

PRACTICAL WIRELESS

APRIL
1973

20p



TRICOLOUR

Mood Lighting

*Loop aerial
1112*



System

also

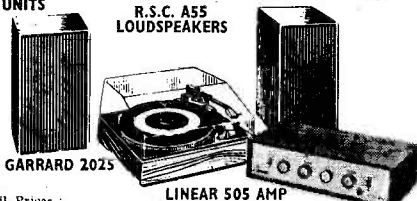
I. C. POWER AMPLIFIER
DARKROOM EXPOSURE METER

PACKAGE PRICE R.S.C. STEREO PACKAGE OFFERS

FOR ILLUSTRATED UNITS

ONLY £39.59

Carr. £1.00
Or deposit £8.85
and 9 monthly
payments £4.22
(Total £44.98).



Individual Rec. Retail Prices:
LINEAR 505 5 + 5 Watt Amplifier ... £17.50
GARRARD 2025 Autochanger + KS40A Cartridge ... £13.58
Teak Veneer Plinth with Transparent Plastic Cover ... £8.10
Pair A55 LOUDSPEAKERS (Inc 8" x 5" 10,000 Gauss) ... £11.50
TOTAL £48.68

SEND S.A.E. FOR
FREE COLOUR
BROCHURE

SAVE £31.60

MONARCH
SPEAKERS

GOLDRING
GL72



'SUPER 30' AMP

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. ... £31.89
GOLDRING G800
Magnetic Cartridge ... £12.91
DE-LUXE PLINTH
with Roll-over Cover ... £10.50
Pair R.S.C. MONARCH
LOUDSPEAKERS ... £38.75
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 **£9.95** post free
Response 25 Hz-2 KHz.
Impedance 8-15 ohms.
Or Dep. £2.25 & 9 monthly payments. £1 (Tot. £11.26)

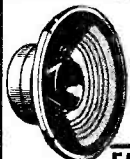
RSC G66 MkII 6.6 WATT high quality STEREO AMPLIFIER

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 £17.60).



COMPREHENSIVE WIRING DIAGRAMS & INSTRUCTIONS
OR FACTORY BUILT IN TEAK VENEERED CABINET **£11.50** Carr. 40p
as illustrated £14.99 or dep. £2.20 and 9 monthly payments £1.70 (Total £17.60).

AUDIOTRINE HIGH FIDELITY SPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Plastisol 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" 15W	£2.68	HF120D	12" 15W	£4.99
HF102D	10" 10W	£3.40	HF120	12" 15W	£5.75
HF120	12" 15W	£4.50	HF126D	12" 15W	£6.25

FANE 807T HIGH FIDELITY SPEAKER



A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 3 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Impedance 3 or 8-15 Ω.
PLEASE STATE IMPEDANCE WHEN ORDERING
MODEL 807T 8" 15w. with parasitic Tweeter. **£4.95**
Response 25 Hz to 15 KHz. Gauss 13,000 Imp 3 or 8-15.

R.S.C. BATTERY/MAINS CONVERSION UNITS



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

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

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

MIDGET CLAMPED TYPE 2 1/2 x 2 1/2 x 2 1/2	TOP SHROUDED DROP-THERO TYPE	CHARGER TRANSFORMERS 0.9-15v. 1 1/2a. 99p:
250v., 60mA, 6.3v. 2a. 99p	250-0-250v. 70mA, 6.3v. 2a., 0-6-6.3v. 2a. ... £1.35	2 1/2a. £1.10; 3a. £1.25; 4a. £1.45; 5a. £1.65; 6a. £2.00
250-0-250v., 60mA 6.3v. 2a. £1.05	250-0-250v. 100mA, 6.3v. 3.5a. £1.55	AUTO (Step Up/step DOWN) TRANSFORMERS
	250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a. £1.60	0-110/120v. 200-220-250v. 50-80 watts £2.10,
	350-0-350v. 80mA, 6.3v. 2a., 0-6-6.3v. 2a. ... £1.65	150 watts; £1.90-250 watts £2.75; 500 watts £5.75
	250-0-250v. 100mA, 0.3v. 4a., 0-6-6.3v. 3a. ... £2.20	OUTPUT TRANSFORMERS
	300-0-300v. 100mA, 6.3v. 4a., 0-6-6.3v. 3a. ... £2.20	Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω 50p
	300-0-300v. 130mA, 6.3v. 4a., c.t. 6.3v. 1a. ... £2.20	Push-Pull 8 watts EL84 to 3 or 15 Ω 83p
	Suitable for Mullard 610 Amplifier. £2.60	Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω ... £1.37
	350-0-350v. 100mA, 6.3v. 4a., 0-6-6.3v. 3a. ... £2.20	Push-Pull EL84 to 3 or 15 Ω 10-12 watts. ... £1.35
	350-0-350v. 150mA, 6.3v. 4a., 0-6-6.3v. 3a. ... £2.60	Push-Pull Ultra Linear for Mullard 510, etc. £2.20
		Push-Pull 15-18 watts, sectionally wound 6L6, KT66 etc. for 3 Ω or 15 Ω ... £1.99
		Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT88 etc. to 3 or 15 Ω £3.30

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 8 Ω. Frequency Response 7 Hz to 70 KHz ± 1 1/2 dB.



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

£25

R.S.C. STEREO FM TUNER.

Visually matches Super 30 Mk. III **£44.95**

FACTORY BUILT UNIT INC. CABINET with 12 months' guarantee. Or Dep. £7 and 9 monthly payments £3.99 (Total £42.91). **£38.75**

£38.75

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.
DORCHESTER (Illustrated) Size 16 x 11 x 9in. approx. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13 x 8in. **£9.45** Carr. 40p.
Dual Cone speaker. Imp. 3 or 15 ohms.
MONARCH Size 19 x 10 x 9in. approx. Rating 10 watts. Inc. 13 x 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. 60p **£19.35**

HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. Sizes approx. Carr. 35p. per enc.
JES8 Size 16 x 11 x 9in. SE8 For optimum performance with any 8in. Hi-Fi speaker. Size 22 x 15 x 9in. **£6.47**
SE10 For outstanding results with 10in. Hi-Fi speaker. Size 24 x 15 x 10in. P.t'd. **£6.74**
SE12 For excellent performance with 12in. Hi-Fi speaker and tweeter. Size 25 x 16 x 10 1/2in. **£7.87**

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 **£6.95** Carr. 35p
HF126 15,000 LINE SPEAKER

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

200-250v. A.C. 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 6mV Output rating I.H.F.M. Fully enclosed enamelled case. 9 1/2 x 2 1/2 x 3 1/2in. Attractive brushed silver finish fascia plate 10 1/2 x 3 1/2in. 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**

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.

SELENIUM RECTIFIERS F.W. (Bridged) All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 25p. 2a. 35p. 3a. 50p. 4a. 65p. 5a. 80p. SMOOTHING CHOKES 150mA, 7-10H, 250 Ω 70p; 100mA, 10H, 200 Ω 80p; 80mA, 10H, 250 Ω 80p; 60mA, 10H, 300 Ω 400 Ω 25p.

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

* Moderate size only 25 x 14 x 10in. approx. COMPLETE KIT **£23** Carr. 65p
* Response 30-20,000 c.p.s. Impedance 15 ohms
* Performance comparable with units costing considerably more
Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet.
(2) 3-way quarter section series cross-over system.
(3) 8 x 5in. high flux middle range speaker.
(4) High efficiency tweeter. (5) Appropriate quality acoustic damping material. (6) Handsome Teak veneered cabinet.
(7) Circuit and full instructions. Terms: Dep. £4.60 and 9 monthly payments £2.47 (Total £26.83).



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 HEADPHONES
(c) MATCHING DYNAMIC 'MIKE' (attached to headphones)
(d) PAIR 50 WATT SPEAKERS
Black Rexine covered Cabinets
Size approx. £72-85
18" x 18" x 8"
(a)(b)(c)&(d) Carr. £1-25

RSC TDI DISCO CONSOLE
Incorporating twin Garrard SP95 Mk.III turntables and Sonotone or Acos Cartridges with diamond styl. 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
Or Dep. £18-25 and 9 mthly pymts £8-88
(Total £75-17) or Dep. £15 and 18 mthly payments £3-82 (Total £80-16). **£67-10**

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

FANE ULTRA HIGH POWER LOUDSPEAKERS

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

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt 14,000 gauss 8/15"	15" 60 Watt 14,000 gauss 8/15"	12" 50 Watt 13,000 gauss 15"
£22-95	£12-90	£10-90
Dep. £8 and 9 mthly payments £2-20 (Total £25-80)	Dep. £3-80 and 9 mthly payments. £1-80 (Total £15).	Dep. £2 and 9 mthly payments £1-20 (Total £12-80)

FOR BASS GUITAR, ELECT. ORGAN, ETC. **PAIR SUITABLE ALL PURPOSES**

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 high characteristic high flux 12" x 8" 50 watt speakers. Terms: Dep. £3 and 9 mthly payments £2-22 (Total £22-98) Carr. 50p.
TYPE C4100 100 WATTS inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58 x 16 x 10". Acoustically filled and pressurised. Terms: Dep. £11 and 12 mthly. pyts. £5-18 (Total £73-16). 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 E123 EF66, EC93, EL34, EL34, GZ34. Separate Bass and Treble Controls. Sensitivity 38 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. 200-260v. 60 c/s A.C. mains. For 5 and 15 ohm speakers. Twin-handled perforated cover £1-90. 12 MONTHS GUARANTEE. Carr. 50p
TERMS: Deposit £4 and 9 monthly payments of £2-10 (Total £22-90). Send S.A.E. for leaflet. **£19-75**

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.U.s and Crystal or Ceramic Gram. P.U.s
★ Frequency response 30-20,000 Hz.
★ Output overload protection plus double using 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
Simulated black rexine, plastic bonded metal case. **£49-50** Carr. free
Or Deposit £7-50 and 9 monthly payments £5-87 (Total £25-88)
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 Speakers 2 to 30 ohms. Size 17" x 7" x 200-250v. A.C. mains. Output 50 watts music rating. **£34-95** Carr. 75p.
Or Deposit £7-25 and 9 monthly payments £3-55. Total £29-20.

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 £22-95). Carr. £1-50
ONLY £55-95

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 £2.60 and 9 monthly payments of £4.92 (Total £60.78)	£34-95 £12-50 £45 Carr. £1	PACKAGE PRICE
F.A.L. PHASE 50 MK.III AMPLIFIER PR. FANE POP 50 L/SPEAKERS Terms: Deposit £10 and 9 monthly payments of £6-37 (Total £63-38)	£34-95 £21-80 £52 Carr. £1	PACKAGE PRICE
F.A.L. PHASE 50 MK.III AMPLIFIER PAIR L12/25 25W L/S in cabinets Terms: Deposit £10 and 9 monthly payments of £6-88 (Total £82-82)	£34-95 £28-90 £56 Carr. £1-25	PACKAGE PRICE
F.A.L. PHASE 100 AMPLIFIER 4 FANE POP 50 L/SPEAKERS Terms: Deposit £15-95 and 9 monthly payments of £10-78 (Total £112-52)	£81-95 £43-80 £99-95 Carr. £2	PACKAGE PRICE

HIGH QUALITY LOUDSPEAKER UNITS
ALL TWO TONE REXINE AND VYNAIR FINISH
L125 50 WATT Fitted pair of 12" 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. £1-50. Or deposit £6-50 and 9 monthly pmts. of £3-70. Total £28-80
L12/20 12" 20-25 WATT L13 13" x 8" 10 Watt 13,000 lines 3 or 15 ohms. State impedance required. Carr 40p
£34-50
£11-95
£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 £2-25. **£65**
(Total £71-25). Carr. £2

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 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 £2-25 (Total £26-45). **£23-50** Carr. 65p

NOW FOUR NEW BRANCHES
NOTTINGHAM 19/19A MARKET STREET
SUNDERLAND 5 MARKET SQUARE
STOCKPORT 8 LITTLE UNDERBANK
COVENTRY 17 SHELTON SQUARE
NEW LARGER PREMISES AT **HULL, DARLINGTON & NEWCASTLE** See Addresses

RSC HI-FI CENTRES LTD.
MAIL ORDERS & EXPORT ENQUIRIES TO:—
AUDIO HOUSE, HENCONNER LANE, LEEDS, 13. Tel: Pudsey (09735) 77681.
TERMS C.W.O. or C.O.D. NO C.O.D. under £1. POSTAGE 25% 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.
MAIL ORDERS MUST NOT BE SENT TO SHOPS

R.S.C. Branches operate a 5-day week
Open all day Saturday

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STOCKPORT 8 Little Underbank. Tel: 480-0777.
SUNDERLAND 5 Market Sq. (Closed Wed.) Tel. 70873



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



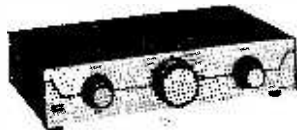
TRADE & EDUCATION ENQUIRIES WELCOME

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

TOP QUALITY — LOW COST



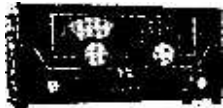
AMATEUR RADIO EQUIPMENT



P.R.40

SOLID STATE
R.F. PRESELECTOR

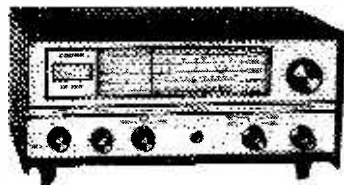
The PR40 R.F. Preselector is the solid state version of the world famous PR30 which it now supercedes. It employs Silicon "N" Channel FET (Field Effect Transistor) front end, followed by silicon NPN Broad Band R.F. Amp., and will substantially improve receiver performance over the range 1.5 to 35 MHz, providing a considerable increase in gain up to an overall average of 30 dB, with improved image rejection and noise ratio. Supplied complete with co-ax plug (less standard 9 volt PP6 Battery), 12 months Guarantee . . . £8-90 Carriage 30p.



MULTIBAND-6

SOLID STATE
SHORT WAVE RECEIVER KIT

All transistor T.R.F. Receiver tunes 550 KHz to 30 MHz (540 to 10 metres) complete coverage—no gaps. Medium waves—Trawlers—Ship/Shore Telephone—All Six Amateur Bands 160-10 metres—International Broadcast from Australia, Far East, Russia, USA etc. using 4 miniature plug in Coils. Hi-Gain FET Regen. Det./AF/AF Module giving full loudspeaker output to any external 2/3 ohm speaker. Receives AM/CW/SSB. Separate Electrical Bandsread, Calibrated Main Tuning. A Quality CODAR-KIT with 12 months Guarantee. No technical knowledge required, simple to build, printed circuit and Pictorial Instruction Manual, fully detailed step by step. Complete Kit with 4 Coils (less standard PP6 battery). £13-20 Carriage 35p. Stamp brings illustrated leaflets.



CR70A

COMMUNICATION RECEIVER

The CODAR CR70A is an outstanding general coverage communication receiver, ideal for the keen S.W.L. It tunes from 540 metres medium through to 10 metres with no gaps. Covers shipping, coastguard and distress frequencies, all six amateur bands 160-10 metres, International broadcast, Met. stations etc. etc. giving world-wide reception. Exclusive features include Air-spaced CODAR-COIL Hi-"Q" Aerial input, illuminated Meter and Slide Rule Scale, Two Speed vernier tuning, Switched B.F.O. for CW/SSB signals. Separate output for Tape recorder. Ready to plug in to 200/240 volts A.C. it only needs your aerial and a 2/3 ohm loudspeaker to bring the world to your finger tips. 12 months full guarantee.

Complete ready built £27-50, Carriage 70p.
SEND FOR YOURS TODAY!

NOTE: These CODAR Receivers meet the B.R.E.M.A. specification for Communication Receivers and are FREE of Purchase Tax. Some portable receivers being advertised as Communication Receivers do not meet these requirements.



ON THE DESIGN STAFF—
G3SZM G3IRE

CODAR

TELECOMMUNICATIONS AND ELECTRONIC
EQUIPMENT SUPPLIERS TO H.M. AND OVERSEAS
GOVERNMENTS

VALCON WORKS · BURRELL BUILDINGS · CHURCHILL INDUSTRIAL ESTATE · LANCING · SUSSEX
Tel. 090-63-61901 BNI5 - 8TZ



A special message to the Fumble Fingered Freds among us

NEW STEPHENSPEAKERS

A new range of loudspeaker kits and cabinets with a style and specification for every purpose. You'll be cheating a bit if you tell your friends "made it myself". We supply superb craftsmen built fully finished cabinets in beautiful stain and scuff resistant vinyl in white or teak.

Just fit the speaker cloth (supplied) and screw in your speaker.

HIGH QUALITY
AT LOW COST

Send for our free booklet
"Choosing a Speaker"



STEPHENSPEAKERS,
WILMSLOW AUDIO, Dept. 'PW', Swan
Works, Bank Square, Wilmslow SK9 1HF

ELECTROKIT

SCORPIO CAPACITOR DISCHARGE IGNITION SYSTEM (P.E. Nov. 1971)

Complete kit with full instruction data £9-50

"MUSIC MAKER" ORGAN KIT (P.W. Dec. 1972)

Kit includes only capacitors, semiconductors, switches, preset and loudspeaker. £2-80 OR

COMPLETE kit including above plus resistors, PC board and box £4-40

TRIFFID RADIO (P.E. Feb. 1973)

Kit of resistors, Capacitors, Transistors, Diodes, Potentiometer and I.C. £4-95

LIGHT DIMMER kit contains all parts including circuit and construction data. Fully suppressed, 480 Watts £2-10

DRILL SPEED CONTROLLER (E.E. Aug. 1972)

Complete kit (less MK box, plate and socket) £1-05

Complete kit including MK box, plate and socket £2-20

P.C. Boards not supplied, unless otherwise stated.

We are also able to supply other kits for articles published in *Practical Wireless* and other Electronic magazines. Send for details of other kits available. Please enclose a stamped addressed Envelope.

ELECTROKIT

12 Lauderdale Road, London, W.9

Telephone 01 - 286 0011

MON.-FRI. 9.30-5.30
THURS. 9.30-6.30

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 (Dull), 14 and 16 pin
Our Price 1p per pin

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
E29B ED/A25B	10p			VA1053	10p
E29B Z2/O6	10p			VA1065B	10p
GL16	£1			VA1034	10p

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

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		0.01μF		
1000pf	10p	4700pf	10p	
2200pf	10p	10,000pf	10p	

Slider Pots

Single	Dual	log
10K	10 + 10K	or
25K	25 + 25K	lin
50K	50 + 50K	
100K	100 + 100K	Knobs
30p	50p	10p.

Resistors

3 watt 5% Carbon Film - low noise Hi-Res type

All E24 values 1p each plus p. & p. 7p for up to 50 Resistors and a further 2p for each additional 50. Deduct 33% 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 5p each
2 W 5% Wire wound 5p 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.

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
7 1/2 volt for cassette recorders £2.00
6, 7 1/2 or 9 volt @ 500mA (illus.) £3.99
Car Battery Converter fully stabilised to provide 8, 7 1/2 or 9 volts (£4.99 (p. & p. 15p on all types))

NEW LISTS

LOUDSPEAKERS No. 4
COILS AND INDUCTORS No. 3
TRANSFORMERS No. 2
(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
BA116	17p	OA80	7p	IN4002	7p
BA130	10p	OA81	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

SGS

EA1000



3 Watt Audio Amplifier

Our Price inc. handbook £2.49

FM TUNER

chassis fully transistORIZED
8 volt operation.
OUR PRICE £8.25

Matching stereo decoder £4.97
Ask for model list No. 11.



10-less 15%
25+ less 25%
100+ less 35%

5 Watt Audio Amplifier

Our Price £3.99
Less quantity discount.



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

Ceramic - plate

1-8pf	8 2pf	63V (C333)	120pf
2-3pf	3 10pf	33pf	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	

mylar film

1000pf	2p	0.1μF	3p	0.68μF	4p
2000pf	2p	0.2μF	3p	1μF	4p
5000pf	2p	0.4μF	3p	2μF	5p
		0.5μF	3p		

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

metallised polyester 250V (C280)

0.1μF 3p	0.08μF	3p	4.7μF	8p
0.15μF 3p	0.1μF	4p	68μF	11p
0.22μF 3p	0.15μF	4p	1μF	13p
0.33μF 3p	0.22μF	5p	1.5μF	20p
0.47μF 3p	0.33μF	6p	2μF	24p

metallised polyester 800V (C281)

0.1μF 43p	0.047μF	6p	22μF	10p
0.15μF 43p	0.068μF	6p	33μF	14p
0.22μF 43p	0.1μF	7p	47μF	15p
0.33μF 53p	0.15μF	8p		

silvered mica 1% (>50pf) 500V

2-2pf-820pf	7p	4.7nF-5600pf	19p
1nF-2.2nF	9p	6800pf-0.1μF	29p
2.7nF-3.6nF	16p		

mixed dielectric 800V

0.1μF 7p	0.047μF	7p	22μF	16p
0.22μF 7p	0.068μF	8p	47μF	24p
0.33μF 7p	0.1μF	8p	1μF	33p

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

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

CHROMASONIC electronics

Heat Sinks

TO5 TO18 5p
TO66 TO3 14p
Power Tab 13p



DIP10/2 for SL403D 15p

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	LO5T51	£1.50
AC187	15p	BC149	10p	BF272	53p	OC170	23p	2N1893	30p	LC30T1	£1.50
AC128	15p	BC157	12p	BFY50	24p	OC171	30p	2N2926	all 10p	LC37T1	£1.50
AC176	15p	BC158	10p	BFY51	21p	ZTX107	15p	2N3033	23p	MC1203L	£1.75
AC187	25p	BC159	12p	BRY39	38p	ZTX108	12p	2N3054	50p	MC1330	85p
AC187K	40p	BC169	15p	BSX21	28p	ZTX109	15p	2N3055	49p	MC1390	85p
AC188	25p	BC268	15p	BSY95A	14p	ZTX300	12p	2N3702	12p	MC1391	£1.00
AC188K	25p	BD115	67p	BU105/02	£1.75	ZTX301	15p	2N3703	12p	MC1392	£1.00
ACV20	20p	BD181	70p	MJE340	67p	ZTX302	20p	2N3704	10p	MFC4000B	49p
AD146	40p	BD192	70p	MPP192	40p	ZTX303	20p	2N3705	10p	MFC4000A	55p
AD149	40p	BD191/2M.P.		MPP193	37p	ZTX304	25p	2N3706	10p	LM380	£1.45
AD161	60p			MPP194	37p	ZTX341	20p	2N3707	15p	PA234	£1.95
AD162	60p			MPP195	40p	ZTX500	15p	2N3708	12p	SL403D	£1.50
AF114	18p	BF167	20p	MPP196	45p	ZTX501	15p	2N3709	12p	TAD100	£1.50
AF115	18p	BF173	20p	OC28	40p	ZTX502	20p	2N3710	12p	FILTER LP175	£1.50
AF116	18p	BF180	25p	OC35	40p	ZTX503	17p	2N3711	12p	HA709C	34p
AF117	18p	BF181	30p	OC44	15p	ZTX504	50p	2N3815	35p	HA710	45p
AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3803	15p	HA709C	95p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3804	17p	HA741C	47p
BC108	10p	BF194	15p	OC72	17p	2N708	12p	2N3905	21p	HA749C	60p
BC109	10p	BF195	15p	OC78	15p	2N708	15p	2N3906	12p		

mixed dielectric 1000V

1000pf 6p	6800pf 9p	1μF 12p
2200pf 6p	0.1μF 9p	0.22μF 12p
3300pf 6p	0.022μF 9p	0.47μF 12p
4700pf 6p	0.047μF 9p	

Ceramic

12KV d.c.	8KV d.c.	Hi-K 750V.
100pf 9p	200pf 8p	1000pf 5p
15pf 9p	220pf 9p	1500pf 5p
22pf 9p	250pf 9p	2000pf 5p
68pf 9p	270pf 9p	3000pf 5p
82pf 9p	300pf 9p	6000pf 5p
100pf 9p	750V Disc	10,000pf 5p
120pf 9p	470V	5p feed-through
140pf 9p	1000pf 5p	
150pf 9p	5000pf 5p	
180pf 9p	10,000pf 5p	1000pf 5p

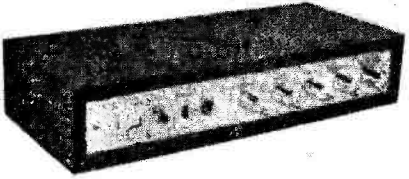
Veroboard

Copperclad Plain

0.1"	0.15"	0.15"
2 1/2" x 1"	6p	6p
2 1/2" x 3 1/2"	20p	16p (9)
2 1/2" x 5"	24p	21p (7)
3 1/2" x 3 1/2"	24p	21p (8)
3 1/2" x 5"	27p	27p (10)
17" x 2 1/2"	6p	50p
17" x 3 1/2"	90p	70p
17" x 5"		75p

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

THE TEXAN



Complete Kit (inc. Teak Case) **£28.50** 6pD 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 complement 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			
	6.3	16	25	40 63
1.5	—	—	—	6p
2.2	—	—	—	6p
3.3	—	—	—	6p
4.7	—	—	—	6p
6.6	—	—	—	6p
10	—	—	—	6p
15	—	—	—	6p
22	—	—	—	6p
33	—	—	—	6p
47	6p	6p	6p	6p
68	—	—	—	10p
100	6p	6p	6p	12p
150	6p	6p	6p	12p
220	6p	6p	6p	12p
330	6p	6p	10p	12p
470	6p	6p	10p	12p
680	—	10p	12p	12p
1000	10p	12p	12p	12p
1500	10p	12p	12p	12p
2200	—	18p	21p	—
3300	—	18p	21p	—
4700	—	21p	—	—

CAP μF	VOLTAGE			
	16	25	40	64
500	—	—	35p	40p
1250	—	—	50p	—
1600	—	—	—	75p
2000	—	40p	50p	—
2500	—	—	—	75p
3200	—	50p	75p	85p
4000	—	—	—	—
5400	—	75p	85p	—

Quantity Prices on application.

Hi-Volt Electrolytics

1. 2. 4; 8μF 450V	14p	32μF	450V	20p	
15μF	450V	15p	50μF	350V	20p
8.18μF; 450 V.W	18p	32 + 32μF; 350 V.W	25p		
8.18μF; 450 V.W	20p	32 + 32μF; 450 V.W	43p		
16 + 16μF; 450 V.W	25p	50 + 50μF; 350 V.W	35p		

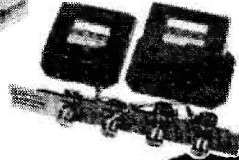
UNISOUND FOR THE NEW SOUND



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 Unilux system brought up-to-date by RTVC using integrated 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 gluing 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



**£7.70
 inc. vat**

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.

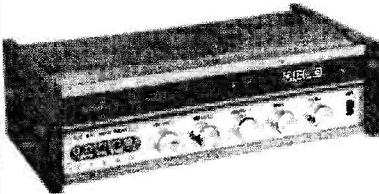
Apart from the output stage, which is an integrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulated IF stages which are pre-aligned before despatch. As well as electronic components 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 4½" 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 Mk IV

A GOOD QUALITY AMPLIFIER—12 Watts £10.50 (inc. VAT). 20 Watts £13.50 (inc. VAT)

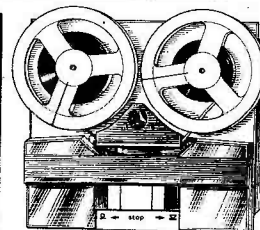
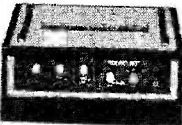
*5 Electrically Mixed inputs. *3 Individual Mixing controls. *Separate bass and treble controls common to all 5 inputs. *Mixer employing F.E.T. (Field Effect Transistors). *Solid State Circuitry. *Attractive Styling INPUTS 1. Crystal Mic or Guitar 9mV. 2.

