the design had been finalised, it was found that the units could be relied upon to work correctly immediately they had been assembled and adjusted. Most faults are likely to be caused by wire links in the wrong places and diodes or transistors the wrong way round. Remember that the circuit uses both *npn* and *pnp* transistors. A puzzling intermittent fault in one unit was traced to C6 being open-circuit. This resulted in the supply rails

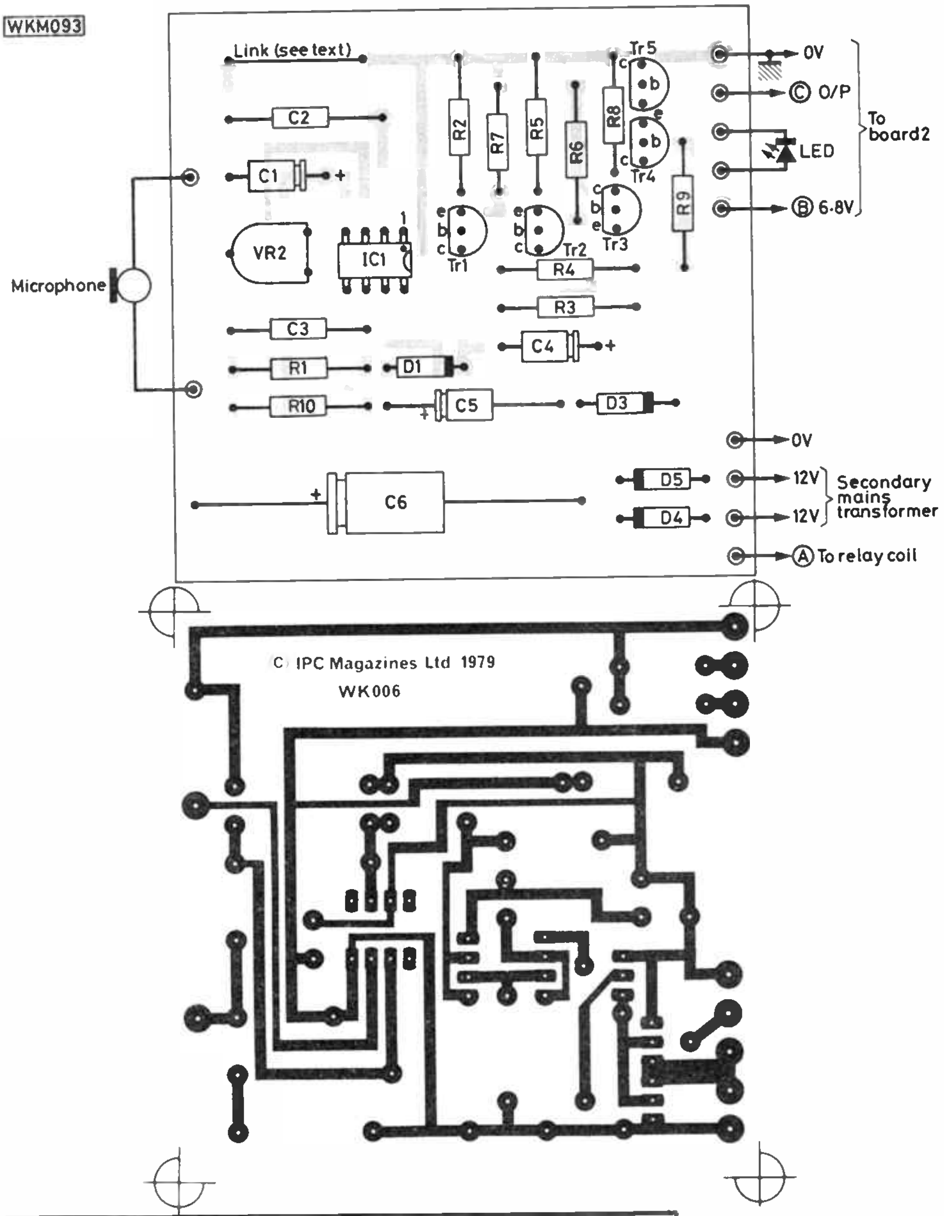


Fig. 3: The copper track pattern and component placement drawing for Board 1 shown full size

carrying unsmoothed a.c. and played havoc with the logic functions.

Provided that the l.e.d. flashes in response to sounds then faults are best traced by first checking the outputs of the monostables (pins 4, 10, 11 of IC2) and then following the voltage levels through the rest of the circuit. Remember that the monostables give an inverse output, i.e. "1" in the quiescent state and "0" when active, and remember also that the circuit takes 5 seconds to complete its cycle and if it receives an input before G1 has reset it will ignore it.

If the l.e.d. does not light up then first check IC1. The voltage on pin 6 (output) should equal that on the wiper of VR2, except at extreme settings of VR2. The Schmitt trigger, Tr1, Tr2 should turn on when the voltage on Tr1 base exceeds about 5V, turning on the l.e.d. via Tr3-Tr5, and should turn off sharply as the voltage is lowered. These functions can easily be checked with a multimeter and should show up the location of any fault. However, provided the unit is constructed carefully, there is no reason why it should not work first time. ●

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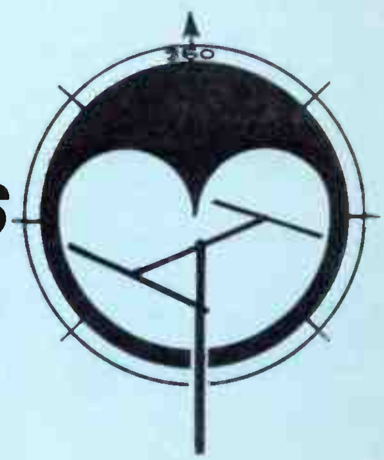
Ultrasonic Remote Control

A short introduction to the use of ultrasonics for cordless on/off control of domestic appliances etc. The article suggests some suitable circuits based on i.c.s intended for use in other fields, allowing the construction of very small transmitters and receivers.

Aerial Design with Scale Models



Aerial designs can be tested and developed easily by building scale models of the proposed systems and making measurements at u.h.f. This article describes how a surplus marine radar display can be adapted to plot the resulting polar diagrams automatically

Plus SPECIAL PRODUCT REPORT on the LOWE SRX-30 Receiver

VMOS top band tran

J. R. Green BSc, G3WVR*

This low-power a.m. transmitter design illustrates the use of power f.e.t. devices—in particular, the VN66AF recently introduced by Siliconix Ltd.—and takes full advantage of modern semiconductor technology. The unit is particularly suitable for use within the 160-metre band, although operation at higher frequencies is quite possible.

Design Considerations

The Author has carried out a great number of experiments with low-power transmitter circuitry using bipolar (i.e. "conventional") devices over the last few years. Some degree of success was achieved in later designs, using the now-defunct BD123, but en route many pitfalls for the unwary were uncovered.

Technically, however, the bipolar device fell down on several counts, notably:

1. High drive power was required; typically 10%, even at low frequencies.
2. Difficulty was experienced in achieving really linear amplitude modulation, even when modulating both the driver and p.a. stages. Modulation of the p.a. only, by swinging the supply rail, was unsuccessful. Modulation of the driver as well was essential and far more modulator power was required.
3. Problems were encountered in achieving stability in the transmitter r.f. strip. Often appreciable "slugging" was called for to prevent h.f. or v.h.f. parasitics.
4. Modulation excursions also tended to introduce instability, often producing undesirable steps of modulation non-linearity in the modulated r.f. carrier envelope.
5. It proved remarkably easy to destroy the p.a. transistor(s) if instability occurred or the transmitter was mis-tuned.

These difficulties led the Author to the conclusion that solid-state transmitter design could be much simplified if a device existed which exhibited the characteristics of a thermionic valve. In particular, low drive power, modulation linearity and stability were desirable in addition to the ability to operate from low voltages. In other words, a high-power f.e.t. was needed.

During 1978, Siliconix Ltd. produced the VN66AF and samples were supplied to further the Author's experiments. The ultimate results are incorporated into the transmitter featured in this article. Whilst the published form is for 160-metres, the basic circuit could be used to produce a transmitter capable of at least 10MHz and possibly more.

Circuit Description

The transmitter employs a crystal oscillator which incorporates a twice-frequency, parallel-resonant crystal, with a TIS88A f.e.t. as the oscillator transistor (Care with substitutes! The circuit may fail to oscillate with devices requiring different d.c. conditions.). This stage provides sufficient drive to switch Tr2, a 2N2369A switching transistor which provides a twice-frequency 5 volt peak-to-peak square-wave to drive IC1. This i.c. is a 7473 flip-flop wired to divide-by-two, thus producing the output frequency "f".

The 7473 limits the "$2f$" crystal to around 6MHz (therefore the output frequency "f" to 3MHz) but this may be extended by substituting a Schottky 7473 (i.e. a 74S73).

From IC1 the signal is passed to Tr3, another 2N2369A switching transistor, to present 12 volts peak-to-peak square-wave drive to the output devices. With Tr3 looking into 100Ω the two VN66AF p.a. devices are easily driven. Their input capacity of 50pF each is the prime limiting factor with untuned drive, although a BFY50 could be substituted for Tr3 and R11 reduced in value to increase the operating frequency or drive more than two p.a. devices. A power output of 6 watts is typical for a 10 watt d.c. input.

A simple "constant K" type low-pass filter is provided, together with transformer matching to transfer the output power effectively into a 50Ω load and remove harmonics.

* *Senior Development Engineer—Gould Instruments Division*

smitter

Note that since a 1:1 mark-space square-wave drive is derived for the p.a., optimum efficiency with minimal second-harmonic radiation in the unfiltered output is assured, with the filter biting hard at the third and subsequent harmonics.

Filter values shown are for a cut-off frequency of 2500kHz, but others may be calculated from the expressions:

$$C = \frac{1}{f_c \pi z} \quad \text{and} \quad L = z^2 C$$

$$\text{where } z = 50\Omega \quad \text{and} \quad L = L1 = L2 = L3$$

$$C = C_{10} = C_{11} \quad \text{and} \quad C_9 = C_{12} = \frac{C}{2}$$

f_c is the cut-off frequency.

The modulator circuit is merely a modified version of the Author's hi-fi amplifier design and should not present any problems. A speaker matching transformer rated at 10 watts (T2) is used to transfer the modulator power to the p.a. This should have a core area of around 25mm square and a winding resistance between the 0 and 16Ω taps of not more than 1Ω. The modulator input sensitivity is in the order of 100mV, so a pre-amplifier will be necessary for microphone level signals.

The r.f. matching transformer T1 was wound on a Mullard binocular "balun" ferrite block, measuring approximately 25 × 20 × 8mm and consists of three turns on the primary (transistor) side and nine on the secondary (filter) side. Experiments using these baluns showed a power-handling capability of 100 watts peak! Substitutes should have the following characteristics:

1. Suitable for the intended operating frequency.
2. 1:3 turns ratio for 6 watts, 50Ω output with wire gauge as large as possible.
3. 50Ω secondary reactance to be ≫50Ω at operating frequency.
4. Peak power rating of at least 20 watts.

If a suitable ferrite block cannot be found, three Mullard FX2249 blocks can be used.

No Adjustments Needed!

It will be apparent from the r.f. circuitry that no tuning is required on the r.f. strip, which should work from switch-on. Trimmer VC1 is used for very fine frequency adjustment and could well be omitted, replacing it with a fixed capacitor of 18pF if the facility is not required. The pre-set potentiometer VR2 should be rotated until Tr11 and Tr12 just start to conduct—say 50mA of standing current.

The VMOS VN66AF devices performed very impressively throughout the development of the prototype transmitters. Only very low drive was necessary and very linear upward and downward modulation was produced. In every respect, the devices performed entirely to specification and simply shut down if an unacceptably-low load was connected.

Possibly it will be found that the modulator output is not quite sufficient to achieve 100% upward modulation but with a suitable transformer the quality is very good indeed and certainly far superior to so-called "communications quality", which covers a multitude of sins!

Construction

The construction techniques are clearly seen in the photograph, most of the components being soldered and mounted on one side of a double-sided "earth-plane" printed-circuit board, measuring 160 × 100mm. The top of the board, the component side that is, forms an earth-plane and the copper should be cleared (using a drill and an outsized bit) around the larger holes indicated in Fig. 2. The remainder form earth-plane connections. Details of the p.c.b. are given in Fig. 2 and the component locations are shown in Fig. 3.

The modulation transformer T2 is mounted on the bottom panel of the West Hyde Developments instrument case, as are Tr4 and 5 (on insulated washers). Transistors Tr11 and 12 are mounted on the extrusion as shown in the photograph. (In fact, the VMOS devices could also be fixed in the same manner, if preferred).

For the prototypes, the p.c.b.s were made by the rather laborious drilling-painting-etching-cleaning techniques, which are more arduous than difficult. However, constructors who wish to purchase ready-made boards will find them available from advertisers.

Components used in the output filter should be exactly as specified—i.e., abnormally high voltage capacitors to take high circulating currents and air-cored inductors to avoid the saturation which would occur with the smaller type of ferrite cores. Remember that the filter is passing 6–7 watts of r.f. energy and retaining 1–2 watts of harmonic energy.

Loss of harmonic power and the bottoming resistance of the power f.e.t.s are the principal causes of efficiency loss in this transmitter. The filter values may be "scaled" for other frequencies.

