

PRACTICAL WIRELESS

MARCH
1974

25p

FREE INSIDE



CASSETTE RECORDER AND TUNER AMPLIFIER



also: I.C. WAVEFORM GENERATOR
CRYSTAL HARMONIC CALIBRATOR

Write the Specification of your perfect iron

and compare it with an Antex

low leakage and Precision for delicate equipment Interchangeable Bit Iron-coated large 25watts?



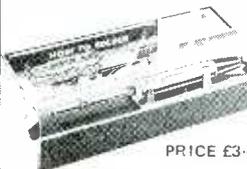
MODEL X25 Soldering Iron 220-240 or 100-120 Volts. The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered live". Tested at 1500v. A.C. This 25 watt iron with its truly remarkable heat capacity will easily "out-welder" any conventionally made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron coated bit 1/8". 2 other bits available 3/32" and 3/16". Totally enclosed element, ceramic and steel shaft. Bits do not "freeze" and can easily be removed. **PRICE £2-05** (rec. retail) P & P 10p. Suitable for production work and as a general purpose iron.



MODEL G 18 watt miniature iron, fitted with long life iron-coated bit 3/32". Voltage 240, 220 or 110. **PRICE £2-26** (rec. retail) P & P 10p.



MODEL SK.2 KIT
Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder, and "How to Solder" booklet. **PRICE £3-25** (rec. retail) P & P 10p.



MODEL SK.1 KIT
Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet. **PRICE £3-48** (rec. retail) P & P 12p.

MODEL C Miniature 15 watt soldering iron fitted 3/32" iron coated bit. Many other bits available from 3/64", to 3/16". Voltages 240, 220, 110, 50 or 24. **PRICE £2-05** (rec. retail) P & P 10p.



MODEL MLX KIT
Battery operated 12v. 25 watt iron fitted with 15" lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet and with booklet "How to Solder". **PRICE £2-54** (rec. retail) P & P 12p.



ST3 Stand - This stand is made from high grade insulation material with a chromium plated strong steel spring. It is suitable for all models and replaces all previous stands. The two sponges at the side which are easily replaceable, serve to keep the soldering bits clean. Spare bits can be accommodated as shown on the illustration. **PRICE: £1-00** (rec. retail) P & P 10p.



ALL PRICES include VAT at 10%



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PRACTICAL WIRELESS

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BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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Price increase

LIKE many other magazines and paper products "Practical Wireless" has become victim of a world paper shortage resulting in massive increases in the cost of raw materials. In order to maintain the high standard of providing technical information and projects to our readers, we regret that we have been compelled to increase the cover price to 25p.

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We regret that we cannot answer technical queries by telephone nor can we provide information or advice on manufacturers' products other than that given in the magazine. We will endeavour to assist readers who have queries relating to articles published but we cannot offer advice on modifications to our published designs. All correspondents expecting a reply should enclose a stamped addressed envelope.

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RSC

DISCO SYSTEM

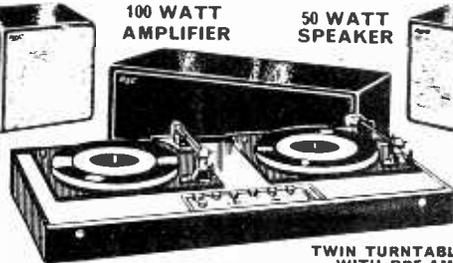
50 WATT SPEAKER

100 WATT AMPLIFIER

50 WATT SPEAKER



HEADPHONES MICROPHONE



TWIN TURNTABLE WITH PRE-AMP

Units listed below

- (a) 100w POWER AMPLIFIER
- (b) PAIR OF HI-FI HEAD- PHONES
- (c) MATCHING DYNAMIC 'MIKE' (attached to h'phone)
- (d) PAIR 50 WATT SPEAKERS Black Rexine covered Cabinets Size approx. 18" x 18" x 8"
- (e) RSC TDI DISCO CONSOLE

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Aco Cartridges with diamond stylis. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or Dep. £23-50 and 12 mthly pymts £24-54 (Total £77-98) Carr. £1-50

(a) (b) (c) (d) £149-95
Carr. £3-00

Terms Deposit £50 and 18 monthly payments of £7-06 (Total £177-08).