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 controlled 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)**



PE TAPE LINK CONSTRUCTORS

Suitable 3 speed tape deck, less leads. Caters up to 7ins. spools. Unused but store soiled hence no warranty. **£8** plus 1p & p

* Denotes VAT has been absorbed in the price without increase on VISCOUNT audio systems.

crease with VAT!

VISCOUNT III AUDIO STILL ONLY £52* COMPLETE

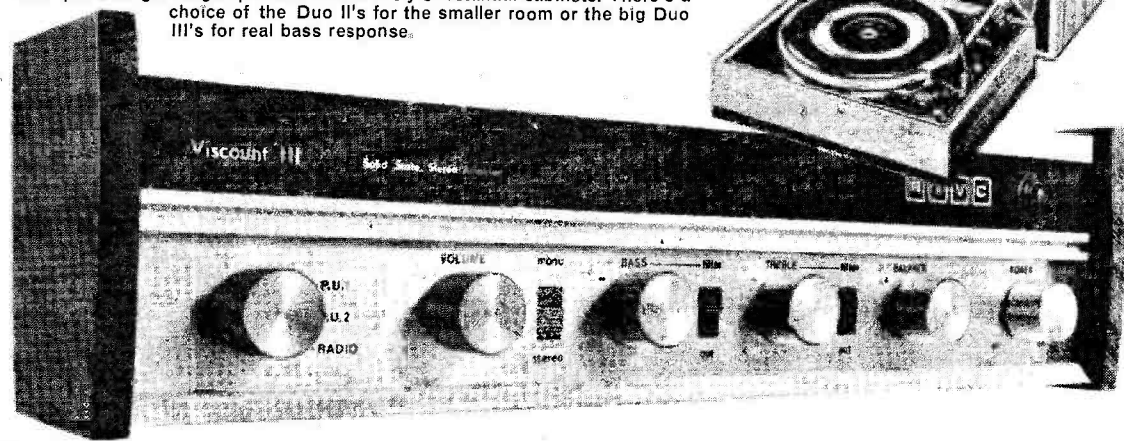
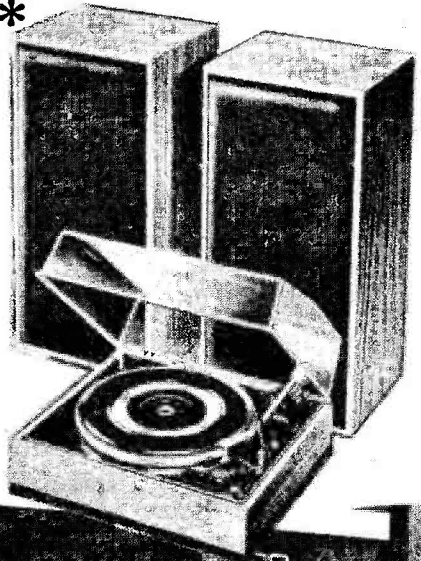
14 + 14w. r.m.s. 40Hz to 40kHz ± 3dB. Total distortion at 10w. at 1kHz - 0.1%. This is real value for money! We have designed 2 systems and the heart of them both is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. FET's (Field effect, transistors) are incorporated on 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.

PRICES: SYSTEM 1
 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
 Viscount 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
 total £84.40
 Available complete for £69* + £4 p & p



SPEAKERS: Duo Type II Size approx. 17in. x 10½in. x 6½in. Drive unit 13in. x 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. x 11½in. x 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.1. and radio —65dB, P.U.2 —58dB. Cross talk better than —35dB on all inputs. Size approx. 13½in. x 9in. x 3½in. Send S.A.E. for fully illustrated brochure. 12 month's written guarantee.

ONLY FROM US

TIMES OF OPENING: Acton—Mon.—Sat. 9.30-5.
 Closed all day Wed.
 Edgware Rd.—Mon.—Sat. 9.30-5. Closed all day Thurs

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 Radio and TV Components (Acton) Ltd.
 21c High Street, Acton, London W3
 323 Edgware Road, London W2
 Mail orders to Acton. Terms C.W.O.
 Goods not despatched outside U.K.
 All enquiries S.A.E.

All prices in pounds and new pence

VALVES		25 6J6		20 7CC		£1.13 12SR7		40 37		40 DAF91		30 EDL31		£1.50 EL34		50 N78		£1.50 PL500		80 U403		60	
6BA6	6BE6	20 6AT7	20 6C5	45 706	75 14H7	50 42	50 DAF96	45 EC90	33 EL41	50 N108	£1.50 PL504	80 U404	60										
1A7GT	45 8BJ6	50 6I7GT	60 7H7	60 8AQ3	50 50H5	50 DFC90	£1.35 EVC81	35 EL42	65 O42	38 PL508	80 U401	£1.18											
1CP31	£7.00 6BQ7A	45 6K6GT	60 7H7	50 20P1	50 60C5	50 DF70	45 EVC83	30 EL83	35 O24	40 PL509	£1.10 PAB90	40											
1D5	50 6BR7	90 6K7M	35 7A4	85 20P1	£1.10 50L6GT	55 DF91	30 EVC84	30 EL88	£1.00 PC86	60 PX4	£2.50 PCB41	50											
1H5	50 6BR8	70 6K7G	35 7A4	85 20P1	£1.10 75	55 DF92	20 EVC85	40 EM80	45 PC86	60 PX4	£2.50 PCB41	50											
1N6GT	55 6BR7	£1.20 6K7GT	35 9BW6	60 30P5	£1.20 75	45 DF96	45 EVC88	40 EM81	60 PC97	50 PY33	63 UBPR80	40											
1R5	40 6BW6	55 6K8M	50 10C2	65 30A6	35 80	55 DHC91	£7.00 EVC81	62 EM84	35 PC94	40 PY81	30 CBP89	35											
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2A4	40 6C5	25 6L6G	50 10F15	50 50Z6GT	55 801	60 DK92	55 EVC82	45 KZ40	50 PC92	35 PY80	40 PCB42	70											
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3Y3GT	40 6P6G	35 6R7GT	30 12AX7	30 30FL12	£1.20 7193	30 DM70	45 EPC7A	£1.20 HN309	£1.50 PCL82	35 SUV980/80	UML80	30											
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6A87G	85 6G6	45 6R7GT	35 12S4GT	50 35A6	75 CBL3	55 EBC30	35 EPC92	35 KZ41	50 PEN46	40 U26	80 VR150/30	35											
6AT6	35 6H6	25 6C5G	35 12S4GT	35 35L6	50 CCH35	75 EBP80	40 EPC98	35 M14	88 PL36	55 U26	80 VU11	75											
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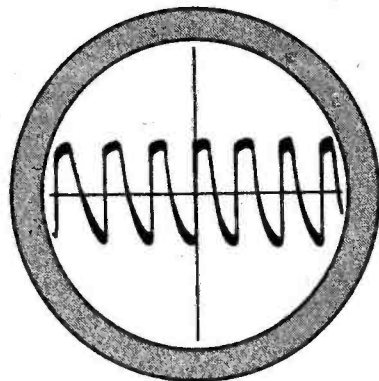
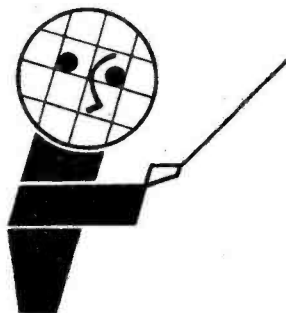
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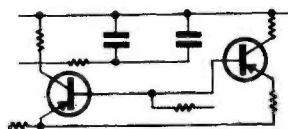
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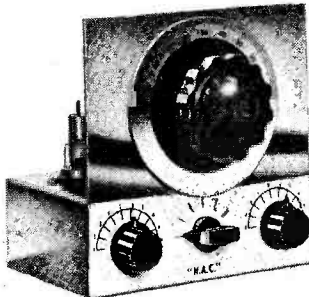
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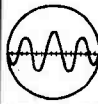
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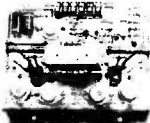
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VA06 Suitable crystal/ceramic P.U., Mic, guitar, radio tuner, vol., treble & bass controls. Sensitivity 8mV for 30mV O/P Treble + 22 -15dB @ 12KHz. Bass ± 18dB @ 40Hz.

VA08 As VA06, but with extra middle control. Treble +28dB @ 18KHz. Middle +20 -15dB @ 4KHz. Bass +20 -10dB @ 40Hz. Sensitivity 4mV.

SVA01 As VA08 but stereo with bal. control. £9.47

MVA01 Suitable for disco, mic, tape input. 2 inputs, with Vol. & tone control on each input. Sensitivity 2mV. +25dB @ 12KHz to +20dB @ 40Hz.

MEVA01 Magnetic Cartridge equalisation. Connects to input of VA06 or VA08 with volume control. £2.60

SIPAM Master volume and presence control. High treble boost of +15dB @ 15KHz. £2.40

EFVUA01 Increases the output of any of the above to 1V. RMS. Low impedance emitter follower output. £2.50

Constructed on glass fibre P.C. Board, individually tested.

NEW RANGE

HPA01 Headphone Amplifier. 8-15Ω 200mW output. Left right fader. Volume control. £3.72

AMF01 Auto Fade Unit. Feed deck and Mic. Pre-amps in, output to power module. With fade depth and sensitivity controls. See spec. on disco mixer. £4.40

PS201 Phase Splitter unit to drive two TP100W modules in bridge O/P. £1.75

WAA01 WAA-WAA Module. This is an exceptional unit, producing a superb WAA-WAA for guitars. Pedal soon available. £2.75

FUZ01 Fuzz Module. Professional standard. Volume, tone & fuzz sustain controls. Case soon available. £4.75

FXD01 Frequency Doubler Module. Doubles the frequency of any sinusoidal wave, such as that obtained from the WAA-WAA module. £3.17

TUAC LIGHT MODULATORS



3 Channel 51LMB illus.

Constructed on glass fibre P.C. board, individually tested. Three channel light modulator will control three separate sets of lights, up to 1000 watts each set. One channel responds to the bass, one to the middle, and one to the high frequencies. Input sensitivity only 0.5 watts/ Three individual controls allow for adjustment of the three channels, and a master sensitivity control allows for input levels up to 100 watts to be safely accommodated. Full interference suppression. Full wave control. Isolating input transformer does not affect amplifier operation. Fully Fused.

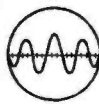
Single Channel version. S2LMD Increased capacity of 1800 watts. Sensitivity control. Isolating input transformer does not affect amplifier operation. S2LMB 3 Channel £17.45 p. & p. 35p. S2LMB 1 Channel £6.47 p. & p. 25p.

POWER SUPPLY UNIT

For use with all pre-amp modules and discotheque mixer. Output 40V. 100mA £3.25 p. & p. 25p.

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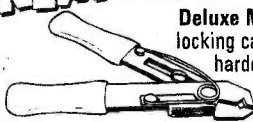
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AC107	0-20	AD162	0-33	BC148	0-10	BD187	0-45	BF188	0-40	OC19	0-35	2G371	0-16	2N2219	0-20	2N3054	0-46	2N4059	0-10
AC113	0-20	AD161 & 1		BC149	0-12	BD138	0-50	BF194	0-12	OC20	0-63	2G371B	0-12	2N2220	0-22	2N3055	0-50	2N4060	0-12
AC115	0-23	AD162 (MP)		BC150	0-18	BD139	0-55	BF195	0-12	OC22	0-38	2G373	0-17	2N2221	0-20	2N3091	0-18	2N4061	0-12
AC117K	0-20		0-55	BC151	0-20	BD140	0-80	BF196	0-14	OC23	0-42	2G374	0-17	2N2222	0-20	2N3092	0-18	2N4062	0-12
AC122	0-12	ADT140	0-50	BC152	0-17	BD155	0-80	BF197	0-14	OC24	0-58	2G377	0-30	2N2266	0-17	2N3392	0-14	2N4284	0-17
AC125	0-17	AF114	0-24	BC153	0-23	BD175	0-80	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	0-80	BD176	0-80	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	0-60	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	2N2416	0-47	2N3403	0-21	2N4289	0-17
AC134	0-14	AF124	0-30	BC160	0-45	BD180	0-70	BF262	0-85	OC36	0-50	2G417	0-25	2N2417	0-21	2N3404	0-28	2N4290	0-17
AC137	0-14	AF125	0-25	BC161	0-50	BD185	0-65	BF263	0-65	OC41	0-20	2N388	0-25	2N2712	0-21	2N3405	0-42	2N4291	0-17
AC141	0-14	AF126	0-28	BC167	0-13	BD186	0-65	BF270	0-35	OC42	0-24	2N388A	0-25	2N2714	0-21	2N3414	0-15	2N4292	0-17
AC141K	0-17	AF127	0-28	BC168	0-12	BD187	0-70	BF271	0-80	OC44	0-15	2N404	0-20	2N2904	0-17	2N3415	0-15	2N4293	0-17
AC142	0-14	AF129	0-30	BC169	0-12	BD188	0-70	BF272	0-80	OC45	0-12	2N404A	0-28	2N2904A	0-21	2N3416	0-28	2N4294	0-12
AC142K	0-17	AF178	0-50	BC170	0-12	BD189	0-75	BF273	0-85	OC70	0-10	2N524	0-42	2N2906	0-21	2N3417	0-28	2N4295	0-32
AC151	0-15	AF179	0-50	BC171	0-14	BD190	0-75	BF274	0-85	OC71	0-10	2N527	0-49	2N2906A	0-21	2N3325	0-75	2N5458	0-32
AC154	0-20	AF180	0-60	BC172	0-14	BD195	0-85	BF276	0-80	OC72	0-14	2N598	0-42	2N2906	0-15	2N3646	0-09	2N5459	0-32
AC155	0-20	AF181	0-45	BC173	0-14	BD196	0-85	BF289	0-27	OC74	0-14	2N599	0-45	2N2906A	0-18	2N3702	0-10	2R301	0-50
AC156	0-20	AF186	0-45	BC174	0-14	BD197	0-80	BF284	0-22	OC75	0-15	2N696	0-12	2N2907	0-20	2N3703	0-10	2R302A	0-42
AC157	0-24	AF239	0-37	BC175	0-22	BD198	0-90	BF285	0-30	OC76	0-15	2N697	0-18	2N2907A	0-22	2N3704	0-11	2R302	0-42
AC165	0-20	AL102	0-65	BC177	0-19	BD199	0-95	BF286	0-22	OC77	0-25	2N698	0-24	2N2907	0-14	2N3705	0-10	2R303	0-55
AC166	0-20	AL103	0-65	BC178	0-19	BD200	0-95	BF287	0-24	OC81	0-15	2N699	0-24	2N2924	0-14	2N3707	0-09	2R304	0-42
AC167	0-20	ASX26	0-25	BC179	0-19	BD205	0-80	BF288	0-22	OC82	0-15	2N706	0-08	2N2925	0-14	2N3707	0-11	2R305	0-84
AC168	0-24	ASX27	0-30	BC180	0-24	BD208	0-95	BF290	0-20	OC82D	0-15	2N706A	0-08	2N2926	(G)	2N3708	0-07	2R306	0-84
AC169	0-14	ASX28	0-25	BC181	0-24	BD207	0-95	BF291	0-20	OC82D	0-15	2N708	0-12	0-12	2N3709	0-09	2R307	0-84	
AC176	0-20	ASX29	0-25	BC182	0-10	BD208	0-95	BF292	0-20	OC83	0-20	2N711	0-80	2N2926 (Y)		2N3710	0-09	2R321	0-58
AC177	0-24	ASX50	0-25	BC182L	0-10	BDY20	1-00	BFY23	0-17	OC84	0-20	2N717	0-85	0-11	2N3711	0-09	2R322	0-42	
AC178	0-28	ASX51	0-25	BC183	0-10	BF116	0-24	BFX25	0-85	OC139	0-20	2N718A	0-50	2N2926 (O)		2N3819	0-28	2R322A	0-42
AC179	0-28	ASX52	0-25	BC183L	0-10	BF117	0-45	BSX19	0-15	OC140	0-20	2N718A	0-50	2N2926 (R)		2N3820	0-50	2R323	0-58
AC180	0-20	ASX53	0-25	BC184	0-12	BF118	0-70	BSX20	0-15	OC169	0-25	2N726	0-28	2N2926 (R)		2N3821	0-35	2R324	0-70
AC180K	0-20	ASX55	0-25	BC184L	0-12	BF119	0-70	BSX25	0-15	OC170	0-25	2N727	0-28	0-10	2N3823	0-28	2R325	0-70	
AC181	0-17	ASX56	0-25	BC186	0-28	BF121	0-45	BSY29	0-15	OC171	0-25	2N743	0-20	2N2926 (B)		2N3903	0-28	2R326	0-42
AC181K	0-20	ASX57	0-25	BC187	0-28	BF123	0-60	BSY27	0-15	OC200	0-25	2N744	0-20	0-10	2N3904	0-30	2R327	0-70	
AC187	0-22	ASX58	0-25	BC207	0-11	BF123	0-45	BSY28	0-15	OC201	0-25	2N914	0-14	2N3011	0-14	2N3906	0-27	4O361	0-40
AC187K	0-20	ASX21	0-40	BC208	0-11	BF127	0-55	BSY29	0-15	OC202	0-25	2N918	0-30	2N3011	0-14	2N3908	0-27	4O362	0-40
AC188	0-22	ASX54	0-25	BC184	0-12	BF152	0-45	BSY38	0-18	OC203	0-25	2N929	0-21	2N3053	0-17	2N4058	0-12	4O392	0-40
AC189K	0-22	BC108	0-09	BC212L	0-11	BF153	0-45	BSY39	0-18	OC204	0-25	2N930	0-21						
AC197	0-25	BC109	0-10	BC213L	0-11	BF154	0-45	BSY40	0-28	OC205	0-35	2N131	0-20						
AC197A	0-20	BC113	0-10	BC214L	0-14	BF155	0-70	BSY41	0-28	OC309	0-40	2N132	0-22						
AC199	0-20	BC114	0-15	BC225	0-25	BF156	0-48	BSY95	0-12	F346A	0-20	2N1302	0-14	AA119	0-08	BY133	0-21	OA10	0-35
AC200	0-20	BC115	0-15	BC226	0-25	BF157	0-65	BSY95A	0-12	F347	0-45	2N1302	0-14	AA120	0-08	BY164	0-50	OA47	0-07
AC201	0-20	BC116	0-15	BCY30	0-24	BF158	0-65	Bu109	2-00	OCF71	0-45	2N1304	0-17	AA129	0-08	BYX38/30		OA70	0-07
AC202	0-15	BC117	0-25	BC231	0-28	BF159	0-60	CI11E	0-60	ORP12	0-48	2N1305	0-17	AA129	0-08	BYX38/30		OA70	0-07
AC203	0-15	BC118	0-10	RCY32	0-30	BF160	0-40	C400	0-30	ORP60	0-40	2N1306	0-21	AA130	0-09		0-42	OA79	0-07
AC204	0-15	BC119	0-30	BFY33	0-22	BF162	0-40	C407	0-25	ORP61	0-40	2N1307	0-21	AAZ18	0-10	BYZ10	0-35	OA81	0-07
AC205	0-35	BC120	0-80	BCY34	0-25	BF163	0-40	C424	0-20	8T140	0-12	2N1308	0-23	BA100	0-10	BYZ11	0-30	OA85	0-09
AC206	0-35	BC125	0-12	BCY70	0-14	BF164	0-40	C425	0-50	8T141	0-17	2N1309	0-23	BA116	0-21	BYZ12	0-30	OA90	0-08
AC207	0-25	BC126	0-18	BCY71	0-18	BF165	0-40	C426	0-58	T1843	0-80	2N1613	0-20	BA126	0-22	BYZ13	0-25	OA91	0-06
AC208	0-21	BC134	0-18	BCZ10	0-20	BF167	0-22	C428	0-20	U746	0-27	2N1711	0-20	BA148	0-14	BYZ16	0-40	OA95	0-07
AC209	0-28	BC135	0-12	BCZ11	0-25	BF176	0-35	C442	0-80	2G301	0-09	2N1889	0-32	BA154	0-12	BYZ17	0-35	OA920	0-08
AC210	0-17	BC136	0-15	BCZ12	0-25	BF177	0-35	C444	0-85	2G302	0-19	2N1890	0-45	BA155	0-14	BYZ18	0-35	OA202	0-07
AC211	0-18	BC137	0-15	BD121	0-80	BF178	0-30	C450	0-50	2G303	0-19	2N1892	0-37	BA156	0-13	BYZ19	0-28	SD10	0-05
AC212	0-35	BC138	0-15	BD123	0-85	BF179	0-30	MAT100	0-19	2G304	0-24	2N2147	0-72	BC100	0-15	C682		SD19	0-05
AC213	0-38	BC141	0-30	BD131	0-50	BF180	0-30	MAT101	0-20	2G306	0-40	2N2146	0-57	BY101	0-12	(Eq) OA91		IN84	0-07
AD102	0-48	BC142	0-30	BD132	0-60	BF182	0-40	MAT121	0-20	2G308	0-35	2N2160	0-60	BY105	0-17	0-05	IN84A	0-07	
AD143	0-38	BC143	0-30	BD133	0-65	BF183	0-40	MAT120	0-19	2G309	0-85	2N2192	0-85	BY114	0-12	C6651		IN914	0-06
AD149	0-50	BC146	0-45	BD135	0-40	BF184	0-25	MAT121	0-20	2G339	0-20	2N2193	0-85	BY126	0-14	(Eq) OA70		IN916	0-06
AD161	0-33	BC147	0-10	BD136	0-40	BF185	0-30	MPP102	0-42	2G339A	0-18	2N2194	0-35	BY127	0-15	OA79	0-06	IN914B	0-06
								MPP104	0-37	2G344	0-18	2N2217	0-82	BY128	0-15	OA8	0-35	IN921	0-10
								MPP105	0-37	2G345	0-16	2N2218	0-20	BY130	0-18	OA55L	0-21	IN951	0-06

Cut these 3 pages out and keep for reference

DIODES AND RECTIFIERS

AA119	0-08	BY133	0-21	OA10	0-35
AA120	0-08	BY164	0-50	OA47	0-07
AA129	0-08	BYX38/30		OA70	0-07
AA130	0-09		0-42	OA79	0-07
AAZ18	0-10	BYZ10	0-35	OA81	0-07
BA100	0-10	BYZ11	0-30	OA85	0-09
BA116	0-21	BYZ12	0-30	OA90	0-08
BA126	0-22	BYZ13	0-25	OA91	0-06
BA148	0-14	BYZ16	0-40	OA95	0-07
BA154	0-12	BYZ17	0-35	OA920	0-08
BA155	0-14</				

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PIV 1A	3A	5A	7A	10A	16A	30A
T06	T066	T066	T064	T048	T048	T049
50	0.23	0.25	0.35	0.35	0.47	0.60
100	0.25	0.33	0.47	0.47	0.50	0.58
200	0.35	0.37	0.49	0.49	0.57	0.61
400	0.43	0.47	0.56	0.56	0.67	0.75
600	0.53	0.57	0.68	0.68	0.77	0.87
800	0.63	0.70	0.80	0.80	0.90	1.20

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1.5A	2A	10A	30A
50	0.04	0.05	0.05	0.07	0.14	0.21	0.60
100	0.04	0.06	0.05	0.13	0.16	0.23	0.75
200	0.05	0.09	0.06	0.14	0.20	0.24	1.00
400	0.06	0.13	0.07	0.20	0.27	0.37	1.25
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	2.50
1000	0.11	0.25	0.14	0.30	0.46	0.63	2.50
1200	0.11	0.33	0.14	0.38	0.57	0.75	2.50

TRIACS		
VBOM 2A	6A	10A
TO-1	TO-66	TO-88
\$p	\$p	\$p
100	30	50
200	50	60
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T2	8 D1374 OC85
T3	8 D1216 OC81D
T4	8 2G381T OC81
T5	8 2G382T OC82
T6	8 2G344B OC44
T7	8 2G344B OC45
T8	8 2G378 OC78
T9	8 2G399A 2N1909
T10	8 2G417 AF117

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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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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
UI09	= 12 x 7400	0.50	UI06	= 5 x 7446	0.50	UI08	= 5 x 7486	0.50
UI01	= 12 x 7401	0.50	UI07	= 5 x 7447	0.50	UI09	= 5 x 7490	0.50
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UI07	= 8 x 7407	0.50	UI04	= 12 x 7454	0.50	UI06	= 5 x 7496	0.50
UI08	= 12 x 7410	0.50	UI05	= 12 x 7455	0.50	UI07	= 5 x 7497	0.50
UI09	= 8 x 7413	0.50	UI06	= 8 x 7472	0.50	UI08	= 5 x 7498	0.50
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UI08	= 5 x 7444	0.50	UI05	= 5 x 7480	0.50	UI07	= 5 x 7416	0.50
UI09	= 5 x 7445	0.50	UI06	= 5 x 7481	0.50	UI08	= 5 x 7417	0.50
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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 random 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 260mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

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

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BP709—72709	38p	34p	30p	
BP 709P—LA709C	38p	34p	30p	
BP 710—72710	44p	42p	40p	
BP 711—LA711	45p	43p	40p	
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ROCK BOTTOM PRICES LOGIC DTL 930 Series I.C.'s

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BP945	25p	24p	22p	
BP946	12p	11p	10p	
BP948	25p	24p	22p	
BP951	65p	60p	55p	
BP952	12p	11p	10p	
BP9032	40p	38p	35p	
BP9094	40p	38p	35p	
BP9097	40p	38p	35p	
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	2015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2-3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1.70	£1.55	£1.90

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CONTROL UNIT CAMERA. Contains meter 2½" dia FSD I Ma special scale markings, 3 x toggle swts, 2 x Ind lamps, push swt etc. supplied in fitted wooden transit case. New condition. £1-85.

NAVY Rx type B40 range 640 Kc to 30 Mc/s in 5 bands have int mains P.U. and Spk, xtal cal etc. Supplied tested with circ. Few only £27-00.

SELECTOR UNIT Contains meter I Ma scale 0 to 1 and 0 to 180, motor 24v DC with gears, this drives multiway swt also 13 relays, swts, etc. All in useful case size 12 x 6 x 7" £2-60.