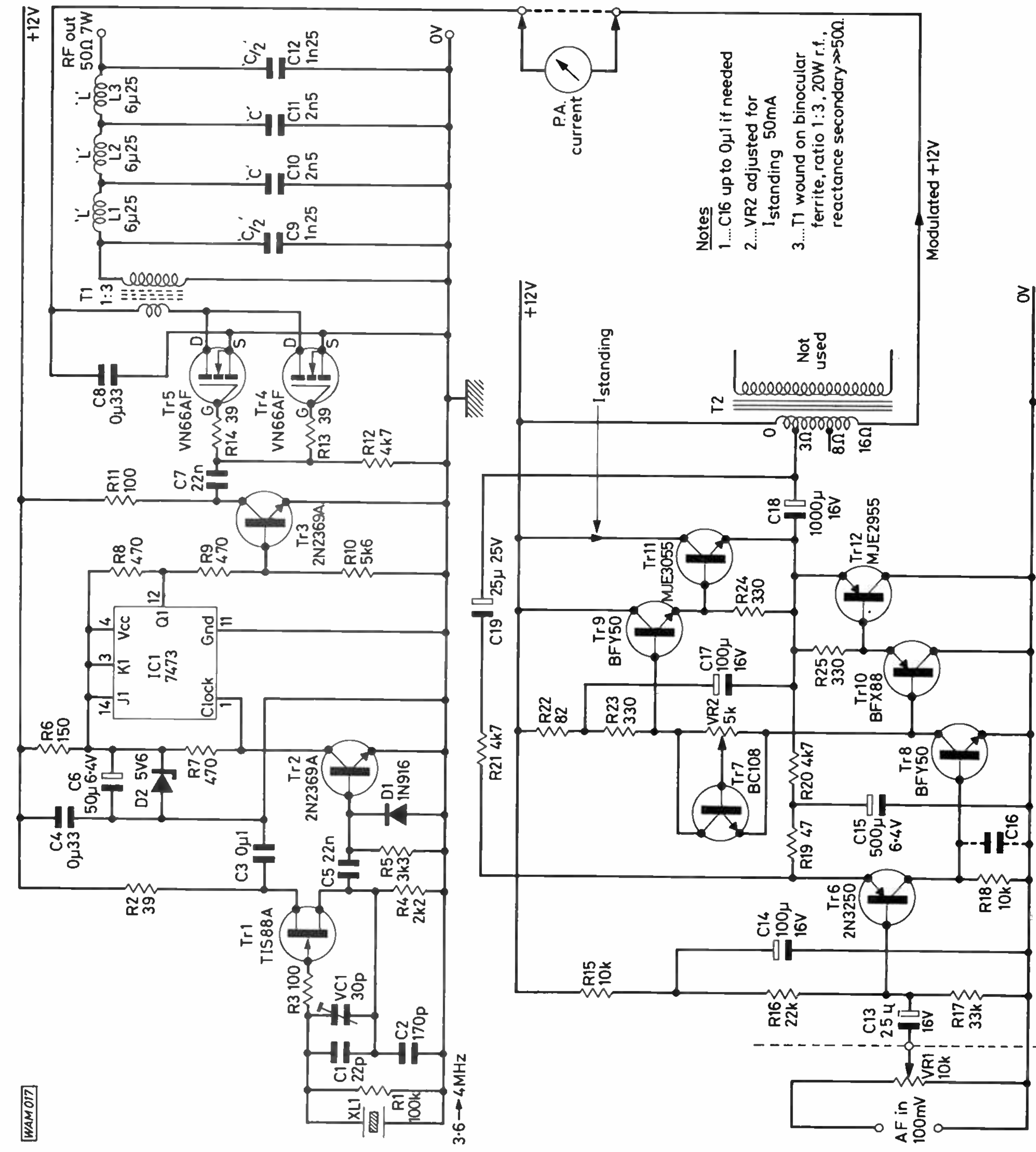


Fig. 1: Circuit diagram

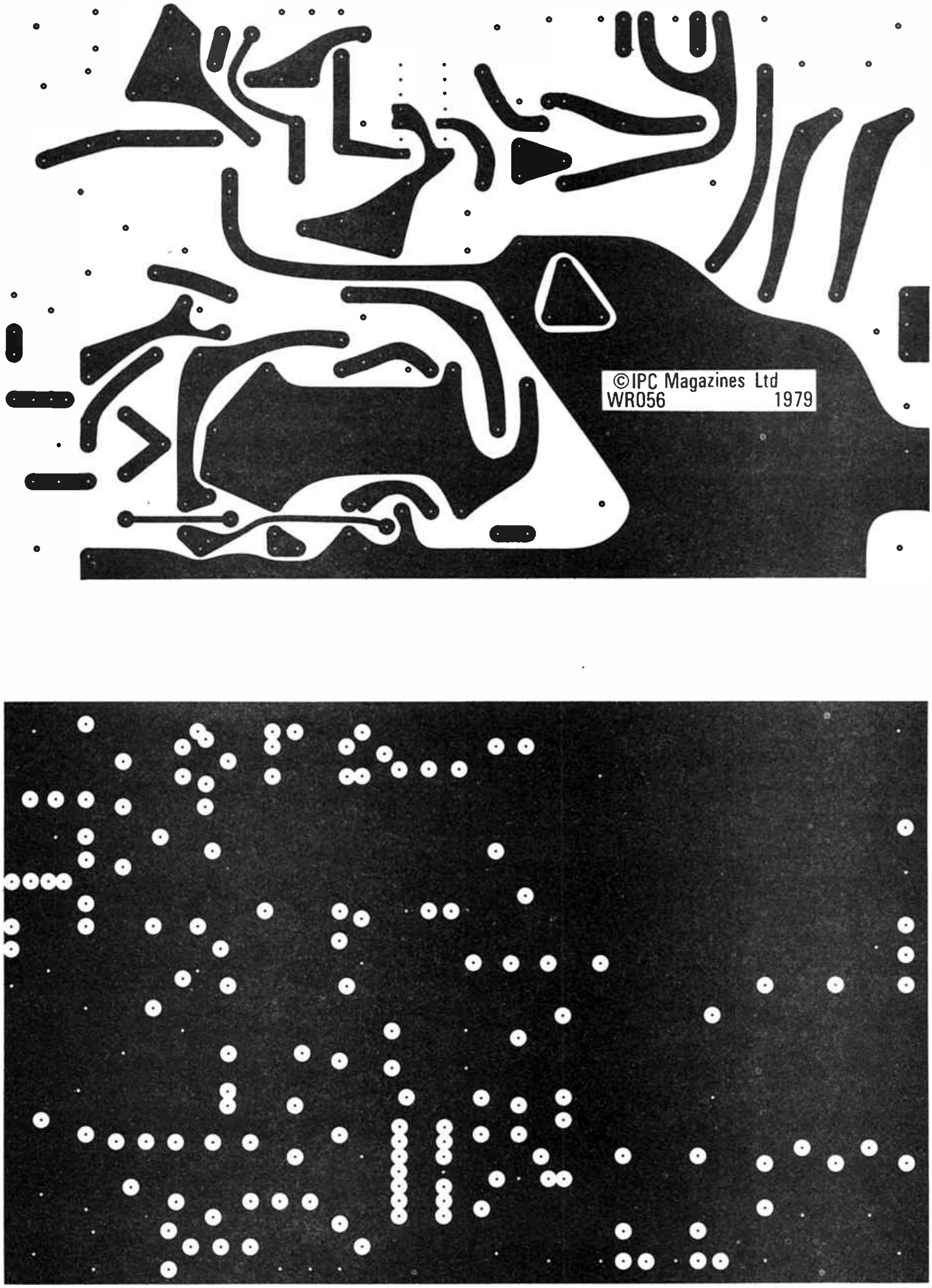


Fig. 2: The copper track side of the p.c.b. is shown full size at the top with the copper ground plane on the component side below it.

★ components

Resistors

¼ watt 5% Metal Oxide

39Ω	3	R2, 13, 14
47Ω	1	R19
82Ω	1	R22
100Ω	2	R3, 11—see text
150Ω	1	R6
330Ω	3	R23, 24, 25
470Ω	3	R7, 8, 9
2·2kΩ	1	R4
3·3kΩ	1	R5
4·7kΩ	3	R12, 20, 21
5·6kΩ	1	R10
10kΩ	2	R15, 18
22kΩ	1	R16
33kΩ	1	R17
100kΩ	1	R1

Potentiometers

5kΩ	1	VR2 Skeleton pre-set
10kΩ	1	VR1 Log. Panel mtg. pre-set with locking nut and cap

Capacitors

Silver Mica

22pF	1	C1
170pF	1	C2 180pF may be necessary

Ceramic disc

22nF	2	C5, 7
0·1μF	2	C3, 16 see text
0·33μF	2	C4, 8

Polystyrene 350 volt

1·25nF	2	C9, 12 (Use 1·2nF)
2·5nF	2	C10, 11 (Use 2·2nF)

Tantalum bead, 16 volt

25μF	1	C13
47μF	1	C14 100μF may be used

Electrolytic, axial leads

25μF 25V	1	C19
50μF 6·4V	1	C6
100μF 16V	1	C17
220μF 16V	1	C15 470μF may be used
1000μF 16V	1	C18

Trimmers

Dau type ceramic

3–30pF	1	VC1 see text (from J. Birkett)

Semiconductors

Diodes

1N914	1	D1 1N916 may be used
1N5339B	1	D2 5·6 volt Zener

Transistors

TIS88A	1	Tr1
2N2369A	2	Tr2, 3
VN66AF	2	Tr4, 5 (from C. Bowes & Co.)
2N3250	1	Tr6
BC108	1	Tr7
BFY50	2	Tr8, 9
BFX88	1	Tr10
MJE3055	1	Tr11
MJE2955	1	Tr12

Integrated circuit

SN7473N	1	IC1 SN74S73N for higher frequency operation

Crystal

XL1 Twice-frequency HC6U type, parallel-resonant

Inductors

Calculated filter values for 160 metres:
6·25μH, fc = 2·5MHz.

L1, 2, 3 — 38 turns of 26 s.w.g. enamelled copper wire on 25mm long 8mm diameter former, air cored.

Transformers

T1 20 watt rating r.f. transformer (peak). Turns ratio 1:3, secondary reactance ≫50Ω, wound on suitable binocular balun-block ferrite (or 3 type FX2249, see text).

T2 10 watt rating speaker matching transformer with 0–3–8–16Ω taps. The step-up ratio using 0Ω as common 3Ω as input and 16Ω (or 15Ω) as output is a fraction in excess of 1:2.

Hardware

Insulating kits for VN66AF transistors (2), MJE3055 and MJE2955. Socket for crystal. 50Ω BNC connector (or SO239). West Hyde Developments instrument case type "Classic" CL2ADK (See advertisers' index). Printed-circuit board.

Setting Up

A very short section this! No tuning is required and the r.f. strip should work straight away. The d.c. input current to the final stage can be monitored and should be about 800mA when looking into 50Ω. Other loads will affect the p.a. current and in extreme cases may require some sort of matching transformer.

Poor quality "inactive" crystals will reduce the oscillator drive level and this may reach proportions where Tr2 will not switch and consequently there will be no output.

The quiescent current of the modulator should be set at around 50mA by means of VR2. If this adjustment is a smooth one all is well, but if the current flicks up to a high value check for amplifier instability. This can be cured by fitting C16, which also helps to keep r.f. from reaching the modulator.

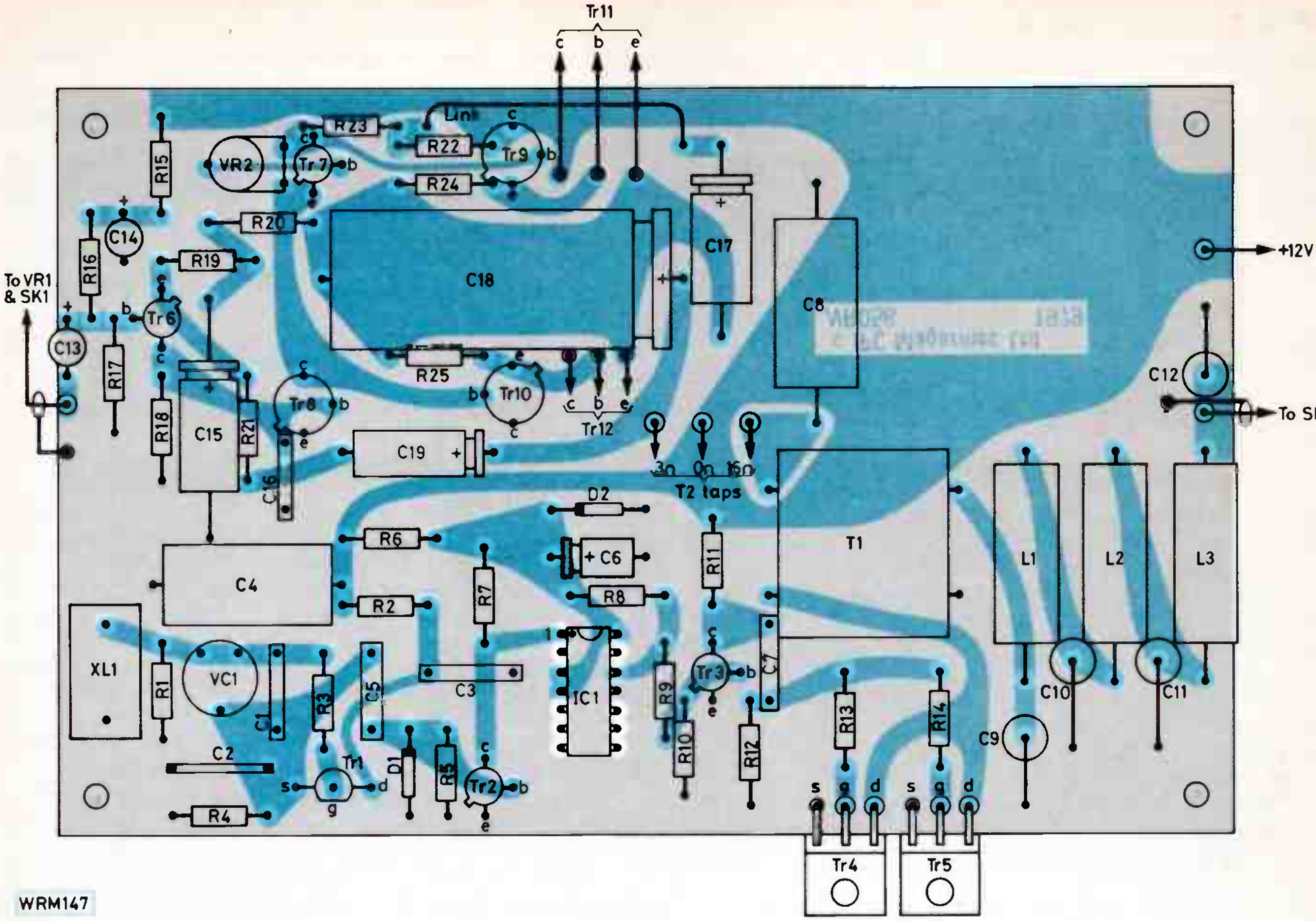
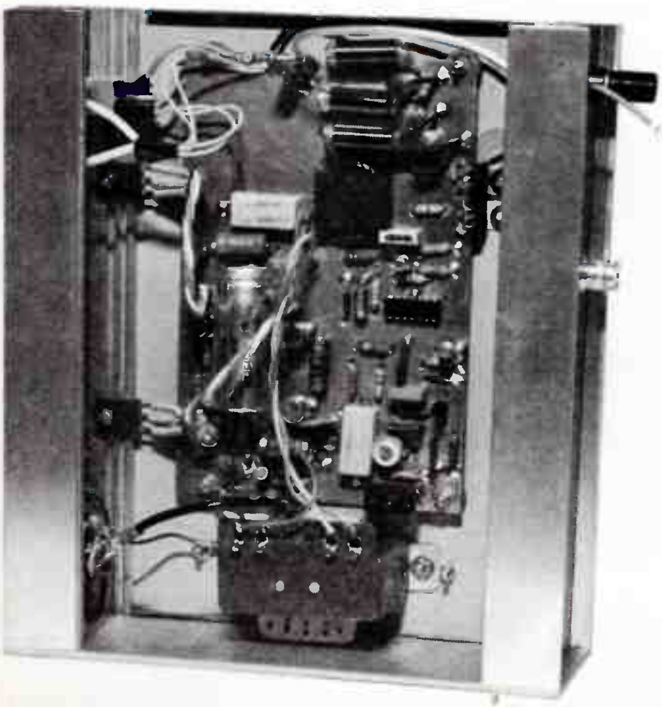


Fig. 3: The component placement drawing of the p.c.b. showing the ground plane (component) side of the board.



Aerial Matching

Most low-frequency aerials in amateur use are unlikely to present a good 50Ω match due to their small electrical size. The following techniques, based on a little theory and a lot of experimentation, are suggested.

The transmitter filter is quite tolerant of a mis-match—say 30–80Ω—but placing a low impedance load on the output may violate the d.c. input power requirements. A really low load will cause the VN66AFs to overheat, but do not worry if this should occur; adequate protection is afforded within the devices, and they will merely shut down.

VFO Operation

Those who develop the transmitter may well wish to add the facility of v.f.o. operation. This is easily achieved by feeding the twice-frequency v.f.o. signal, at 2 volts peak-to-peak, into C5, in place of the injection from the crystal oscillator.

No problems with f.m. pulling should be encountered, as the v.f.o. and output frequencies are not the same.

Well, now you know how to build and operate your VMOS transmitter. Incidentally, the VN66AFs should only cost around £1 each. We hope it brings you enjoyment.

Changes in BROADCAST-BAND LISTENING on Short Waves

PART 1

Jonathan MARKS

If you follow *Practical Wireless* regularly, then by now you may have put together or bought a short-wave general coverage receiver. Tuning around between 3 and 30MHz it soon becomes apparent that the spectrum is divided into blocks which are used for various purposes. If you listen between the frequencies 5950–6200, 7100–7300, 9500–9775, 11 700–11 975, 15 100–15 450, 17 700–17 900, 21 450–21 750 and 25 600–26 100kHz you'll hear radio programmes originating from broadcasting organisations all over the world. These radio stations are obviously different from the BBC or IBA domestic broadcast channels that the general public are used to, since their target audience is often a whole continent if not the world, rather than a single country or indeed a particular town.

A first flick through any short-wave (usually abbreviated to s.w.) broadcast band may prove disappointing. Many stations seem to be talking in foreign languages and are all crowded together. The secret with this hobby though is slow, careful tuning and frequent checks on "who's around". Most stations put out a magazine-style programme of about half-an-hour's duration in a number of languages, and with English the most common international language there are few stations without an English section. Indeed many s.w. stations broadcast specifically to Great Britain and Ireland every evening with programmes in English.

Station Types

Short-wave broadcasting stations fall into two main categories. The first group of stations aim to provide their listeners with news which is unlikely to hit world headlines (and therefore overseas newspapers and radio bulletins), yet never-the-less would be interesting to people with a desire for information on world events and culture. Such stations are usually given a grant by their government, but the journalists and broadcasters are given a free hand to make programmes without government censorship. Hence the programmes give an objective, often critical insight into current affairs in the country, the reaction of its people to world events and a sample of the culture, music and perhaps even language. Stations in this category include Radio Finland, the Swiss Broadcasting Corporation, Radio Canada International, Austrian Radio, Radio Sweden and the BBC World Service.

In the second category are the government-run stations, whose main aim is to put over the political views of the government in power. As a result programming is rather one-sided, promoting only national achievements and churning out masses of statistics. That aside, such stations can be a source of quite fascinating information, and it is often interesting to compare their version of a news story with others, either in your national newspaper or on TV. Such government-run stations include Radio Moscow, Radio Peking, Radio Berlin International, Radio Tirana and the Voice of Vietnam.

ABOUT THE AUTHOR

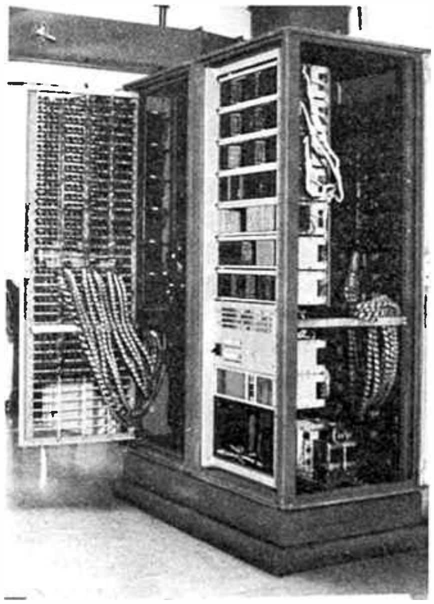
Jonathan Marks is a broadcaster/journalist who formerly worked in Vienna for the Austrian Radio Short Wave Service, becoming involved with the weekly SWL news programme "Austrian SW Panorama", broadcast world-wide every Sunday. Since returning to the UK, he has continued to make regular contributions to the programme, and is an active DX enthusiast

A view of the BBC Monitoring Service listening room, as seen from the console

Photo courtesy BBC

Austrian Radio studio centre in Vienna, with s.w. section in foreground

Photo courtesy ORF, Vienna



Computer-controlled switching gear selects appropriate transmitters and aerials to suit propagation conditions

Photo courtesy ORF, Vienna

Continuity suite for Radio Sweden. The cartridge machine on the left provides multi-lingual station identifications

Photo courtesy Arne Skoog, R. Sweden

Reception Reports

While reading *PW*'s "On the Air" feature you may have heard of QSLs and reception reports. These are really terms adopted by the broadcasting stations from the amateur radio world, and go back to the early thirties when many s.w. stations started up. In those days, stations didn't know if they were being heard in the target areas at all, and so in return for a listener sending in a report of reception (containing details of time, date, frequency and quality of reception, plus notes on the programme heard and receiving equipment used), stations would issue a confirmation card or QSL. This consisted of a picture postcard with the time, frequency and date of the transmission heard confirmed in writing on the back.