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 C132 30-40 WATTS Fitted two exceptionally efficient, low feedback bowl characteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £23-95 and 8 m'thly payments £26-67 (Total £285-31) Carr. 65p. **£21-95**

TYPE C313 50 WATTS Low feedback characteristic. Fitted three 13" x 8" deep cone high flux speakers with high power voice coils. Size approx. 54" x 14" x 11". Dep. £4-72 & 8 mthly pymts **£32-72** £4-15 (£37-92) Carr. 85p

TYPE C4100 100 WATTS Inc. four 12" 60 watt speakers for conservative rating. Extra heavy construction. Size approx. 68 x 16 x 10" Acoustically tiled and pressurised. Terms: Dep. £22-00 & 12 mthly. pyts. £24-29 (Total £78-48). Carr. £1-50 **£66-00**

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 8/15Ω	15" 60 Watt 14,000 gauss 8/15Ω	12" 50 Watt 13,000 gauss 15Ω
£27-50	£15-75	£12-75
Dep: £2-32 and 8 mthly payments £2-32 (Total £29-88)	Dep: £1-92 and 8 mthly payments £1-92 (Total £17-28)	Dep: £1-61 and 8 mthly payments £1-61 (Total £14-49)

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

POP 40 10" 40W Gauss 16,000 Imp 8/15	£10-95	POP 55 12" 60W Gauss 15,000 Imp 8/15	£15-95
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ALL RSC PRICES INCLUDE VAT FANE CRESCENDO SPEAKERS

MINSTREL 8W GUITAR AMP. Incorporating Tremolo and 13" x 8" or 10" Speaker. Output 8 watts R.M.S. Continuous. 3 Jack Inputs for Microphone and Instrument. Mains Neon Controls: Volume, Tone, Tremolo Speed Tremolo Intensity. Terms: Deposit £3-95 and 8 monthly payments £2-39 (Total £23-07). Carr. free **£19-95**

Full range available at ALL BRANCHES

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

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

GROUP EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER	£39-98	PACKAGE PRICE	
PB. FANE POP 25/2 5W L/SPEAKERS	£17-50		
Terms: Deposit £17-82 and 12 monthly payments of £3-38 (Total £267-88)	£57-43	£51-95	carr. £1-10
F.A.L. PHASE 60 MK.III AMPLIFIER	£39-98	PACKAGE PRICE	
PB. FANE POP 50 L/SPEAKERS	£28-98		
Terms: Deposit £19-19 and 12 monthly payments of £4-00 (Total £267-89)	£68-91	£59-99	carr. £1-10
F.A.L. PHASE 50 AMPLIFIER	£39-98	PACKAGE PRICE	
PAIR L12/20 SPEKS (in Cabinets)	£26-30		
Terms: Deposit £20-00 and 12 monthly payments £2-90 (Total £68-80)	£66-23	£59-99	carr. £2-00

FAL PHASE 50 Mk.III AMPLIFIER 50 WATT.

Solid state. 4 Separately controlled Inputs Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker 15 to 30 ohms. Size 17" x 7" x 7 1/2". 200-250V. A.C. mains. Output 50 watts music rating. Or deposit £23-95 and 8 monthly payments £4-81. Total £44-41. **£39-93**

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 £20-00 and 12 monthly payments £2-90 (Total £68-80). Carr. £1-50 **ONLY £59-95** UK Mainland SAE for leaflet

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 **£37-95**

L12/20 12" 20-25 WATT 13,000 Gauss 16 Ohms	Dep. £4-15 & 8 mthly pymts £1-42 (Total £15-51)	£13-15	Carr. 55p.
L12/10 10-16 WATT Vaneer finish cabinet 12" unit 8-15 ohm. Size approx. 14" x 14" x 9". Carr. 60p.	Dep. £2-25 & 8 mthly pymts £1-04 (Total £10-57)	£8-25	

CREDIT INTEREST CHARGES REFUNDED

if account cleared in 3 months

REGENT 50 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 £24-50 & 12 monthly payments of £4-68. (Total £280-66). Carr. £2-50 **£72-50**

R.S.C. BATTERY/MAINS CONVERSION UNITS

TYPE BML. An all-dry battery eliminator. Size 5 1/2 x 4 1/2 x 2 1/2 in. Completely replaces batteries supplying 1.5v and 90v, to battery radio where A.C. mains 200/250v. 50c/s is available. Carr. 30p. **£4-15**

GP30 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 vices. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/silver P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £24-40 and 8 monthly payments of £3-09 (Total £29-12). **£25-85** Carr. 75p

FAL PHASE 100/2 AMPLIFIER

100 WATTS MUSIC RATING. Solid State. Sep. Bass and Treble Controls. 4 separate controlled inputs plus master control. Output for speakers 3-30 ohms. Includes protective circuit against damage from short circuits. Terms: Deposit £23-29 & 12 monthly payments £4-54 (Total £77-77). **£69-85** Carr. free