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INST SWTS 2 pole 23 way 2 bank 70p. **CONDS.** -1 of 1-½% 2 for 60p. **POT CORES** 1½ x ½" 2 for 60p. **FUSE HOLDERS** miniature type 3 for 30p. **HEAT SINKS** size 11 x 9 x 1½" ready drilled for 4 T.O.3 types with 4 l ohm res £1-00. **IND 208.** This is a repeater ind with tube 2-75" dia, green med persis with base shield and front plate base conn and volts req. supplied with scan burns £1-55. **TEST UNIT** contains 2 vinkors, 4 Sil transis 15v zener, 4 miniature relays, 3 min valves pots conds. etc. New condition 85p. **BLOWER MOTORS** double ended type 24v DC new £1-60. **SPEAKER UNITS P.A.** type speaker 8 ohm in case size 9 x 9 x 8" with 600 ohm line trans suitable outdoor use. Good condition. £2-75. **BATTERIES** 6 volt lead acid type metal cased 40 amp/hr, size 10 x 9 x 5". New with filling inst. £2-75 **DYNAMOTOR UNITS** 12v DC in 220v 100 Ma DC O/P fully enclosed for TCS Rx £1-50. also 12v in 440v 200 Ma O/P £2-00. **DIODES 800 P.I.V.** 1 amp. New 12 for £1-00. **DIODES 200 P.I.V.** 8 amps ZR22 type 4 for 60p. **TRIMMERS** 20pf air spaced ceramic. New 10 for 50p or £4-00 per 100. Also 10/110 pf ceramic dielectric 5 for 50p. **METER UNIT** part of nav display centering type scale L & R as two coils on magnet enables reading to be controlled from two circs. New condition with circ. 95p. Also available cross pointer ind part of R1155 Rx as two movements of 115 Ua ea. £1-40. **TAG STRIPS** solder type 24 way new 10 for 25p. **VIDICONS** camera tubes E.E. and E.M.I. types graded according to scan marks £9-00 grade A. £6-00 grade B. **JOY STICK CONTROLLERS** give control in N, S, E and W directions with 1 pole c/o micro swts. £1-20 **TRANSFORMERS,** All 230 50 c/s Pria as follows: Sec 1125-O-1125V at 565 Ma. New boxed £7-00. Sec 415-143-0-143-415 at 360 Ma on 415v and 120 Ma on 143v. New boxed £3-00. Sec 350-310-0-310-350 at 220 Ma, 5v 6a. 6-3 5a, 6-3 3a twice and 6-3 1a twice £2-65. Also Pria 210/250 Sec 27v at 41 amps cont new £11-00 **VALVES** 5U4, 6X5, 6X4, 12AT7, 85A2, OB2, 12AX7, 6BH6, 6AK5, 6AK6, 6SN7, 6SK7, 6SJ7, 6H6, 12AU7, 6BA6, 6AS6, any 3 for 50p.

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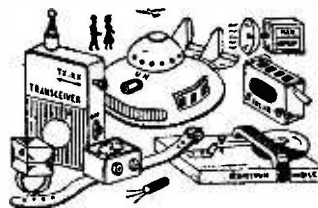
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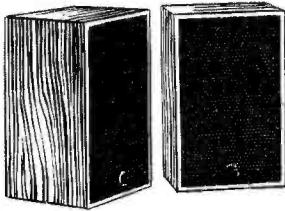
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REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500

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



As reviewed in "POPULAR HI-FI" February 1972

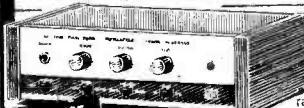
ROC PRICE £35.20
Normal Price £55.50



OLSON RA-310 AM/FM/MPX STEREO TUNER

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as its 'good looking design'! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10.00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for 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 Sensitivity: FM, 3µV; AM, 250µV. Stereo separation 30db at 1kHz, image rejection 60db. Size: 11 1/2" wide, 4" high, 7 1/2" deep.

ROC PRICE £31.20
Normal Price £50.00



REALISTIC SA-100B 6-WATT STEREO AMPLIFIER

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

ROC PRICE £12.45
Normal Price £21.00



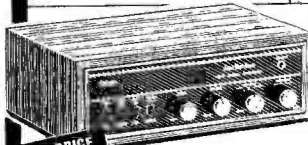
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When you want to listen to the radio all by yourself. Then this will solve the problem. Separate volume and tuning controls with easy-to-use knobs. Frequency range is 535 to 1605 kHz medium wave band. Maximum output is 300 mW. **Normal Price £7.50 ROC PRICE £5.80**



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



ROC PRICE £24.10
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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

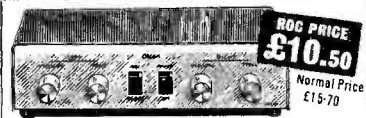
buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz \pm 3db. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3-mV RIAA, crystal phono 100mV, tape 160mV; tuner 160mV. Size 11 1/2" wide, 4" high, 7 1/2" deep. The specification reads well - sounds even better!



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 (\pm 2db) Inputs Magnetic, Ceramic, Tuner, Tape, Aux. Tape Play. Size: 345mm x 300mm x 130mm.

ROC PRICE £28.00
Normal Price £35.70



ROC PRICE £10.50
Normal Price £15.70

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 \pm 3db. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tuner/aux 80mV. Size 8" wide, 2 1/2" high, 4 1/2" wide.

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



ROC PRICE £27.25
Normal Price £39.95 each.

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



ROC PRICE £27.55
Normal Price £42.00

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

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

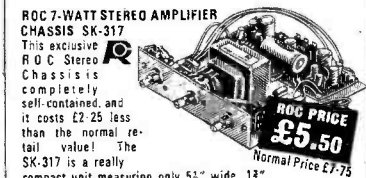
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ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317

This exclusive R O C Stereo Chassis kit is completely self-contained, and it costs £2.25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5 1/2" wide, 1 1/2" high and 6 1/2" deep. It contains its own mains power supply, and has a ganged volume control and separate treble controls for each channel. Specification: frequency response 40-17,000 Hz \pm 3db; output 3.5 watts music power per channel into 8 ohms; input, phono, 60mV; signal-to-noise ratio better than 45db.

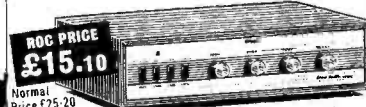
ROC PRICE £5.50
Normal Price £7.75



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 6 1/2" base unit plus tweeter. Frequency range: 40 to 19,000 Hz. Size 14" high, 9" wide, 6 1/2" deep.

ROC PRICE £20.00
Normal Price £27.00 per pair.



ROC PRICE £15.10
Normal Price £25.20

OLSON AM-372 16-WATT STEREO AMPLIFIER

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

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1B3GT	.35	6BW6	.72	6SA7M	.35	19AQ5	.24	150B2	.58	EB91	.10	EL61	.50	EF183	.25	PL609	.90	U10	.45	AC165	.25	BCY38	.25	OA91	.09
1H5GT	.33	6BW7	.50	6SC7GT	.33	19AG6	.50	507	.87	EB91	.10	EL61	.50	EF184	.27	PL609	.90	U12/14	.38	AC166	.25	BCY39	.25	OA91	.09
1L4	.13	6BZ6	.31	6SG7	.33	20D4	1.05	5702	.80	EB91	.10	EL61	.50	EF184	.27	PL609	.90	U19	1.73	AC168	.38	BCZ11	.38	OA95	.09
1N5GT	.37	6CB6A	.26	6SH7	.53	20P2	.65	5763	.50	EBF80	.30	EL86	.38	EF184	.27	PL609	.90	U25	.82	AC176	.55	BF158	.29	OA90	.09
1R5	.86	6C4	.28	6SH7	.53	20P2	.65	5763	.50	EBF80	.30	EL86	.38	EF184	.27	PL609	.90	U25	.82	AC176	.55	BF158	.29	OA90	.09
1S4	.32	6C9	.73	6SK7GT	.23	20P1	.59	AC/PEN	.98	EBF89	.26	EL95	.32	EF184	.27	PL609	.90	U25	.82	AC176	.55	BF158	.29	OA90	.09
1U4	.29	6CD8G	1.06	6SQ7GT	.33	20P2	.78	AC/PEN	.98	EBF89	.26	EL95	.32	EF184	.27	PL609	.90	U25	.82	AC176	.55	BF158	.29	OA90	.09
1U5	.48	6C6A	.50	6U4GT	.60	20P4	.59	DD	.98	EBF89	.26	EL95	.32	EF184	.27	PL609	.90	U25	.82	AC176	.55	BF158	.29	OA90	.09
2D21	.35	6CH6	.38	6V6GT	1.7	20P5	1.00	AC/PEN	.98	EBF89	.26	EL95	.32	EF184	.27	PL609	.90	U25	.82	AC176	.55	BF158	.29	OA90	.09
2GK5	.50	6CL6	.43	6V6GT	.27	25A6G	.29	AC/TH1	.50	EC92	.34	EM80	.37	PCF84	.44	Q875/20	.63	U111	.44	ADP140	.63	BY114	.18	OC70	.13
3A4	.25	6CM7	.50	6X4	.20	25L6G	.20	AC/TFP	.98	EC93	1.50	EM84	.31	PCF80	.28	R19	.28	U133	.35	AF115	.15	BYZ10	.25	OC74	.23
3D6	.19	6C05	.30	6X5GT	.25	25V5G	.43	AL60	.78	EC93	.95	EM85	1.00	PCF80	.28	SP41	.75	U107	.50	AF117	.19	BYZ11	.25	OC75	.11
3Q4	.33	6CW4	.63	7B6	.58	25Z4G	.48	ATP4	.12	EC94	.40	EM87	.34	PCF80	.28	SP41	.75	U107	.50	AF117	.19	BYZ11	.25	OC75	.11
3Q8GT	.35	6D87	.50	7B7	.32	25Z5	.28	AZ1	.40	EC94	.40	EM87	.34	PCF80	.28	SP41	.75	U107	.50	AF117	.19	BYZ11	.25	OC75	.11
384	.33	6DT6A	.50	7B7	.32	25Z5	.28	AZ1	.40	EC94	.40	EM87	.34	PCF80	.28	SP41	.75	U107	.50	AF117	.19	BYZ11	.25	OC75	.11
4CB6	.50	6E6W6	.55	7R7	.65	30A5	.44	AZ41	.53	EC93	.21	EY81	.35	PCL82	.29	TP2620	.98	Transistors		AF125	.17	CG126	.30	OC78	.15
5CG8	.50	6E55	.55	7Y4	.60	30C15	.55	CL33	.90	EC94	.28	EY84	.50	PCL84	.32	UAP42	.48	2N404	.18	AF139	.65	F8Y41A	.23	OC81	.11
5T4	.30	6F1	.59	7Z4	.50	30C17	.74	CV63	.53	EC95	.32	EY87	.27	PCL85/85	.50	UBC41	.45	2N966	.53	AF173	.68	GD9	.20	OC81D	.11
5U4G	.30	6F6	.63	8B6W	.50	30C18	.58	CY15	.53	EC95	.32	EY88	.46	PCL86	.36	UBC81	.45	2N1756	.50	AF180	.48	GET113	.20	OC82	.11
5V4G	.33	6F13	.33	9D7	.78	30F5	.61	CY31	.29	EC95	.32	EY88	.46	PCL86	.36	UBC81	.45	2N1756	.50	AF180	.48	GET113	.20	OC82	.11
5Y3GT	.25	6F14	.40	10C2	.48	30F11	.85	DAF91	.20	EC95	.32	EY88	.46	PCL86	.36	UBC81	.45	2N1756	.50	AF180	.48	GET113	.20	OC82	.11
5Z4G	.33	6F18	.45	10D1E7	.50	30FL2	.58	DAF96	.33	EC95	.32	EY88	.46	PCL86	.36	UBC81	.45	2N1756	.50	AF180	.48	GET113	.20	OC82	.11
5Z4GT	.33	6F23	.65	10P1	.75	30FL12	.67	DC90	.60	EC95	.32	EY88	.46	PCL86	.36	UBC81	.45	2N1756	.50	AF180	.48	GET113	.20	OC82	.11
6/80L2	.53	6F24	.68	10P9	.45	30FL13	.47	DF91	.14	ECF86	.64	GY801	.75	PEN45	.40	UC984	.33	2N3053	.33	BA116	.25	GET873	.55	OC138	.23
6A8G	.33	6F25	.61	10P18	.35	30FL14	.66	DF96	.34	ECF80	.44	GZ32	.39	PEN45DD	.40	UC984	.33	2N3053	.33	BA116	.25	GET873	.55	OC138	.23
6AC7	.15	6F28	.60	10PD11	.53	30L15	.65	DH76	.28			GZ32	.39	PEN45DD	.40	UC984	.33	2N3053	.33	BA116	.25	GET873	.55	OC138	.23
6A08	.25	6F32	.15	10P13	.54	30L17	.65	DK40	.55	ECH21	.63	GZ34	.47	PEN46	.20	UC921	.60	2N3709	.20	BA153	.15	GET898	.23	OC201	.32
6AH6	.50	6G8A	.50	10P14	1.06	30P1R	.95	DK92	.35	ECH35	.50	GZ37	.67	PEN463DD	.40	UC921	.60	2N3709	.20	BA153	.15	GET898	.23	OC201	.32
6AJ5	.75	6GK5	.50	12A6	.63	30P12	.69	DK96	.35	ECH43	.50	GZ37	.67	PEN463DD	.40	UC921	.60	2N3709	.20	BA153	.15	GET898	.23	OC201	.32
6AK5	.25	6G07	.50	12A6C	.40	30P19/	.69	DL92	.23	ECH81	.25	HL123DD	.40	PENDD	.98	UC921	.60	2N3709	.20	BA153	.15	GET898	.23	OC201	.32
6AK6	.30	6H6GT	.15	12AD6	.40	30P4	.55	DL96	.35	ECH83	.38	HL14DD	.88			UC921	.60	2N3709	.20	BA153	.15	GET898	.23	OC201	.32
6AM8A	.60	6J5G	.29	12A7E	.48	30PL1	.57	DM70	.30	EC94	.34	HL42DD	.50	PLF200	.50	UF41	.50	AA129	.15	BC116	.25	OA47	1.0	ORP12	.53
6AN8	.49	6J5GT	.29	12AT9	.23	30PL13	.75	DM71	.32	EC94	.34	HL42DD	.50	PLF200	.50	UF41	.50	AA129	.15	BC116	.25	OA47	1.0	ORP12	.53
6A05	.21	6J8	.18	12AT8	.21	30PL14	.62	DY87/6	.22	ECL82	.28	HN309	1.40	PL33	.38	UF42	.60	AA123	.18	AC107	.15	LP15	(AC113, AC154, AC167, AA120)	53p	
6AR5	.30	6J7G	.24	12AV6	.28	30PL15	.87	DY802	.32	ECL82	.28	HVR2	.53	PL36	.46	UF80	.35	AC113	.25						
6AT6	.18	6J7(M)	.23	12BA6	.30	35A3	.48	EB80C	1.85	ECL84	.54	KT2	.25	PL5A	.48	UF86	.63	AC136	.18	1-OC44 & 2-OC45	.43p	1-OC82D & 2-OC82E	.48p	Set of 3-OC83	.65p
6AV6	.28	6J7A	.50	12BE6	.30	35D5	.70	EB80F	1.20	ECL85	.54	KT41	.98	PL82	.28	UF89	.27	AC127	.17						
6AV6	.28	6K7G	.10	12BH7	.27	35L6GT	.42	EB83F	1.20	ECL86	.38														
6AW8A	.54	6L8G	.16	12J7GT	.33	35W4	.23	EB80C	.60	EF22	.63														
6AX4	.39	6L1	.98	12K5	.50	3Z4GT	.24	EB90C	.40	EF40	.58														
6B8G	.13	6L6GT	.39	12K7GT	.34	3Z5GT	.30	E180F	.90	EF41	.53														
6BA6	.19	6L7	.38	12Q7(M)	.28	50C5	.32	E180PCC1	.00	EF42	.53														
6BC8	.50	6L18	.44	12SC7	.35	50CDDGG		E1148	.53	EF73	.75														
6BE6	.20	6L19	1.38	12SG7	.23			E1A50	.27	EF80	.58														
6BH6	.43	6LD20	.48	12SH7	.15	50EH5	.55	E1A76	.58	EF83	.58														

All goods are unused, boxed, and subject to the standard 90 day guarantee. Terms of business - 49 Cash or cheque with order only. Post/packing 3p. per item, subject to a minimum of 9p. per order. 58 Orders over £5.00 post/packing free. Same day despatch by first class mail. Any parcel insured against damage in transit for only 3p. extra per order. Complete catalogue with conditions of sale price 7p. post paid. Business hours Mon.-Fri. 9-5.30 p.m.
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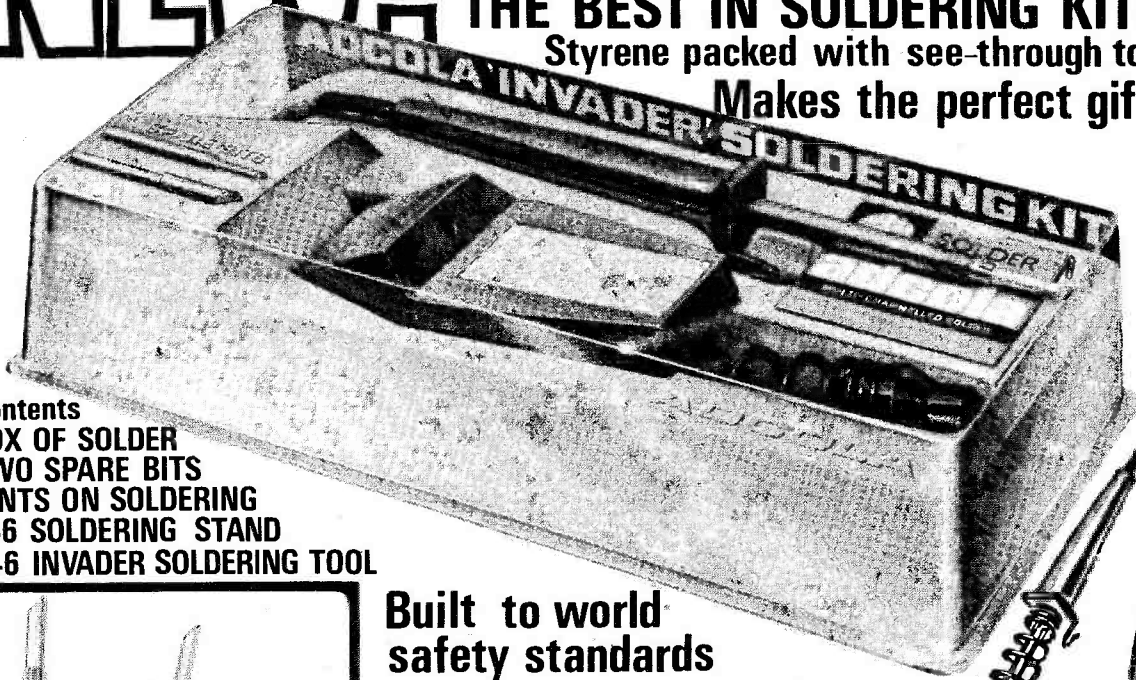
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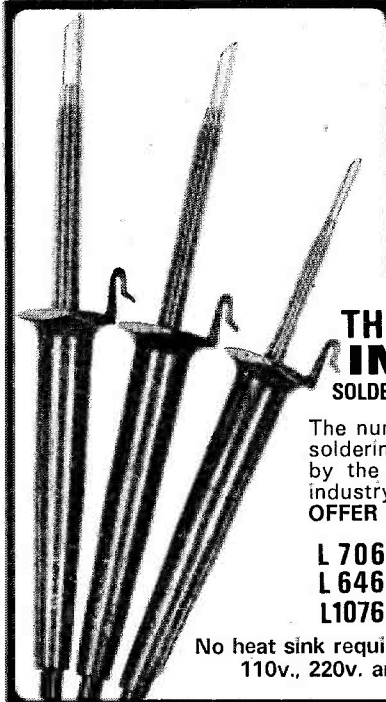
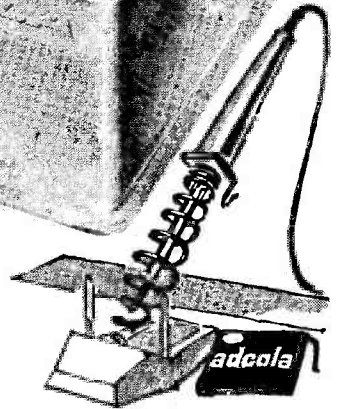


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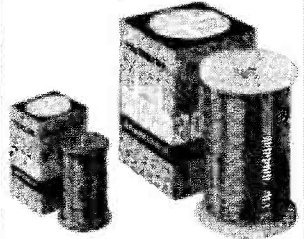
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AKAI 8500	137.50	79.95
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Module 90	119.00	91.95
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MCDONALD HT70	20.63	14.50
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PIONEER PL12D with base and cover	49.18	34.50
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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

PEAKERS

*Speakers are tax free—buy now before V.A.T.

*AMSTRAD 138 (pair) Teak	26.00	13.95
*AKAI SW 135	64.50	44.95
*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	65.40	42.50
*Ditton 25	65.00	42.50
*Ditton 44	54.00	35.00
*Ditton 66	99.00	70.95
*FERROGRAPH St inc. stand	95.00	67.95
GOODMANS Minister Pair	49.20	35.95
*Havant (pair)	57.12	39.40
*Hester	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
DITTON KN Kit	12.19	8.50

KELETRON

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
*LN1600 3-speaker system	25.20	14.95
*KN2100 3-speaker system	39.50	24.95
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
*02P	21.50	14.50
*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	44.95
TL 25 Teak (pair)	71.50	66.95
*TL 50 Teak	68.00	50.95
TELETON 8000 (pair)	21.08	11.95
*THORPE GRENVILLE TG100 (pair)	29.95	16.95
*TG200 (pair)	41.95	24.95
*TG300 (pair)	55.95	29.95

WHARFEDALE Denton Mark II

(pair)	42.00	28.95
Linton Mark II (pair)	52.00	37.50
Triton 111 (pair)	65.00	46.95
*Milton Mark II	35.00	23.75
*Dovedale 3 Mark III	47.50	32.25
*Rosedale 3 Mark II	66.00	44.95
*Unit 3 speaker kit	12.50	8.95
*Unit 4 speaker kit	19.00	12.95
*Unit 5 speaker kit	27.50	18.75

PICK UP ARMS AND HEADS

AUDIO Technica AT 1005 Mk. 11	18.78	14.25
AUDIO Technica L2 lifts	2.61	1.95
CONNOISSEUR SAU2	14.61	11.95
GOLDRING Lenco 75	13.96	9.25
GOLDRING Lenco L69	10.60	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

CHASSIS SPEAKERS

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GOODMANS Twin-axiom 8

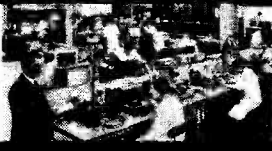
*Twin Axiom 10	9.12	6.95
*Axiom 401	10.06	7.50
Axiom 8P	17.68	11.95
Axiom 10P	5.49	4.15
Axiom 12P	5.97	4.50
*Axiom 15P	13.00	9.15
*Axiom 18P	21.00	14.60
*Axiom 18P	35.70	24.45
*Axiom 100 40 watts din.	17.00	8.35
*Axiom 112	4.12	3.20
*Axiom 100	6.90	4.60
*Midax 650	13.59	9.50
*Attenuator	3.73	2.60
*Crossover network XO/950	7.77	5.45
WHARFEDALE 8 in. Bronze/RD/DD	4.75	3.30
Supr 8/R5/DD	8.50	6.50
Supr 10/R5/DD	14.00	9.95

CARTRIDGES

AMSTRAD 900D	5.32	3.40
AMSTRAD 900E	8.10	5.40
AMSTRAD 900 EX	11.90	8.50
AUDIO TECHNICA AT 66	6.47	3.45
*CONNOISSEUR Ceramic SCU1	6.09	4.95
GOLDRING G850	6.10	3.10
GOLDRING G800	12.21	4.50
GOLDRING G300E	17.67	7.60
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
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EMPIRE 998VE/X	44.44	28.95
EMPIRE 998TE/X	26.18	18.95
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	Rec. Price	Retail Price	Comet Price
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EMPIRE 90E/X	12-79	8-50	8-50
EMPIRE 90EE/X	9-94	6-95	6-95
SHURE M3DM	6-10	3-75	3-75
SHURE M31E	11-63	6-95	6-95
SHURE M32E	10-73	6-50	6-50
SHURE M44-G	8-30	4-95	4-95
SHURE M44-7	7-90	4-90	4-90
SHURE M44C	7-90	4-90	4-90
SHURE M44E	8-60	4-75	4-75
SHURE M55E	9-70	5-45	5-45
SHURE M75G	14-70	8-35	8-35
SHURE M75-6 (S)	8-36	5-45	5-45
SHURE M75-6	13-60	7-50	7-50
SHURE M75D	15-40	8-75	8-75
SHURE M75D	19-00	10-15	10-15
SHURE M75E/95G	20-80	12-95	12-95
SHURE M91ED	18-45	9-95	9-95
SHURE V15-11	39-40	24-95	24-95

*SONOTONE 9TAHC Diam/Saph
 Starred cartridges above are ceramic. All others are magnetic.