Many stations still send out QSLs, but since the thirties there have been a lot of changes on the technical side. Stations now use very much higher power (many in the order of 500kW), and because of the existence of professional monitoring stations, the larger broadcast stations know exactly how they are being received in target zones. Thus, as far as these stations are concerned, listeners' reception reports are now of marginal interest and the QSL card is more of a public relations venture since the reports are not checked. However, the smaller stations operating in only a few languages (especially religious stations), still need reception reports from listeners. They have only a limited budget and very much lower powered equipment, so regular reports on more than one frequency remain very important.

How can you judge if the station wants your report? The answer is to look in an excellent annual publication called the *World Radio and Television Handbook* which is available through most bookshops. It lists all known radio organisations in the world and where and when to listen out for them. It will give you a clear idea as to the size of the station, its QSL policy and the exact address to send your report to. In general, the smaller the station the more welcome your reception report, with the exception of small stations in West and Central Africa and South Amercia. Stations in these areas use s.w. for domestic broadcasting in much the same way as v.h.f. is used in Europe, and distant reception reports are usually QSLd only out of courtesy.

Programmes

All international broadcast stations, large or small, welcome your comments on the programmes heard. Over the last 10 years, programming standards have improved enormously compared with the sixties when most stations were of the "cold war" variety, deadly dull and boring. Then, the hobbyist could do little but send a technical reception report. In 1979, though you'll still find some pure propaganda stations, most stations in the Western world (and even a few in the Eastern Bloc) have woken up to the fact that sheer political fact switches Mr Average SWL off. Instead you can now find interesting, well-presented cultural material, whether it be tips on hitch-hiking across Sweden, eating out in Brussels, getting around in Tokyo or exploring caves in the Alps of Austria. Younger listeners too are catered for, with music programmes which broaden one's outlook on the pop music scene and enable one to get world-wide contacts. It is also important to point out that listeners who provide stations with critical constructive comments are well respected by the editorial staff.

Who listens to these international s.w. programmes? In the UK, s.w. broadcast listening is not widely known. Radios sold today in the average British hi-fi shop have no facilities for s.w. listening, but this is not the case in other parts of Europe. In West Germany or Finland for example, thanks to publicity of SWL clubs and the availability of suitable sets, SWL means more to the man in the street. There are signs though that the UK may be catching up on its European neighbours, as good s.w. receivers become cheaper thanks to integrated circuits, and digital readout eases the tuning problem. Also with more holidays being taken abroad, people like to keep in touch with countries they've seen. In the USA and Canada, s.w. is catching on simply because listeners are fed up with their local station full of commercials, time and weather men and rip-and-read news.

The more factual style of s.w. is also important in the developing countries, where radio is very different to Europe. There is usually no v.h.f. or m.w. service, and s.w. radio is the only means for the government to reach listeners in its own country. Thanks to ionospheric propagation though, signals from other countries (e.g. in Europe) can also reach developing countries. The BBC's African Service for example, thanks to a network of on-the-spot correspondents, provides a very fast, accurate picture of what is going on in Africa for African listeners, often before the national radio station reports it. Of course politics comes into play here. Many stations in the Western world beam vernacular programmes towards a developing country which disagree with what the national government station in that country is saying; something which often worries the latter if it is trying to influence its population.

Local Stations

Most stations in Latin America broadcast on the 60 metre tropical s.w. band (4750–5060kHz) instead of medium waves, which are full of static due to tropical thunderstorms. Propagation is such that from about midnight until dawn in the UK you can hear these stations broadcasting to their local population: an excellent insight into Latin America with wide opportunities to study the language or simply enjoy the music. Such small stations in the jungle run on a shoe-string and provide amusing stories for those who've visited them.

The official time signal on one station in Peru for example, turned out to be made by a simple audio oscillator triggered by the DJ watching the second hand on an ancient clock. A station in Bolivia came up on the wrong frequency for over a month because the station engineer had plugged in the wrong crystal. Similar stories come from Asia where the national station in Nepal sometimes comes on the air late when they forget to switch on the carrier of the transmitter. All this added together makes for a fascinating hobby.

The secret is to know when and where to look. One of the best ways is to contact one of the UK Broadcast DX Clubs as well as reading "On the Air". In addition stations themselves put out SWL programmes to assist listeners, for example: *Sweden Calling DXers* (Radio Sweden), *World Radio Club* (BBC World Service), *Austrian SW Panorama* (Austrian Radio), *World DX News* (AWR, Portugal) and *DX Juke Box* (Radio Nederland) to name just a few. In addition, an organisation exists in the UK, called the Handicapped Aid Programme, to help introduce this hobby to the disabled. Undoubtedly, broadcast listening can open up new horizons for a person who is house-bound, and no licence is needed.

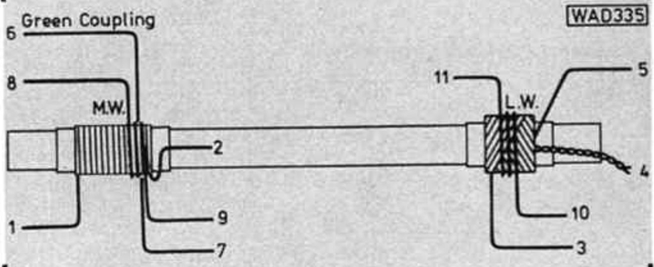
Finally, if you would like to combine your hobby with a holiday, then you might consider joining a DX camp for a few days. These take place during the summer months in Austria, West Germany, Sweden, Finland and, starting in 1979, in the UK. These meetings offer an excellent chance to try out new equipment and antennas as well as meeting fellow DXers and SWLs. Such camps are often co-ordinated under the European DX Council which acts as an umbrella organisation for European clubs and has a number of useful publications for broadcast band listeners. Meetings on a local basis also explode the myth that a typical SWL is someone who hibernates in his shack, to find friends all over the world but none in his own country!

CONTINUED NEXT MONTH

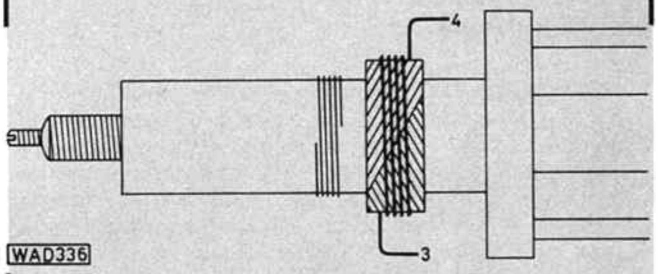
KINDLY NOTE!

PW Imp 3-Waveband Receiver May 1979

The details of the extra windings to be added to the coils were unfortunately omitted from Figs. 5 and 6. They are given below.



Additional reaction windings. 38s.w.g. enamelled copper wire. 8-9, 2 full turns in sense shown above; 11-10, 2 full turns in sense shown above. Note that the coils should be on the rod as shown so that the windings are in the same direction from the 'live' ends (1 and 3).



Reduce winding 5-7 to 2 turns. Add 12 turns of 38s.w.g. enamelled copper wire on top (3-4) in direction shown above.

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RADIO SPECIAL PRODUCT REPORT

FRG-7

YAESU

GENERAL COVERAGE RECEIVER

There are many types of communications receivers currently available, the choice of which is initially determined by where the user's interests lie. General-coverage receivers, as the name implies, cover a range of frequencies which include broadcast bands, amateur bands and other communications channels, and the Yaesu FRG-7 falls into this category.

On the other hand, if only the amateur bands are required, then receivers for this purpose, offering a greater bandspread over these frequencies, are available.

In both instances, the tuned frequency may be displayed by "conventional" analogue means, or a digital readout, which gives the tuned frequency in illuminated digits.

The FRG-7 tested by *PW* was already fitted with a digital readout when supplied by SMC Ltd. This is an option which can be retro-fitted to existing FRG-7s and replaces the original dial unit with a $4\frac{1}{2}$-digit red l.e.d. display. The digital display indicates the kilohertz part of the frequency to which the receiver is tuned, while the megahertz part is set using the original MHz knob in conjunction with the "Lock" indicator lamp and the "Band" switch.

A Preselector control is provided which enables the r.f. circuits to be tuned for optimum signal. This control operates a vertically mounted drum which has four bands marked on it. The Band switch selects the basic range over which the Preselector and MHz controls operate, at the same time illuminating the appropriate preselector band.

The "Lock" indicator lamp is extinguished when the MHz tuning control is correctly set to mid-band.

The main tuning control is fitted with a large diameter handwheel knob which has a large felt washer fitted behind it to provide a measure of friction although by no stretch of the imagination could the control be described as flywheel. The fine tune control is fitted just to the right of the main tuning knob and was positioned too close to the main knob for comfort. It proved to be annoying when, after getting the main control set, operating the fine tune meant that one's thumb or index finger caught the large knob putting the set off tune. The fine control also seemed to be much too coarse in operation making precise adjustment of setting, so essential for successful s.s.b. listening, very difficult. In fact with an adjustment of $\pm$6kHz over 180° swing it was only four times better than the main control and it was almost as easy to set the tuning using only the main control and ignoring the fine one. As supplied the fine control operated in reverse to the main control but this was easily altered by slackening the grub screw of the knob and turning the knob through 180°.

An input attenuator is fitted with a three position switch labelled DX, NOR, Local. The handbook indicates that in the DX position a station which is swamping the set can be attenuated to enable a weaker distant station to be received. We were not able to verify this as in the Bournemouth area no signals seemed strong enough to overload the front-end. All the attenuator seemed to do was cut down the signal strength, so the set was operated with the attenuator in the normal position.

The Tone switch changes the audio response of the receiver and has three positions, 250Hz to 3kHz, 400Hz to 2·5kHz and 250Hz to 1·5kHz.

The other front panel controls fitted are a volume control and the Mode switch. A horizontal scale S-meter is fitted above the tuning dial. The dial lamps can be switched off independently of the main power, which cuts down on current drain from the battery pack when running from batteries.

The audio output, rated at 2 watts, is not hi-fi but is presentable and enables the receiver to be used on the broadcast bands.

A pair of phones can be used instead of the speaker fitted, the phone jack being on the front panel together with the jack for the record output.

The performance of the FRG-7 on a.m. was excellent with a very good single-signal response. However, on s.s.b. and c.w. the set lacked selectivity with the standard filters. Alternative filters are available as optional extras but were not tried in this test.

Three sockets are provided on the rear of the case for aerials. Two of these are push-type terminals for long-wires while the third is a SO239 socket for use with a coaxial type

THE WADLEY LOOP

The FRG-7, in common with many other contemporary communications receivers, employs the Wadley Loop, triple-conversion superheterodyne system. This offers a number of advantages in terms of performance.

A high first intermediate frequency can be used, in this case around 55MHz, giving good image (second-channel) rejection. The problems inherent in achieving satisfactory frequency stability in the first oscillator ("MHz Set"), which must operate in the v.h.f. band and tune over a range of some 30MHz (55·5–84·5MHz), are overcome by mixing its output in twice, so that any errors due to drift are self-cancelling.

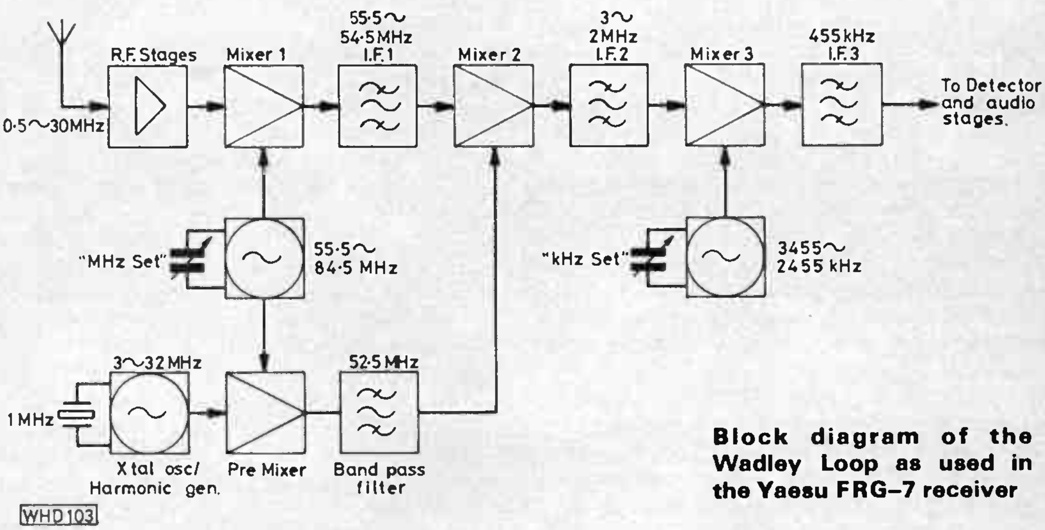
As shown below, this is done by mixing the first oscillator output with a spectrum of harmonics from a stable 1MHz crystal oscillator. The product at 52·5MHz is selected by the Band-pass Filter and mixed with the 1MHz-wide band of signals coming from IF1 to translate them to the band 3-2MHz for IF2.

The output of IF2 is mixed with the output of the "kHz Set" oscillator in Mixer 3. Because this oscillator operates at a reasonably low frequency, and over a band just one megahertz wide, it is not too difficult to make it adequately stable. The output of Mixer 3 is at 455kHz, and is passed to a conventional i.f. filter/amplifier chain, detectors and a.f. stages.

Because there are no conventional band switches other than in the r.f. preselector stage, problems due to varying contact resistance in the oscillator circuits (a common cause of instability) are eliminated. Because the whole range of 0·5–30MHz is tuned in bands 1MHz wide, the tuning resolution of the receiver is the same at 1MHz as at 30MHz.

Disadvantages of the system are the large number of mixing stages employed, calling for careful screening and filtering if spurious products are to be kept low, and the need to design efficient filters operating in the v.h.f. band, for IF1 and the Band-pass Filter.

The actual frequencies adopted in the early stages of receivers using the Wadley Loop principle vary between different models; those shown here are as used in the FRG-7. Anyone checking the sums for themselves may wonder about the fact that the "MHz Set" oscillator tunes down to 55·5MHz, which is within the passband range of IF1, inferring that the receiver will tune down to zero frequency! In fact the lowest band is cut off at just below 0·5MHz by the response of the r.f. stages, and on that band, the signals passed to IF1 are limited to 55–54·5MHz and those in IF2 to 2·5–2MHz. The "kHz Set" oscillator only tunes over 2955–2455kHz on this band. In many Wadley Loop receivers, IF2 is fixed-tuned with a 1MHz passband, but in the FRG-7 it is tuned in step with the "kHz Set" oscillator.



Block diagram of the Wadley Loop as used in the Yaesu FRG–7 receiver

feeder and this is electrically common with the push terminal labelled SW1. This can cause confusion since the coaxial socket is labelled SW1 on the circuit diagram, SW2 on the receiver back panel and to add to the confusion a label immediately above the aerial sockets gives the ranges as SW1, SW2, SW3 and SW4.

The handbook provided with the set was generally good, with an adequate circuit description, a full circuit diagram drawn reasonably well and very legible, a block diagram of the set and a comprehensive components listing.

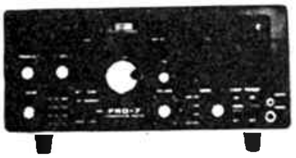
The operating instructions were generally good but there were some omissions. The English was very good for a Japanese model with none of the usual funny sentences which seem to occur during translation from the original.

Maintenance and alignment information together with a voltage chart and p.c.b. component layout drawings should help if it is ever necessary to overhaul or repair the set.

As well as the operating manual, the FRG-7 is supplied with two lengths of copper flex for use as aerials, all the necessary plugs and two spare fuses.

The maker's guarantee is for twelve months but does not include the semiconductors.

THE COMMUNICATIONS RECEIVER THAT HAS IT ALL . . .



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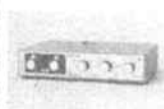

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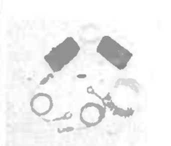

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★ specifications

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Sensitivity: SSB/CW better than 0·7μV for 10dB S/N at 30% modulation

Selectivity: 3kHz – 5dB
7kHz – 50dB

Frequency stability: Within 500Hz during any 30 minute period after warm-up

Input Impedance: 0·5MHz – 1·6MHz High Impedance
1·6MHz – 29·9MHz 50–75Ω unbalanced

Output Impedance: 4Ω

Audio Output: More than 2 watts

Power requirements: 100/110/117/200/220/234V a.c. 50/60Hz or 13·5 d.c.
Negative ground

Batteries: Type UM–1 x 8

Dimensions: 340 x 153 x 285mm

Weight: 7kg without batteries

The standard of engineering is excellent as can be seen from the photograph of the inside of the set we tested.