FAL TWIN CHANNEL AMPLIFIERS

Solid State. 4 sep. controlled inputs plus master volume control. Individual Bass and Treble controls. Output for speakers 3-30 ohms. Protective circuitry against damage from short circuits. **FAL 'SUPER 50'** 50W ATTS MUSIC RATING **£59-50** Terms: Dep. £19-95 & 12 mthly payments £3-90 (Total £88-65) Post free

FAL 'SUPER 100' 100 WATTS MUSIC RATING. Terms: Dep. £26-65 & 12 mthly. pymts £5-17 (Total £88-95). Prices **£79-95** Include protective dust cover. Post free

R.S.C. TRANSFORMERS, L.F. CHOKES & RECTIFIERS FULLY GUARANTEED. Impregnated and Interwoven where necessary.

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250-0-250v. 60mA 6-3v. 2a	£1-16	250-0-250v. 100mA, 6-3v. 3-6a.	£1-71	All 6 1/2". D.C. output. Max A.C. input 18v.	
FULLY SHROUDED UPRIGHT MOUNTING		250-0-250v. 100mA, 6-3v. 2a., 0-5-6-3v. 1a.	£1-75	1a, 2Sp. 2a, 3Sp. 3a, 5Sp 4a, 7Sp. 6a, 8Sp.	
250-0-250v. 60mA, 6-3v. 2a., 0-5-6-3v. 2a.	£1-55	250-0-350v. 80mA, 6-3v. 2a., 0-5-6-3v. 2a.	£1-81	SMOOTHING CHOKES	
250-0-250v. 100mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-45	250-0-250v. 100mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-45	150mA, 7-10H, 250 Ω 77p; 100mA, 10H, 20 Ω 66p; 80mA, 10H, 350 Ω 56p; 60mA, 10H, 400 Ω 28p.	
300-0-300v. 100mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-45	300-0-300v. 100mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-45		
300-0-300v. 130mA, 6-3v. 4a., c.t., 6-3v. 1a.	£2-45	300-0-300v. 130mA, 6-3v. 4a., c.t., 6-3v. 1a.	£2-45		
For Mullard 610 Amplifier	£2-95	Suitable for Mullard 610 Amplifier	£2-95		
350-0-350v. 100mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-45	350-0-350v. 100mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-45		
350-0-350v. 150mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-95	350-0-350v. 150mA, 6-3v. 4a., 0-5-6-3v. 3a.	£2-95		
425-0-425v. 200mA, 6-3v. 4a., c.t., 6v. 3a.	£2-45	FILAMENT or TRANSISTOR POWER PACK			
425-0-425v. 200mA, 6-3v. 4a., c.t., 6v. 3a.	£2-45	Types 6-3v. 1-5a. 5Sp; 6-3v. 2a. 6Sp; 6-3v. 3a. 8Sp;			
425-0-425v. 200mA, 6-3v. 4a., Twice 6v. 3a.	£2-80	6-3v. 6a. £1-45; 12v. 1a. 61p; 12v. 3a. or 24v. 1-5a. £1-50; 0-9-18v 1 1/2a. £1-25; 0-12-25-42v 2A2L1-95.			
450-0-450v. 250mA, 6-3v. 4a., c.t., 6v. 3a.	£2-80				
		CHARGER TRANSFORMERS 0-9-15v. 1 1/2a. \$10, 2 1/2a. \$1-85; 3a. \$1-40; 6a. \$1-80; 6a. \$1-85; 8a. \$2-20			
		AUTO (Step UP/step DOWN) TRANSFORMERS			
		0-110/120v. 200-230-250v. 50-80 watts \$1-25, 150 watts, \$2-10 250 watts \$3-00; 500 watts \$6-40			
		OUTPUT TRANSFORMERS			
		Push-Pull 8 watts EL84 to 3 Ω or 15 Ω . . . 85p			
		Push-Pull 10 watts 6V6, ECL86 to 3-5-8-15 Ω . . . \$1-85			
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		Push-Pull Ultra Linear for Mullard 510, etc. £2-45			
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AKAI 4000DS Tape Unit	£69.95 (Rec. Price £97.50)	Carr. £1
AKAI 1721L Tape Unit	£72.95 (Rec. Price £104.50)	Carr. £1
AKAI CR81D Tape Unit	£58.95 (Rec. Price £84.10)	Carr. £1
GOLDRING GL72 T/Table & P.U.	£29.95 (Rec. Price £37.29)	Carr. 75p
with Goldring G800 Cartridge worth over £10 fitted to above unit.		
GOLDRING GL75 T/Table P.U.	£34.95 (Rec. Price £47.19)	Carr. 85p
with Goldring G800 Cartridge worth over £10 fitted to above unit.		
BSR MP60 T/Table & P.U.	£9.95 (Rec. Price £14.95)	Carr. 40p
T/TABLES with MAGNETIC CARTRIDGE/ PLINTH & COVER		
GARRARD SP25 with G800	£16.95 SPECIAL PRICE	(Carr. £1)
BSR MP60 with G800	£17.95 SPECIAL PRICE	(Carr. £1)
GARRARD AP76 with G800	£28.95 SPECIAL PRICE	(Carr. £1)