	Rec. Price	Retail Price	Comet Price
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CONNOISSEUR Plinth BD1	5-57	4-50	4-50
CONNOISSEUR Cover	4-17	3-40	3-40
CONNOISSEUR P.U. Mount Board	0-95	0-75	0-75
GARRARD W8B Base	3-78	2-95	2-95
GARRARD W8A Base	5-60	4-25	4-25
GARRARD SPC1 Cover	3-68	2-75	2-75
GARRARD SPC4 Cover	4-38	3-25	3-25

	Rec. Price	Retail Price	Comet Price
Special Offer of Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500			
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GOLDRING Plinth 72	9-42	6-50	6-50
GOLDRING Covers for 72P	4-71	3-25	3-25
Cover for 75P De Luxe	5-23	3-60	3-60
Cover for 85P	6-98	4-95	4-95
THORENS TX 25 (for TD125AB)	8-85	6-50	6-50
THORENS TX11 Cover	4-49	3-50	3-50
SME Plinth System 2000 with motorboard	46-20	35-95	35-95
MOTORBOARDS only	5-85	4-45	4-45
SME P1 Spacer	0-98	0-75	0-75

	Rec. Price	Retail Price	Comet Price
BLANK TAPES			
SCOTCH DYNARANGE CASSETTES			
C80	0-71	0-40	0-40
C90	0-99	0-50	0-50
C120	1-49	0-75	0-75

	Rec. Price	Retail Price	Comet Price
SCOTCH HIGH ENERGY COBALT CASSETTES			
C80	1-10	0-85	0-85
C90	1-45	0-95	0-95

	Rec. Price	Retail Price	Comet Price
SCOTCH Low Noise 8-TRACK BLANK CARTRIDGES			
40 mins.	1-50	0-90	0-90
80 mins.	1-80	1-10	1-10

	Rec. Price	Retail Price	Comet Price
SCOTCH HI-FI DYNARANGE SPOOLED TAPES			
5 1/2" L.P. 900	1-20	1-10	1-10
5 1/2" L.P. 1200	2-20	1-30	1-30
7 1/2" L.P. 1800	2-95	1-80	1-80

	Rec. Price	Retail Price	Comet Price
SCOTCH HI-FI DYNARANGE DOUBLE PLAY			
5 1/2" D.P. 1200	2-31	1-40	1-40
5 1/2" D.P. 1800	3-15	1-95	1-95
7 1/2" D.P. 2400	4-03	2-50	2-50

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HEADPHONES			
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AMSTRAD HPSSA	7-50	3-90	3-90
HP56A with volume control	10-70	6-70	6-70
HP57A bass and treble controls	13-95	9-90	9-90
AKAI A5E9	7-25	4-25	4-25
AKAI A5E22	11-90	7-25	7-25
AKG K180	28-00	16-95	16-95
AKG K60	15-00	8-95	8-95
AKG 100	8-00	4-95	4-95
AKG 120	10-00	4-50	4-50
KOSS HV1	20-00	15-95	15-95
KOSS ESP-9 Electrostatic	69-00	52-95	52-95
KOSS ESP-5 Electrostatic	45-90	34-95	34-95
KOSS K2 plus 2 Quadrafone	45-00	35-00	35-00
KOSS PRO 5 L/C	30-00	23-95	23-95
KOSS PRO-4AA	28-00	20-95	20-95

	Rec. Price	Retail Price	Comet Price
HEADPHONES—continued			
KOSS K0-727B	16-50	12-45	12-45
KOSS 747	20-00	14-95	14-95
KOSS K-711	10-00	7-75	7-75
KOSS K6	12-50	9-50	9-50
KOSS K6/LC (with volume control)	14-00	10-50	10-50
KOSS K6/LCQ Quadrafone	20-00	16-95	16-95
PIONEER SE 30	21-90	13-25	13-25
PIONEER SE 30A	12-60	8-25	8-25
PIONEER SE 20A	7-88	4-95	4-95
PIONEER SEL 20	10-53	6-80	6-80
PIONEER SEL 40	17-43	11-30	11-30
SOUND MD806	6-50	2-80	2-80
WHARFEDALE DD1	12-50	8-75	8-75
WHARFEDALE ISODYNAMIC	19-95	14-95	14-95

	Rec. Price	Retail Price	Comet Price
HI-FI STEREO SYSTEMS—COMPLETE			
ALBA UA 552	47-75	29-95	29-95
BUSH A1005	69-89	50-95	50-95
DANSETTE Consort Stereo	34-43	23-95	23-95
DANSETTE 4005	71-45	49-95	49-95
DANSETTE 4020	47-95	32-95	32-95
DECCA SOUND 613	Sp. Price	66-50	66-50
DECCA SOUND 614	Sp. Price	52-95	52-95
DECCA COMPACT 2 with Radio	Sp. Price	78-95	78-95
DECCA COMPACT 3 with Radio	Sp. Price	97-95	97-95
DECCA 403	Sp. Price	44-95	44-95
FERGUSON 3450 B with Radio (new model)	79-50	61-95	61-95
FERGUSON 345 B with Radio (new model)	107-00	82-95	82-95
FERGUSON 3454	41-50	32-95	32-95
FIDELITY UA1 Music Master with Radio	100-00	69-95	69-95
FIDELITY UA2 Music Master	43-50	30-95	30-95
FIDELITY Stereo Nine	38-50	31-95	31-95
G.E.C. 2810	79-00	59-95	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	41-50
HMV 2451	122-00	95-95	95-95
HMV 2452	66-00	49-95	49-95
HMV 2455	175-00	136-95	136-95
KB 1025 with 662 speakers	46-25	37-95	37-95
KB 1250 with KS 653 Speakers	71-00	53-95	53-95
KB 2010 with 658 speakers and Radio	101-50	77-95	77-95
KB 2250 with 658 speakers and Radio	124-00	95-95	95-95
MURPHY 902 Studio 1, with AM/VHF/Radio	84-50	64-95	64-95
MURPHY 940	69-89	52-95	52-95
PHILIPS 808	105-00	74-95	74-95
PHILIPS GF 824	65-30	49-65	49-65
PHILIPS 825	49-50	37-95	37-95
PHILIPS 826	75-00	51-95	51-95
PHILIPS 835 with Radio	69-50	47-95	47-95
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ULTRA 6027	57-50	44-95	44-95
ULTRA 6028	59-95	45-95	45-95
ULTRA 6450B (new model) with Radio	79-50	61-95	61-95
ULTRA 6451	79-50	61-95	61-95
ULTRA 6455	41-35	31-95	31-95
ULTRA 6454	38-85	29-95	29-95

	Rec. Price	Retail Price	Comet Price
HI-FI STEREO SYSTEMS—COMPLETE			
ALBA UA 552	47-75	29-95	29-95
BUSH A1005	69-89	50-95	50-95
DANSETTE Consort Stereo	34-43	23-95	23-95
DANSETTE 4005	71-45	49-95	49-95
DANSETTE 4020	47-95	32-95	32-95
DECCA SOUND 613	Sp. Price	66-50	66-50
DECCA SOUND 614	Sp. Price	52-95	52-95
DECCA COMPACT 2 with Radio	Sp. Price	78-95	78-95
DECCA COMPACT 3 with Radio	Sp. Price	97-95	97-95
DECCA 403	Sp. Price	44-95	44-95
FERGUSON 3450 B with Radio (new model)	79-50	61-95	61-95
FERGUSON 345 B with Radio (new model)	107-00	82-95	82-95
FERGUSON 3454	41-50	32-95	32-95
FIDELITY UA1 Music Master with Radio	100-00	69-95	69-95
FIDELITY UA2 Music Master	43-50	30-95	30-95
FIDELITY Stereo Nine	38-50	31-95	31-95
G.E.C. 2810	79-00	59-95	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	41-50
HMV 2451	122-00	95-95	95-95
HMV 2452	66-00	49-95	49-95
HMV 2455	175-00	136-95	136-95
KB 1025 with 662 speakers	46-25	37-95	37-95
KB 1250 with KS 653 Speakers	71-00	53-95	53-95
KB 2010 with 658 speakers and Radio	101-50	77-95	77-95
KB 2250 with 658 speakers and Radio	124-00	95-95	95-95
MURPHY 902 Studio 1, with AM/VHF/Radio	84-50	64-95	64-95
MURPHY 940	69-89	52-95	52-95
PHILIPS 808	105-00	74-95	74-95
PHILIPS GF 824	65-30	49-65	49-65
PHILIPS 825	49-50	37-95	37-95
PHILIPS 826	75-00	51-95	51-95
PHILIPS 835 with Radio	69-50	47-95	47-95
PHILIPS 838 with Radio	95-00	67-95	67-95
RIGONDA Party Time	28-50	20-95	20-95
STEEPLETONE Stereo System	41-75	22-95	22-95
ULTRA 6027	57-50	44-95	44-95
ULTRA 6028	59-95	45-95	45-95
ULTRA 6450B (new model) with Radio	79-50	61-95	61-95
ULTRA 6451	79-50	61-95	61-95
ULTRA 6455	41-35	31-95	31-95
ULTRA 6454	38-85	29-95	29-95

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

	Rec. Price	Retail Price	Comet Price
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AKAI CR80T 8-track stereo recorder and tuner amplifier	149-84	89-95	89-95
AKAI CR81	109-50	80-95	80-95
AKAI CR81D	89-50	65-95	65-95
FERGUSON 3258 4-track	70-45	51-95	51-95
FERROGRAPH 702/704 Dolby	285-53	241-95	241-95
FERROGRAPH 725 Dolby	297-28	251-95	251-95
FERROGRAPH 722/724 Dolby	326-65	276-95	276-95
FERROGRAPH 722H Dolby	338-40	286-95	286-95
FERROGRAPH 702/704	235-00	172-95	172-95
FERROGRAPH 722/724	276-15	198-95	198-95
FIDELITY Braemar 4-track	34-75	19-95	19-95
GROSVENOR RP900, 8-track, record/playback deck	54-50	38-95	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	41-50
GRUNDIG TK 121 (twin-track)	56-25	39-95	39-95
GRUNDIG TK 141 (4-track)	62-10	45-95	45-95
GRUNDIG TK 146 (4-track auto)	66-95	49-95	49-95
GRUNDIG TK 147 (4-track auto)	98-65	76-95	76-95
GRUNDIG TK 148 (4-tr. auto 2 spd.)	74-10	57-95	57-95
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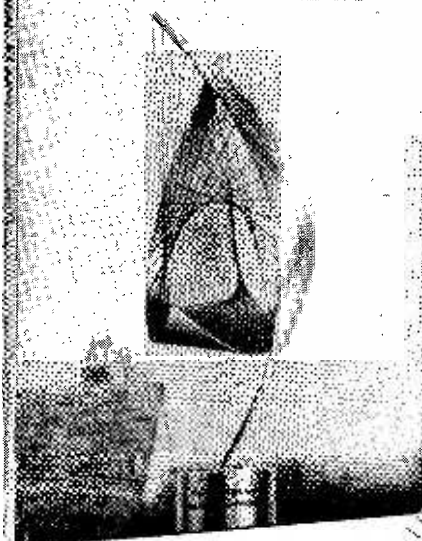
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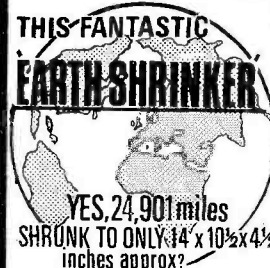
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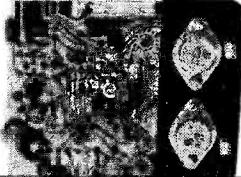
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ALL THREE MODULES HAVE OPEN & SHORT CIRCUIT PROTECTION, AND THE SA100 IS PROOF AGAINST OVER-DISSIPATION & FAULTY INDUCTIVE LOADS. ONLY ADVANCED DESIGN TECHNIQUES MAKE THESE EXTRA-ORDINARILY LOW PRICES POSSIBLE.

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OTHER SAXON PRODUCTS . . .

120 WATT HEAVY DUTY MODULE £13-90 + 20p carr. or with supply

£18-95 + 40p carr.

Featuring a rugged class A driver stage, this module will run from all our mixers, etc., and most other makes of mixer. It delivers 120 watts into an eight ohm load and employs 4 T03 can (115 watt) output transistors.

SPECIFICATION

Power output	120 watts into 8 ohms
Freq. response	20-20,000 HZ ± 2dB
Input sensitivity	200 mV into 10K
Construction	Fibreglass board
Size	8" x 4" x 4" (5" with supply)

Low distortion parallel push-pull output stage.

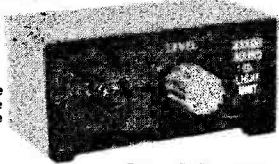


NEW 160 watt version & supply **£27-90**

SINGLE CHANNEL SOUND/LIGHT CONVERTER

This compact and reliable unit operates from amplifiers with outputs from 5-100 watts. Does not impose a heavy load on the amplifier, or, if connected in the wrong polarity, cause any damage, as with some units.

Operation is simplicity itself and the unit is fully fused. The unit is supplied to function from bass notes but may easily be converted to respond only to treble or mid-range notes by the addition of components costing less than 5p.



£8-90 carr. free



THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3000 watt (3kw) this unit is unique for its price in that not only bass, middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads etc. Supplied in tough white steel case with a blue hooded cover. Fully guaranteed.

£19-75 carr. 30p

MONO VERSION £6-50 carr. 20p (As illustrated, S.A.E. details 9 volt operation) Outputs up to 1 volt RMS



£15-80 carr. 30p

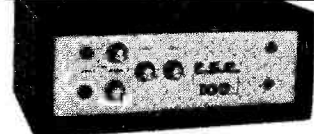
SAXON STEREO CONTROL UNIT

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½" x 3" x 4" deep and is finished with a smart white on black fascia. The controls are: Left/Right deck fader, volume, bass, treble, Headphone Selector and volume, Microphone volume, bass, treble, mains on/off. THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCO THEATRE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE. (N.B.—Stereo only has mic input.)

COMPLETE AMPLIFIERS

The CSE 100. £34-90 carr. free

This versatile unit is now available in a black vynid case and so represents even better value than ever delivering speech and music powers of up to 100 watts RMS and continuous signal outputs of 70 watts. Two individually controlled inputs with wide range bass and treble controls. Ideal for small groups D.J.S., etc.



The SAXON 100 £48-50 carr. free



With an RMS output of 120 watts speech and music, 100 watts continuous power, four individually controlled FET input stages and wide range bass and treble controls, this amplifier has established itself as a unit offering quality and reliability at low cost.

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A.K.G. MICROPHONES suitable for disco, group or general P.A. use.

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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.

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**THE MAY ISSUE WILL BE
PUBLISHED ON APRIL 6th**

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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 Honorary 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 *P.W.* 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.

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 pickups, 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.

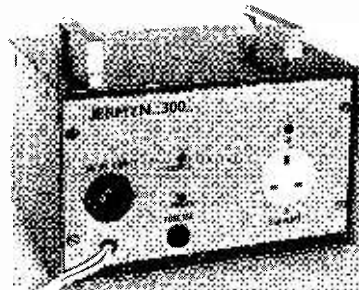
Jermyn Inverters

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



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*.

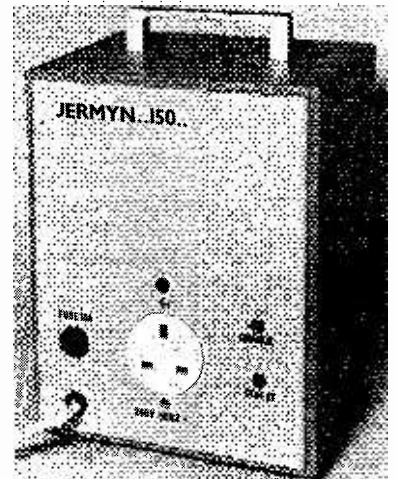
De-soldering Unit

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.

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

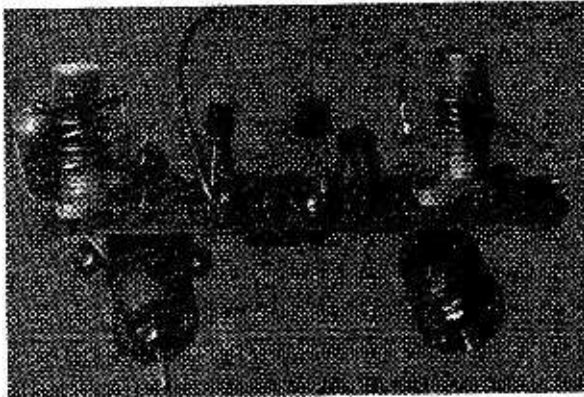


VHF radio provides a most useful signal source for any hi-fi enthusiast and, despite the 15 kHz frequency limits, the live BBC broadcasts are certainly up to the standards of the finest records.

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 μ V 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 μ V—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.

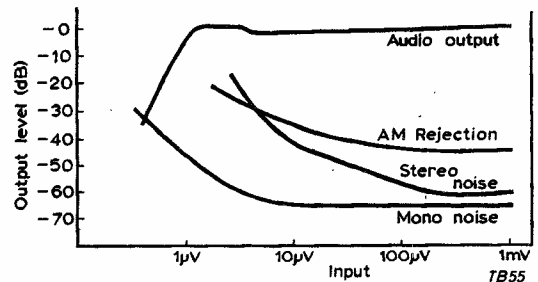


Fig. 1: Graphs comparing receiver performance with the input signal level.

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 multipath 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.

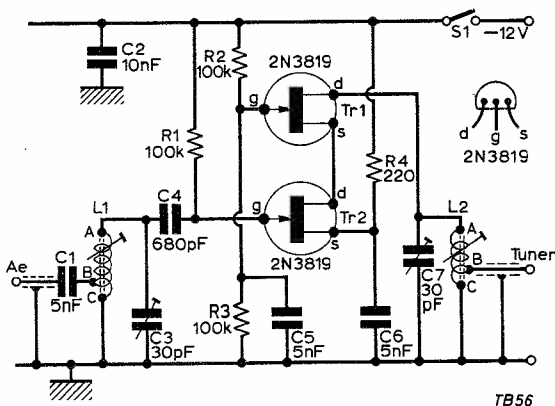


Fig. 2: Circuit of the amplifier using two f.e.t.'s.

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.

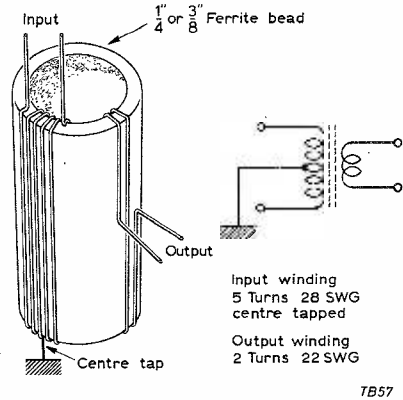


Fig. 3: Details of simple transformer to match balanced 400Ω feeder to 75Ω coaxial feeder.

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 Aradite. 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

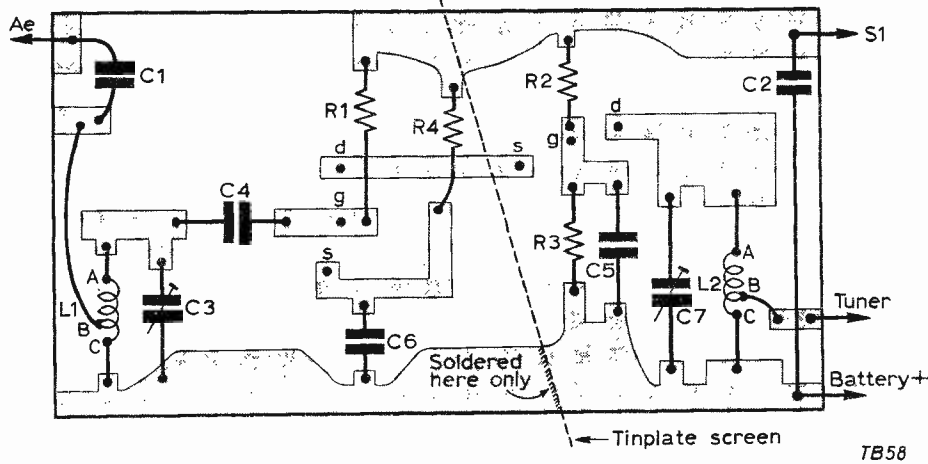
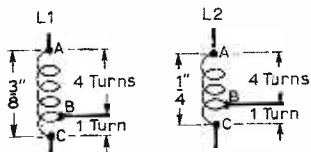


Fig. 4: Printed circuit board, for the circuit of Fig. 2, shown actual size.



Note:
L1 and L2 both
wound on $\frac{1}{4}$ " Dia
formers using
18 SWG copper
wire

TB59

Fig. 5: Winding information for L1 and L2.

★ components list

FET AMPLIFIER

Resistors

R1 100k Ω R2 100k Ω R3 100k Ω R4 220 Ω
All $\frac{1}{4}$ W 5%

Capacitors

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

Miscellaneous

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

BF200 AMPLIFIER

Resistors

R1 1.5k Ω R3 6.8k Ω R5 10k Ω
R2 10k Ω R4 1.5k Ω R6 6.8k Ω
All $\frac{1}{4}$ W 5%

Capacitors

C1 1nF 400V C6 30pF Trimmer
C2 30pF Trimmer C7 10nF 12V
C3 10nF 12V C8 680pF 12V
C4 680pF 12V C9 1nF Feed-through
C5 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 2000 μ F 10V C5 100nF 12V
C2 2000 μ F 10V C4 1000 μ F 15V

Miscellaneous

R1, 10 Ω $\frac{1}{4}$ W 5%. D1-D2, 1N4002. D3, 12V zener 2W, mounted on aluminium 2" \times 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 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.

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 27 Ω 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

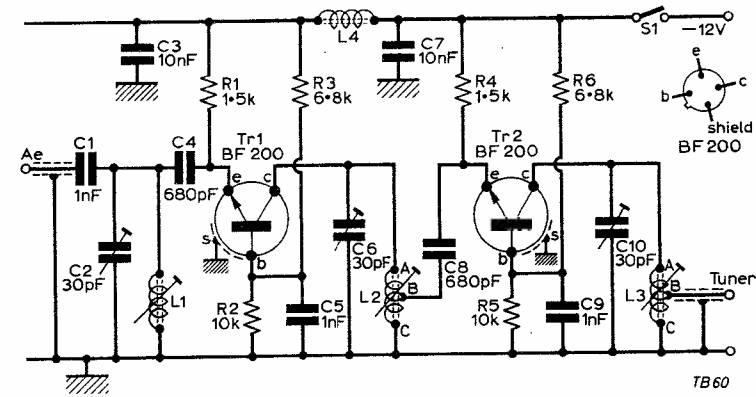


Fig. 6: Circuit of the second amplifier, using BF200 transistors.

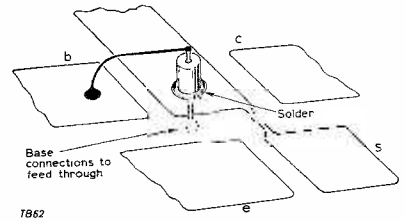


Fig. 8: Method of mounting feed-through capacitors.

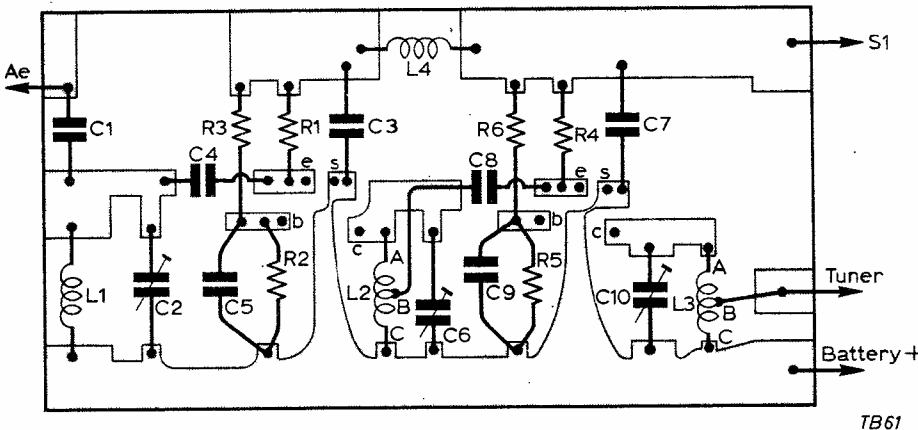


Fig. 7: Illustration, actual size, of the printed circuit board for the BF200 amplifier.

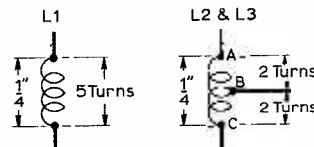
connected in series. The price of f.e.t.'s, however, makes this uneconomical and ordinary low-noise silicon transistors used after the f.e.t.'s work very well. The proposed amplifier, Fig. 6, is two stages of a conventional r.f. amplifier design. Fig. 7 shows a full size print layout for two stages, 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.

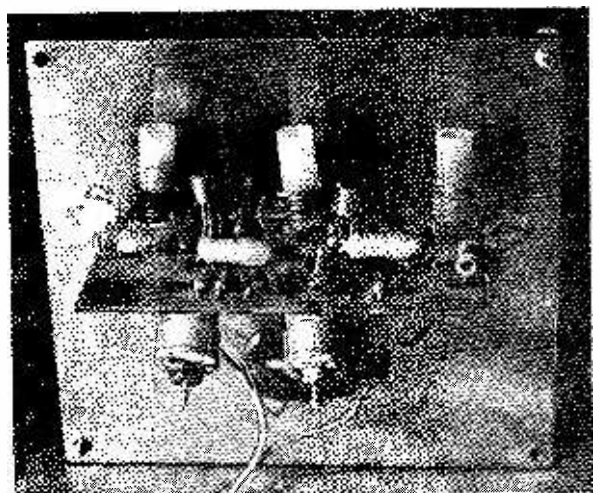
The two amplifiers just described will enable good stereo to be obtained from a mediocre signal without the need for a "fancy" tuner. The improvement that can be expected depends greatly on the individual circumstances. The author has used the amplifiers with a Sony ST5100 tuner and a poor aerial and 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



Note:
L1 L2 & L3 wound on $\frac{1}{4}$ " Dia formers.
L1 use 22 SWG copper wire.
L2 & L3 use 18 SWG copper wire.

TB63

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.

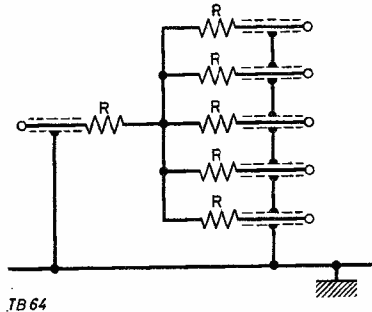


Fig. 10: Circuit of star-splitter enabling several outputs to be obtained from a single input.

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 1/4W 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

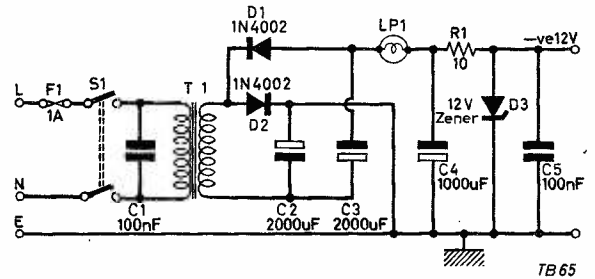


Fig. 11: Suggested power supply for the v.h.f. amplifiers.

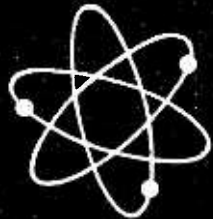
eight ways, two f.e.t.'s followed by three transistors should be adequate. One important point to note is that the outputs of the splitter must all be loaded by a 75Ω resistor when not in use, otherwise a loss of signal results and the splitter may form the node of standing waves in the feeder.

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 transmissions. ■

EXPERIMENTERS CORNER



NOVEL TONE GENERATOR

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.

N. NAUGHTON

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

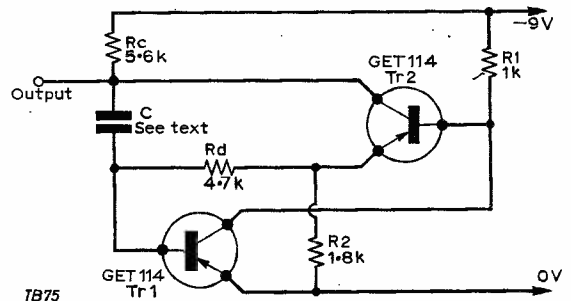


Fig. 1; Circuit of tone generator.

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 R_c 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 R_d. While discharge current is flowing in R_d 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 2 μ F 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 R_d is essential for circuit function, in practice this can be less than 100 Ω 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 R_d—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. ■

TELEVISION

APRIL ISSUE

TOUCH TUNING

The latest development in television receiver design is touch-sensitive tuning, using touch-button units which provide a completely non-mechanical means of channel changing. A very high-impedance electronic switching circuit selects the required channel when a finger is placed across a pair of contacts to complete the appropriate circuit. Several models featuring touch tuning are now on the market and this month we are investigating the technique and the circuitry involved. The change from mechanical to all-electronic channel selection should improve the stability and reliability of TV tuning.

BAND III PREAMPLIFIER

Another Bunney wideband aerial amplifier intended for DX work. The two-transistor (BF272) design on test lifted a weak signal from mere traces of line sync pulses to a solidly locked noisy image. Part of Roger's present programme of improving his DX receiving equipment.

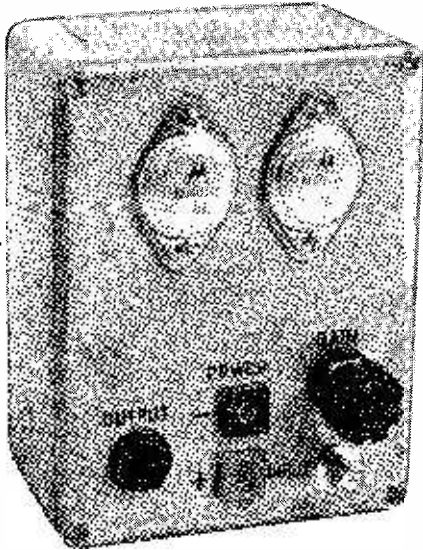
SERVICING

Plenty on the servicing front this month. John Law in his new fault-finding series investigates the line timebase used in most KB-STC models. Vivian Capel completes his guide to power supply circuit servicing. Les Lawry-Johns starts on the single-standard Bush-Murphy TV181S/V2016 series. And Caleb Bradley takes us further with the BRC 2000 colour chassis.

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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.