The receiver was subjected to several air-tests, using a variety of antennas, ranging from a 132ft long wire to a multi-element rotary beam. On the broadcast bands the receiver performed very well indeed and the s.s.b. capability for amateur reception was also quite good. (The latter mode can be quite dramatically improved, incidentally, by the inclusion of the mechanical filter, produced for the FRG-7 by Ambit International.)

The Wadley Loop provides a good degree of stability in the receiver. This is especially necessary for acceptable sideband resolution—at 29MHz, for the receiver to remain within about 25Hz of the tuned frequency, a stability factor of about one part per million is called for. Long-term stability is perhaps less important to the amateur than stability in the short-term, and the FRG-7 performs quite well in this respect. However, since the Wadley Loop system involves multiple conversion, it is difficult to achieve a wide dynamic range, a problem which is overcome to some extent in this receiver by the use of a balanced mixer.

Internal view of the Yaesu FRG-7

Used in conjunction with a 400 watt p.e.p. transmitter, the receiver performed well. Many contacts were made with W, VK, ZL, ZS and so on, some of these on a simple end-fed long-wire antenna. Copy on the h.f. bands was good, but on the more congested frequencies—such as 40m—it was often felt that a little more selectivity would have been nice. Still, "You pays your money . . ." as the old adage goes, and the FRG-7 represents particularly good value.

A 2·4kHz mechanical filter to improve the s.s.b. performance is available from Ambit International, 2 Gresham Road, Brentwood, Essex, priced at £15·30 (inc VAT). We understand that a Yaesu approved s.s.b. filter may be available from SMC in the very near future.

Prices

Basic FRG-7 receiver £210·37
FRG-7 receiver with digital readout £270·00
Yaesu approved digital readout (SMC) £56·25
(All prices quoted include VAT and carriage)

The FRG-7 receiver reviewed was kindly loaned by South Midlands Communication Company Ltd., Osborne Road, Totton, Southampton SO4 4DN. Tel: 04216 7333, and we would like to thank them for their invaluable assistance in this respect.

NEXT MONTH WE REVIEW THE LOWE SRX-30 RECEIVER

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W7OE, U.S.A. Government Electronics Engr. (retd.), claims "VFA 5ft. below ground, same as dipole, elevated 15ft., one "S" point UP on dipole."

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Continued from page 37

should not be taken to Vss via any wire connecting the c.m.o.s. to Vss. When Tr21 is switching a full 140mA, some very strange arithmetic may be evident from the counters if some of the wiring to Vss is common! Anyone contemplating a p.c.b. design is especially warned of this point.

In order to make the touch plate as mechanically simple as possible, a 6BA cheeseheaded bolt was mounted on (but insulated from) the metal front panel and recessed so that the head was flush with the panel. The entire box was earthed and connected to the mains transformer screen, and connected to Vdd via R26 (see Fig. 6).

In this way, a finger placed on the head of the bolt must also touch some of the surrounding painted panel, and this provides sufficient base current to operate the Darlington pair, Tr1 and Tr2. The instrument is thus electrically safe while providing 100 per cent reliable touch operation of the swept-frequency clock.

Fault-finding

It may be found that, on closing S1, the clock does not run. Decreasing R4 to 82kΩ will solve the problem. Similarly, in the swept-frequency mode, it may be found that the clock is still "ticking over" even when C2 is discharged. Increasing R1 to 47kΩ should stop the clock. These problems arise because of the 5% tolerance resistors used to derive quite a precise voltage at point A (Fig. 2). The author has not found this to be a problem, but theory shows that it is quite possible.

The mains switch, S5, is a d.p.d.t. slider switch mounted on the side of the box adjacent to the top of the front panel. It is thus normally out of sight, reducing the temptation to tamper with it.

Summary

This instrument is designed to appeal to children of 2½ years upwards. The visual effects produced by it are pleasant and interesting. There are switches to use, buttons to press, a knob to turn, and a touch-controlled flywheel display. It aids in the teaching of rapid number recognition and matching, without obviously being a "teaching" toy.

It can also be used as a die for other board games when the numbers themselves have become of secondary importance.

With a little judicious help, the child will soon grasp the cyclic nature of counting in the decimal system—the progression from single-digit numbers to dual-digit numbers, the second (tens) digit being the number of complete revolutions of the flywheel, the first (units) digit being the number at which the flywheel stops.

HOTLINES

A REVIEW OF RECENT DEVELOPMENTS
In general, the author does not have any more information on products than appears in the article.

Microprocessor Miscellany

People have long been chanting that microprocessors are going to end up in "everything". One of the latest applications to reach my ageing eyeballs is in typewriters. The new ET 221 for example is not the established "golfball" but a "daisywheel". Built-in is a Z80-based system that uses a number (note: not just one) of 8-bit, single-chip microcomputers. To be sold in the US for under $2000, this new wonder-writer has a 20-character display for showing what you've been typing in line at a time. It can also store lines and page formats too, so it appears to be bordering on a form of word processor.

Another microprocessor application to loom is in controlling motors. When one considers that there are virtually millions and millions of motors in so many different applications, the enormous market becomes apparent.

There are some very good reasons, too, for using microprocessors in this application. The first is that old chestnut—money. For example, many motors rely on costly feedback loop circuitry required for close speed control. It has been claimed that just over £1 worth of digital chip can replace £5 worth of analogue circuitry to do the same job. The microcomputer can also do far more than adjust speed. For example, it can check the motor current against a table of maximum values which it holds safely stored in its ROM. This very same ROM can contain a program that limits both the instantaneous and surge currents drawn by the motor at any given time. This, besides offering a safety factor, also allows the manufacturer to use smaller, and probably cheaper motors to do exactly the same job.

Big Bang Theory

A few Ginsbergs ago I mentioned Lithium batteries. They appeared to offer advantages, but I now hear of disadvantages—like they explode. Perhaps not all Lithium batteries do this, but it is reported from America that the powerful Federal Aviation Administration has ordered that Lithium-Sulphur-dioxide batteries must be removed from emergency aircraft locator transmitters within 30 days. Apparently half a dozen or so reports were received of $LiSO_2$ batteries exploding. Some 6000 aircraft in the US carry equipment that uses $LiSO_2$ batteries.

Mon Dieu

I note with great interest that a British company has come up with an i.c. certain to cause a linguistic stir. By adding it to your teletext/viewdata decoder set, you can have the potential to display the whole lot in one of 28 different languages—Ha so! Perhaps you don't get the whole 28 in one go, but an order has already been received for the chip from across the pond in Canada, where the new i.c. is to enable delighted viewers to see viewdata information in a 20-row format (32 characters/row) in English and French. Had this happened when de Gaulle was in office, the designers would have been given the Legion of Honour and free wine for life. How about it, Giscard?

Stable Arrays

And pleased I am, too, to tell of another British achievement. A well-known establishment has come up with a new way of addressing twisted nematic liquid crystals. The liquid crystal display matrix can be driven continuously over the whole of its area and thus the annoying flicker associated with multiplexed arrays is eliminated.

Complementary m.o.s. (CMOS) powered by only 15V is used to drive a 100 × 100 matrix at around 5kHz. Researchers believe that 1000 × 1000 element arrays are possible. This, coupled with the low voltages and flicker-free display, could have great impact on the small screen TV and scope development. A pocket oscilloscope with a power consumption of, say, 500mW becomes a reality.

Bye-Bye Noise

The Dolby system of noise suppression in audio and hi-fi equipment is now very well entrenched. But a German company has arrived with an alternative—and the claims are that it's better, too. The new system is called High Com and it claims to be an improvement over the Dolby system in two areas. The first is that it removes an extra 10dB of noise. It is also said to perform this kind act over the audio spectrum—that's 30Hz to 20kHz, not just over a narrow band.

The immediate area of obvious improvement is at the l.f. end. The Dolby system starts to be effective at around 300Hz, so it isn't so effective against our old audio enemy "mains hum" at around 50Hz. The name High Com derives from "high fidelity compander" and during compression the lowest level signals are amplified. Thus any noise that is picked up or contributed by either the storage medium employed or the actual transmission path finds the amplified signal that much stronger and therefore that much higher above the noise level.

The immediate application for such a device is in consumer audio goods and it is rumoured that some 20 European electronics manufacturers are very interested indeed, as are four of the big Japanese producers. One claim is that when the High Com was used on an audio cassette tape recorder, the measured noise was found to be no less than 20dB down. The magic i.c. that helps achieve all these wonderful things is designated U401B and it comes disguised in a 24 pin d.i.l. plastic package. It has been suggested that the new device could be very usefully employed in radio and television. Although it will cost a little more than the Dolby counterpart at present, volume production will doubtless bring the prices tumbling down. Please note: you cannot buy one yet.

Ginsberg

INEXPENSIVE AF electronic voltmeter

M. TOOLEY BA G8CKT

Most multi-range meters offer a rather mediocre performance on the a.c. voltage ranges. The Avo 8 MkIV, which has long been one of the writer's favourite test instruments, exhibits an internal resistance of only 250 ohms on the most sensitive (2·5V) a.c. range. This is clearly very unsatisfactory regarding sensitivity and circuit loading when measurements are to be made on today's electronic circuits. The instrument described was therefore developed as a replacement for the Avo on the a.c. voltage ranges and it offers the advantages of a 1MΩ constant input impedance on all ranges and a frequency response which is substantially flat from 10Hz to well over 100kHz. Six voltage ranges are provided, with a maximum sensitivity of 100mV r.m.s.

The unit uses low cost readily available components and can be built for an outlay of around £10. Battery consumption is minimal and a small 9V battery will provide for many hours of operation.

Circuit Operation

The a.c. voltage to be measured is applied to a switched potential divider, R1 to R6. The range is selected by S1 and capacitor C1 is used to remove any d.c. level present on the input voltage. R7 provides a measure of protection for the field effect transistor, Tr1, and C2 provides a degree of high frequency compensation. Tr1 operates as a source follower and exhibits an extremely high input impedance (greater than 100MΩ) thus minimising the loading effect on the potential divider. Tr1 provides a voltage gain of slightly less than unity, the output voltage being developed across R8.

Silicon transistors, Tr2 and Tr3, form a two-stage high-gain amplifier. Both transistors are operated in the common emitter mode. The amplifier incorporates three feedback loops which help to ensure unconditional stability, a wide operating bandwidth and a high degree of linearity. Stabilisation of the transistor bias is provided by means of direct current feedback from the emitter of Tr3 to the base of Tr2 using R9. C4 provides negative feedback in the second stage of the amplifier. This helps reduce any tendency to oscillation at high frequencies and also ensures that the frequency response "rolls-off" beyond a few hundred kilohertz. VR1, the emitter resistor of Tr2, is used to set the overall voltage gain by controlling the amount of negative feedback present.

Germanium diodes, D1 and D2, from a voltage doubler rectifier arrangement. The arrangement of C6 and C7 provides a means of reducing the surge current through the meter movement during switch-on. Silicon diodes, D3 and D4, provide a "last ditch" protection for the meter movement by offering a shunt path to current when a 600mV voltage drop of either polarity appears at the meter terminals; this corresponds to an eight times overload.

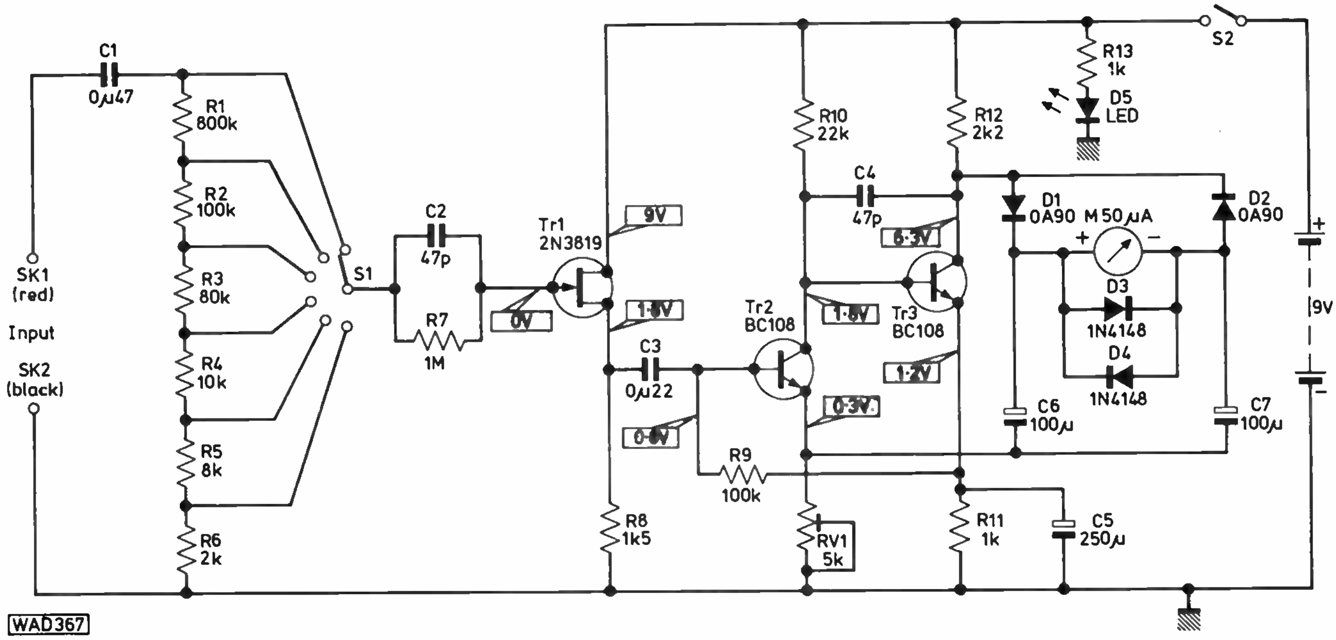


Fig. 1: Circuit diagram of the a.f. electronic voltmeter

★ specifications

Voltage ranges: 100mV, 500mV, 1V, 5V, 10V, 50V

Input resistance: 1MΩ on all ranges

Frequency response: Typically 5Hz to 250kHz at 3dB down

Accuracy: ±5%

Supply: 9V d.c. at 10mA

Construction

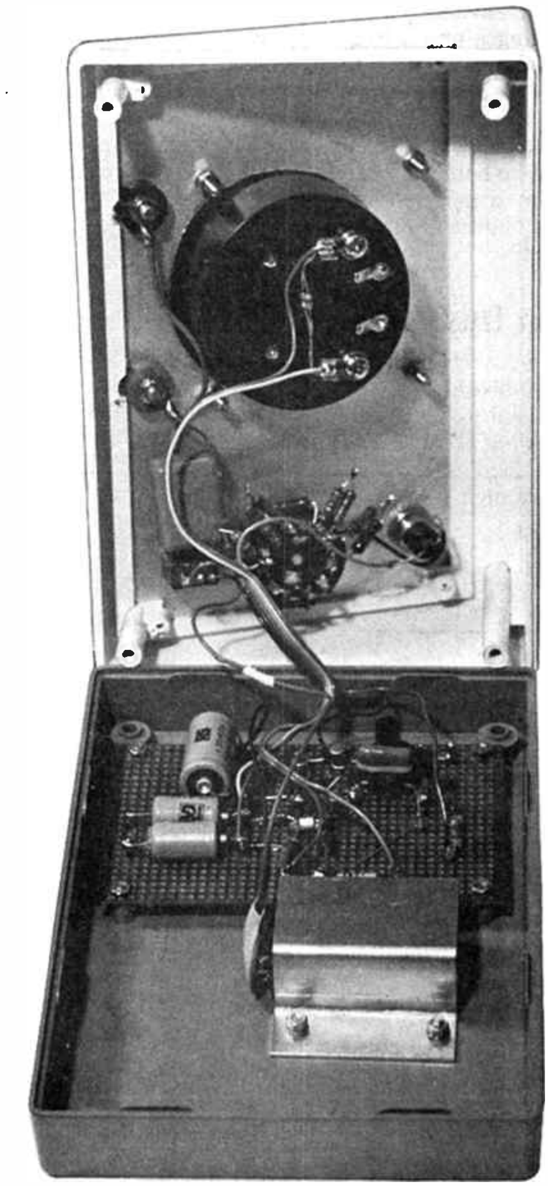
The impedance converter and the amplifier circuit are constructed on a p.c.b. The circuit board layout is shown in Fig. 3. The range selector switch, S1, is mounted on the front panel of the instrument together with the meter movement, power on/off switch, l.e.d. indicator and input sockets. The potential divider resistors, R1 to R6, are most conveniently wired directly to the tags of S1. C1 is wired directly between the input terminal and top end of R1, which is located on S1. Note that the high frequency response of the instrument will depend very much on the stray reactance associated with the input and potential divider wiring. It is essential that all connecting leads be kept as short and direct as possible. The front panel wiring layout is shown in Fig. 4.