A HIGH FIDELITY 30 + 30W STEREO SYSTEM

AUDIO FIDELITY MODEL 60 AMP-LIFIER. PAIR AUDIO FIDELITY MARQUESS 30 SPEAKERS. McDONALD
MP60 with G800 Cartridge
Ready wired on Plinth with Cover.
Send S.A.E. for leaflet.

Total Value over £165

£99.95

RSC G66 MkII 6.6 WATT high quality STEREO AMPLIFIER

Controls: Bass, Treble, Vol. and Bal. 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 £12.75 Carr. 40p

Or FACTORY BUILT IN TEAK VENEERED CABINET as illustrated £16.50 or dep. £2.75 and 8 monthly payments £1.59 (Total £15.47).



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Heavy construction. Latest high efficiency ceramic magnets. Plastised Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 5 or 8-15 ohms. PLEASE STATE CHOICE.

Exceptional performance at low cost.					
HF808T	8" 10W	£2.98	HF120D	12" 15W	£6.50
HF108D	10" 10W	£3.30	HF128	12" 15W	£6.85
HF120	12" 15W	£4.95	HF128D	12" 15W	£6.85

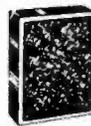
FANE 807T HIGH FIDELITY SPEAKER

A full range 8in. 10 watt unit for excellent sound quality. In suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 16 KHz. Gauss 10,000. Impedance 5 or 8-15Ω. PLEASE STATE IMPEDANCE REQUIRED List £4.99 MODEL 803T 8" 15w. with parasitic Tweeter. Response 25 Hz to 16 KHz. Gauss 13,000 Imp 3 or 8-15Ω. £5.50 List £6.99



HI-FI SPEAKER ENCLOSURES MODERN DESIGN

Teak veneer finish. Acoustically lined. Sizes approx. Carr. 40p. per one
JE8 Size 16" x 11" x 9". SE8 For optimum performance with any 8in. Hi-Fi speaker. £6.50
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SE10 For outstanding results with 10in. Hi-Fi speaker. Size 25½ x 16 x 9in. Ported. £6.75
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Size 19 x 10½ x 9in.



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. £6.50 Carr. 33p
OR SENIOR 15 WATT INCLUDING HF126 15,000 LINE SPEAKER £7.65 Carr. 39p

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

200-250v. AC mains operated. Response 30-20,000 c.p.s. -24dB. Separate Bass and Treble 'lift and cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 9½ x 2½ x 3½in. Attractive silver finish fascia 10½ x 3½in. matching knobs. Complete kit with full wiring diagrams and instructions. £8.50 Carr. 40p
OR FACTORY BUILT £10.95



AUDIO FIDELITY FR1 SPEAKER KIT

Response 30Hz-15KHz. Imp. 8-15 ohm 8" Bass Unit. Pressure Tweeter, Cross-over etc. Carr. Free £10.95
SPECIAL NEW YEAR OFFER £15.95 Pair Carr. 45p.

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

R.S.C. STEREO FM III TUNER. in cabinet. Visually matches Super 30 Mk. III £37.50

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

FACTORY BUILT UNIT INC. CABINET with 12 months' guarantee. Or Dep. £7 and 8 monthly payments £5.17 (Total £48.36).



COMPLETE KIT (less cabinet). Carr. 70p. Cabinet if req. £5 extra.