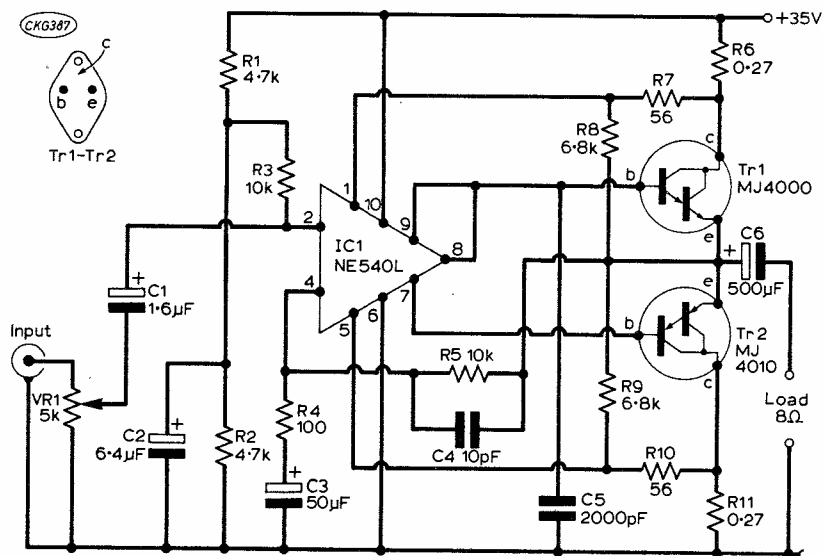


Fig. 1: Circuit diagram of the amplifier and pin connections for the output transistors.

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2G306	0-30	Green	0-10	2N5245	0-43	AF122	0-24	BC308	0-10	BF277	0-28
2G309	0-30	Yellow	0-10	2N5290	0-92	AF126	0-19	BC309	0-09	BF467	0-46
2G344A	0-25	Orange	0-10	2N5191	0-99	AF127	0-20	BC309A	0-10	BF468	0-57
2G345A	0-25	2N3053	0-21	2N5192	1-24	AF129	0-28	BC309B	0-10	BF469	0-57
2G371	0-15	2N3054	0-47	2N5193	1-24	AF130	0-28	BC309C	0-10	BFS21	2-10
2G374	0-15	2N3054	0-48	2N5194	1-10	AF172	0-25	BC31	0-06	BFS22	2-09
2G381	0-23	2N3055	0-60	2N5195	1-46	AF178	0-25	BC328	0-22	BF561	0-27
2G417	0-20	2N3390	0-20	2N5245	0-43	AF179	0-25	BC337	0-19	BF598	0-28
2N109	0-49	2N3391	0-20	2N5245	0-43	AF180	0-25	BC338	0-19	BF598	0-28
2N174	1-40	2N3391A	0-23	2N5468	0-33	AF186	0-40	BCY20	0-85	BFW11	0-61
2N176	0-75	2N3392	0-12	2N5469	0-33	AF186	0-40	BCY31	0-40	BFW13	0-28
2N274	0-75	2N3393	0-12	2N5470	0-43	AF239	0-41	BCY32	0-40	BFX29	0-28
2N335	0-75	2N3394	0-12	3N138	1-37	AF240	0-74	BCY33	0-75	BFX30	0-25
2N351	0-95	2N3402	0-17	3N199	1-38	AF279	0-73	BCY34	0-74	BFX37	0-20
2N375	1-00	2N3403	0-19	3N140	0-76	AF280	0-54	BCY34	0-74	BFX44	0-33
2N384	0-93	2N3404	0-24	3N141	0-89	AFY42	0-74	BCY38	0-40	BFX53	2-48
2N388A	0-40	2N3405	0-27	3N142	0-64	AFY21	0-65	BCY39	1-05	BFX68	0-30
2N404	0-23	2N3414	0-10	3N143	0-64	AL102	0-77	BCY40	0-60	BFX84	0-24
2N404	0-20	2N3415	0-10	3N152	1-04	BCY1	0-24	BCY43	0-43	BFX85	0-30
2N408	0-20	2N3416	0-15	3N163	0-74	ASV26	0-80	BCY43	0-43	BFX86	0-24
2N456A	0-75	2N3417	0-21	3N154	0-74	ASV27	0-80	BCY58	0-21	BFX87	0-25
2N457A	0-20	2N3570	1-25	3N159	1-00	ASV28	0-28	BCY59	0-22	BFX88	0-20
2N491	3-25	2N3571	1-12	3N187	1-20	ASV29	0-30	BCY66	0-66	BFX89	0-45
2N584	0-28	2N3572	0-97	3N200	2-07	ASV30	0-20	BCY67	0-94	BFY10	0-35
2N591	0-34	2N3702	0-10	3N201	1-05	ASV31	0-25	BCY70	0-17	BFY11	0-45
2N606	0-20	2N3703	0-10	40050	0-78	BC107	1-25	BCY71	0-29	BFY17	0-90
2N697	0-15	2N3704	0-10	40051	0-81	BC108	1-18	BCY72	0-13	BFY18	0-25
2N698	0-25	2N3705	0-10	40052	0-81	BC109	0-14	BCY87	3-47	BFY19	0-25
2N699	0-29	2N3706	0-90	40053	0-50	BC110	0-13	BCY88	2-40	BFY20	0-50
2N706	0-12	2N3707	0-10	40054	0-50	BC111	0-15	BCY89	0-80	BFY29	0-40
2N708	0-12	2N3708	0-70	40055	0-92	BC112	0-13	BCZ1	0-25	BFY30	0-20
2N709	0-38	2N3710	0-90	40056	0-50	BC113	0-15	BCZ2	0-25	BFY31	0-20
2N711	0-80	2N3711	0-90	40057	0-92	BC114	0-15	BD115	0-75	BFY43	0-62
2N718	0-21	2N3712	0-95	40058	0-48	BC115A	0-18	BD121	0-75	BFY61	0-16
2N718A	0-80	2N3713	1-08	40059	0-48	BC117	0-21	BD123	0-82	VF Y22	0-16
2N720	0-50	2N3714	1-15	40062	0-44	BC118	0-21	BD124	0-87	BFY63	0-18
2N721	0-55	2N3715	1-23	40063	0-88	BC121	0-23	BD131	0-40	BFY68	0-41
2N914	0-18	2N3716	1-23	40063	0-88	BC121	0-23	BD132	0-50	BFY74	0-42
2N916	0-17	2N3717	2-35	40069	0-48	BC123	0-28	BD132	0-50	BFY75	0-40
2N918	0-30	2N3718	3-33	40084	0-65	BC125	0-15	BD135	0-43	BFY76	0-22
2N919	0-20	2N3719	4-19	40096	0-44	BC126	0-20	BD136	0-49	BFY77	0-24
2N929	0-14	2N3719	5-95	40407	0-83	BC132	0-20	BD137	0-55	BFY78	0-36
2N930	0-14	2N3719	5-95	40408	0-83	BC133	0-21	BD138	0-63	BFY90	0-40
2N1090	0-24	2N3720	3-15	40409	0-82	BC135	0-11	BD139	0-71	BR Y39	0-30
2N1091	0-24	2N3720	3-15	40410	0-83	BC136	0-15	BD140	0-83	BRX19	0-13
2N1131	0-20	2N3780	4-60	40411	0-80	BC137	0-15	BD140	1-25	BRX20	0-14
2N1132	0-20	2N3781	3-87	40414	3-55	BC138	0-20	BDY11	1-50	BRX21	0-20
2N1184	1-27	2N3782	3-87	40438	1-44	BC140	0-24	BDY17	1-60	BRX22	0-84
2N1202	0-16	2N3789	1-78	40478A	0-69	BC142	0-24	BDY19	1-97	BRX28	0-25
2N1203	0-16	2N3789	1-78	40478A	0-69	BC142	0-24	BDY19	1-97	BRX28	0-25
2N1304	0-20	2N3791	2-08	40468A	0-44	BC143	0-21	BDY20	0-98	BRX29	0-47
2N1306	0-20	2N3792	2-20	40690	0-69	BC144	0-24	BDY23	0-65	BRX30	0-68
2N1308	0-22	2N3794	0-10	40692	0-46	BC145	0-21	BDY60	0-90	BRX59	0-78
2N1307	0-22	2N3819	0-28	40693	0-68	BC147	0-11	BDY61	0-85	BRX80	0-64
2N1308	0-25	2N3820	0-47	40694	0-68	BC149	0-13	BFY11	0-28	BRX81	0-25
2N1483	0-90	2N3824	0-75	40636	1-10	BC153	0-18	BF117	0-43	BRX77	0-20
2N1607	0-24	2N3826	0-23	40673	0-58	BC154	0-18	BF119	0-58	AX78	0-25
2N1613	0-20	2N3854	0-16	AC107	0-45	BC157	0-14	BF121	0-25	BSW70	0-28
2N1631	0-85	2N3854A	0-18	AC113	0-16	BC158	0-13	BF123	0-27	BSY24	0-20
2N1637	0-30	2N3855	0-16	AC117	0-20	BC160	0-14	BF125	0-25	BSY25	0-15
2N1638	0-30	2N3855A	0-16	AC121	0-13	BC167B	0-11	BF127	0-27	BSY27	0-15
2N1671	0-00	2N3855	0-16	AC121	0-13	BC167B	0-11	BF127	0-27	BSY27	0-15
2N1701	1-10	2N3856A	0-16	AC126	0-20	BC168B	0-13	BF153	0-29	BSY28	0-15
2N1702	2-15	2N3856	0-16	AC127	0-20	BC168C	0-11	BF154	0-16	BSY38	0-15
2N1711	0-17	2N3856A	0-16	AC141	0-20	BC169B	0-13	BF168	0-15	BSY39	0-15
2N1719	0-24	2N3858A	0-16	AC142K	0-25	BC170	0-13	BF169	0-13	BSY41	0-25
2N2102	0-34	2N3859A	0-16	AC142K	0-25	BC170	0-13	BF169	0-13	BSY42	0-25
2N2147	0-70	2N3860	0-16	AC151V	0-14	BC171	0-13	BF161	0-55	BSY53	0-25
2N2148	0-60	2N3866	0-70	AC152V	0-17	BC172	0-11	BF163	0-20	BSY54	0-30
2N2192	0-40	2N3877	0-25	AC153K	0-25	BC182	0-10	BF165	0-25	BSY56	0-79
2N2192A	0-40	2N3877A	0-25	AC154	0-20	BC182L	0-10	BF167	0-18	BSY56	0-79
2N2193	0-45	2N3878	0-22	AC176	0-18	BC183	0-09	BF173	0-19	BSY78	0-40
2N2193A	0-42	2N3878A	0-22	AC176	0-18	BC183L	0-09	BF177	0-25	BSY79	0-40
2N2194	0-27	2N3900	0-20	AC176K	0-20	BC184	0-11	BF178	0-25	BSY79	0-45
2N2194A	0-30	2N3900A	0-21	AC178K	0-20	BC184L	0-11	BF179	0-20	BSY95A	0-09
2N2195	0-87	2N3901	0-22	ACY17	0-25	BC186	0-26	BF180	0-85	BU104	1-42
2N2195A	0-18	2N3903	0-20	ACY18	0-15	BC187	0-25	BF181	0-32	BU105	2-26
2N2196	0-30	2N3904	0-17	ACY18K	0-20	BC204	0-11	BF182	0-90	C111	0-53
2N2212	0-37	2N3905	0-21	ACY19	0-20	BC205	0-10	BF183	0-40	D40N3	0-42
2N2212A	0-51	2N3906	0-22	ACY20	0-20	BC206	0-11	BF184	0-17	GET111	0-45
2N2220	0-20	2N4036	0-63	ACY22	0-13	BC207	0-10	BF185	0-17	GET112	0-20
2N2221	0-20	2N4037	0-42	ACY28	0-18	BC208	0-09	BF184	0-14	GET114	0-20
2N2221A	0-33	2N4058	0-12	ACY30	0-42	BC209	0-10	BF195	0-15	GET115	0-20
2N2222	0-31	2N4059	0-80	ACY39	0-55	BC215	0-30	BF196	0-15	GET119	0-35
2N2222A	0-41	2N4060	0-81	ACY40	0-17	BC212K	0-12	BF198	0-15	GET120	0-25
2N2368	0-11	2N4061	0-11	ACY40	0-17	BC214L	0-14	BF199	0-18	GET335	0-20
2N2369	0-39	2N4062	0-11	ACY41	0-17	BC236	0-16	BF200	0-85	GET336	0-20
2N2369A	0-17	2N4302	0-25	AD136V	0-98	BC237	0-09	BF224J	0-14	GET338	0-20
2N2648	0-41	2N4303	0-32	AD140	0-50	BC239	0-09	BF225J	0-14	GET373	0-12
2N2647	1-20	2N4913	0-80	AD140	0-55	BC239	0-09	BF257	0-23	GET380	0-30
2N2711	0-12	2N4914	0-67	AD142	0-50	BC251	0-20	BF238	0-22	GET383	0-20
2N2712	0-12	2N4915	0-95	AD143	0-45	BC252	0-18	BF244	0-16	GET387	0-20
2N2713	0-17	2N4916	0-11	AD143V	1-26	BC253	0-23	BF245	0-33	GET390	0-20
2N2714	0-17	2N4917	0-17	AD149V	1-26	BC257	0-29	BF246	0-43	GET397	0-20
2N2904	0-18	2N4918	0-60	AD150	0-63	BC259	0-09	BF247	0-19	GET398	0-22
2N2904A	0-25	2N4919	0-53	AD161	0-37	BC259	0-13	BF254	0-14	GET395	0-25
2N2905	0-20	2N4920	0-60	AD162	0-37	BC261	0-20	BF255	0-41		
2N2905A	0-23	2N4921	0-50	AD161	0-37	BC262	0-18	BF257	0-41		
2N2906	0-18	2N4922	0-55	AD162	0-37	BC263	0-23	BF258	0-41		
2N2906A	0-23	2N4923	0-60	AD211							

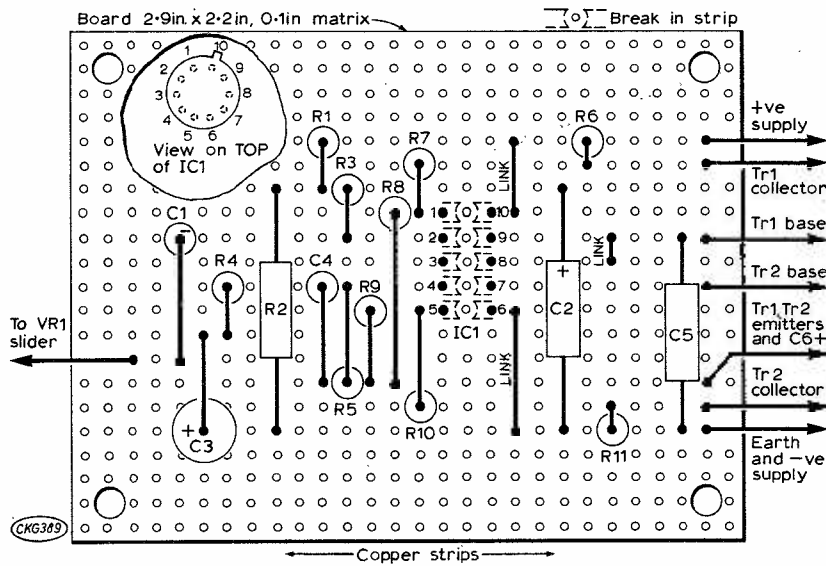


Fig. 3: Component layout on top of veroboard, the copper strips running horizontally underneath.

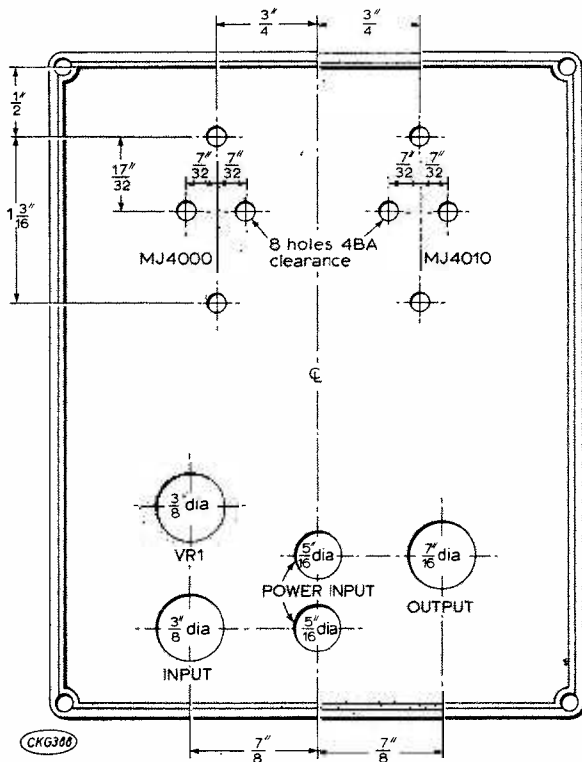
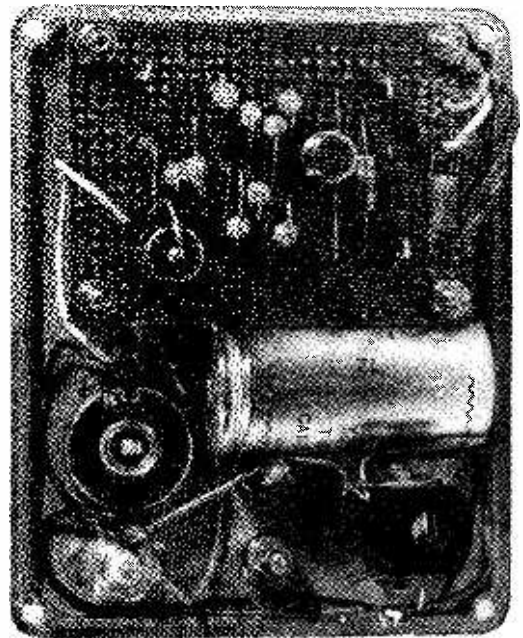


Fig. 2: Drilling details for the box lid on which components are mounted

They are based on a supply voltage (V_{cc}) 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:



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

Peak current in transistors is:

$$\frac{V_{cc}}{2R_L} = 2.2A (I_{pk})$$

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:

$$R6 = R11 = \frac{650mV}{I_{pk}} = \frac{0.65}{2.2} = 0.296 \Omega$$

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:

$$R8 = R9 = \frac{V_{cc}}{6mA} = 5.8k\Omega$$

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 lin. 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.

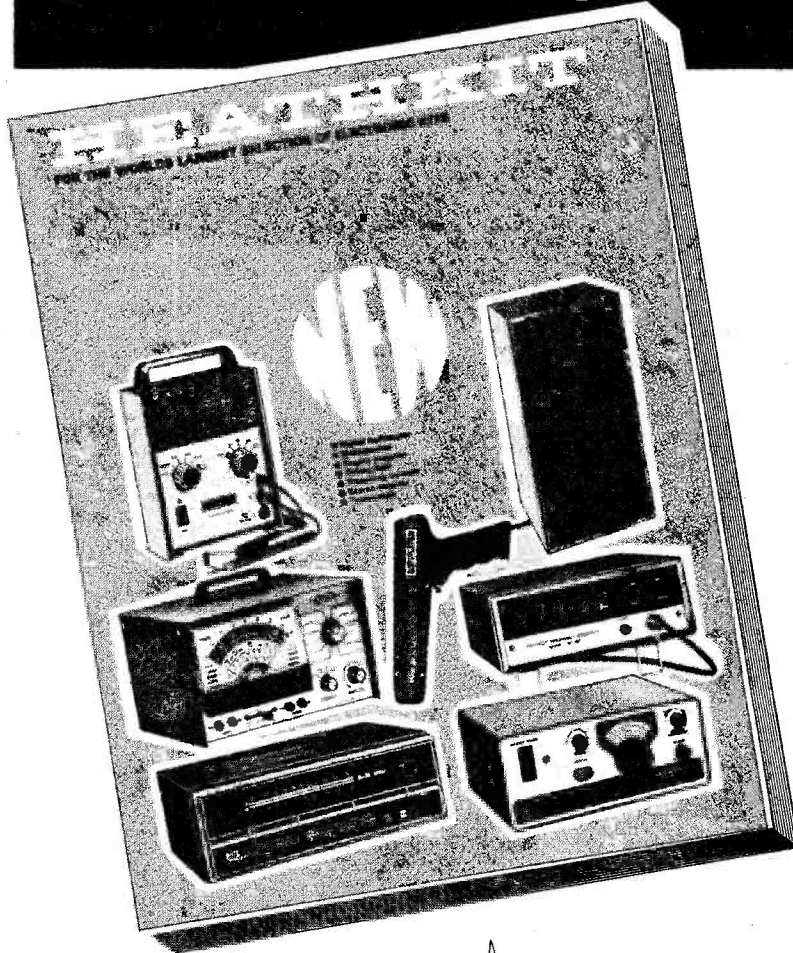
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ECC189	52p	EY88	40p	PX4	£2.50
ECP80	35p	EZ41	50p	PY83	30p
ECP82	35p	EZ50	50p	PY80	35p
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AF246	20p	CRS2	1-W	0.45	
AF247	20p	CRS2	1-W	0.45	
AF248	20p	CRS2	1-W	0.45	
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AF250	20p	CRS2	1-W	0.45	
AF251	20p	CRS2	1-W	0.45	
AF252	20p	CRS2	1-W	0.45	
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6V6GT	40p	35L5GT	50p		
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6X5G	30p	35Z4GT	45p		
6X6GT	37p	50C5	50p		
6Y6G	60p	50C6GT	60p		
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6Z2H	45p				
6Z2I	45p				
6Z2J	45p				
6Z2K	45p				
6Z2L	45p				
6Z2M	45p				
6Z2N	45p				
6Z2O	45p				
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TT21	23p	UF41	50p	IL4	15p
U25	75p	UF80	36p	IL4	15p
U26	72p	UF89	40p	IL4	15p
U27	50p	UL41	63p	IL4	15p
U28	50p	UL84	60p	IL4	15p
U29	50p	UL85	60p	IL4	15p
U30	50p	UL86	60p	IL4	15p
U31	50p	UL87	60p	IL4	15p
U32	50p	UL88	60p	IL4	15p
U33	50p	UL89	60p	IL4	15p
U34	50p	UL90	60p	IL4	15p
U35	50p	UL91	60p	IL4	15p
U36	50p	UL92	60p	IL4	15p
U37	50p	UL93	60p	IL4	15p
U38	50p	UL94	60p	IL4	15p
U39	50p	UL95	60p	IL4	15p
U40	50p	UL96	60p	IL4	15p
U41	50p	UL97	60p	IL4	15p
U42	50p	UL98	60p	IL4	15p
U43	50p	UL99	60p	IL4	15p
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6AN8	50p	6B7C	90p	62D	35p
6AQ5	35p	6B7D	95p	62E	35p
6AQ5W	50p	6B7E	100p	62F	35p
6AS6	37p	6B7F	105p	62G	35p
6AS6G	40p	6B7G	110p	62H	35p
6AT6	30p	6B7H	115p	62I	35p
6B7	30p	6B7I	120p	62J	35p
6B7G	30p	6B7J	125p	62K	35p
6B7H	30p	6B7K	130p	62L	35p
6B7I	30p	6B7L	135p	62M	35p
6B7J	30p	6B7M	140p	62N	35p
6B7K	30p	6B7N	145p	62O	35p
6B7L	30p	6B7P	150p	62P	35p
6B7M	30p	6B7Q	155p	62Q	35p
6B7N	30p	6B7R	160p	62R	35p
6B7O	30p	6B7S	165p	62S	35p
6B7P	30p	6B7T	170p	62T	35p
6B7Q	30p	6B7U	175p	62U	35p
6B7R	30p	6B7V	180p	62V	35p
6B7S	30p	6B7W	185p	62W	35p
6B7T	30p	6B7X	190p	62X	35p
6B7U	30p	6B7Y	195p	62Y	35p
6B7V	30p	6B7Z	200p	62Z	35p
6B7W	30p				
6B7X	30p				
6B7Y	30p				
6B7Z	30p				

68G7GT	32p	30L19	77p		
68Q7	48p	30L1	75p		
68Q7GT	32p	30L13	92p		
6V6G	17p	30PL14	90p		
6V6GT	40p	35L5GT	50p		
6X4	30p	38W4	35p		
6X5G	30p	35Z4GT	45p		
6X6GT	37p	50C5	50p		
6Y6G	60p	50C6GT	60p		

HOTLINES

ON RECENT DEVELOPMENTS

FOR some time now, weather satellites have been happily orbiting 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

NAUTICAL RADIO AIDS



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 inter-connections 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 has 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 minimize 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.

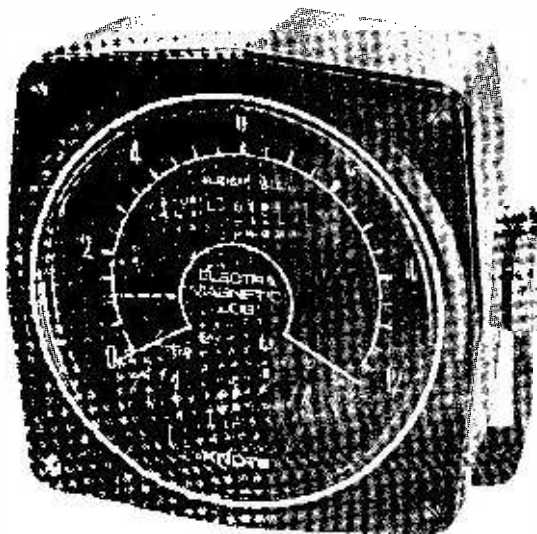
As the sensitivity is reduced, the directional power of the antenna is proportionately increased to a point where the bearing is located on a narrow sector. If this bearing, which is indicated on a compass scale, remains constant, you may be on a collision course, also as the pulse length increases as 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.

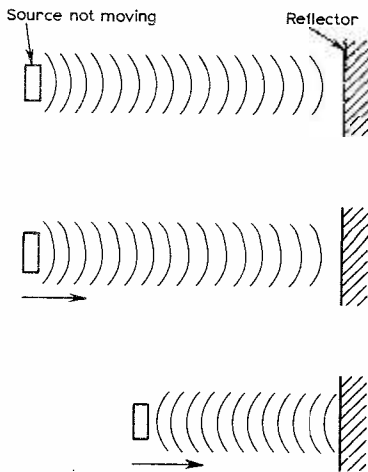


Fig. 1: The Doppler Principle.
 Imagine a transducer giving out sound waves. These waves travel in water at a speed of about 1,000 metres per second. Speed equals frequency multiplied by wavelength.
 If the transducer moves at a speed "V", the speed of the waves towards the reflector is now $1,000+V$ metres per second. We have not changed the frequency of transmission, so the wavelength must now be less.
 ($1,000+V=f \times \text{new wavelength.}$)
 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.

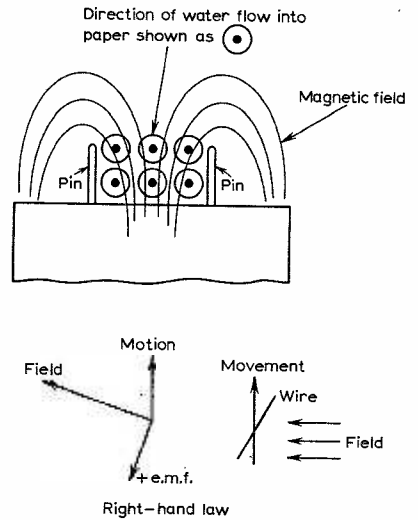


Fig. 2: An e.m.f. is produced between two metal contacts, providing the direction of flow is at right-angles to the line joining the contacts.

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 \times 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 $\pm 1\frac{1}{2}\%$ (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.