Earthing of the metal front panel is achieved by means of the body of S1, which may be soldered to directly in order to provide a common earth point. If an alternative switch is substituted for the recommended type, it may be necessary to locate a separate earth tag on the front panel. This may be most conveniently accomplished by using one of the meter securing nuts. The front panel is labelled by means of dry transfers, and then sprayed with clear lacquer to protect the transfers. During this operation the meter should either be removed from the front panel or be protected using several layers of masking tape.

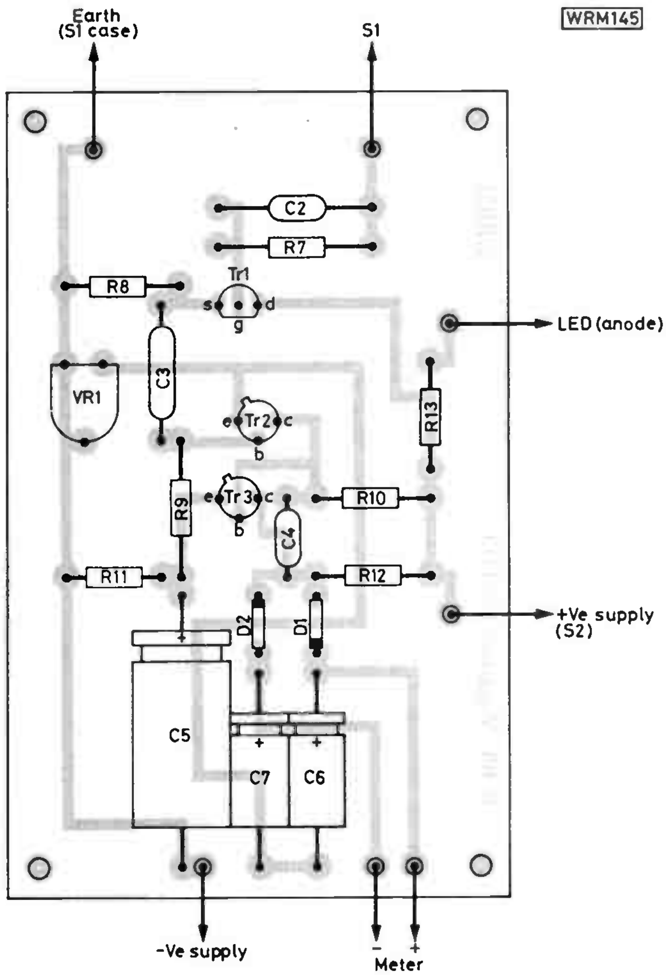
The instrument is housed in a standard Vero case. Any other suitable case may of course be substituted provided that any metal parts are connected to the earth or common rail. It was not found necessary to use a totally screened enclosure for the instrument, as with careful wiring there should be no pick-up of hum or stray signals within the unit. The unit will not, however, give accurate indications in the presence of very strong r.f. fields such as may be experienced when measurements are made on medium or high power transmitters.

Testing and Calibration

After completing the assembly of the instrument it is advisable to carry out a thorough visual check of the wiring. Connect a 9V battery to the instrument and measure the d.c. current supplied. If the circuit is functioning correctly this should be approximately 10mA and will vary slightly according to the setting of RV1. Due to a slight difference in the charging currents of C6 and C7, the meter pointer



Internal view of the complete instrument. This is the prototype which used a matrix board instead of a p.c.b.



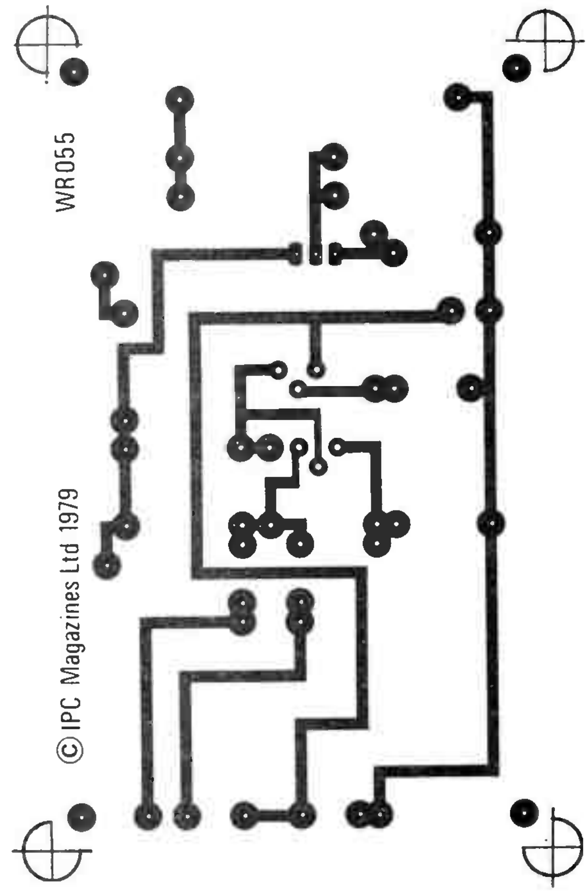
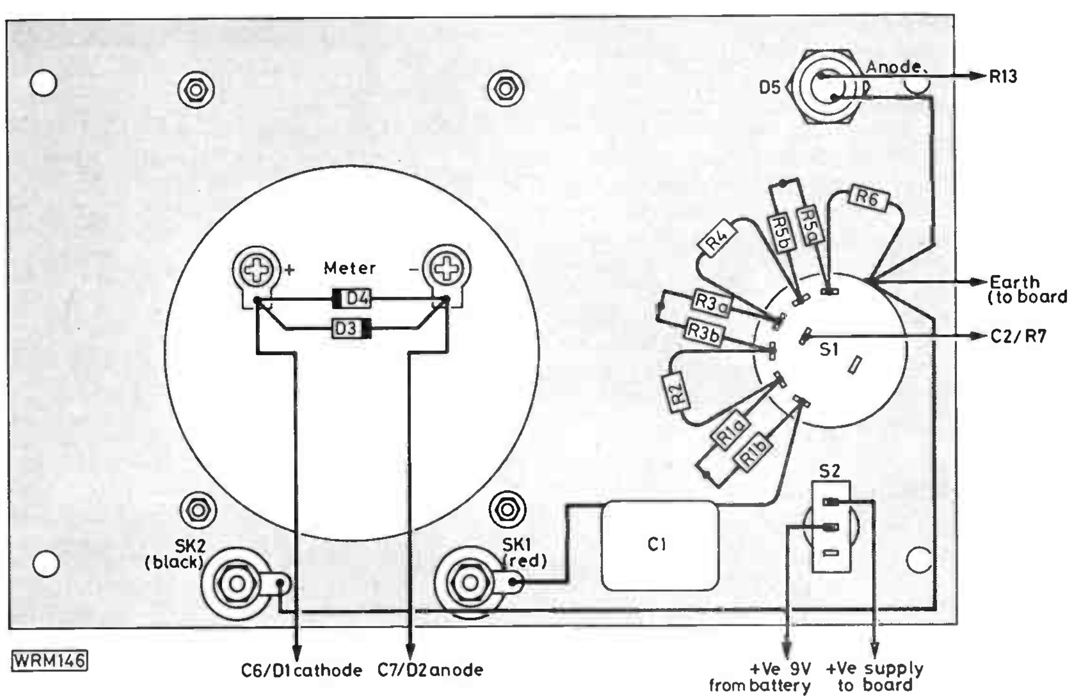


Fig. 2: (above left) The component overlay for the p.c.b. version of the a.f. voltmeter

Fig. 3: (above right) The copper track layout of the p.c.b. shown here full size

Fig. 4: (below) The wiring and layout of the front panel. The resistors on S1 are soldered directly to S1 tags and the end of R6 is soldered directly to the body of the switch



★ components

Resistors		
$\frac{1}{4}$W 2% metal oxide		
1·2kΩ	1	R5a
2kΩ	1	R6
6·8kΩ	1	R5b
10kΩ	1	R4
12kΩ	1	R3a
68kΩ	1	R3b
100kΩ	1	R2
120kΩ	1	R1a
680kΩ	1	R1b
$\frac{1}{2}$W 5% carbon film		
1kΩ	2	R11, 13
1·5kΩ	1	R8
2·2kΩ	1	R12
22kΩ	1	R10
100kΩ	1	R9
1MΩ	1	R7
Capacitors		
Electrolytic axial leads		
100μF 25V	2	C6, 7
250μF 25V	1	C5
Polystyrene		
47pF	2	C2, 4
Polyester		
0·22μF	1	C3
0·47μF	1	C1
Potentiometers		
Miniature horizontal preset		
5kΩ lin.	1	VR1
Semiconductors		
Diodes		
OA90	2	D1, 2
1N4148	2	D3, 4
LED	1	D5
Transistors		
BC108	2	Tr2, 3
2N3819	1	Tr1
Switches		
1p6w rotary	1	S1
s.p.d.t. min. toggle	1	S2

Miscellaneous

Case Vero 75-1798-k 171 × 121 × 75mm (1); 4mm terminals 1 red, 1 black; Meter, 50μA 4 inch scale 110 × 82mm; Printed circuit board; battery connector, knob SW150 with cap and skirt (Sifam).

may give a momentary indication when switching on. The pointer should however return to zero fairly quickly, and if this is not the case the wiring should be re-checked for faults.

To calibrate the instrument a known source of a.c. voltage is required. A signal generator with a calibrated output level may be used, alternatively a comparison may be made with an existing a.c. voltmeter. If neither is available, a rough calibration can be carried out using a low voltage transformer of known output. A 6·3V filament transformer or the 9V transformer of a power supply is ideal for this purpose. The instrument should be switched to the 10V range and RV1 adjusted for the correct reading. The calibration on the other ranges should follow automatically provided that the potential divider has been wired correctly. If a signal generator is available a check can be carried out on each range. The calibration should be consistent to within ±5% on all ranges. If a signal generator is used, it is suggested that calibration be carried out at a frequency of 1kHz. Where a mains transformer is used the calibration will, of course, be at 50Hz. The frequency response of the instrument should be "good" over a wide frequency range, at least 10Hz to 100kHz at the 3dB points, and the frequency response of the prototype instrument on the 1V range is shown in Fig. 5.

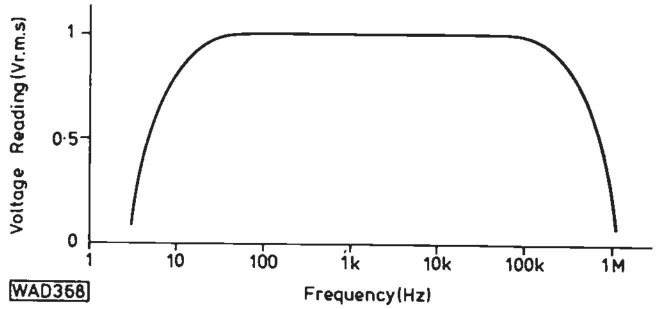


Fig. 5: The frequency response of the instrument

Note that, due to the high input impedance of the instrument, false readings can sometimes be produced on the more sensitive ranges. This is due to pick-up of hum and stray signals on the input leads. The input leads can be screened if desired; the inner lead of the coaxial cable is connected to SK1 (red) and the outer screen to SK2 (black). It is important to note that coaxial cable possesses an appreciable shunt capacitance between the inner conductor and screen (often as much as 100pF per metre). Long screened cables should therefore be avoided since they will impair the high frequency response of the instrument. ●

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ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

The problem of identifying correctly an amateur callsign can present a problem to anyone unaccustomed to listening on the amateur bands. It often seems to be a jargon incapable of being decoded! The answer is not always obvious even if the station is in the clear, but if it is being clobbered with QRM then there really is a problem.

Although there is an ITU phonetic alphabet, given below, it is seldom adhered to by amateur operators who seem to use part of this alphabet and part of their own invention. In a perfect phonetic code the word used to represent a letter, such as "alfa" for A and "bravo" for B, must be neutral, one without any particular connotation and generally understood world-wide.

The approved code starts off all right but then uses "Charlie" for C, although personal and place names ought to be avoided since these can be misleading, especially in amateur use, where station locations and operator's names are constantly being exchanged.

A	Alfa	J	Juliett	S	Sierra
B	Bravo	K	Kilo	T	Tango
C	Charlie	L	Lima	U	Uniform
D	Delta	M	Mike	V	Victor
E	Echo	N	November	W	Whiskey
F	Foxtrot	O	Oscar	X	X-Ray
G	Golf	P	Papa	Y	Yankee
H	Hotel	Q	Quebec	Z	Zulu
I	India	R	Romeo		

There are several words in the phonetics list which I do not agree with personally, but the problem is to find suitable alternatives.

What causes most confusion however is the amateur's own version of the phonetic code, especially the use of "George" for the G in UK callsigns, particularly where the operator is called "Fred"! Might not matter too much among lads and nets on 2m or u.h.f., but used on the DX bands can only make identification of a callsign all that more difficult.

On numbers, the recommended procedure is to use the word "figure" before any number, to indicate that a figure is to follow, thus "Golf, figure four, alfa romeo". This can only help but it is seldom employed by amateurs unless they have been trained on a military or commercial network of some kind. The use of phrases like "Red Hot Momma" for RHM in the suffix of a call may be amusing to some but meaningless to the amateur with little or no knowledge of the English language.

I appreciate that this little homily will have no effect whatsoever, but I hope it will serve to demonstrate to the innocent listener to the amateur bands that there is little or no "system" with amateur phonetics. Initially, it is better to write down in full what is heard and then the callsign ought to become apparent, aided by a good list of prefixes, but, as ever, experience will prove the best teacher.

Here and There

Well known to this column for his SSTV reports in the past, **Paul Barker** of Sunderland is now busy on c.w. and s.s.b. with his new callsign G4HPS, having started off with G8OVD. Paul's first s.s.b. QSO was with FG7AS/FS7 on 10m, which is enough to make anyone's mouth water! He uses a TS520S transceiver to an 18AVT multiband vertical, plus an FT221R on 2m to an indoor 4-element quad. Paul managed to get QSLs from all six continents for SSTV reports before getting his ticket.

In Southport, **Peter Hawks** has got going with a DX160 but, like others, found the manual's calibration chart did not match up to reality. He's talking about a digital readout unit but I think he would be better off initially with a crystal calibrator. **Philip Charlesworth** (Southport) has got going with an outside aerial which he finds "staggering" after his indoor one. As he lives on the only hill in Southport he will find the advantage of much greater importance when he gets his ticket in due course. Philip mentions the PA0AA transmissions on 3750kHz for amateurs, followed by slow Morse transmissions. Details of the latest schedules would be appreciated.

Peter Lucas of Newport, Salop, has dumped his R207 and settled for an AR88 but needs to rewire a lot of it. A circuit or manual would be appreciated at 3 Queen's Drive if anyone can help. Pete's been hearing plenty on 10m of late with only a 16ft vertical. In Chiswick, London, **George Gizebieniak** BRS 41733 has bought an old SX24 receiver for £20 and found it worked fine on the 10m band, with converters for 2m and 70cm.

An appeal from **Jim Timoney** ZS1TK for a spare for his KW2000 transceiver, not having had any success with the descendants of KW in this country. He wants the 3-gang tuning capacitor on the pre-selector, part number C40 on the circuit diagram. Any offers of help to me direct please. Another reader in need of help is **M. David** of 46 Pentathlon Way, Cheltenham, Glos, who has got hold of a Star SR550 for just a £1! It works fine but he'd like a manual for copying and return. He's heard an HK on the 10m band and threatens to send in some logs in future.

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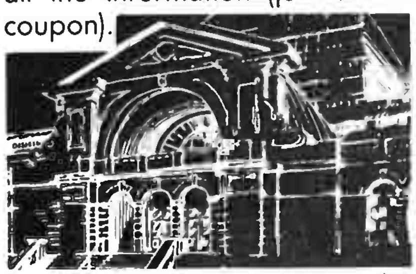

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Mike Stollov of Blackley, Manchester, has not deserted the column although active as G4HWB. Flu laid him low but he was able to drag his FRG-7 to the bedside and keep in touch with the bands on c.w. and s.s.b. Good finds on 15m c.w. were HH2T, HK0BKX, HM1DM and H44LW while on 10m s.s.b. FM7AY, HC1FM, KZ5AS and 6W8AAD were fairly rare ones. After some blush-making comments **R. Beswick** of "Hillhouse", Yatton-Keynell, Chippenham, Wilts, mentions that he has run through quite a few receivers and now has a Trio 9R59D and a Minimitter MR44, but is sadly in need of a circuit or manual for the latter. Any help direct please to him, all expenses paid of course.

We don't often get any RTTY news but here is **Dennis Sheppard** of Sheppey, Kent, with a long log of stations copied in this mode with Creed page printer, tape printer, tape reader and home-made terminal unit driven from a JR310 receiver. Any other RTTY enthusiasts are invited to write in with logs, etc.

Australian **J. Clark** arrived here with his equivalent to the "B" licence and wrote to the RSGB for info on clubs in the Reading area and on the licensing regulations in order to get a full licence while over here. He says: "The RSGB HQ was not particularly forthcoming about licensing exam procedures, nor even too certain about the active status of clubs in this area". Needless to say, he got a full reply from me in a couple of days!