£22.50

£42.50

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

- ★ Moderate size only 25 x 14 x 10in. approx. COMPLETE KIT
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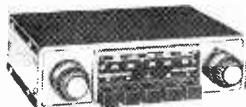
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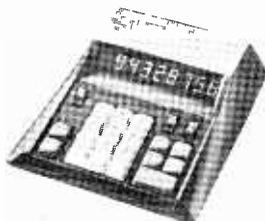
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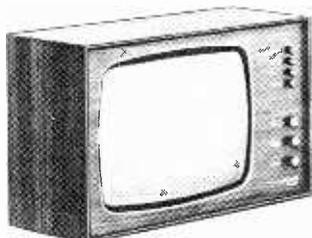
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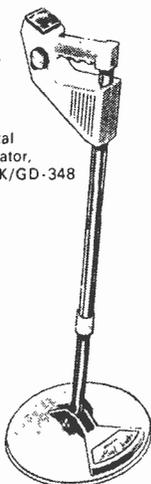
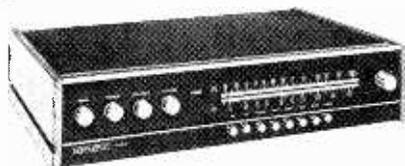


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07	20	1 8	7.0 x 6.0 x 6.0	2.32 30
149	60	3 12	9.9 x 7.7 x 8.6	3.45 36
150	100	5 8	9.9 x 8.9 x 8.6	3.79 52
151	200	8 0	12.1 x 9.3 x 10.2	6.45 52
152	250	13 12	12.1 x 11.8 x 10.2	8.41 67
153	350	15 8	14.0 x 10.8 x 11.8	11.22 82
154	500	19 8	14.0 x 13.4 x 11.8	16.25
155	750	29 0	17.2 x 14.0 x 14.0	22.10
156	1000	38 0	17.2 x 16.6 x 14.0	29.87
158	2000	60 0	21.6 x 15.3 x 18.1	49.25

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Ref. No.	VA (Watts)	Weight lb oz	Size cm.	Auto Taps	P & P
113	20	1 0	5.8 x 5.1 x 4.5	0-115-210-240	1.22 22
64	75	2 4	7.4 x 6.7 x 6.1	0-115-210-240	2.40 30
4	150	3 4	8.9 x 7.7 x 7.7	0-115-200-220-240	2.89 36
66	300	6 8	12.1 x 9.5 x 8.6	"	5.63 52
67	500	12 8	12.1 x 11.8 x 10.2	"	8.36 67
84	1000	19 8	14.0 x 13.4 x 14.3	"	15.19 82
93	1500	30 4	14.0 x 15.9 x 14.3	"	21.99
95	2000	32 0	17.2 x 16.6 x 14.0	"	28.70
73	3000	40 0	21.6 x 13.4 x 18.1	"	39.17

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Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Windings	P & P	
111	0.5	0.25	8	4-8 x 2-9 x 3-5	0-12V at 0-25A x 2	1.22 22
213	1.0	0.5	1 4	6.1 x 5.8 x 4.8	0-12V at 0-5A x 2	1.44 22
71	2	1	1 12	7.0 x 6.4 x 6.1	0-12V at 1A x 2	1.90 22
18	4	2	2 12	8.3 x 7.7 x 7.0	0-12V at 2A x 2	2.68 30
70	6	3	3 8	8.9 x 8.0 x 7.7	0-12V at 3A x 2	3.20 42
109	8	4	5 8	9.9 x 8.9 x 8.6	0-12V at 4A x 2	3.60 52
72	10	5	6 4	9.9 x 9.6 x 8.6	0-12V at 5A x 2	4.25 52
116	12	6	6 12	9.9 x 10.2 x 8.6	0-12V at 5A x 2	5.10 52
17	15	8	8 12	12.1 x 9.9 x 10.2	0-12V at 8A x 2	6.56 52
115	20	10	11 8	14.0 x 9.6 x 11.8	0-12V at 10A x 2	8.36 67
187	30	15	15 8	14.0 x 12.1 x 11.8	0-12V at 15A x 2	15.40 82
226	60	30	32 0	17.2 x 15.3 x 14.0	0-12V at 30A x 2	28.44