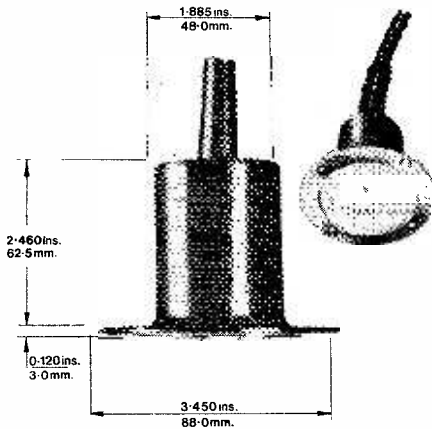
By arranging a magnetic field to cut the direction of water flow at right angles, an e.m.f. is induced between two metal contacts in the moving water, provided that the direction of flow is at right angles to the line joining the contacts (Fig. 2)

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.

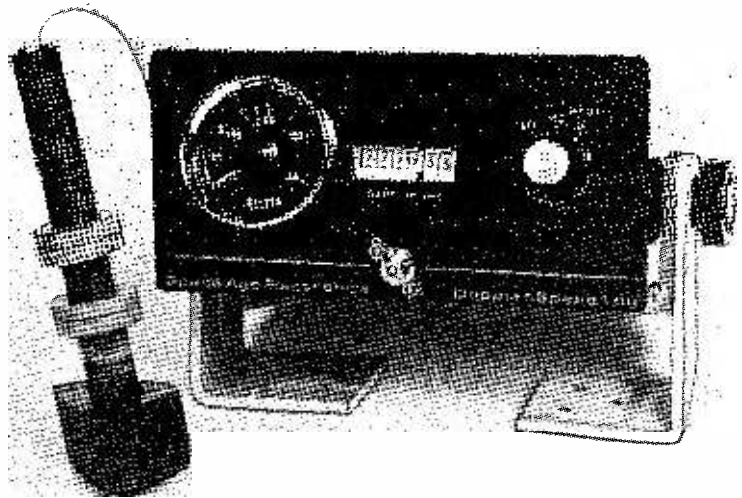
ECHOSOUNDERS

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.

EXTRA!!!

IN NEXT MONTH'S

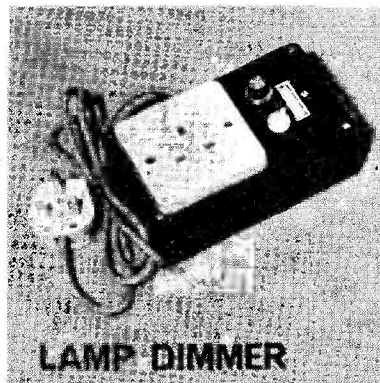
PRACTICAL WIRELESS

SIMPLE PROJECTS FOR THE HOME 8 PAGE SUPPLEMENT

P.W.'s reputation for plenty of simple and straightforward constructional projects is excelled next month by an extra large issue. In addition to the usual constructional articles and features, the May issue will include a special extra 8-page coloured supplement describing eight easy projects for the home, designed and described by one of our top designers; you are bound to find *at least* one of these of interest. This supplement is fully illustrated with all the details on how to build these projects.



RADIO
ALARM CLOCK



LAMP DIMMER



INTERCOM AMPLIFIER



LIGHT POWERED
RADIO



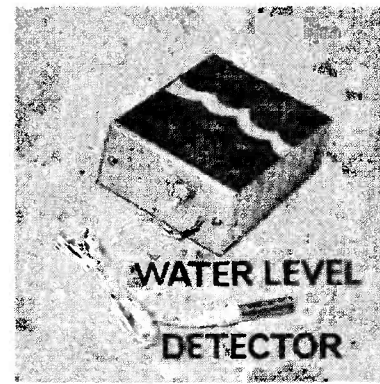
SENSITIVITY
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Following the success of the Texan amplifier published in this magazine during May to August 1972, the applications laboratory of Texas Instruments Ltd. have developed exclusively for P.W., a compatible unit for the control of Psychedelic 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.

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 *luz et lumiere* 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.

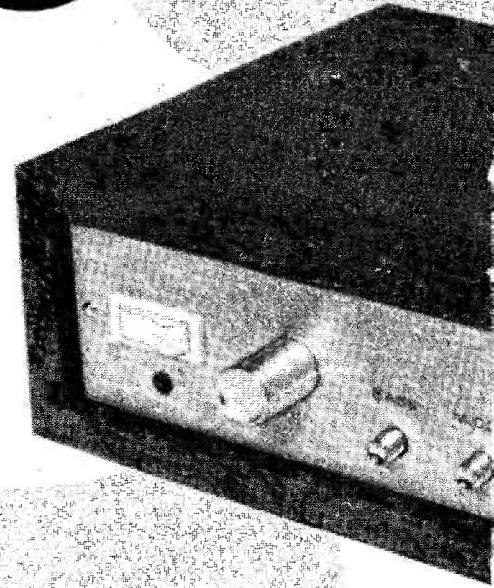
This article will attempt to explain fully the construction of psychedelic light control units for both mono and stereo equipment. It is aimed at the home constructor who possesses nothing more than an average amount of skill.

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 zero 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



TR



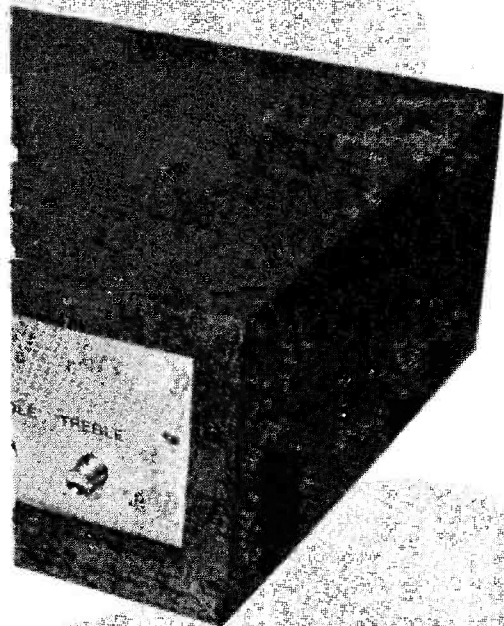
- MONO/STEREO CAPABILITY
- ZERO VOLTAGE SWITCHING
- NEGLIGIBLE RADIO INTERFERENCE
- LAMP OVER-RIDE CONTROL
- OPTIONAL LAMP DIMMING

Mood

PART ONE



COLOUR



Lighting System

JUREK BUDEK*

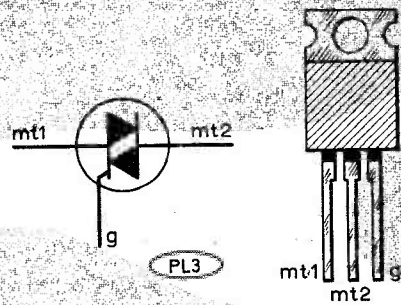
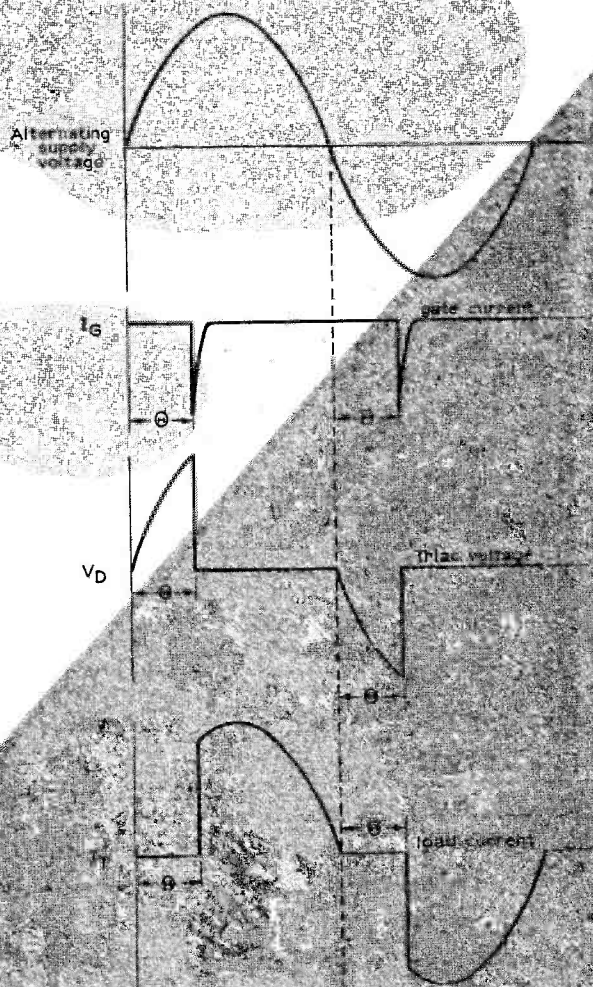


Fig. 1: The TIC226D bidirectional switch



7B76

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 technique 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 inter-

ference (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.

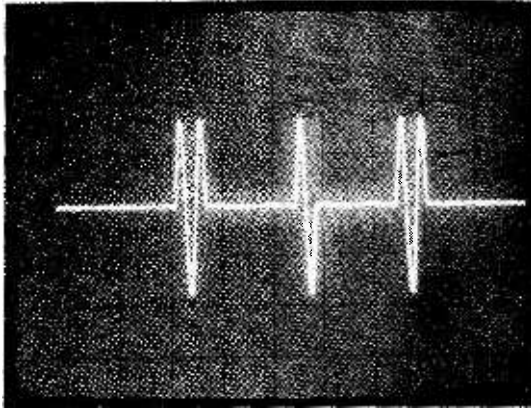


Fig. 3: Waveform depicting zero voltage switching.

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.

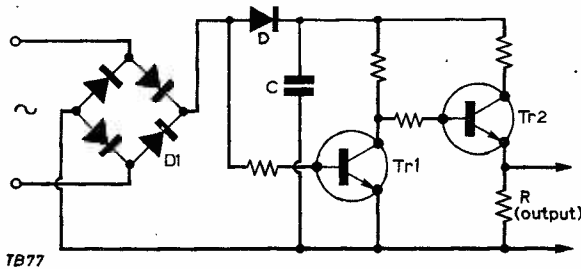


Fig. 4: Basic circuit which generates the pulses at the point of zero voltage crossing.

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.

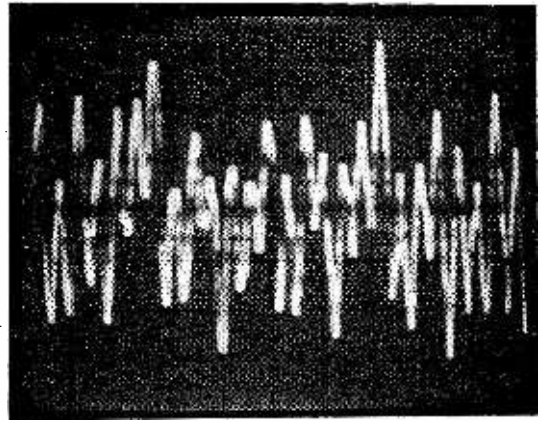


Fig. 5: Typical music voltage waveform at the terminals of a loudspeaker.

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.

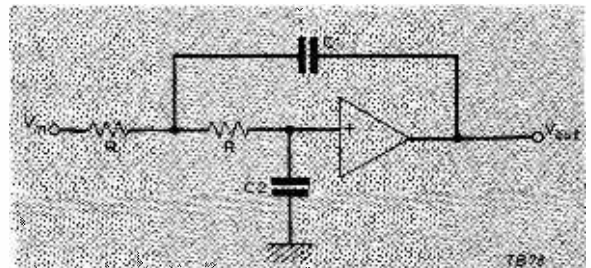


Fig. 6: Basic low pass filter as used in the P.W. *Tricolour*.

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,

$$\omega_0 = \frac{1}{R\sqrt{C_1 C_2}}$$

and the damping factor

$$\zeta = \sqrt{\frac{C_2}{C_1}}$$

Critical damping occurs when

$$\zeta = \frac{1}{\sqrt{2}}$$

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,

$$\omega_0 = \frac{1}{C\sqrt{R_1 R_2}}$$

and the damping factor

$$\zeta = \sqrt{\frac{R_1}{R_2}}$$

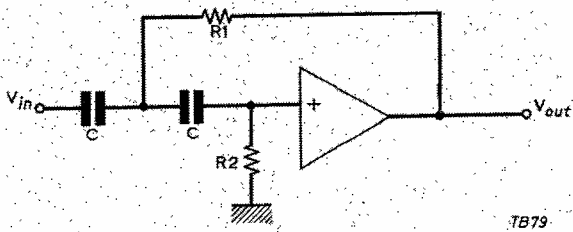


Fig. 7. Basic high pass filter. ▲

Rear view of the P.W. Tricolour. ►

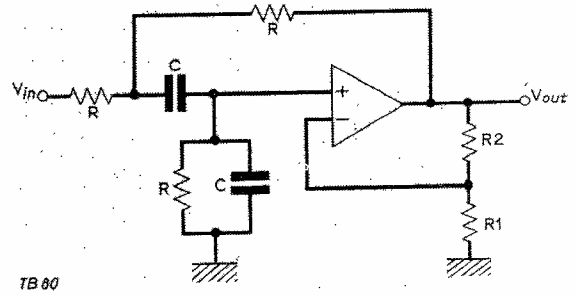
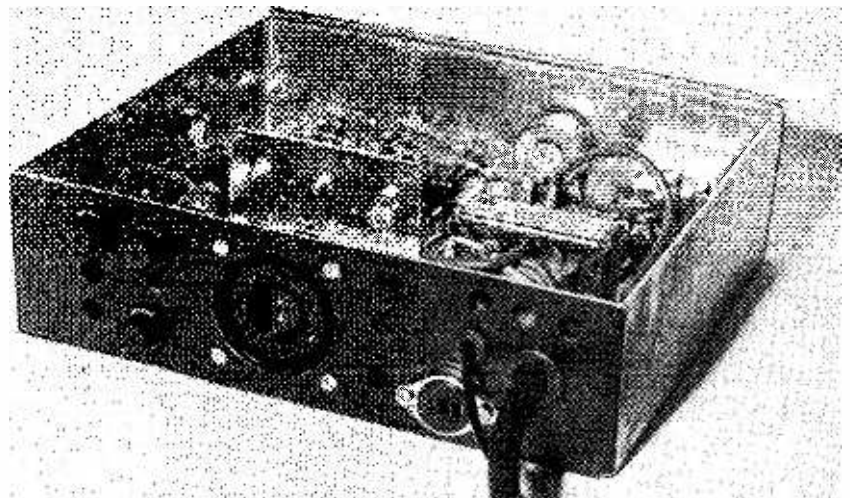


Fig. 8. Basic band pass filter.

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 $\omega_0 = \frac{\sqrt{2}}{RC}$

and the quality factor $Q = \frac{\sqrt{2}}{4 - \frac{R_2}{R_1}}$

$Q = \frac{2\Delta f}{f_0}$, where $2\Delta f$ is the difference between two frequencies at which the voltage output of the filter is $\frac{1}{\sqrt{2}}$ of its maximum value. From the above

formulae, relevant component values can be obtained. Musically oriented readers will recall the 'unison' 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

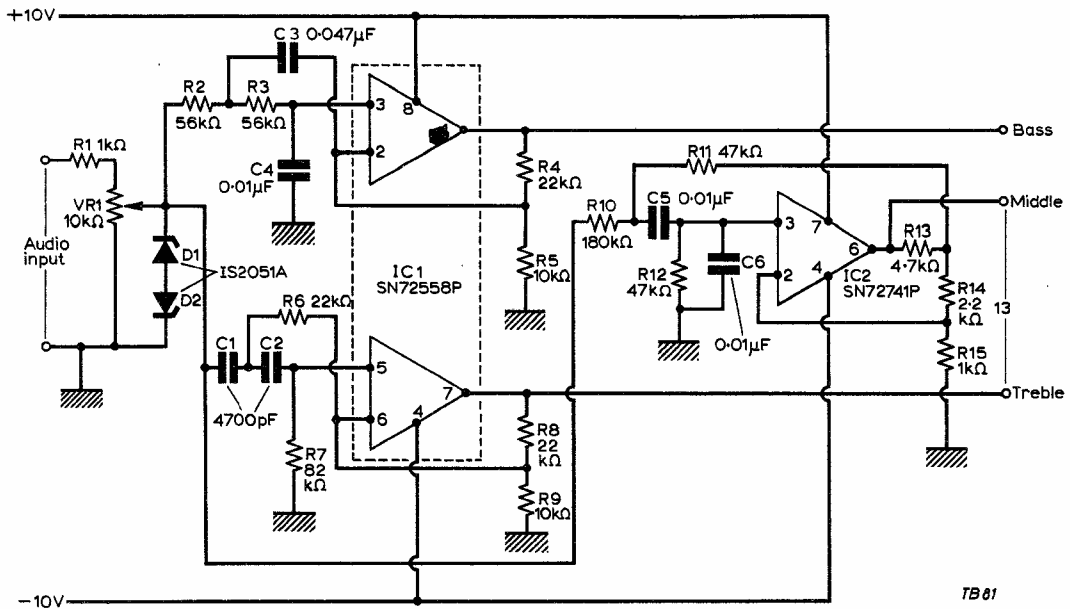


Fig. 9: Complete P.W. Tricolour filter circuit. This unit is used without modification, with either the zero voltage switching unit (Fig. 12) or with the lamp dimming unit, to be described later in this series.

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

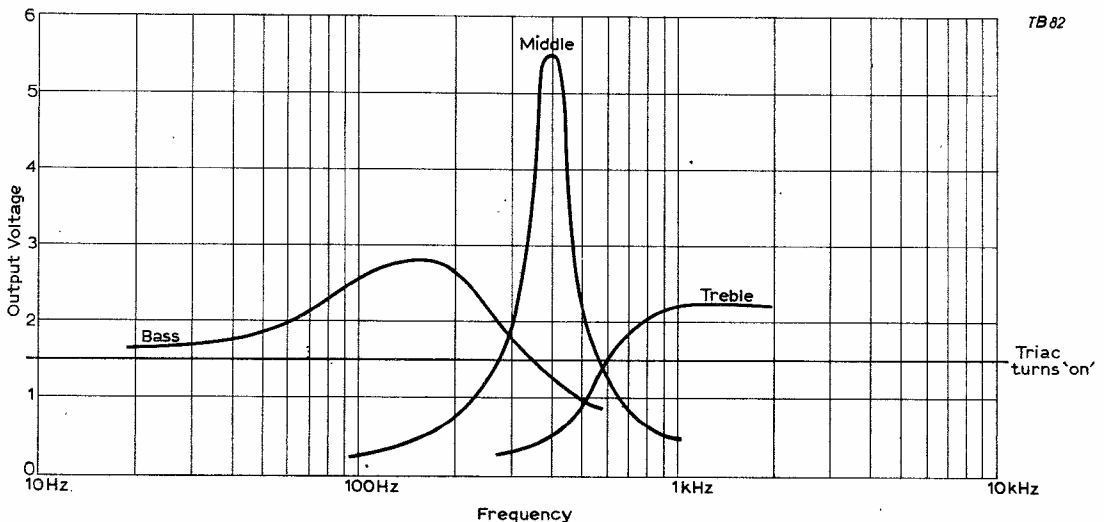


Fig. 10: Output voltage/frequency response of the filter circuit shown in Fig. 9.

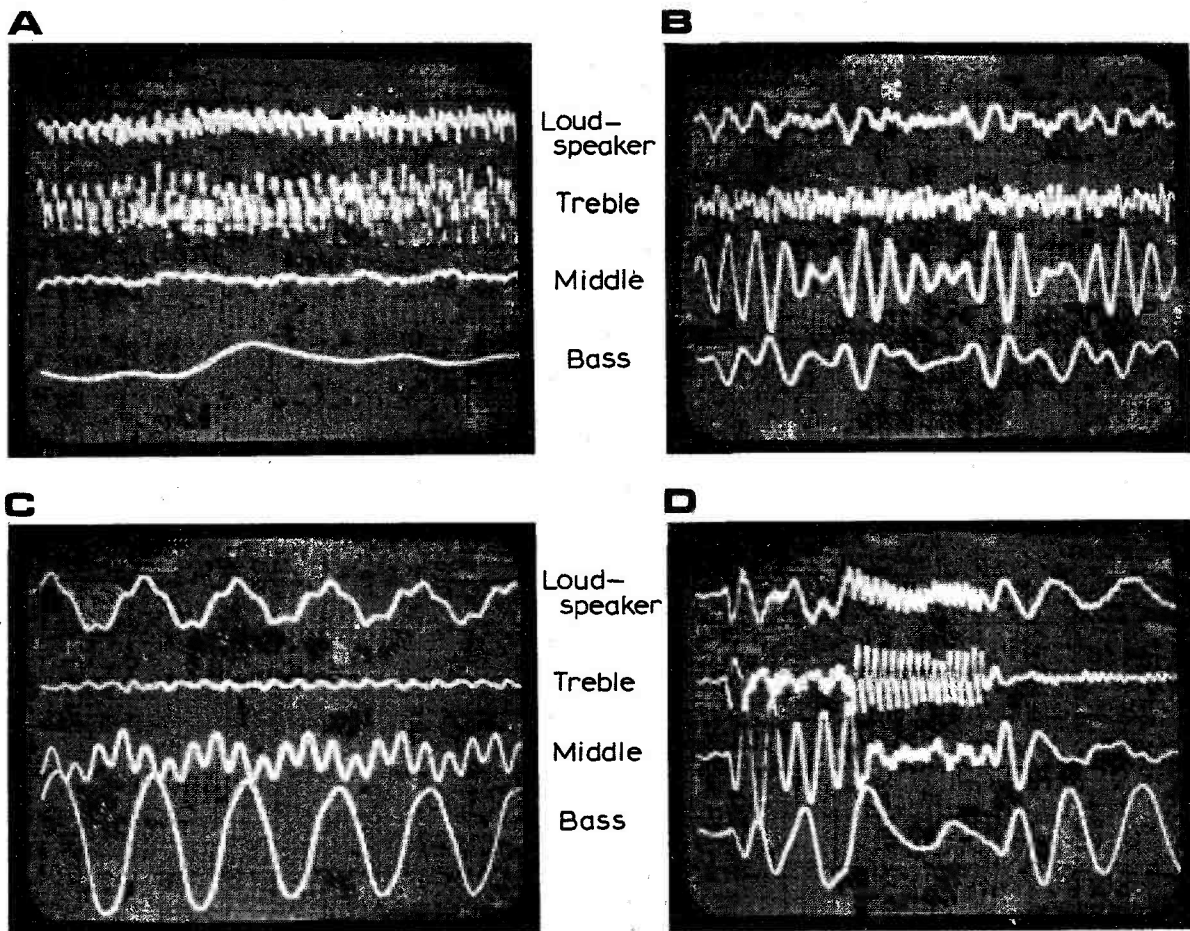


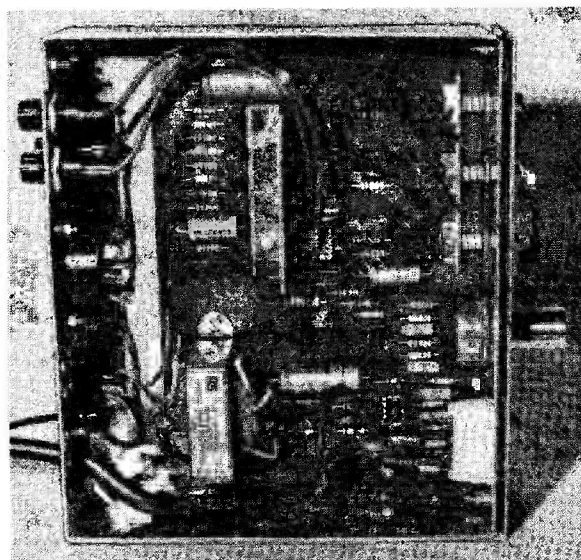
Fig. 11 : (a-d) A full explanation of these waveforms is given in the accompanying text.

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 $10k\Omega$ 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 15 Ω 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.

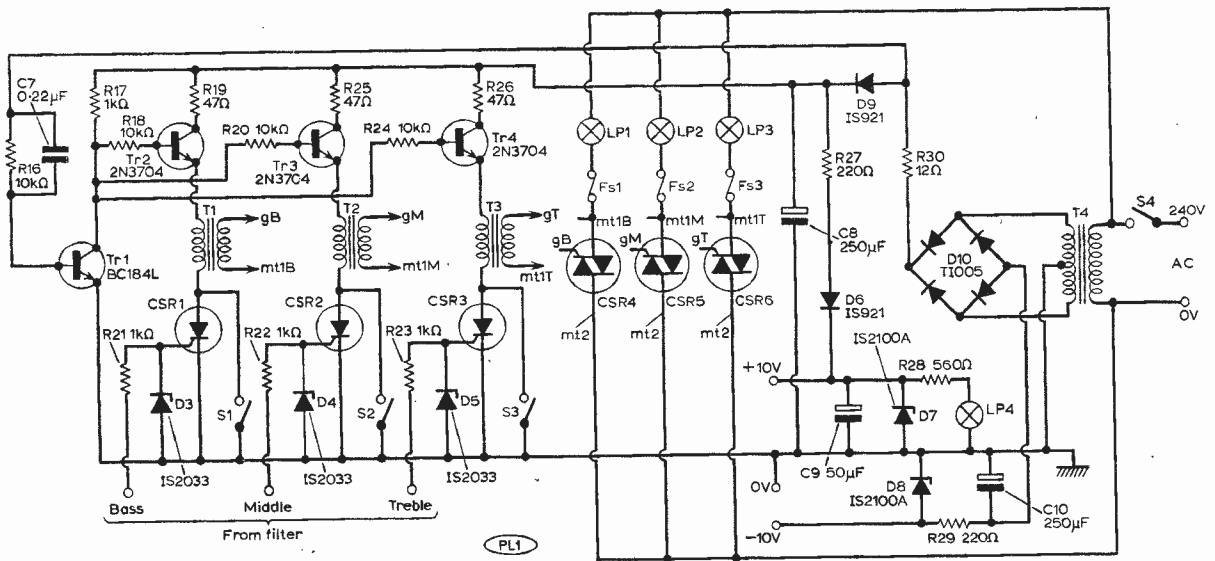


Fig. 12: Zero voltage switching control unit. The positive and negative 10V supply lines are the d.c. supplies to the filter unit (Fig. 9).