DX Notes

Bill Rendell (Truro) has the solution to the S79MC mystery, straight from the horse's mouth! It is the Seychelles after all. Although Bill heard him some time ago, it was only in the middle of March that the QTH was given, seemingly. Bill has been up at sunrise to find the DX still rolling in on 80m such as C6AFR, CT2SH, HC1NJW, VP1KG plus three ZLs one of whom was mobile "out salmon fishing"! 40m revealed Bill's first GD logging, GD3KGC but little else. On 20m CT2YB on St Michael popped up, with D4CBS, J3ABN, M1D, VP2VBK and VP8SO on Signy Island, not to mention VK3MO reputed to have eight quads in a 4-over-4 arrangement!

The 10m band has been very good at times but several readers comment on weird and variable skip at times, which makes it all the more interesting! **P. Lucas** of Newport, Salop mentioned HH2LD, H44CF and S79MC on the band, all good catches in the early evening, on his AR88 and vertical. Looking at the c.w. end of bands can produce some unusual prefixes if one is interested in that direction. **Mike Stollov** found a CP5, EA8, HC2, HP1, OY9 on 20m and HH2, VS6 on 15m, plus KZ5, SV1, 6W8 and 8P6 on 10m. More c.w. logs would be very welcome.

As usual **Ian Marquis** sorted out the better ones at Leigh-on-Sea, Essex, on his FRG-7, 100ft wire and 28MHz dipole, such as M1C and ZB2CJ on 80m, VP2KF, XE1FU and YN1S on 40m, C6ANX and TR8AC on 15m with HC1FM and HL9KE on 10m, all s.s.b.

Club Activity

Let's start with the **Bury RS** which meets every Tuesday evening at Mosses Centre, Cecil Street, where visitors are more than welcome. June 12 sees G8SCA talking on the joys of medium-wave DXing (how did that get in?) and on July 10 there is a foxhunt for those keen on DFing. QRP-lovers may like to know that **Yeovil ARC's** transmitter G3CMH is reputed to have made the first solid-state s.w. DX QSO in the UK in 1954, working 90 miles on 80m with 30mW input to a single transistor. The station is still active with QRP so pop along any Thursday evening to Building 101, Houndstone Camp, Yeovil and meet the gang, or write: D. McLean G3NOF, 9 Cedar Grove, Yeovil.

The second and fourth Thursdays of the month, see the **Edgware and District RS** (Middx), at the Watling Community Centre, 145 Orange Hill Road, Burnt Oak, Edgware. On June 14 a "Bring & Show" your favourite test gear, tools, etc., is a pleasant twist while on June 28 there is a junk sale. Contact: D. Lisney G3MNO, 119 Draycott Avenue, Kenton, Middx. Fridays is the day to find the **West Kent ARS** at the Adult Education Centre, Monson Road, Tunbridge Wells. On June 22 a Mr Constable will talk on the British Vintage Wireless Society and its work.

Trevor Tugwell G8KMV reports his retirement as Sec of the **Stevenage & District ARS** and I hope his replacement Ted Godfrey of 94 Common View, Letchworth, will be equally forthcoming with the club's news. June 14 is devoted to a DF hunt, with G4DDX talking about his Top Band DF receiver on June 21.

Don't forget the deadline for copy, the 15th of the month without fail.

Log Extracts

Ian Marquis:—80m M1C ZB2CJ **40m** HC4JQ VP2KF, XE1FU YN1S **20m** VP8ML VR3AH VS5XU 8Q7AH **15m** C6ANX TR8AC VP9JA **10m** HC1FM HL9KE

R. Bell:—20m OA8ODE **15m** JY5ZM P29MF **10m** CT2CP KZ5FF YB0ADW

P. Hawks:—20m VK7OH A9XBS CT4UU M1D VP9CP XT2AV

P. Charlesworth:—20m JY8AQ JY0OZ VP9BB 7X2LS 9V1TX

M. Stollov:—20m CP5NK EA8FO FY7BF HC2FN HP1XGL OY9J 15m HH2T HI8MOG HM1DM H44LW KL7PJ VS6EN 10m FM7AY HC1FM KZ5AS VS6DT 8P6JQ (Bold are c.w.)

P. Lucas:—10m HH2LD HI8XEA H44CF S79MC VQ9JJ ZF2CL 9J2LL 9L1KB

W. Rendell:—80m C6AFR CT2SH EA8PP HC1NJW PJ2AAX VP1KG YS9RVE ZF1CL ZL3GS ZL4AP **40m** EA8QY **20m** D4CBS HP6JB J3ABN J6LFZ M1D VK7AE VP2VBK VP8ML VQ9JJ ZD7PL **15m** CT2CP HC6FC J6LDE (St Lucia) S79MC VP5JFH VP8SB (Adelaide Is.) VQ9RL YB0WR ZB2DV

D. Sheppard:—All RTTY 20m A4XFW FP8DF 9G1JX 9J2KD **15m** JA1ACB KC6CB LU1NH VE7DIA W7WHY YU3KAA **10m** AG2M C5AAN FG7XT JA2JHR KZ5JA VK3KF ZS6AKO 3D6AD 5Z4PD

Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:

AMATEUR BANDS Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molloy G8BUS, 132 Segars Lane, Southport PR8 3JG. Reports for both bands **must** be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

BROADCAST BANDS

MEDIUM WAVE DX

by Charles Molloy G8BUS

Are you going abroad for your holidays this year? Then why not take along a portable receiver? As well as providing entertainment, it will give you the opportunity to listen to the medium waves from a new location. I had this experience while on holiday in Bulgaria a few years ago where the medium-wave scene was totally unrecognisable. I could have been on another planet! I even tried to do some DXing but could not pick up either the BBC or Luxemburg on the medium waves, though a weak unidentified on 200kHz might have been Droitwich. It would have been very interesting with a decent receiver and a loop.

Holidays abroad these days generally mean Spain, a country which is very interesting from the radio standpoint. As well as having an official government network, there are several chains of privately-owned local radio stations spread across the country. In most locations there are at least three to be heard during the day-time, while after dark many more are just waiting to be picked up. The holidaymaker also has the opportunity to hear "difficult" outlets such as Radio Gibraltar on 1458kHz.

DXing Spain

No need to visit Spain to listen to Spanish radio. A lot of it can be heard from the UK, and it is quite an interesting area to explore at this time of the year. A loop should sort out much of the co-channel QRM, since the DX is coming from the south while much of the QRM is from the east. The easiest stations to pick up are the high-powered RNE outlets at the l.f. end of the band. Listen to 585, 639, 684, 729, 738, 774 and 885kHz for the call Radio Naçional España.

The real interest for the DXer is with the local radio stations which operate on a number of channels between 792kHz and 1602kHz. The best time to listen for them is between 2300 and 0100 GMT when European QRM slackens off and many Spanish locals themselves close down leaving the frequencies clear for other weaker stations to appear in their place. Try on 1026kHz, 1107, 1134, 1224, 1260, 1314, 1395, 1521, 1539, 1584 and 1602kHz.

Identification

Station identification includes the name of the town or city preceded by one of four titles depending on the particular network such as Radio Barcelona, Radio Popular Malaga, Radio Juventud Murcia, La Voz (pronounced Voth) de Granada. A callsign is allotted to each station which is generally used in the sign-off announcement but it can present a problem to the DXer unless he is familiar with the alphabet and numerals in Spanish. Four sets of three letters plus figures are in use depending on the network. For example, EFE14 is in Madrid, ECS5 in Granada, EFJ56 in Malaga and EAJ1 in Barcelona.

A list of Spanish frequency allocations extracted from the Boletin Oficial del Estado of the 13 November 1978 is available from Keith Hatcher, Duquesa de la Victoria 50bis, Logroño, Spain in return for 2 IRCs or 25 Pesetas in unused Spanish stamps. At the time of writing this is the most up-to-date list available, though it does include some stations not yet on the air.

Reception Reports to Spain

Spanish locals are usually good verifiers even to a report written in English, though a Spanish Report Form (obtainable from DX clubs) is better. A full list of callsigns and addresses is to be found in the *World Radio and TV Handbook* though the frequency information in the 1979 edition is quite out of date. No need to worry too much about the full address. A report sent to El Gerente, Radio Popular Malaga, Malaga, Spain will certainly find the station. El Gerente being the station manager. Always include return postage, either unused Spanish postage stamps which are obtainable from stamp shops or an International Reply Coupon (IRC). These are on sale in main post offices.

Region 2 Station Separation

According to a report in *DX Monitor*, the Daylight Broadcasters Association (USA) is asking the US government to press for 9kHz station separation plus a slight extension of the m.w. band, as an alternative to the current proposal to the WARC-1979, to extend the band to 1850kHz. The suggestion is that the band should start at 530kHz with stations spaced at 9kHz intervals up to 1610kHz, which would provide an additional 14 channels.

The DBA just cannot be serious! It would mean that the majority of stations in Region 2—North, Central and South America—would be on the old pre-Geneva channels, which incidentally are at the moment occupied by many broadcasters in the Middle East who have not (yet?) changed over. 1kHz heterodynes would be commonplace and a 1kHz audio notch filter would be an essential item in the m.w. DXer's shack. A more reasonable proposal would be to start at 540kHz and follow the Geneva frequencies right up to 1602kHz. This would give 12 additional channels and would not require approval by the WARC as the m.w. band would not have to be extended. It would only require approval by the countries in Region 2.

It is to be hoped that the DBA will not be successful. At present Region 2 is on 10kHz separation starting at 540kHz which is also a Geneva frequency. Coincidence between the two systems occurs at 90kHz intervals across the band but there are other parts where the separation between the two systems is as much as 4kHz and these are the "DX slots" that would disappear if the Geneva Plan becomes world-wide. Fortunately there is likely to be opposition within the USA to the DBA's proposals, as many stations would be put to considerable expense, not just in changing frequency but with modifications to directional aerials which are in widespread use in that country. None-the-less, m.w. DXers will await further developments with apprehension.

Loops in New Zealand

The Loop becomes Respectable is the title of a short, amusing article sent to me by its author **Tony King,** who is the *Mailbag* editor of Radio New Zealand. It seems that RNZ decided to restrict its racing coverage, which led to the experimental use of a DXer's loop to get better reception. Soon, a commercially produced "punter's loop" appeared which was investigated by the NZ Consumers Council, who had to acknowledge its effectiveness. A competitor, the Space Raker soon turned up. This was a loop built into a briefcase for convenience of use and acceptability in domestic surroundings. Finally "the national TV network screened a programme on the loop, the a.t.u. and on erecting an outside aerial, all in the quest for better reception".

DXing does have a large following in New Zealand but I once knew a Kiwi who was a great leg puller, so you can take your choice. Either way, it is an interesting story.

Readers' Letters

Stephen Donnelly wonders how DXers identify foreign language broadcasts. His method is to look for key words (Voiçi=French). This is alright if you have a list of key words but an easier way is to listen for place names. Most countries carry local items in their news bulletins and if, for example, you hear Ankara mentioned several times then you may be listening to Turkey. Stephen has recently acquired a Trio 9R59D and he would like to hear from other users of this receiver. Replies direct to Stephen Donnelly, 25 Church St, Addlington, Lancs PR7 4EX.

From Pensilva in Cornwall comes another letter from reader **K. Lewis** who has modified the r.f. pre-amplifier intended for use with the *PW* "Dorchester" Tuner. He used it along with a long wire, a.t.u. and Realistic DX160 to pull in WINS on 1010kHz, Radio Margarita, Venezuela 1020, Radio Coro, Venezuela 1210 and Radio Paradise, St Kitts on 1265kHz, all heard between 0250 and 0330 during March. Listen in mid-summer during the hour before sunrise for this type of DX; results are sometimes very good.

DX Circle is the name of the weekly DX programme in English carried by Deutschlandfunk on 1269kHz each Tuesday at 1900 GMT. It is compiled and presented by DXer **Alan Thompson** and it has been running now for over 10 years, the session on the last Tuesday of the month being designed especially for newer members of the hobby.

It is nearly 10 years since I met Alan at the DX Convention he organised in his home town, Neath. It was attended by **Arthur Cushen** who was on a tour from New Zealand at the time, and this was the first gathering of Broadcast Band DXers to take place in this country so far as I know. Alan is the UK/Europe representative for the NASWA/FRENDX, Indian DX Clubs International and the Union of Asian DXers, which means that subscriptions to those bodies can be made through him. Alan can be contacted via the DX Circle, Deutschlandfunk, 5 Koln 51, Raderberggürtel 40, West Germany.

BROADCAST BANDS

SHORT-WAVE BROADCASTS

by Charles Molloy G8BUS

Questions asked by a number of readers recently have prompted me to produce the following few notes written in non-technical language which will, I hope, show how a receiver converts the incoming radio signals into the sounds heard from the loudspeaker or headphones. An understanding of what is happening should help the DXer to get the most out of the quite sophisticated gear that is under his control.

The Superhet Receiver

A block diagram of a superhet receiver suitable for broadcast reception is shown in Fig. 1. Facilities for s.s.b. and c.w. are not included, as these are not generally used for broadcast band DXing. Each square represents a particular job the receiver has to do. Starting at the left-hand side, radio signals are picked up by the aerial and applied to the aerial socket where they pass into the r.f. stage and out again to earth. The r.f. stage selects the wanted signal, amplifies it and applies it to the mixer where a further stage of frequency selection is encountered. The local oscillator is maintained at a frequency 465kHz higher than the incoming signal by the tuning control. The mixer, which is aptly named, mixes the two together and supplies a 465kHz difference frequency complete with modulation (programme) to the intermediate frequency (i.f.) stages. Here the signal is amplified and further selectivity is encountered.

The output from the i.f. stages is applied to the detector where the audio is extracted and applied to the audio amplifier. The output goes either to headphones or to a further amplifier which drives a loudspeaker. The output from the i.f. stages is also fed to the automatic gain control (a.g.c.) circuit, which adjusts the gain of the amplifiers in the r.f. and i.f. stages in sympathy with the strength of the signal.

That, very briefly, is the make-up of the supersonic heterodyne receiver, to give it its full name. In this case the

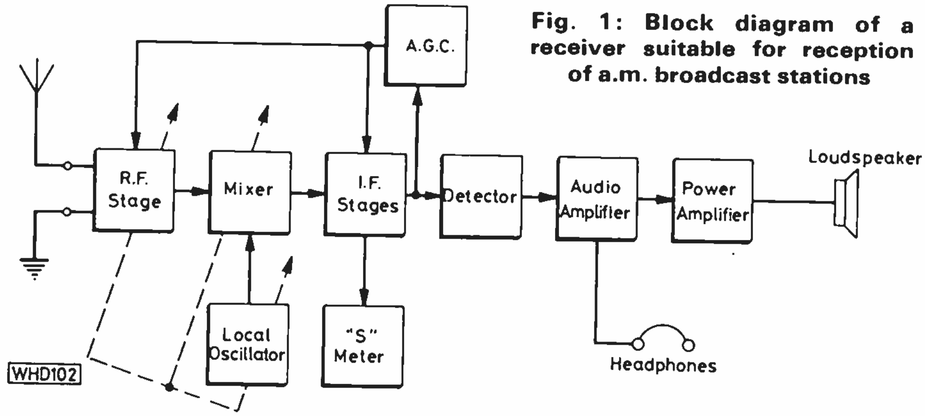


Fig. 1: Block diagram of a receiver suitable for reception of a.m. broadcast stations

heterodyne is 465kHz which is the standard value used in the UK. Anyone interested in the history and development of the superhet should try to get hold of a copy of *The Superhet Receiver* by Witts, first published in 1935. There are a number of later editions and although long out of print, copies can be found in secondhand bookshops. This book contains a fascinating account of the efforts of the early radio experimenters to produce a design that is now regarded as standard throughout the world.

Images

To get back to the block diagram. It is important that a receiver intended for DXing should have an r.f. stage. The majority of domestic receivers do not have one, the aerial going straight to the mixer. As well as increasing sensitivity, the r.f. stage helps to reduce what is known as second-channel or image interference. The mixer can produce the 465kHz heterodyne in two ways—by beating with a station 465kHz lower than itself, and also by beating with one 465kHz higher. The second is the image. For example, if the receiver is tuned to 6180kHz (49m band), the local oscillator will be generating 6645kHz and the image will be 7110kHz (41m band). The selectivity in the r.f. stage reduces the strength of the image compared with the wanted signal.

It is easy to tell if a receiver has an r.f. stage. Have a look inside at the tuning capacitor. It should be a three-gang, one section for the r.f., one for the mixer and one for the oscillator, all under the control of the main tuning knob. The dotted lines in Fig. 1 represent the 3-gang tuner. If it is only a twin-gang then there is no r.f. stage. Paradoxically, a receiver without an r.f. stage will sound a lot more lively than one with an r.f. stage. It picks up many more stations, in the example quoted, in the 49m band plus the stronger images in the 41m band. A receiver with poor image rejection will pick up the stronger stations at two points on the dial and this effect becomes worse the higher in frequency you go.