30 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P
112	0.5	1 4	6.1 x 5.8 x 4.8	0-12-15-20-24-30V	1.42 22
79	1.0	2 4	7.0 x 6.7 x 6.1	"	1.92 36
3	2	3 4	8.9 x 7.7 x 7.7	"	2.90 36
20	3	4 8	9.9 x 8.3 x 8.6	"	3.58 42
21	4	6 4	9.9 x 9.6 x 8.6	"	4.25 52
51	5	6 12	12.1 x 8.6 x 10.2	"	5.30 52
117	6	8 0	12.1 x 9.3 x 10.2	"	6.31 52
88	8	12 0	12.1 x 11.8 x 10.2	"	8.18 67
89	19	0 13	14.0 x 10.2 x 11.8	"	10.33 67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P
102	0.5	1 12	7.0 x 6.4 x 6.1	0-19-25-33-40-50V	1.90 30
103	1.0	2 12	8.3 x 7.4 x 7.0	"	2.80 36
104	2.0	5 8	9.9 x 8.9 x 8.6	"	3.87 42
105	3.0	6 12	9.9 x 10.2 x 8.6	"	5.26 52
106	4.0	10 0	12.1 x 10.5 x 10.2	"	6.99 52
107	6.0	13 4	14.0 x 10.2 x 11.8	"	10.35 67
118	8.0	18 0	14.0 x 12.7 x 11.8	"	13.51 97
119	10.0	25 0	17.2 x 12.7 x 14.0	"	16.93 97

60 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	P & P
124	0.5	2 4	7.0 x 6.7 x 6.1	0-24-30-40-428-69C	1.93 36
126	1.0	3 4	8.9 x 7.7 x 7.7	"	2.70 36
127	2.0	6 4	9.9 x 9.6 x 8.6	"	4.25 42
125	3.0	8 12	12.1 x 9.9 x 10.2	"	6.46 52
123	4.0	13 12	12.1 x 11.8 x 10.2	"	8.36 67
40	5.0	15 0	14.0 x 10.2 x 11.8	"	9.85 87
120	6.0	18 0	14.0 x 12.1 x 11.8	"	12.14 82
121	8.0	25 0	14.0 x 14.7 x 11.8	"	13.65 *
122	10.0	25 0	17.2 x 12.7 x 14.0	"	20.09 *
189	12.0	29 0	17.2 x 14.0 x 14.0	"	22.49 *

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Ref. No.	MA	Weight	Size cm	VOLTS	P & P
238	200	1 2	2-8x2-6x2 0	3-0-3	1.31 10
212	1A, 1A	1 4	6-1x5-8x4 8	0-6-0-6	1.52 22
13	100	3 4	3-9x2-6x2 9	9-0-9	1.12 10
235	330,330	4 4	4-8x2-9x3 5	0-9-0-9	1.52 10
207	500,500	1 00	6-1x5-4x4 8	0-8-9-0-8-9	2.03 22
208	1A, 1A	1 12	7-0x6-4x6 1	0-8-9-0-8-9	2.73 30
236	200,200	1 4	4-8x2-9x3 5	0-15-0-15	1.52 10
214	300,300	1 4	6-1x5-8x4 8	0-20-0-20	1.60 22
221	700 (D.C.)	1 8	7-0x6-1x6-1	20-12-0-12-20	1.41 30
206	1A, 1A	2 12	8-3x7-7x7 0	0-15-20-0-15-20	3.08 36
203	500,500	2 4	8-3x7-0x7 0	0-15-27-0-15-27	2.82 38
204	1A, 1A	3 4	8-9x7-7x7 7	0-15-27-0-15-27	2.86 38