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:		Semiconductors:	
R1 1kΩ	R16 10kΩ	Tr1 BC184L	Texas Instruments Ltd.
R2 56kΩ	R17 1kΩ	Tr2 2N3704	
R3 56kΩ	R18 10kΩ	Tr3 2N3704	
R4 22kΩ	R19 47Ω	Tr4 2N3704	
R5 10kΩ	R20 10kΩ	D1 IS2051A	
R6 22kΩ	R21 1kΩ	D2 IS2051A	
R7 56kΩ	R22 1kΩ	D3 IS2033	
R8 22kΩ	R23 1kΩ	D4 IS2033	
R9 10kΩ	R24 10kΩ	D5 IS2033	
R10 180kΩ	R25 47Ω	D6 IS921	
R11 47kΩ	R26 47Ω	D7 IS2100A	
R12 47kΩ	R27 220Ω	D8 IS2100A	
R13 4.7kΩ	R28 560Ω	D9 IS921	
R14 2.2kΩ	R29 220Ω	D10 T1005 Bridge rectifier	
R15 1kΩ	R30 12Ω ½W	CSR1 TIC44	
All 10% ½W unless otherwise specified		CSR2 TIC44	
Capacitors:		CSR3 TIC44	
C1 4700pF	Transformers:	CSR4 TIC226D	
C2 4700pF		T1 Pulse trans-	
C3 0.047µF		former, type	
C4 0.01µF		T2 PT-ATA ITT Ltd.	
C5 0.01µF		T3 Miniature mains	
C6 0.01µF		transformer 240V	
C7 0.22µF		primary 0-12V, 0-	
C8 250µF 25V		12V r.m.s. 6VA,	
C9 50µF 25V		type 12V R.S.	
C10 250µF 25V		Components	
Integrated Circuits:		Miscellaneous:	
IC1 SN72558P	} Texas Instruments Ltd.	VR1 10kΩ linear potentiometer	
IC2 SN72741P		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	

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AF139 pnp germanium UHF 33p
BCN 10: 13p; BC108 12p; BC109 13p; } npn
BC187 10p; BC168 9p; BC169 10p
BC177 15p; BC178 14p; BC179 15p; } pnp
BC257 9p; BC258 8p; BC259 9p
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BD135 npn med power 28p
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DIODES
OA90, OA91, OA95 each 8p
OA200 8p; OA202 10p
Other semiconductor
AC128 21p; AF117 24p
BFY61 20p

Full lists and technical data will be found in Catalogue No. 6.

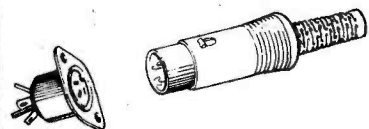
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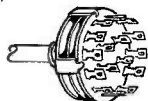
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409 DPDT toggle 28p. (These are chrome plated 2.5A rating)
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22			5p	5p	5p	6p		6p
47			5p	5p	5p	6p		6p
100	5p	5p	5p	5p	5p	6p	10p	15p
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1000	8p	10p	10p	14p	16p	19p		
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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% \pm 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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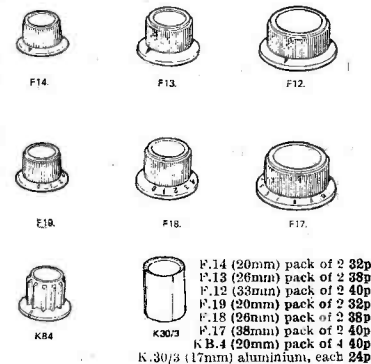
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E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
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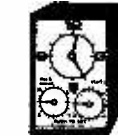
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3 poles	40p	40p	40p	40p	40p	40p	40p	40p	40p	40p
4 poles	40p	40p	40p	70p	70p	70p	70p	70p	70p	70p
5 poles	40p	40p	40p	70p	70p	85p	85p	85p	85p	85p
6 poles	40p	70p	70p	70p	70p	85p	85p	85p	85p	85p
7 poles	70p	70p	70p	85p	85p	1.20	1.20	1.20	1.20	1.20
8 poles	70p	70p	70p	85p	85p	1.20	1.20	1.20	1.20	1.20
9 poles	70p	70p	70p	85p	85p	1.45	1.45	1.45	1.45	1.45
10 poles	70p	70p	70p	85p	85p	1.45	1.45	1.45	1.45	1.45
11 poles	70p	70p	70p	85p	85p	1.20	1.20	1.20	1.20	1.20
12 poles	70p	70p	70p	85p	85p	1.20	1.20	1.20	1.20	1.20

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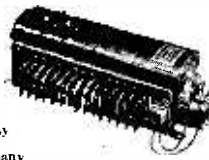
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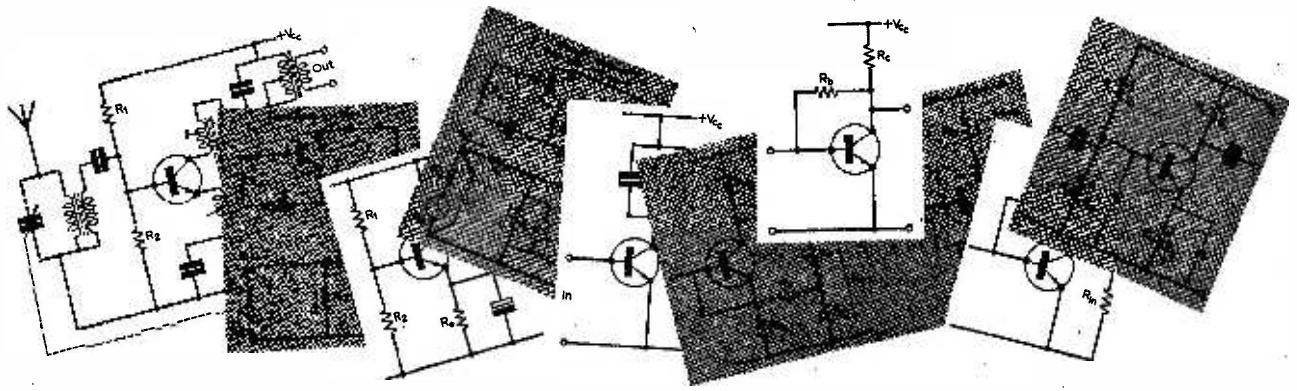
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TRANSISTOR CIRCUITRY for beginners

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 some 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

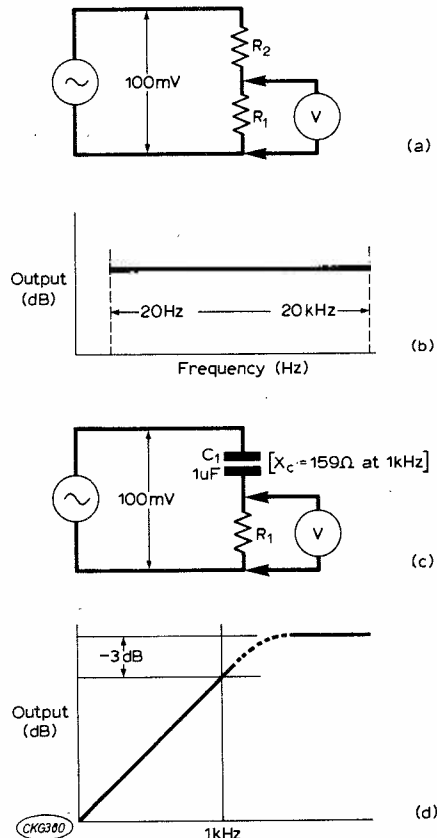


Fig. 74: (a) For a simple resistive network the output shown by the voltmeter is in proportion of the ratio of the resistors to the applied input voltage. In (b) theoretically, the output should not change with frequency, giving a "straight-line" graph. (c) Substituting a capacitor for R_2 makes the 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 $1\mu\text{F}$ capacitor at 1kHz, we get $\frac{10^6}{6.28 \times 1000 \times 1} = 159$ 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

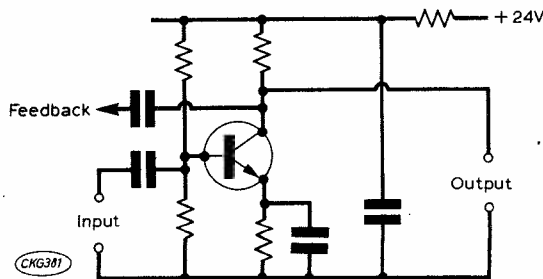


Fig. 75: A collector-follower amplifier arranged so that its output can be measured with and without feedback.

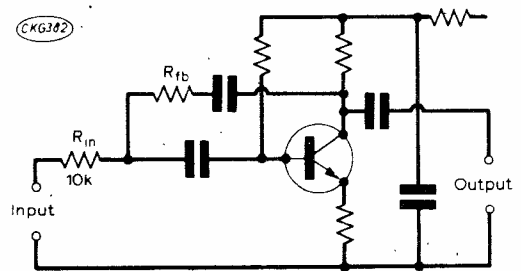


Fig. 76: The basic circuit used for tests.

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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30 amp.	...	\$2-15
60 amp.	...	\$2-15
5V. D.C.	...	\$2-15
10V. D.C.	...	\$2-15
20V. D.C.	...	\$2-15
50V. D.C.	...	\$2-15
150V. D.C.	...	\$2-15
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30V. A.C.*	...	\$2-20
50V. A.C.*	...	\$2-20
150V. A.C.*	...	\$2-20
300V. A.C.*	...	\$2-20
600mV. A.C.*	...	\$2-15
1 amp. A.C.*	...	\$2-15
5 amp. A.C.*	...	\$2-15
10 amp. A.C.*	...	\$2-15
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50 amp. A.C.*	...	\$2-15
100mA	...	\$2-15
500mA	...	\$2-15

25µA \$2-85
50µA \$2-80
50-0-50µA \$2-80
100µA \$2-80
100-0-100µA \$2-80
500µA \$2-45
500-0-500µA \$2-15
1mA \$2-15
1-0-1mA \$2-15
5mA \$2-15
10mA \$2-15
20mA \$2-15
50mA \$2-15
100mA \$2-15
500mA \$2-15

Type SD.830 82.5mm x 110mm Fronts

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50mA	...	\$2-50
100mA	...	\$2-50
500mA	...	\$2-50
1 amp.	...	\$2-50
5 amp.	...	\$2-50
10 amp.	...	\$2-50
5V. D.C.	...	\$2-50
10V. D.C.	...	\$2-50
20V. D.C.	...	\$2-50
50V. D.C.	...	\$2-50
300V. D.C.	...	\$2-50
300V. A.C.	...	\$2-50
VU Meter	...	\$2-75

Type MR.52P. 2 1/2 in. square fronts

50µA	...	\$3-40
50-0-50µA	...	\$2-85
100µA	...	\$2-85
100-0-100µA	...	\$2-75
500µA	...	\$2-55
1mA	...	\$2-20
5mA	...	\$2-20
10mA	...	\$2-20
50mA	...	\$2-20
100mA	...	\$2-20
500mA	...	\$2-20
1 amp.	...	\$2-20
5 amp.	...	\$2-20

10V. D.C. \$2-80
20V. D.C. \$2-80
50V. D.C. \$2-80
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S Meter 1mA \$2-80
VU Meter \$2-80
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5 amp. A.C.* \$2-20
10 amp. A.C.* \$2-20
20 amp. A.C.* \$2-20
30 amp. A.C.* \$2-20

Type MR.45P. 2 in. square fronts

50µA	...	\$2-60
50-0-50µA	...	\$2-80
100µA	...	\$2-80
100-0-100µA	...	\$2-85
200µA	...	\$2-05
500µA	...	\$1-95
500-0-500µA	...	\$1-85
1mA	...	\$1-85
5mA	...	\$1-85
10mA	...	\$1-85
20mA	...	\$1-85
50mA	...	\$1-85
100mA	...	\$1-85
150mA	...	\$1-85

5 amp. \$2-85
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20V. D.C. \$2-85
50V. D.C. \$2-85
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300V. A.C. \$2-00
S Meter 1mA \$2-05
VU Meter \$2-50
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5 amp. A.C.* \$1-85
10 amp. A.C.* \$1-85
20 amp. A.C.* \$1-85
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Type S-80 80 mm. square fronts

50µA	...	\$3-50
50-0-50µA	...	\$3-40
100µA	...	\$3-40
100-0-100µA	...	\$3-30
500µA	...	\$3-05
1mA	...	\$2-85
10V. D.C.	...	\$2-85
50V. D.C.	...	\$2-85
300V. D.C.	...	\$2-85
1 amp. D.C.	...	\$2-85

5 amp. D.C. \$2-85
300V. A.C. \$2-85
VU Meter \$2-70

Type SD.440 63.5mm x 85mm Fronts

50µA	...	\$2-60
50-0-50µA	...	\$2-55
100µA	...	\$2-55
100-0-100µA	...	\$2-55
200µA	...	\$2-55
500µA	...	\$2-35
50mA	...	\$2-35
1mA	...	\$2-35
5mA	...	\$2-35
10mA	...	\$2-35
50mA	...	\$2-35
100mA	...	\$2-35

500mA \$2-35
1 amp. \$2-35
5 amp. \$2-35
10 amp. \$2-35
5V. D.C. \$2-35
20V. D.C. \$2-35
50V. D.C. \$2-35
300V. D.C. \$2-35
15V. A.C. \$2-40
300V. A.C. \$2-40
VU Meter \$2-70

Type MR.65P. 3 1/4 in. x 3 1/4 in. fronts

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50-0-50µA	...	\$3-00
100µA	...	\$3-00
100-0-100µA	...	\$2-80
200µA	...	\$2-80
500µA	...	\$2-65
500-0-500µA	...	\$2-40
1mA	...	\$2-40
5mA	...	\$2-40
10mA	...	\$2-40
50mA	...	\$2-40
100mA	...	\$2-40
500mA	...	\$2-40
1 amp.	...	\$2-40
5 amp.	...	\$2-40
10 amp.	...	\$2-40
15 amp.	...	\$2-40
20 amp.	...	\$2-40
30 amp.	...	\$2-40
50 amp.	...	\$2-40
5V. D.C.	...	\$2-40

10V. D.C. \$2-40
20V. D.C. \$2-40
50V. D.C. \$2-40
150V. D.C. \$2-40
300V. D.C. \$2-40
15V. A.C. \$2-55
50V. A.C. \$2-55
150V. A.C. \$2-55
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200mA A.C.* \$2-40
500mA A.C.* \$2-40
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1A d.c.	...	\$4-85
5A d.c.	...	\$4-85
10V d.c.	...	\$4-85
20V. d.c.	...	\$4-85
50V. d.c.	...	\$4-85
300V. d.c.	...	\$4-85
Dual range	...	
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5V/50V d.c.	...	\$5-10

Type SD.460 46mm x 59.5mm Fronts

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50-0-50µA	...	\$2-35
100µA	...	\$2-35
100-0-100µA	...	\$2-35
200µA	...	\$2-35
500µA	...	\$2-20
1mA	...	\$2-15
5mA	...	\$2-15
10mA	...	\$2-15
50mA	...	\$2-15
100mA	...	\$2-15
500mA	...	\$2-15

1 amp. \$2-15
5 amp. \$2-15
10 amp. \$2-15
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10V. D.C. \$2-15
20V. D.C. \$2-15
50V. D.C. \$2-15
300V. D.C. \$2-15
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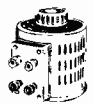


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Input 88 125 VAC or 176 250VAC. Output 120V AC. or 240 VAC. 280 VA rating. \$11-97. carr. 50p.



240° Wide Angle 1mA Meters

MW 1-6 60mm square	...	\$3-97
MW 1-8 80mm square	...	\$4-97

P. & P. extra

RP214 REGULATED POWER SUPPLY
Solid state. Variable output 0-24V DC up to 1 amp. Dual scale voltage and current

Input 220/240V AC	...	\$2-50
Size 185 x 85 x 105mm.	...	\$2-97

P. & P. 25p.

PS.200 REGULATED P.S.U.
Solid state. Variable output 5-20 volt D.C. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240 V A.C. Size 7 1/2" x 5 1/2" x 3 1/2". \$14-97. P. & P. 25p.

PS.1000B REGULATED POWER SUPPLY
Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240V AC. Size 4" x 2 1/4" x 6 1/2". \$11-97. P. & P. 25p.

230V/240V SMITHS SYNCHRONOUS GEARED MOTORS
Built in gearbox. All brand new and boxed. 30 RPH CW; 2 RPH CW; 20 RPH CW; 3 RPH ACW; 30 RPH CW.
50p each Post 12p.

LB4 TRANSISTOR TESTER
Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with all instructions, etc. \$4-60. P. & P. 20 p.

LB3 TRANSISTOR TESTER
Tests ICO and B, PNP / NPN. Operates from 9V battery. Complete with all instructions, etc. \$3-95. P. & P. 20p.

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 \$8-62, P. & P. 17p.

SEND SAE FOR LIST OF SEMI CONDUCTORS & VALVES

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

MULTIMETERS for EVERY purpose!



TS60 POCKET MULTIMETER
High-precision at low-cost. Ranges: D.C. 15V, 150V, 1,000V (10,000 op.v.), A.C. 15V, 150V, 100V (1,000 op.v.), D.C. Current 150mA. Resistance 100K ohms. \$1.85. Post 15p.

ROUND SCALE TYPE PENCIL TESTER MODEL T.S.68
Completely portable, simple to use pocket sized tester. Ranges: 0/3/30/300V AC and DC at 2,000 op.v. Resistance 0-20K ohms. ONLY \$1.97 P. & P. 13p.

LT601 MULTIMETER

New style 20,000 o.p.v. pocket multi-meter. 5/25/50/250/500/2500 V, D.C. 10/50/100/500/1000V. A.C. 50μA/250mA. 6K/6 meg ohms -20 to +22 db. \$3.75. Post 20p.

MODEL TH-12

20,000 o.p.v. Overload protection. Slide switch selector 0/25/2.5/10/50/250/1000V. D.C. 0/10/50/250/1000V. A.C. 0/50μA/25/250mA. D.C. 0/3K/30K/300K/3 meg -20 to +50dB \$4.97. Post 15p.

MODEL TE-300

20,000 O.P.V. Mirror scale overload protection 0/6/3/15/50/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30μA/3mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm -20 to +63 db. \$5.97. P. & P. 15p.

MODEL PL436

20K Ω/Volt D.C. 8k Ω/Volt AC. Mirror scale. -6/3/12/30/120/600 V D.C. 3/30/120/600 V A.C. 50/600μA/60/600 mA. 10/100K/1 Meg/10 Meg Ω -20 to +46db. \$5.97. P. & P. 12p.

TMK MODEL TW-50K

46 ranges, mirror scale, 50K/Vol. D.C. 5K/Volt A.C. D.C.: Volts -125, -25, 1.25, 2.6, 5, 10, 25, 50, 125, 250, 500, 1000V, A.C. Volts: 1.5, 3, 5, 10, 25, 50, 125, 250, 500, 1000V. D.C. Current: 25, 50μA, 2.5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: -20 to +81.5db \$8.50. P. & P. 17p.

MODEL K228A

Taut band suspension. Overload protection. Polarity reversing switch. 30,000 o.p.v. 0/5/2.5/15/50/250/500/1000/2500V. D.C. 0/15/50/150/500/1000V. A.C. 0/50μA/5/50/150/500mA/5 A. D.C. 0/3K/300K/3 meg. \$8.95. Post 20p.

HIKOKI MODEL 700X

100,000 O.P.V. Overload protection. Mirror scale. -3/6/12/30/120/600/1200V DC 15/60/120/300/600/1500/3000/600/1200 V. A.C. 15/30μA/3/6/30/60/150/300mA 6/12 AMP. DC. 2K/200K/2 Meg/20 Meg ohm -20 to +63db. \$13.50. P. & P. 20p.

MODEL C-7080 ENR

Giant 8" mirror scale. 20,000 o.p.v. 0/25/1/2.5/10/50/250/1000/5000V. D.C. 0/2.5/10/50/250/1000/5000V. A.C. 0/50μA/1/10/100/500mA/10 amp. D.C. 0/2K/200K/20 meg -20 to +50 db. \$13.95. Post 35p.

U4312 MULTIMETER

Extremely sturdy instrument for general electrical use. 300 o.p.v. 0/31/5/7/5/80/60/150/300/600/900 VDC and 75mV. 0/31/5/7/5/80/60/150/300/600/900 VAC. 0/300μA/1.5/6/15/60/150/600mA/1.5/6 AMP. D.C. 0/1/5/6/15/60/150/600mA/1.5/6 AMP. A.C. 0/200 Ω/3K/30K Ω. Accuracy DC 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. \$9.50 plus P. & P. 25p.

MODEL 1092 TESTMETER

8,000 O.P.V. 0/3/15/150/300/1200 V. D.C. 0/6/30/300/600 V. A.C. 0/300μA/300 MA 0/10K/1 meg Ω Decibels -10 to +16db \$2.75 each +15p P. & P.

HIKOKI MODEL 720X

20,000 O.P.V. Overload protection 5/25/100/500/1000 VDC. 10/50/250/1000 VAC. 50μA/250mA. 20K/2 meg ohm -5 to +83db. \$4.97. P. & P. 15p.

HIKOKI MODEL 730X

30,000 O.P.V. Overload protection. 6/30/60/300/600/1200 VDC. 12/60/120/600/1200 VAC. 80μA/30 mA/300 mA. 2K/200K/2 megohm -10 to +63db. \$6.50. P. & P. 15p.

MODEL TE-12

20,000 O.P.V. 0/0-6/6/30/120/600/1,200V. 0/0-6/6/30/120/600/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/60μA/6/60/600mA. 0/8K/600K/6MEG/60 MEG. Ω 50pF 0-2mFd. \$5.97. P. & P. 17p.

MODEL TE-200

20,000 O.P.V. Mirror scale overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50 μA/250 MA. 0/6K/600K/6 meg Ω -20 to +62db. \$3.95. P. & P. 15p.

MODEL 500

30,000 O.P.V. with overload protection mirror scale 0/5/2.5/10/25/100/250/500/1,000V. D.C. 0/2.5/10/25/100/250/500/1,000V. A.C. 0/50μA/5/50/500mA. 12 amp. D.C. 0/60K/6 Meg/60 Meg Ω \$8.97. Post paid.

HIKOKI MODEL 750X

50,000 o.p.v. 43 ranges 0-0.3 to 1,200V D.C. 0-3 to 1,200V A.C. 0-30μA/300mA. 0-3K/30 meg ohms. -10 to +17db. \$8.97. Post 20p.

HT10084 MULTI-METER

Features A.C. current ranges. 100,000 o.p.v. Mirror Scale. Overload protection. 0/5/2.5/10/50/250/500/1000 V D.C. 0/2.5/10/50/250/1000 V. A.C. 0/10/250μA/2.5/25/250 MA/10 Amp. D.C. 10 Amp A.C. 0/20K/200K/2 MEG/20 MEG. -20 to +62db. \$12.50. P. & P. 25p.

370 WTR MULTI-METER

Features A.C. current ranges. 20,000 o.p.v. 0/5/2.5/10/50/250/500 1000 V. D.C. 0/2.5/10/50/250/500/1000V A.C. 0/50μA/1/10/100mA/10 AMP D.C. 0/100mA/1/10 Amp AC 0/5K/50K/300K/6 MEG/50 MEG. -20 to +62db. \$15. P. & P. 25p.

RUSSIAN 22 RANGE MULTIMETER

Model U437. 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2.5/10/50/250/500/1000V. D.C. 2.5/10/50/250/500/1000V. A.C. DC Current 10mA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3m Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE \$5.97. P. & P. 25p.

Selected TEST EQUIPMENT

FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and I.C. NPN or PNP. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. \$7.50. Post 20p.



TE-16A TRANSISTORISED SIGNAL GENERATOR

5 ranges 400KHz-30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800KHz modulation. 5 1/2 x 5 1/2 x 3 1/2 in. Complete with instructions and leads. \$7.97. Post 25p.



Model S-100TR MULTIMETER TRANSISTOR TESTER

100,000 o.p.v. mirror scale/overload protection. 0/12/6/8/12/30/120/600 V DC. 0/8/30/120/600. V AC. 0/12/600μA/12/300mA/12 AMP DC. 0/10 K/1 MEG/100MEG. -20 to +50db. 0-0.1-2 MFD. Transistor tester measures Alpha, beta and Icc. Complete with batteries, instructions and leads. \$13.50. P/P 25p.



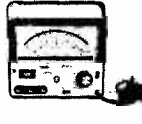
TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω 11/1 meg Ω. 6 Ranges ±1% L, μ H ±1% HENRY'S 6 Ranges 2-2% C. 0.10pF to 110mF. 6 Ranges ±2%. TURNS RATIO 1:1/1000-1:1/100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication. Attractive 2 tone metal case. Size 7 1/2 x 5 x 2 1/2 in. \$20. P. & P. 25p.



MODEL 449A IN CIRCUIT TRANSISTOR TESTER

Checks true A.C. beta in/out. Checks Icc. Checks diodes in / out. Checks SCR, etc. Beta. HI 10 - 500. LO 2 - 50. Icco 0-5000μA. 220/240 V A.C. operation \$17.50. Post 25p.



MODEL TE 15 GRID DIP METER

Transistorised. Operates as Grid Dip, Oscillator, Absorption Wave Meter and Oscillating Detector. Frequency range 40Kc/s-20Mc/s in 6 coils. 500μA Meter. 500μA battery operation. Size 180 x 80 x 40mm. \$12.50. Post 20p.



BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Sine 18 x 200,000 Hz. Square 18 x 50,000 Hz. Output max. +10 db. (10 K ohms) Operation internal batteries. Attractive 2-tone case 7 1/2 x 5 x 2 1/2. Price \$17.50. Carr. 17p.



TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s 500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions \$15. Carr. 37p. Size 140 x 215 x 170 mm.



MODEL L-55 FET V.O.M.

Input impedance 10 meg ohms. 0/3/12/6/30/120/600V. D.C. 0/3/15/30/120/600V. A.C. 0/15/30/120μA/120mA D.C. 0/1K/100K/10 meg Ω/100 meg ohms \$15.97. Post 15p.



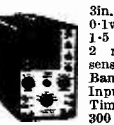
CI-5 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100KHz VRMS/μm. -1.25; HOR. AMP. Bandwidth 500KHz. Sensitivity at 100KHz, V RMS/mm. -3.25; Ereset triggered sweep 1-3,000μsec.; free running 20-200,000Hz in nine ranges. Calibrator dpps. 220 x 360 x 430mm. 115-230V. AC operation. \$39.00. Carr. paid.



TO-3 PORTABLE OSCILLOSCOPE

3in. tube, Y amp. Sensitivity 0.1v p-p/CM. Bandwidth 1-5 cps-1.6 MHz. Input Imp. 2 meg Ω 25pF X amp. sensitivity 0.9v. p-p/CM. Bandwidth 1.5cps-800KHz. Input Imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps 300 kHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 230 mm. Weight 15lb. 220/240V. A.C. Supplied brand new with handbook. \$40.00. Carr. 50p.



RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

5 mcs Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in. x 4in. C.R.T. Calibrated triggered sweep from 2 μsec. to 100 milli-sec. per cm. Free running time base 50 o/s-1 mcs. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual \$87. Carr. Paid.



MODEL AT201 DECADE ATTENUATOR

Frequency range 0-200KHz. Attenuator 0-111db. 0.1db step. Impedance 600 ohms. Max. input power 30dbm. Size 180 x 90 x 55mm. \$12.50. Post 37p.



TE-65 VALVE VOLTMETER

28 ranges. D.C. volts 1.5-1,500V. A.C. volts 1.5-1,500V. Resistance up to 1,000 megohms. 200/240V. A.C. operation. Complete with probe and instructions. \$17.50. P. & P. 30p. Additional probes available: R.F. \$2.12; H.V. \$2.50.



MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER

Sensitivity 330 ohms/Volt AC and DC. Accuracy 5% D.C. 1% A.C. Boale length 105mm. 0/300/750μA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5-AMP DC 0/1.5/3/7.5/15/30/75/150/300/750V DC 0/750mV/1.5/3/7.5/15/30/75/150/300/750V AC. Automatic cut out. Supplied complete with test leads, manual and test certificates. \$49.00. Post 50p.



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

UNR-30 RECEIVER

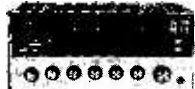
4 Bands covering 550Kc/s - 30Mc/s. B.F.O. Built-in Speaker 220/240v. A.C. Brand new with instructions. £15.75. Carr. 37p.



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. 12 3/4" x 4 3/4" x 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 3 1/2 x 2 1/8 x 1 3/8". Complete with instructions and circuit. £32.50. 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, Bandsread, RF Gain. 15" x 9 1/2" x 8 1/2". 18 lbs. 220/240v. A.C. or 12v. D.C. Bra. d. new with instructions. £50. Carr. 50p.