Automatic Gain Control

The a.g.c. does electrically what you can do for yourself manually—turn down the volume when listening to a strong station; turn it up to hear a weak one. The a.g.c. does it much faster and is therefore useful for dealing with fading. There are occasions, though, when you are better off without a.g.c. When two stations are operating on the same frequency, there will probably be a beat of a few hertz, equal to the slight difference between them. This can occur even if one station is a lot weaker than the other. The a.g.c. will follow the beat and may produce an unpleasant blasting effect at the loudspeaker. If you are searching for a weak station close to a strong one then the a.g.c. may respond to the strong station, reducing the receiver gain, so that the weak one is missed.

A.G.C. ON/OFF Switch

An a.g.c. on/off switch is fitted to communications receivers but seldom to other types. If you switch off the a.g.c. then you must be able to adjust the r.f. and i.f. gains, otherwise strong stations will cause overloading, therefore a separate r.f. gain control will have to be provided. In spite of the name, the r.f. gain control usually controls the gain of both r.f. and i.f. stages. To operate a receiver with the a.g.c. switched off; adjust the volume (a.f. gain) to a comfortable level and follow the strength of the incoming signal with the r.f. gain control, which replaces the a.g.c.

To sum up, a receiver for DXing should have an r.f. stage to provide adequate sensitivity and freedom from images. You can check by examining the tuning capacitor. It is also desirable to be able to switch off the a.g.c. but if you do this then you must have a manually operated r.f. gain control as a replacement.

Radio Finland QSLs

From Tullebody in Scotland comes a note from **James Thompson** who is a civilian instructor on radio with the ATC and a keen DXer. He sent a reception report to Radio Finland expecting to get a listener card in return, but much to his surprise he received a proper QSL giving the date, time, frequency and verifying that the report was correct. Whether this is the result of a genuine change of policy or the result of an error is not clear but let's hope it is the former.

Readers' Letters

The National Panasonic RF1105 is in the news again with a report from **E. Roper** who obtained his first experience of s.w. listening with this receiver and is more than satisfied with its performance. He finds that by increasing the diameter of the tuning control to 75mm, a more sensitive touch was obtained when tuning. Fitting a large knob to the tuning control is an old dodge, but it can spoil the appearance of the receiver. DX picked up with the RF1105 included Pakistan on the 16m band at 1100, Afghanistan on 19m at 1600 and Radio Australia on 25m at 1900.

"I am at present compiling a survey of the FRG-7 as there seem to be so many conflicting reports about these receivers," writes **George Tyler** from 41 Park Crescent, St George, Bristol BS5 7AY. George has already contacted about 20 FRG-7 owners and he would like to hear from more as he thinks some hints and guidelines could emerge from his survey. In particular he would like to know the good points, the faults and how the FRG-7 performs with an a.t.u., audio filter, etc. George has promised me a copy of the survey when complete and a summary of it will appear in this column. *See also Special Product Report this month. Ed.*

Arthur T. Cushen, MBE, writes from New Zealand to say that his book *The World in my Ears* will be published in August or September 1979. It is the story of a blind radio listener who has become a world authority in his hobby and who is a regular broadcaster on RNZ and Radio Nederland. The book, which is partly autobiographical and partly a guide to short-wave listening, can be obtained direct from Arthur Cushen, 212 Earn St, Enwood, Invercargill, New Zealand, at a pre-publication price of £7 until June 30.

DX Heard

Japan has been heard on 9585kHz at 2000, SIO 433 by **Chris Howles** (Lichfield) using his Vega 206 and 40ft loft aerial. **David Stevenson** (Thurso) has a National Panasonic receiver and a 100ft length of wire wound round his bedroom and he picked up Afghanistan on 11 805 at 1900 and Taiwan on 15 425 and 15 345 at 0100. **Bob Bell** (Blyth) reports hearing Radio RSA on 25 790kHz in the 11m band at 1520. According to a recent report in *Sweden Calling DXers*, IBA Jerusalem is now on 25 640kHz as well as on 25 645, Radio Nederland is on 25 650 at 0800 and the VOA is also on 25 880kHz.

A newly-acquired Sanyo RP 8880 is in use by newcomer to the s.w.s **Alan Curry** (Stockton-on-Tees) who pulled in Japan on 15 195 in English at 2300 using the telescopic aerial. All India Radio was logged on 11 620 at 2225, SIO 444 with a programme in English about the Indian fishing industry. **Mark Hattam** (Hereford) is amazed at propagation on the 13m and 16m bands (the higher frequencies are really opening up now). His Realistic DX160 and 45ft long wire pulled in VOA Philippines on 17 780 at 1500, Chile on 17 715 at 2330 and Peking 17 680kHz all in the 16m band. **P. R. Sixe** (Cambourne) is puzzled by Radio Naçional de Colombia which was noted on 13 848kHz and he wonders if this could be the first station to appear on the new 22m band. This band has not (yet) been authorised and you may have heard a harmonic. **Craig Kelly** (Walsall) has been unable to identify a station on approx 31·2m with the call Hebra Radio (anyone any ideas?). **David Grimshaw** (Bury) has an FRG-7, long wire and a.t.u., and he reports that Radio Japan comes in well on 17 795 and 17 825kHz, in English, at 0800.

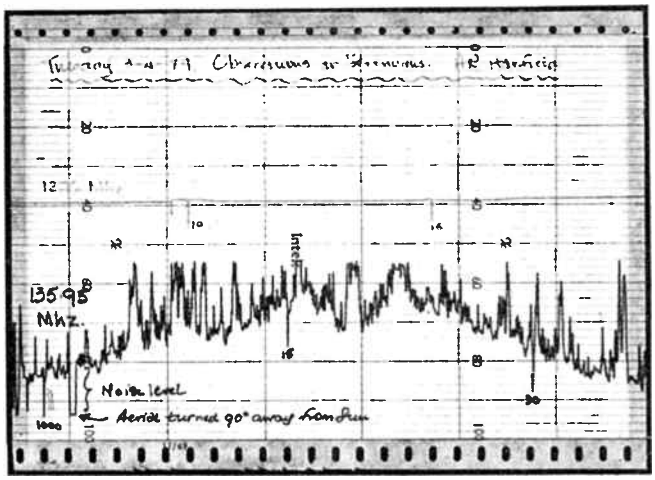


Fig. 2: Chart recording of solar noise received on 135·95MHz on 3 April 1979 by Henry Hatfield

VHF BANDS

by Ron Ham BRS15744

The propagation of radio waves between two points is a complex subject, because, whatever the wavelength of the transmitted signal it must travel somewhere through the earth's gaseous atmosphere, which, in a variety of ways can be upset by the sun. Every month, with the help of my readers, I endeavour to show what natural events have taken place and how our terrestrial radio communications are affected. New readers to my column often ask about basic reading matter so they can better understand such words as aurora, meteor scatter, sporadic-E, sunspots and solar radio noise, so, my first suggestion is, Chapter 11, in Volume 2 of the RSGB's *Radio Communication Handbook* (Fifth edition), and secondly, J. A. Ratcliffe's *Sun Earth Radio,* World University Library.

Solar Activity

On March 21, **Cmdr Henry Hatfield**, Sevenoaks, recorded bursts of solar radio noise at both 136 and 1296MHz, on the 22nd he saw an active plage through his spectroheliscope and on the 23rd he counted between 30 and 40 sunspots, in 8 groups, in addition to a long ribbon flare. **Nigel Fisher,** South-East Essex Astronomical Society, recorded a solar burst at 60MHz during the morning of the 27th and I heard strong solar noise in the 10m band at midday on the 30th. During the BBC's *World Radio Club* programme on April 8, **Lucian Prechner** said that ionospheric conditions were disturbed between April 2 and 6, mainly on the western paths, which was no doubt caused by the very large sunspot group, about 35 spots, and a long arched filament which occupied almost a quarter of the sun's diameter. This was a massive affair, bearing in mind that the sun's diameter is about 865 000 miles.

It was not surprising that Henry Hatfield, **John Smith,** Rudgwick, Sussex, and myself, were recording a solar noise storm, Fig. 2, at 136, 142 and 146MHz during the morning and early afternoon of the 3rd. On the 5th, Henry noted that the large sunspot group was declining and the filament was much less active, explaining why we recorded only a few small bursts on the 4th and a slight noise storm on the 5th. Bursts of about 5 minutes duration were recorded around midday on the 8th and 11th, one 1·5 minute burst at 1310 on the 14th, and a 4 minute burst during the midday observation on the 16th.

The 10 Metre Band

Apart from the relatively few disturbed periods, 10m conditions were generally good between March 19 and April 16. On March 22, **Harold Goble** G4FDQ, Lancing, worked all Continents, UA6, VE, ZL3, 4S7, 5N2, and 8P6, on 10m using his KW 2000A into a 66ft end-fed long-wire aerial. The band was so good on the 22nd, a VK station told Harold, that they were burning the midnight (local time) oil working DX. "The band was running wild," said Harold; too true it was, around 1900, I was at a meeting of the Mid-Sussex ARS and listened to **Alan Baker** G4GNX, have a 59 contact with WB4HHY, Utah, using the club station G3ZMS. At 0843 on the 22nd, **Ern Hoare** G3RZD, Hove, and Harold had a joint QSO with 9H1CD who has established a beacon, using his own callsign on 432·25MHz, for use during the sporadic-E season, reports, of course, are welcome. Back in July 1976, Ern worked 9H1CD on 2m phone, during a sporadic-E disturbance.

From my own observations the 10m band was blacked out during the early mornings of March 23, 28, 30, and April 4, 6, 7, 15 and 16. The event on March 30 was reported by the BBC World Service and on April 4 the disturbance persisted for most of the day. On the majority of days throughout the period I received signals, averaging 549, from the International Beacon Project stations in Bahrain A9XC, and Cyprus 5B4CY, but, unlike previous months, the signals from the German beacon, DL0IGI, were much less frequent. During the afternoon, on the good days, signals, about 559, were heard from the Bermuda beacon VP9BA. The RSGB are responsible for the IBP service and in the April issue of *Radio Communication* they say: "The establishment of the beacon stations has stimulated scientific interest in the propagation paths revealed by reception of the beacons. In addition, they fulfil a practical role by providing signals on what may otherwise be a dead band."

Aurora

The aurora borealis which followed the big solar storm on April 3 began around 2300 and ended during the early hours of the 4th. Alan Baker noticed that the 20m band was almost dead towards the late evening of the 3rd, and what weak stations there were had an auroral tone. He soon checked the 2m band, turned his beam just east of north and had an auroral contact with G8BHH, Wolverhampton, and heard GM4COK, GM4DSZ and GI4GID. **John Cooper** G8NGO, Cowfold, Sussex, using his 14-element beam, had 59A contacts with G4HSS, GM4DSZ, GM8EYB, and weaker contacts with G8LHT, Doncaster, and G8RHI. John also heard GM8NET and tried to contact GI4GID who was very strong in southern England, but the pile up to work him was too great.

During the event I heard G8ODN, GI4GID, GM4COK and GM8NET. Up in Scotland the aurora affected v.h.f. signals earlier in the evening and between 1700 and 2000 GMT **John Branegan** GM8OXQ, Saline, Fife, heard 5 Gs, 4 GIs, 7 GMs, 2 LAs, 1 PA0 and the 2m beacons in Germany DL0PR, Northern Ireland GB3GI, and Cornwall GB3CTC. **Dermot Cronin** EI9DC/G4GRO, who normally reports from the Royal Sovereign Light, heard, at his home in Killiney, tone-A signals from G, GI, GM and LA during the evening of March 29. John Branegan said it was "A very odd aurora", and between 1700 and 1830 he heard signals from EI, DL, LA, G, GI, GM, OZ, SM and the beacons from Cornwall and Germany. At 1746, John heard EI3S, OZ1OF, GM3UU and GI5AJ all calling at once and writes: "they all appeared at or near the same tuning point but they were clearly not hearing one another. However, the OZ called the EI and was answered by the GI so at least he got a QSO eventually". Auroral signals, mainly confined to GM, were heard by John during the early evenings of March 22, 26 and 27 and, around 1115 on April 13, Alan Baker noticed that some 10m signals had an auroral tone.

European DX

While at the BBC on April 6, I met **Rudolf Heim,** Secretary General of the European DX Council, who was visiting Bush House to see a recording of *World Radio Club.* The EDXC has some 35 member organisations throughout the world, among whom are several international broadcasters acting as observers. Rudolf told me that only about 10 per cent of broadcast DXers are interested in v.h.f. and TV DX, but the number is growing. The Dutch are well ahead in this field however, and have some remarkable aerial systems. Some German clubs are moving in this direction and the German DX Federation, AGDX, frequently publish their own v.h.f and TV DX Bulletin. The use of Citizens' Band in Germany is popular among people of all age groups.

Radio Astronomy

John Smith is experimenting with a receiver to record the bursts of radio noise which come from Jupiter between 20 and 30MHz. So far he has built a pair of 4 half-wave dipoles on a 300 metre baseline, the signals being fed to an FRG-7 followed by a d.c. amplifier to drive a pen recorder. John is also working on a microprocessor, based on the SC/MP chip, to drive his 30ft dish which he intends to use for astronomical observations at 1420MHz.

Satellites

As a result of John Branegan's article about 70cm propagation from satellites, published in the quarterly journal of AMSAT–USA, he has been busy answering letters, one of which came from JR1SWB, editor of the Japanese *OSCAR NEWS.* John is pleased to do this and play his part in the international co-operation of the OSCAR project. His talk on satellites to the Mid-Lankark ARS was well received. Recently, John's first QSL card arrived from OK3CDI for a contact through the Russian satellite, RS-1 and another card from W4AXR, Florida, confirming his best DX to date, 4300 miles, via OSCAR 7B. So far, John has had nearly 50 satellite QSOs with W2BXA who was the first amateur to work 100 countries via satellite and the one who helped John through his first transatlantic QSO via OSCAR.

Tropospheric

The predominantly poor weather conditions and the low atmospheric pressure between March 19 and April 12 gave little help to the v.h.f. enthusiast, in fact at midnight on March 27 it was 29·1in and only just reached 30·1in for a few hours on the 23rd, when a brief improvement in conditions took place. Suddenly, on Good Friday, April 13, the weather turned warmer, the pressure began to rise and by midday on Easter Sunday it was 30·2in and rising. At 2200 on March 23, Alan Baker heard DB5KGI and PA3ALK on 2m s.s.b. and at 2320, ON6CP on c.w. At 1931 on April 13, Alan had a difficult QSO with F3CF, Lille, and heard G3BDQ in nearby Hastings working a German station on 2m s.s.b. Later, Alan, from his home in east-Sussex, worked stations in Bedfordshire, Hampshire and Kent, via the London repeater GB3LO, R7. At 0853 on the 15th, I heard a QSO between GB2RN, HMS *Belfast,* London and G4EVI, Yeovil, Somerset, via the

Hampshire repeater GB3SN, R5 and both stations were saying that they had not heard SN so strong for a long time.

Around 0730 on the 16th, I heard signals through GB3BC on R6, received a picture from Lichfield on Ch. 8, (189MHz) and noted some continental interference to the BBC stations in Band II. During the day **Barry Ainsworth** G4GPW, Sompting, Sussex and **Roy Bannister** G4GPX, in nearby Lancing, had a QSO via the French repeater FZ2THF on R9 and around 1530, G4GNX worked DJ0JW/A and DL0GO, who were both at their club station, DD8EE and using 4 × 21-element beams on 2m s.s.b.

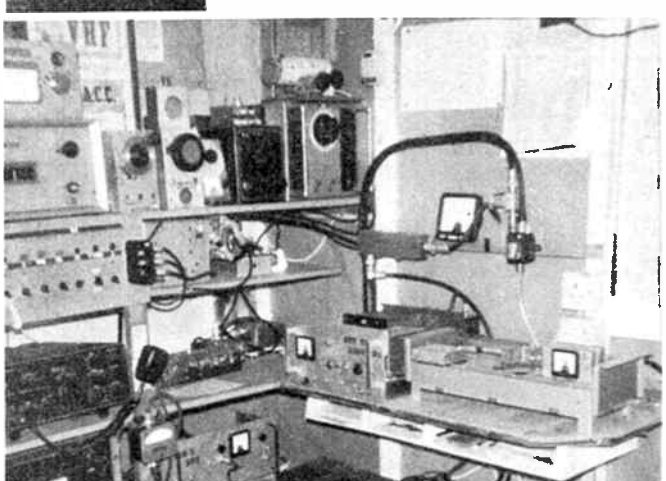
DX Television

On April 1, **Andrew Coetzee,** one of my readers in Transvaal, SA received Ch.1 BBC TV, 45MHz on his KB receiver with a dipole aerial. Although the vision was only good enough to make out the figures, the sound was very strong. Congratulations are also due to Andrew, who has passed his amateur exams, and now has a restricted licence, callsign ZR6QP.

VHF PERSONALITY

JOHN TYE

by RON HAM



Part of John Tye's shack, on the right is home constructed equipment for 13 and 23cm

John Tye's interest in radio began around 1940 when, at the age of 14, he assisted with the servicing of broadcast receivers. His fascination for communications was fostered through listening to the short-wave bands on the government surplus receivers, R107 and R1155, which became available soon after the war. Later he joined the RSGB and, as BRS 27622, expanded his listening activities, with home-brew equipment, into the v.h.f. bands. John passed the RAE in May 1968 and, although he was soon active on 2m as G8BYV, his mind was set on building gear and experimenting on the centimetric bands. He passed the Morse test in 1973, and was then granted the callsign G4BYV.