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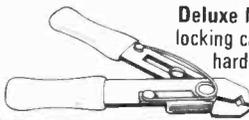
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YES, "YOU'VE GOT THE WHOLE WIDE WORLD IN YOUR HANDS"! ALMOST UNBELIEVABLE! Think of the year 1984 and what might be produced then—now gets the fantastic **ASTRAD 17** and **SEE** for yourself the incredible Russians have done it all **NOW!** It's the radio perfectionist's dream models! **THIS ONE SUPERSEDES ALL EARLIER MODELS!** It will probably make your present radio seem like a "crystal set"! Complete with optional battery eliminator for both battery and mains use! We're almost giving them away at only **£18.50**—a mere fraction of even today's Russian "miracle price!" We challenge you to compare performance and value with £80 radios! **★Send quickly, test or mail order 7 days approval, from receipt of goods, refund if not delighted.** Or call. Volume controlled from a whisper to a roar that would fill a hall! Much wider band spread, for absolute "pin-point" station selection! Plus "MAGIC EYE" tuning level indicator for ultra perfect tuning sensitivity! Yes, the Russians have surpassed themselves, proving again their fantastic ability in the field of electronics and brilliantly reflecting their advanced micro-circuitry techniques and the field of spaceship and satellite communications. **Yes, EVERY WAVEBAND** instantly at your fingertips including Standard Long, Medium, Short and Ultra Short Waves to cover the four corners of the earth during 24 hours a day including all normal transmissions, VHF/FM, USW, AM, LW, MW, SW, gets, locally, local & new stations, not yet operational, and messages from all over the world! Expensive **TURRET TUNER** side control waveband selection unit (as used on expensive T.V.'s!). Every waveband clicks into position giving incredible ease of station tuning! Genuine push-pull output! ON/OFF volume and separate Treble and Bass tone controls for ultra perfection of reproduction and tone! Press-button dial illumination! Take it anywhere—runs economically on standard batteries (obtainable everywhere) or direct through battery eliminator from 220/240V AC mains supply. Internal ferrite rod aerial plus built-in "rotatable" telescopic aerial extending to 39 in approx. It's also a fabulous **CAR RADIO**. Can also be used through extension amplifier, tape recorder or public address system. **SIZE** 13in x 10in x 4 1/2in overall approx. Magnificently designed, in highly polished cases. Made to give years of perfect service. Purer & sweeter tone than ever. (U.K. service facilities & spares available for years & years to come, if ever necessary!). With **WRITTEN GUARANTEE**, manual with simple operating instructions & circuit diagram. **PLUS** ultra sensitive earphone for personal listening. **ONLY £18.50** (with mains/battery eliminator £2.25 extra) **BOX, POST, ETC. 45p. NO MORE TO PAY! ★BUT WAIT**, for only 75p extra you get the sensational "COMPUTERISED" **WORLD TUNING GUIDE** (it enables you to zone & time in a flash for transmissions the whole world over—even a child can do it in a flash—it even lets you know when to tune into the U.K. when abroad. **NO GUESSING! NO MESSING!**) **PLUS** Standard "longlife" batteries and Converter Plug. (Sorry—We cannot change these new radios for any earlier model purchased.) Send quickly to Uxbridge Road address, or call at either Store. **BUT HURRY! SHOPERTUNITIES SAVE YOU £££'s and £££'s.**

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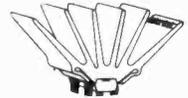
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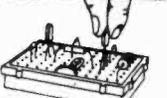
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BZ78 Series 400mW	
3-3-33V. 5%	15p
1-5 watt range	25p
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L.E.D.	
TIL 209 H.P.5092	28p
L.D.R.	
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VALVE AMPLIFIERS

5 Watt	£12-50	50 Watt	£38-25
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(with 70W RMS Amp)

HEAVY DUTY LOUDSPEAKERS

★ SPECIAL OFFER PRICE ★
Decca 8in 10 watt Hi-Fi speaker, plus matching tweeter £7-50 complete
Suitable 2 way Xover £1-21
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Sound-lighting module £7-90
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Suitable for any 12in. speaker covered in rexine and vinyl. Size: 18in x 18in x 8in approx. £9-90

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For 8 x 5in speaker £3-50 each
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3W AMPLIFIER	1 500 Carbon resistors, 1, 1, 1, 2 watt
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ALL COMPONENTS NEW AND UNUSED

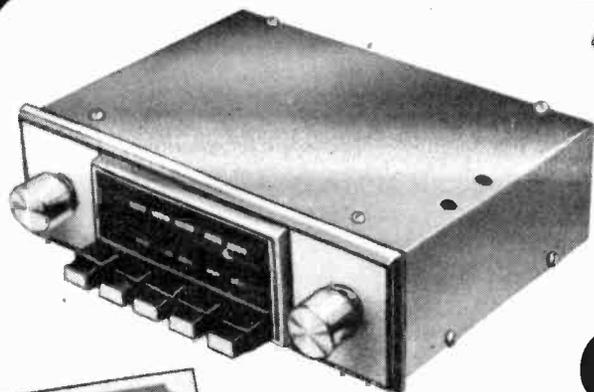
£1 + 25p p.p. per pack, £5 for 5 packs p/tree.

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Large selection in stock, £20 each.	
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R T V C



Remember! one of the Top Ten Accessory Awards from Motor magazine **PUSH BUTTON CAR RADIO KIT**



BUILD YOUR OWN TOURIST PUSH BUTTON CAR RADIO

Technical specification:

- 1.) Output 2.5 watts R.M.S. into 8 ohms. For 12 volt operation on negative or positive earth.
- 2.) Integrated circuit output stage, pre built three stage IF Module.

Controls Volume, manual tuning and five push buttons for station selection, illuminated tuning scale covering full medium and long wave bands.

Size Chassis 7 ins. wide, 2 ins. high and 4 $\frac{1}{8}$ ins. deep approx.