TRIO 9R59DS COMMUNICATION RECEIVER

4 band covering 550Kc/s. to 30 Mc/s. continuous and electrical bandsread 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. bandsread dial. IF frequency 455 Kc/s. audio output 1-bw. Variable RF and AF gain controls 115/230v. A.C. Size: 7" x 13" x 10" with instruction manual. £49.50. Carr. Paid.

EMI LOUSPEAKERS

Model 350. 13" x 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" x 8" with twin tweeter/crossover. 55-13,000 Hz. 8 watt RMS. Available 8 or 15 ohms. £8.82 each. P. & P. 25p.

HONEYWELL DIGITAL VOLT METER VT.100

Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt. current and ohms with 5 optional plug in cards. Specifications: Accuracy: ± 0.2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1.999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5 1/2 in. x 2 1/8 in. x 8 3/16 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. £25.50. Carr. 30p.



SINCLAIR IC-12

List Price £2.98
OUR PRICE £1.80
P. & P. 10p

SINCLAIR EQUIPMENT

Project 60 Package offers:
2 x Z30 amplifier, stereo 60 pre-amp. PZ5 power supply. £15.95 Carr. 37p. Or with PZ6 power supply £18.00 Carr. 37p. 2 x 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 £18.00 for pair of Q16 speakers. All other Sinclair products in stock.
2000 Amp £21.95 Carr. 37p.; 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, phone, guitar, etc. and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7 1/2 x 3 x 4 1/2 in. £5.97. P. & P. 15p.

SPECIAL OFFER! STEREO SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size 14 1/2" x 9" x 7 1/2". 8 ohms. 8 watt RMS. 16 watt peak. Complete with DIN lead. £12.95 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 13 Hz to 220 KHz. AF square wave 13 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

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| 1721 Tape Rec. | £75.95 | GXC40 Cassette Rec. | £82.95 |
| X5000 Tape Rec. | £99.95 | GXC40D Cassette Rec. | £87.95 |
| GX370 Tape Deck | £259.95 | GXC40T Cassette/Receiver | £123.95 |
| 4000DS Tape Deck | £73.95 | GXC45D Cassette Deck | £89.95 |
| 4000DS Dust Cover | £4.75 | GXC46D Cassette Deck | £108.50 |
| X200 Tape Deck | £99.95 | GXC46 Cassette Receiver | £115.95 |
| X201D Tape Deck | £132.85 | GXC60D Cassette Deck | £111.25 |
| X221D Tape Deck | £109.95 | GXC65D Cassette Deck | £110.25 |
| GX220D Tape Deck | £148.50 | CR85D Cassette Deck | £59.50 |
| GX280D Tape Deck | £249.40 | AA6300 Receiver | £79.95 |
| X1810D Tape/8 track Deck | £189.95 | AA830 Receiver | £106.95 |
| GX1900D Tape/Cas/8 Track Rec. | £177.95 | AA880 Receiver | £144.85 |
| CR81 8 track Rec. | £223.30 | AA850 Receiver | £175.00 |
| CR81T 8 track/Receiver | £95.95 | ADM11 Microphones (Pair) | £7.50 |
| CR80DS 8-track | £118.90 | | |
| CR80SS 8-track | £121.95 | | |
| CR80SS 8 track system | £145.00 | | |
- Carriage 50p extra. (Recorders & Decks 75p)

DOLBY SYSTEM NOISE REDUCTION UNIT

Improves the performance of cassette and semi-professional recorders. Reduces tape hiss 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 15 1/2" x 9" x 3 1/2". 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" x 4" x 2 1/2". £2.25. P. & P. 15p.

MP7 MIXER PREAMPLIFIER

5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9 1/2" x 5" x 3". Inputs Mics: 3 x 3mV 50K; 2 x 3mV 500 ohm. Phono neg. 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 £29.50
AP76 Module/M75-6 £33.80
AP96 Module/M75-6 £38.75
Zero 100S Module/M93F £58.80
Carr. 50p extra any item.

HOSIDEN DH-085 DE-LUXE STEREO HEADPHONES

Features unique mechanical 2 way units and fitted adjustable lever, 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 4-8 ohms. Brand new, Boxed & fully guaranteed (List £9.50). OUR PRICE £6.50. P. & P. 25p.

HOSIDEN DH-025 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.
C90 3 for 75p. 10 for £2.35
C90 3 for £1.05 10 for £3.30
C120 3 for £1.35 10 for £4.20
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 x 4 x 2 1/2 in. 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. £6.37. P. & P. 12p. Stereo multiplex adaptors £4.87.

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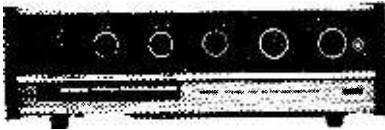
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NIKKO TRM50 17 + 17 watt rms stereo amplifier, BSR MP60, plinth & cover. Goldring G800 cartridge, pair of Linton 2 speakers and all leads.

OUR PRICE **£104.90**

Carr. and Ins. £1.50

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Leak Delta 30 stereo amplifier, Goldring GL75, plinth, cover and G800 cartridge. Pair of Leak 150 speakers and all leads.

OUR PRICE **£123.50**

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Teleton SAQ206B 8 + 8 watt Amplifier, BSR MP60, plinth & cover, Goldring G800 cartridge, pair of Apollo speakers and all leads.

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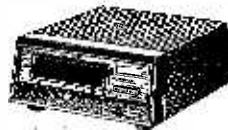
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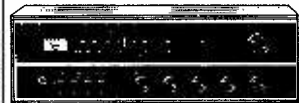


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7413	29p	7475	47p	74110	1.25p	7413	1.25p	74110	1.25p	7413	1.25p
7420	15p	7476	43p	74111	1.00p	7420	95p	74111	1.00p	7420	95p
7430	15p	7480	67p	74118	1.00p	7430	95p	74118	1.00p	7430	95p
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330µF	6p	150µF	7p	220µF	10p
1000µF	12p	220µF	8p	470µF	17p
4700µF	26p	680µF	15p	680µF	23p
		1000µF	15p	1000µF	23p
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		2000µF	39p		

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33µF	6p	10µF	6p
68µF	6p	22µF	6p
150µF	6p	47µF	7p
470µF	10p	100µF	7p
680µF	12p	150µF	9p
1500µF	16p	220µF	7p
2200µF	16p	470µF	12p
3300µF	24p	680µF	18p
		1000µF	20p
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10 VOLT		40 VOLT	
22µF	6p	6.8µF	6p
47µF	6p	15µF	6p
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709c	TO99	28p	741c	8 Pin DIL	34p
709c	DIL	31p	747c	DIL	42p
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AC142K	20p	BC145	24p	BFX84	25p	OC72	13p
AC141K	18p	BC147	8p	BFX85	25p	OC81	13p
AC176	14p	BC148	8p	BFX86	25p	OC83	20p
AC187	12p	BC149	8p	BFX87	25p	OC84	25p
AC187K	18p	BC163	15p	BFX88	24p	TIP29A	48p
AC188K	18p	BC154	10p	BFY50	19p	TIP30A	58p
AC188K	18p	BC157	12p	BFY51	15p	TIP31A	58p
AC171	21p	BC158	11p	BFY52	15p	TIP32A	65p
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AC222	16p	BC177	14p	C426	30p	18121	14p
AC239	22p	BC179	14p	C428	25p	18130	8p
AD140	35p	BC182L	8p	C450	15p	18131	10p
AD142	40p	BC183L	8p	MP8111	32p	18132	10p
AD143	35p	BC184L	8p	MP8112	42p	18132	10p
AD149	55p	BC186	30p	MP8113	32p	18132	10p
AD150	55p	BC212L	10p	MP8121	30p	18132	10p
AD161	27p	BC213L	10p	MP8122	40p	18132	10p
AD162	27p	BC214L	10p	MP8123	45p	18132	10p
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AF115	14p	BC267	12p	NKT214	25p	BA144	24p
AF116	14p	BC268	18p	NKT217	50p	BA145	20p
AF117	14p	BC300	36p	NKT261	21p	BA154	12p
AF119	22p	BC301	29p	NKT271	15p	BA154	12p
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AF139	36p	BC303	45p	NKT275	23p	BA154	12p
AF239	37p	BC304	35p	NKT403	85p	BY100	17p
AL100	68p	BCY70	15p	NKT405	79p	BY126	30p
AL102	40p	BCY71	33p	NKY603S		BY127	17p
AS120	27p	BD123	60p	NKT613C	50p	BYX10	22p
AS27	25p	BD130	45p			OA5	17p
AU103	50p	BD131	62p	NKT674	24p	OA9	10p
AU110	57p	BD132	81p	NKT677G		OA10	22p
AU111	67p	BD135	38p			OA47	8p
BC107	8p	BD136	44p	NKT713	55p	OA70	7p
BC108	8p	BD141	£1.70	NKT773	25p	OA73	10p
BC115	14p	BF159	30p	OC20	50p	OA79	7p
BC116	15p	BF173	26p	OC23	30p	OA81	8p
BC125	15p	BF177	25p	OC25	25p	OA85	10p
BC126	25p	BF178	26p	OC28	30p	OA90	7p
BC132	14p	BF179	32p	OC29	30p	OA91	7p
BC134	14p	BF194	14p	OC35	25p	OA95	7p
BC136	14p	BF195	15p	OC36	25p	OA96	7p
BC137	14p	BF244	25p	OC41	18p	OA200	10p

MULLARD POLYESTER'S

MULLARD POLYESTER CAPACITORS C280 SERIES
250V P.C. mounting: 0.01µF, 0.015µF, 0.02µF, 8p, 0.03µF, 0.047µF, 0.068µF, 31p, 0.1µF, 4p, 0.15µF, 0.22µF, 5p, 0.33µF, 6p, 0.47µF, 8p, 0.68µF, 11p, 1.0µF, 13p, 1.5µF, 20p, 2.2µF, 24p

MULLARD POLYESTER CAPACITORS C296 SERIES
400V: 0.001µF, 0.0015µF, 0.0022µF, 0.0033µF, 0.0047µF, 21p, 0.068µF, 701pF, 0.015µF, 0.022µF, 0.033µF, 5p, 0.047µF, 0.068µF, 0.1µF, 4p, 0.15µF, 6p, 0.22µF, 7p, 0.33µF, 11p, 0.47µF, 13p, 0.68µF, 15p, 1.0µF, 13p, 1.5µF, 20p, 2.2µF, 24p

VOLUME CONTROLS

Potentiometers
Carbon track 500 Ω to 2-2M Ω
Log or Linear
Single 12p. Dual gang (stereo) 40p
Single type with D.P. switch 12p extra.

SLIDE POTENTIOMETERS

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

CARBON SKELETON PRESETS

Small high quality type (linear only).
All valves 100-5 meg ohms.
-1 watt 5p each
-2.5 watt 8p each

VEROBOARD

	0-15 Matrix	0-1 Matrix
24in x 34in	27p	23p
24in x 5in	25p	25p
34in x 34in	25p	25p
34in x 5in	30p	29p
5in x 17in (plain)	8p	

Vero cutter, 45p; Pin insertion Tools (0-1 and 0-15 matrix) at 55p.

SLIDE SWITCH

SPST 10p each. D.P.D.T. 12p each.

MINIATURE NEON LAMPS

240V or 110V 1-4 5p, 5 plus 41p each.

MINITRON DIGITAL INDICATOR TYPE 3015F

Reads 0-9 and decimals (Data Sheet on request)
ONLY £1.50
16 DIL Socket 80p
Driven by 7447 96p

RECTIFIERS

P.I.V.	1 AMP	1.5 AMP
50	IN4001 4p	PL4001 7p
100	IN4002 4p	PL4002 8p
200	IN4003 5p	PL4003 9p
400	IN4004 6p	PL4004 9p
600	IN4005 7p	PL4005 12p
800	IN4006 8p	PL4006 12p
1000	IN4007 9p	PL4007 18p

BRIDGE RECTIFIERS

P.I.V.	1 AMP	2 AMP	5 AMP	10 AMP
50	30p	48p	£1.60p	£2.00p
100	32p	52p		
200	34p	55p	£1.80p	£2.10p
400	38p	62p	£1.95p	£2.20p
800	45p	68p	£2.20p	£2.50p

THYRISTORS

PIV	50	100	200	300	400
1 Amp	25	23	37	40	47
3 Amps	40	45	55	—	60
7 Amps	—	87	92	—	1-12

RESISTORS

½ watt 5% carbon 1p each
½ watt 10% carbon 1p each
1 watt 10% carbon 2½p each
Range 10 ohms to 4.7 meg.
½ watt m/o 2% 8p each
Range 10-1 meg ohms

FULLY MARKED TYPES

AD161, AD162	M/P	
1-9	M/P	54p
10 plus		45p
BC107-BC108	BC109	
1-9		8p
10-99		7p
100 plus		6p
BC 182L:3-4-212-4		
1-9		8p
10 plus		7p

ZENER DIODES

AC127 or AC128		
1-9		12p
10 plus		11p
100 plus		9p
400 M/W 5% Miniature BZX 88 Range		
All voltages 3-3-33 Volt		8p each
1 watt 5%		

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

FANTASTIC BARGAIN. New 6 inch tubes. E450 4/B/16 4VH, medium Persistence, green. Ideal scope tube.

Also 09J 4 1/2 in. dia. Length 15in, Also 7BP7. All unused as new. Price £1.40 post paid.

NEW HEAVY COAX CABLE dia. 3/8" 70 ohms approx. 50ft. lengths £1.40, p. & p. 30p. 100 ft. lengths £2.70, p. & p. 50p.

AERIALS. New Condition Whip Type, 4ft. 20p; 11ft. 75p. all collapsible type. P. & p. 4ft. 10p, 11ft. 15p. New bases on adjustable clamp for the above, 62 1/2p. p. & p. 25p.

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

OUR SELECTION OF 6-Ex. Equ. METERS consisting of 3in., 2 1/2in., 2in. mill amps; volts, amps. Mixed at the bargain price of £2 P. & P. 25p. minimum order of six.

ANY HEIGHT AERIAL TUBULAR SECTIONS 3/4" dia. x 3ft. long. Brass screw in ends, copper coated and painted. Good condition. 20p p. & p. 5p each. Minimum order 6.

AS NEW AERIAL TUNER UNIT No. 6 RF, consisting of 1 1/2 inch 500 micro/ampmeter 3 gang tuner 75 PF geared BNC type socket size 5 1/2" x 4 1/2" x 5". Price £1.50, p. & p. 25p.

HEADPHONES DI. High impedance. Good condition 75p. p. & p. 15p. R209. Set of valves 62 1/2p. p. 25p.

NEW AERIAL WIRE ON BOARDS 7/22 UNCOVERED 75ft. 40p. 90ft 47 1/2p. 100ft. 55p. p. & p. 20p.

AERIAL MAST POLES approx. 5ft high 2" dia. Interlocking ends. Minimum order three. New condition. £1 each section. Carriage 35p each section. 1/4" 75 ohms Coax in 50ft coils with BNC plugs good condition. Price £1 + 30p p.p.

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

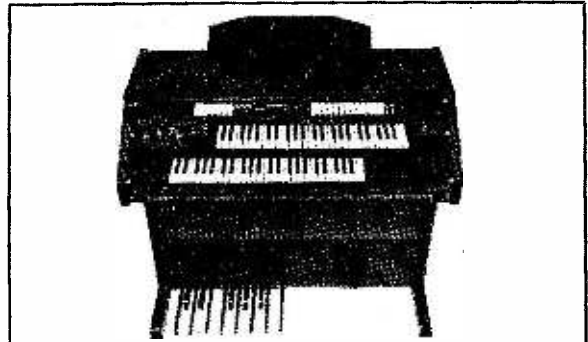
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★ Portable—4 octave keyboard with 10 voices, 3 pitches—vibrato, £145.29. ★ Console—5 octave keyboard with 10 voices, 3 pitches. Keyboard can be split into solo and accompaniment. Vibrato, built in amplifier and speaker £250.93. ★ Console—2 x 4 octave keyboards and 13 note pedal board, 29 voices, Vibrato, Delay Vibrato, Sustain, Reverberation, Precussion, Wah Wah, £406.00. ★ Console—2 x 5 octave keyboards and 32 note pedal board, 32 voices. Vibrato, Delay Vibrato, Sustain Reverberation, Precussion, 3 Couplers, etc., at £572.55.

ALL COMPONENTS CAN BE BOUGHT SEPARATELY. SEND 50p FOR LATEST CATALOGUE, WHICH INCLUDES SPECIALIZED COMPONENTS, HI-FI EQUIPMENT AND ELECTRICAL HOUSE-HOLD APPLIANCES.

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NEW! TESTED! GUARANTEED!

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Set of 4 for £1.12. DAF96, DF96, DK96, DL96, 4 for £1.55.

1R5	28	30C17	76	EAF42	50	EM80	38	PCF808	68	UB01	75
1S5	22	30C18	79	EB91	12	EM81	38	PCJ82	30	UABC90	31
1T4	18	30F5	64	EBC33	40	EM84	32	PCL83	55	UAF42	60
3B4	38	30FL1	65	EBC41	49	EM87	50	PCL84	33	UBC41	45
3V4	47	30FL12	69	EBC81	30	EY61	38	PCL85	38	UBF80	34
5U4G	31	30FL14	68	EB090	32	EY86	39	PCL86	37	UBF89	32
5V4G	35	30L1	59	EBF80	32	EY87	39	PCL88	30	UCC84	33
5Y3GT	30	30L15	70	EBF83	39	EZ40	39	PCL800	39	UCC85	35
5Z4C	35	30L17	70	EBF89	39	EZ41	39	PCL805	38	UCF80	30
6B0L2	54	30P4	65	ECC81	17	EZ80	31	PENA4	77	UCF82	38
6AM6	13	30P12	69	ECC82	20	EZ81	32	PEN36C	70	UCB1	30
6AQ5	22	30P19	65	ECC83	35	EZ90	25	PFL200	51	UCL82	30
6AT6	20	30P1	60	ECC85	34	GZ30	34	PL36	48	UDL83	35
6AU6	20	30P13	59	ECC804	54	GZ32	40	PL81	43	UP41	30
6LA6	29	30P14	59	ECC80	50	KT41	77	PL81A	47	UPF89	30
6BE6	31	3SL6GT	45	ECP82	36	KT61	55	PL82	31	UL41	33
6B7E	41	35W4	25	ECS35	55	KT66	78	PL83	38	UL84	30
6BW7	50	36Z4GT	25	ECH42	59	LN319	63	PL84	30	UM84	22
6P14	35	50CD6G	68	ECH81	29	LN329	60	PL600	63	UY41	30
6P23	68	807	49	ECH83	38	LN339	65	PL604	63	UY85	25
6P25	50	AC/VP2	77	ECH84	35	N78	21-05	PM84	30	VP4B	77
6V6GT	29	B949	70	ECL80	30	P81	40	PX25	95	W77	43
6V7G	24	B729	54	ECL82	29	PABC80	31	PY32	52	Z77	23
6K7G	12	CCH35	67	ECL86	35	PC86	47	PY33	53	Transistors	
6K8G	38	CY31	28	EF39	38	PC88	47	PY81	25	ACI97	17
6Q7G	35	DAF91	22	EF41	57	PC96	42	PY82	25	ACI97	15
6SL7GT	32	DAF96	38	EF60	53	PC97	38	PY83	28	AD140	37
6SN7GT	32	DF96	36	EF86	30	PC900	29	PY88	38	AF115	20
6V6GT	28	DF96	36	EF86	30	PC884	29	PY800	31	AF116	20
6V6GT	28	DH77	20	EF89	28	PC985	23	PY801	31	AF117	20
6X4	23	DK32	33	EF91	13	PC988	38	R19	30	AF126	17
6X5GT	28	DK91	28	EF92	27	PC989	43	R20	70	AF127	15
10P18	58	DK92	50	EF98	65	PCO189	48	U25	73	OC26	25
12A7	17	DK96	45	EF183	27	PC905	70	U26	65	OC44	12
32A17	26	DL25	40	EF184	29	PCF80	28	U47	78	OC45	12
12AX7	22	DL92	26	EH90	36	PCF82	33	U49	70	OC71	12
19B6G	75	DL94	47	EL33	55	PCF86	46	U52	31	OC72	12
20F2	67	DL96	38	EL34	48	PCF800	58	U78	24	OC76	12
20P3	75	DY86	24	EL41	54	PCF801	28	U191	63	OC81	12
25L6GT	19	DY87	24	EL64	23	PCF802	39	U251	61	OC82	12
28U4GT	37	DY802	33	EL65	33	PCF805	78	U201	38	OC82D	12
30C1	26	DY802	33	EL65	33	PCF806	56	U329	66	OC170	23
30C15	58	EABC80	32	EL500	42	PCF806	56	U329	66	OC170	23

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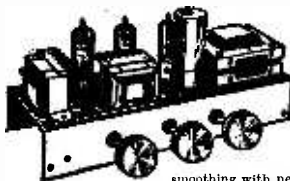
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SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 3 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohm. Frequency response 12Hz-30KHz \pm 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 8" high x 6" wide x 7 1/2" 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 a quiet

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

POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v, and 7.5v, and 9v, and 12v, at 1 amp continuous (1amp intermittent). Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" x 3 1/2" x 2 1/2". Suitable for Transistor Radios, Tape Recorders, Amplifiers etc. Ready **PRICE £4.50 P. & P. 35p.** built and tested.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TOS, complete with mica's and bushes. Size 2 1/2" x 8" approx. 25p pair. P. & P. 5p.

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BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-15-20-25-30-35-40-50v, half wave at 1 amp, or 10-10-10, 20-0-20, 30-0-30, at 2 amps full wave. Size 3in. long x 3 1/2in. wide x 3in. deep. Price £1.95 P. & P. 30p.

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SPECIAL OFFER MAINS TRANSFORMER 200/240v. A.C. Input 35v at 1 1/2 amp A.C. output overall size 2 1/2" x 2 1/2" x 3" approx. Suitable drop through or vertical mounting 90p. P. & P. 30p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100uA. For balance or tuning. Approx. size 1" x 1" x 1" 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 1 1/2" x 1 1/2" x 1". Brand new complete with instructions. Price 88p. P. & P. 13p.

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LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER.
With latest mono compatible cartridge £26.97 Carr. 50p.
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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, ECL86, EL84, 6X4, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide x 3in. deep x 6in. high. Ready built and tested. **PRICE £3.95 P. & P. 40p**
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Beautifully made teak finish enclosure with most attractive Tygan-Vnair front. Size 16 1/2" high x 10 1/2" wide x 5 1/2" deep. Fitted with E.M.I. Ceramic Magnet 12" 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

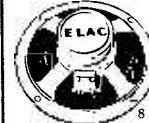
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5in. 3 ohm £1.05, P. & P. 15p. 7 x 4in. 8 ohm £1.15, P. & P. 20p. 10 x 6in. 3 or 15 ohm £1.90, P. & P. 30p. E.M.I. 8 x 5in. 3 ohm with high flux magnet £1.82, P. & P. 20p. E.M.I. 13 1/2" x 8in. with high flux ceramic magnet with parasitic tweeter 3, 8 or 15 ohm £2.20, P. & P. 30p. E.M.I. 13 x 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. 35p



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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 (ONE LOUDSPEAKER. 10 watts peak handling, 3, 8 or 15 ohm £2.20, P. & P. 30p. 85 ohm SPEAKERS 3in. only 65p P. & P. 13p.

"POLY PLANAR" WATER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11 1/2" x 14 1/2" x 1 1/2" 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.

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Adjustable headband with comfortable flexit foam ear-muffs. Wired and fitted with standard stereo 3 1/2in 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



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Sinclair Project 60

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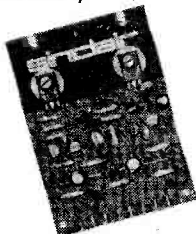
with built-in automatic transient overload protection

When originally introduced, the Sinclair Z.50 proved how 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 symmetrical 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.



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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 ($3\frac{1}{8}$ x $2\frac{1}{2}$ x $\frac{1}{2}$). Z.30, Z.50 and Z.50 MK.2 modules are compatible and interchangeable.

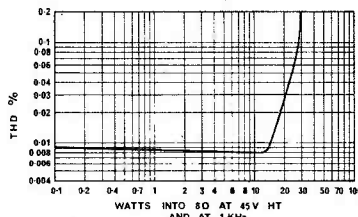
Guarantee

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.

Brilliant new technical specifications

Input impedance 100 K Ω
Input (for 30W into 8 Ω) 400mV
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better
Distortion 0.02% up to 20W at 8 Ω . See curve
Frequency response 10Hz to more than 200 KHz ± 1 dB
Max. supply voltage 45v (4 Ω to 8 Ω speakers) (50v 15 Ω speakers only)
Min. supply voltage 9v
Load impedance — minimum: 4 Ω 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 deluxe 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.

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SPECIFICATIONS—Input sensitivities: Radio – up to 3mV. Mag. p.u. 3mV; correct to R.I.A.A. curve ± 1 dB: 20 to 25,000 Hz. Ceramic p.u. – 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

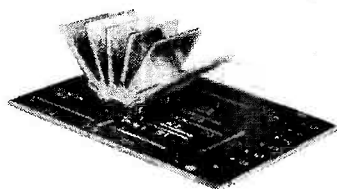


The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other advanced features include varicap diode tuning, printed circuit coils, an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

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108MHz. **Sensitivity:** 7 μ V for lock-in over full deviation. **Squelch level:** Typically 20 μ V. **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10Hz – 15KHz (± 1 dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2 μ V. **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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Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC, make possible. It is the equivalent of a 22 trans-

istor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8 Ω . **Frequency Response:** 5Hz to 100KHz ± 1 dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0.1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 x 45 x 28mm including pins and heat sink.

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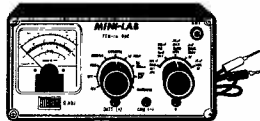
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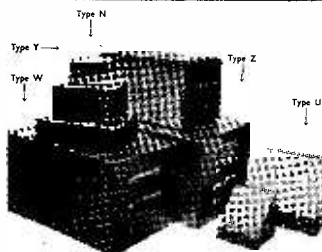
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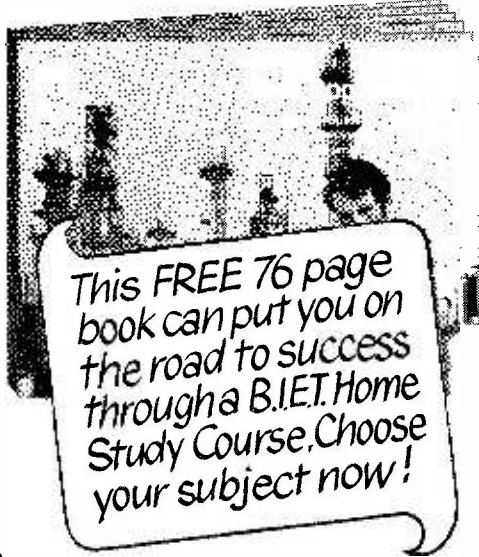
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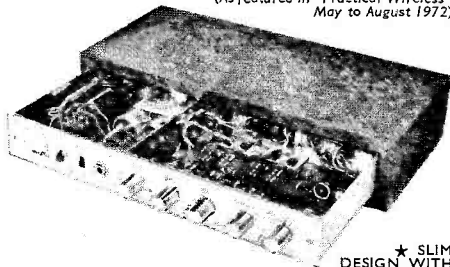
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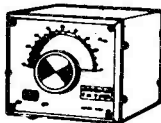
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