John's signals have been heard in many European Countries on 70, 23 and 13cm from his home in Dereham, Norfolk and in September 1976 he earned the No. 1, Four Metres and Down, Microwave award from the RSGB for a contact of 883km on 1·3GHz with SK6AB. By the end of that year, he had achieved enough confirmed QSOs to qualify for the Society's 23cm award and the 70cm Senior award. One of John's overseas honours came in October 1973 when he received the Mirabel II certificate for sending a tape recording of Mirabel's 1296MHz beacon to F2LM. Mirabel II was a transponder with an up and down link on 144–432MHz, and a beacon on 23cm. It was launched from Nancy, France, by balloon and descended by parachute.

John's present aerial array, consisting of a 13-element Yagi for 70cm, an 8-element Yagi for 2m and separate 4ft dishes for 23cm and 9/13cm, is mounted on a tower which can be raised if required. For almost 30 years, John, a carpenter by trade, has been a reader of *Practical Wireless* and is supported in his amateur radio activities by his wife, Joan, who enjoys listening to the h.f. bands when driving their car. For the future, John plans to stay on the centimetric bands, use s.s.b. on 9cm and develop gear for 6cm.

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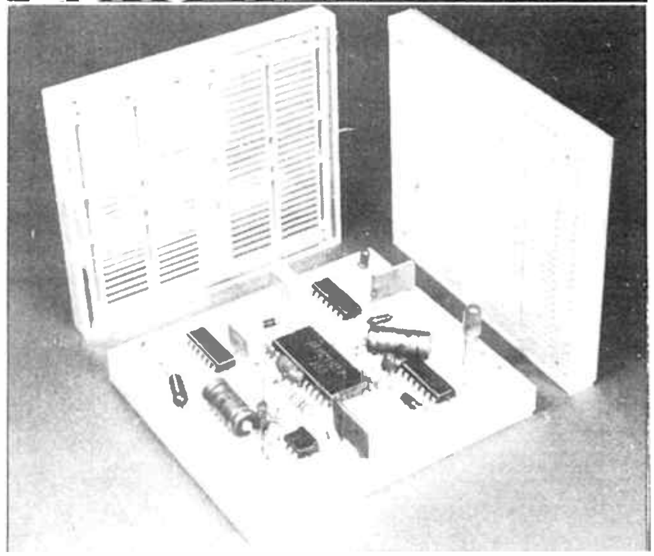

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AC176 0·22
AC187 0·22
AC188 0·22
ACY17 0·92
ACY18 0·86
ACY19 0·81
ACY20 0·76
ACY21 0·81
ACY39 1·62
AD149 0·76
AD161 0·49
AD162 0·49
AF106 0·49
AF114 0·81
AF115 0·81
AF116 0·81
AF117 0·81
AF139 0·43
AF186 1·30
AF239 0·49
AFZ11 2·97
AFZ12 2·97

ASY26 0·43
ASY27 0·43
ASZ15 1·35
ASZ16 1·35
ASZ17 1·35
ASZ20 1·62
ASZ21 2·16
AU110 1·84
AU113 1·84
AUY10 1·84
8A145 0·15
8A148 0·15
8A154 0·10
8A155 0·11
8A156 0·10
8AW62 0·06
8AX13 0·07
8AX16 0·10
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8C108 0·13
BC109 0·14
8A113 0·13
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8C137 0·17
8C147 0·10
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8D138 0·43
BD139 0·46
BD140 0·48
8D144 2·16
8D181 1·19
8D182 1·27
8D237 0·43
BD238 0·59
8DX10 0·98
BDX32 2·16
BDY20 1·35
BDY60 1·62
8F115 0·27
BF152 0·19
8F153 0·22
8F154 0·18
8F159 0·25
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8F167 0·22
8F173 0·22
8F177 0·26
8F178 0·26
8F179 0·27
8F180 0·32
BF181 0·32
BF182 0·32
BF183 0·27
BF184 0·27
BF185 0·27

8F194 0·10
8F195 0·10
8F196 0·11
8F197 0·14
8F200 0·29
8F224 0·23
8F244 0·30
8F257 0·26
8F258 0·28
8F259 0·35
8F336 0·32
8F337 0·32
8F338 0·33
8FS21 4·28
8FS28 2·41
8FS61 0·23
8FS98 0·23
BFW10 0·70
BFW11 0·70
8FX84 0·24
8FX85 0·25
8FX87 0·23
8FX88 0·23
8FY50 0·28
8FY51 0·28
8FY52 0·28
8FY64 0·28
8FY90 1·35
BSX19 0·23
8SX20 0·22
8SX21 0·22
8T106 1·35
8TY79/400R 3·45
BU205 1·97
8U206 2·53
BU208 2·25
BY100 0·49
8Y126 0·15
8Y127 0·16

8ZX61 0·19
·Series
8ZY88 0·14
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CRS/140 0·65
CRS/340 0·81
CRS/360 0·97
GEX66 1·62
GEX541 1·89
GJ3M 0·81
GJ5M 0·81
GM037BA 1·89
KS100A 0·51
MJE340 0·86
MJE370 1·26
MJE371 0·66
MJE520 0·56
MJE521 0·59
MJE2955 1·35
MJE3055 0·81
MPF102 0·34
MPF103 0·34
MPF104 0·34
MPF105 0·34
MPSA06 0·26
MPSA56 0·29
MPSU01 0·41
MPSU06 0·52
MPSU56 0·55
NE555 0·49
NKT401 2·46
NKT403 1·87
NKT404 1·87
OA5 1·03
OA7 0·59
OA10 0·65
OA47 0·15

OA70 0·32
OA79 0·32
OA81 0·32
OA85 0·32
OA90 0·09
OA91 0·09
OA95 0·09
OA200 0·10
OA202 0·10
OA211 1·08
OAZ200 1·08
OAZ201 1·08
OAZ206 1·08
OAZ207 1·08
OC16 2·16
OC20 2·70
OC22 2·70
OC23 2·97
OC24 3·24
OC25 0·97
OC26 0·97
OC28 2·16
OC29 2·16
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OC41 0·86
OC42 0·81
OC43 2·43
OC44 0·65
OC45 0·59
OC71 0·59
OC72 0·59
OC73 1·08
OC74 0·70
OC75 0·70
OC76 0·59
OC77 1·30
OC81 0·70
OC81Z 1·30

OC82 0·70
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OC84 0·70
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OC123 1·89
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OC141 3·51
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OC171 1·08
OC200 1·62
OC201 1·89
OC202 1·89
OC203 1·89
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OC205 2·70
OC206 2·70
OC207 1·89
OCP71 1·35
ORP12 0·81
R2008B 1·97
R2009 2·46
R20108 1·97
T1C44 0·32
T1C226D 1·30
T1L209 0·22
T1P29A 0·46
T1P30A 0·50
T1P31A 0·49
T1P32A 0·52
T1P33A 0·75
T1P34A 0·79
T1P41A 0·68
T1P42A 0·76
T1P2955 0·72
T1P3055 0·60
T1S43 0·51
ZS140 0·28
ZS170 0·24
ZS178 0·61

ZS271 0·26
ZS278 0·64
ZTX107 0·12
ZTX108 0·11
ZTX109 0·14
ZTX300 0·14
ZTX301 0·15
ZTX302 0·17
ZTX303 0·19
ZTX304 0·21
ZTX311 0·14
ZTX314 0·23
ZTX500 0·15
ZTX501 0·16
ZTX502 0·18
ZTX503 0·19
ZTX504 0·23
ZTX531 0·23
ZTX550 0·18
1N914 0·06
1N916 0·08
1N4001 0·07
1N4002 0·07
1N4003 0·08
1N4004 0·08
1N4005 0·09
1N4006 0·09
1N4007 0·10
1N4009 0·07
1N4148 0·07
1N5400 0·14
1N5401 0·14
1S44 0·05
1S920 0·08
1S921 0·08
2G301 1·08
2G302 1·08
2G306 1·19
2N404 1·08
2N696 0·27

2N697 0·27
2N698 0·32
2N705 1·30
2N706 0·16
2N708 0·22
2N930 0·22
2N1131 0·28
2N1132 0·28
2N1302 0·38
2N1303 0·38
2N1304 0·49
2N1305 0·49
2N1306 0·54
2N1307 0·54
2N1308 0·59
2N1309 0·59
2N1613 0·27
2N1671 1·62
2N1893 0·27
2N2147 1·89
2N2148 1·78
2N2218 0·27
2N2219 0·26
2N2220 0·19
2N2221 0·19
2N2222 0·19
2N2223 2·97
2N2368 0·18
2N2369A 0·23
2N2484 0·22
2N2646 0·59
2N2904 0·27
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2N3866 0·81
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2N4126 0·18
2N4286 0·23
2N4288 0·25
2N4289 0·27
2N5457 0·39
2N5458 0·39
2N5459 0·39

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CBL31 1·69
CL33 2·25
CY31 1·13
DAF91 0·45
DAF96 1·13
DF91 0·45
DF96 1·13
DK91 1·18
DK92 1·41
DK96 1·24
DL92 1·24
DL94 1·35
DL96 1·24
DY86/7 0·72
DY802 0·95
E80CC 6·22
EA8C80 1·35
EAF42 1·41
EAF801 1·97
E841 2·25
EB91 0·95
E8C33 1·97
E8C41 1·41
E8C81 1·24
E8C90 0·96
E8F80 0·57
E8F83 1·41
E8F89 0·96
E8L31 2·81
ECC40 1·41
ECC81 0·99
ECC82 0·81

ECC83 0·99
ECC84 1·34
ECC85 1·35
ECC88 2·03
ECC91 7·45
ECC189 1·87
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ECF82 1·35
ECH35 2·25
ECH42 1·29
ECH81 1·35
ECH83 1·41
ECH84 1·44
ECL82 1·13
ECL83 1·69
ECL86 1·35
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EF39 3·09
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EF41 1·35
EF42 2·25
EF50 1·69
EF80 0·90
EF83 1·97
EF85 0·90
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EL91 6·92
EL95 1·49
EL360 5·98
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EM81 1·13
EM84 1·13
EM85 1·41
EM87 1·69
EN91 2·76
EY51 1·97
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EZ41 1·41
EZ80 0·95
EZ81 0·95
EZ90 1·35
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GZ33 4·50
GZ34 2·14
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KT88 7·59
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PC88 1·58
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UA8C80 1·41
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U8C41 1·69
U8F89 1·35

UCC84 1·24
UCC85 1·35
UCF80 1·29
UCH42 1·35
UCH81 2·61
UCL82 1·17
UCL83 1·62
UF41 1·13
UF80 1·62
UF85 1·62
UF89 1·62
UL41 1·82
UL84 1·35
UM80 1·13
UY41 1·41
UY85 1·17
Z803U 8·53
183GT 2·44
1R5 1·18
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2AS15 10·80
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3A5 1·46
3CX100A5 21·60
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5U4G8 2·54
5V4G 1·71
5Y3GT 0·96
5Z3 1·69
5Z4G 1·71
5Z4GT 1·69

6-30L2 1·76
6A87 1·69
6AC7 1·58
6AF4A 1·80
6AG7 2·25
6AH6 5·40
6AK5 3·89
6AK6 2·75
6AL5 0·99
6AM4 2·59
6AM5 4·29
6AM6 2·03
6AN5 5·99
6AN8A 4·66
6AO5 1·08
6AR5 1·80
6AS6 6·28
6ASTGA 7·29
6AT6 0·96
6AU5G7 4·70
6AU6 1·22
6AV5GA 4·25
6AV6 0·96
6AX5GT 3·49
687 1·69
688 1·97
68A6 1·13
68A7 5·76
68A8A 4·22
68C4 4·17
68E6 1·22
68H6 1·71
68J6 1·22
68K4 4·74
68L6 91·80
68L7GT 4·34
68N6 1·86

68O7A 4·05
68R7 4·50
68R8 1·97
68S7 4·50
68W6 4·50
68W7 1·71
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68Z6 2·57
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6H2N 1°18
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6H6 1·69
6J4 5·96
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6K4N 1·41
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6K7 1·69
6K8 1·97
6KD6 6·93
6L6G 2·81
6L6GA 1·69

6L6GT 0·96
6L6GC 2·19
6L7 2·25
6N2P 1·18
6N3P 1·18
6N7 1·69
6P25 4·05
6O7 2·48
6R7 2·03
6SA7 1·63
6SC7 1·69
6SF7 1·80
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6SJ7 1·80
6SK7 1·46
6SL7OT 3·02
6SNG7 1·80
6SO7 1·47
6SR7 1·69
6SS7 2·03
6U5G 2·25
6U8 0·90
6U8A 3·17
6V6GT 1·80
6X4 1·35
6X5GT 0·96
787 1·91
7C5 1·97
7C6 1·41
7H7 2·25
7R7 1·69
7S7 2·53
7Y4 1·80
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12BE6 2·50
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12E1 7·67
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30C15 1·80
30C17 1·80
30C18 1·80
30F5 1·89
30FL1/2 1·26
30FL12 2·03
30FL14 1·80
30L1 1·13
30L15 2·03
30L17 2·03
30P4 1·04
30P19 1·35
30PL1 1·49
30PL13 2·03
30PL14 1·89
30PL15 2·03
35W4 0·68
50C5 0·79
85A2 2·00
90AG 8·60
90AV 8·60
90C1 1·94
90CG 14·77
90CV 14·36
92AG 8·60

92AV 8·60
95A1 5·24
150B2 2·32
150B3 4·21
150C2 1·62
150C4 1·89
211 6·48
723A8 37·80
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811A 9·18
812A 9·02
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866A 6·21
872A 14·85
931A 13·22
2050 7·52
5642 5·68
5654 3·80
5651 1·94
5670 4·97
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6080 7·40
6146A 5·53
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6973 3·96
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7401 0·17
7402 0·17
7403 0·17
7404 0·18
7405 0·17
7406 0·43
7407 0·43
7408 0·22
7409 0·22
7410 0·17

7412 0·28
7413 0·35
7416 0·35
7417 0·35
7420 0·18
7422 0·22
7423 0·35
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7427 0·32
7428 0·46
7430 0·18

7432 0·32
7433 0·39
7437 0·35
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7440 0·19
7441AN 0·92
7442 0·78
7447AN 0·97
7450 0·19
7451 0·19
7453 0·19

7454 0·19
7460 0·19
7470 0·38
7472 0·36
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7475 0·58
7476 0·43
7480 0·59
7482 0·81
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7484 1·08
7486 0·38
7490 0·56

7491 0·86
7492 0·65
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7495 0·78
7496 0·86
7497 3·24
74100 1·62
74107 0·49
74109 0·76
74110 0·54
74111 0·76
74116 1·89

74118 1·08
74119 1·62
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74145 0·97
74147 2·16
74148 1·89
74150 1·73
74151 0·92
74154 1·89
74155 0·92
74156 0·92
74157 0·81
74159 2·27
74170 2·48
74172 4·75

74173 1·51
74174 1·62
74175 0·97
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74196 1·30
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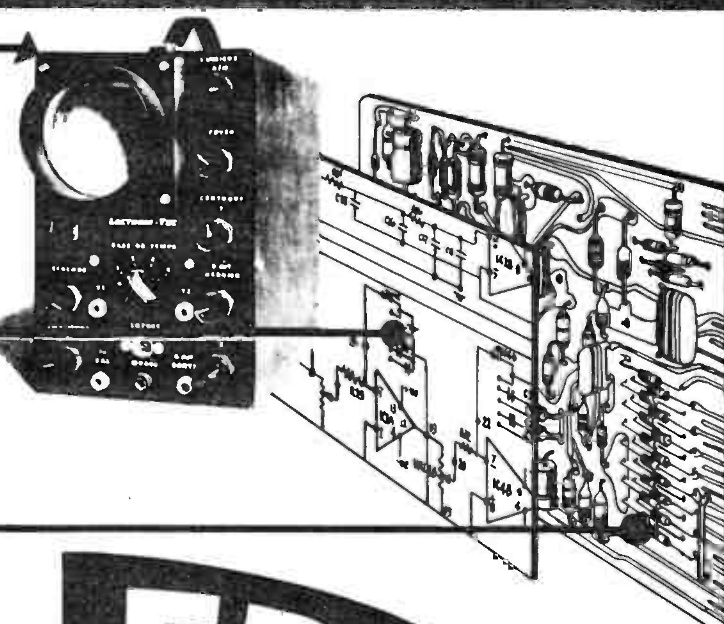

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M1

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M2

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M3

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M4

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M5

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Dual time zone facility
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Only 9mm thick

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M6

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Dual time zone facility
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SOL M7

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METAC ★ PRICE

M8

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M9

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METAC PRICE

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M10

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M11

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M12

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M15

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M16

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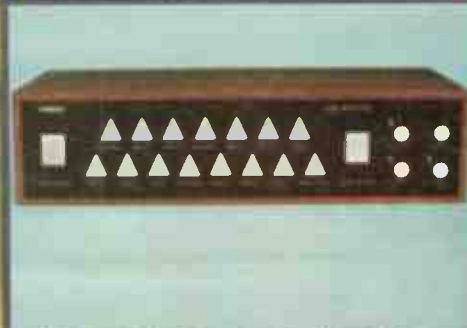

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