NOTE: The ability to solder on a printed circuitboard is necessary to complete this kit successfully. Circuit diagram and comprehensive instructions 55p. free with kit.

Car Radio Kit

£6.60 + 55p. postage & packing.

Speaker including baffle and fixing strips

£1.65 + 23p. postage & packing.

Recommended Car Aerial - fully retractable and locking,

£1.35 post paid.

STEREO 21



QUALITY SOUND FOR LESS THAN £19.00

Stereo 21 easy to assemble audio system kit, - no soldering required. Includes: -

BSR 3 speed deck, automatic, manual facilities together with ceramic cartridge.

Two 8" 5" speakers with cabinets.

Amplifier module. Ready built with control panel, speaker leads and full, easy to follow assembly instructions.

For the technically minded: -

Specifications:

Input sensitivity 600mV; Aux. input sensitivity 120mV; Power output 2.7 watts per channel; Output impedance 8-15 ohms.

Stereo headphone socket with automatic speaker cutout.

Provision for auxiliary inputs - radio, tape, etc., and outputs for taping discs. **Overall Dimensions**. Speakers approx.

15 $\frac{1}{2}$ " x 8" x 4". Complete deck and cover in closed position approx. 15 $\frac{1}{2}$ " x 12" x 6". Complete only **£18.45. 16p. p & p**

Extras if required.

Optional Diamond Styl: **£1.37**

Specially selected pair of stereo headphones with individual level controls and padded earpieces to give optimum performance. **£3.85.**



DISCO AMPLIFIER

Reliant Mk IV Mono Amplifier, ideal for the small disco or house parties.

Outputs 20 watts R.M.S. into 8 ohms (suitable for 15 ohms).

Inputs *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.

1) Crystal Mic or Guitar 9mV. 2) Moving coil Mic or Guitar 8mV. 3), 4), 5) Medium output equipment (Gram. Tuner. Monitor. Organ, etc.) - all 250mV sensitivity.

Size approx. 12 $\frac{1}{2}$ ins x 6 ins x 3 $\frac{1}{2}$ ins

£13.50 + 60p.

postage & packing.



8 TRACK CARTRIDGE PLAYER

Elegant self selector push button player for use with your own stereo system. Compatible with Viscount III system, the Stereo 21 and the Unisound module.

Technical specification.

Mains input, 240V. Output sensitivity 125mV

Comparable unit sold elsewhere at £24.00 approx.

Yours for only £10.60 + 90p. p & p



BUILD YOUR OWN STEREO AMPLIFIER

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 which ensure very low distortion over the audio spectrum.

£7.64 + 55p. p & p

PE TAPE LINK CONSTRUCTORS



A suitable 3 speed tape deck, less heads. Caters up to 5 $\frac{3}{4}$ ins. spools. 240V AC mains.

Unused but store soiled hence no warranty. **£4.00 + £1.00 p & p**



£49.00

40 Watt Amplifier.
Viscount III - R102 now 20 watts per channel.
System I includes.
Viscount III amplifier - volume, bass, treble and balance controls, plus switches for mono/ stereo on/off function and bass and treble filters. Plus headphone socket.

Specification
 20 watts per channel into 8 ohms.
 Total distortion @ 10W @ 1kHz 0.1% *P.U.1* (for ceramic cartridges) 150mV into 3 Meg *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K, equalised within 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power).
 Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: 12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble 12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) -58dB.
 Crosstalk better than 35dB on all inputs. Overload characteristics better than 26dB on all inputs. Size approx. 13 1/2" x 9" x 3 1/2".

Garrard SP. 25 Mk III deck with magnetic cartridge, plinth and cover.
Two Duo Type II matched speakers - Enclosure size approx. 17" x 10 1/2" x 6 1/2" in simulated teak. Drive unit 13" x 8" with parasitic tweeter. **Complete System £49.00**

£65.00

System II
Viscount III amplifier (As System I)
Garrard SP. 25 Mk III deck (As System I)
Two Duo Type III matched speakers
 Enclosure size approx. 23" x 11" x 9"
 Finished in teak veneer. Drive units approx. 13" x 8" with 3" HF speaker. Max. power 20 watts. 8 ohms. Freq. range 20Hz to 20kHz.

Complete System £65.00

PRICES: SYSTEM 1

Viscount III R102 amplifier	£24.20	£1 p 8 p
2 Duo Type II speakers	£14.00	£2.20 p 6 p
Garrard SP25 Mk III with MAG cartridge plinth & cover	£18.00	£1.75 p 6 p
total	£56.20	

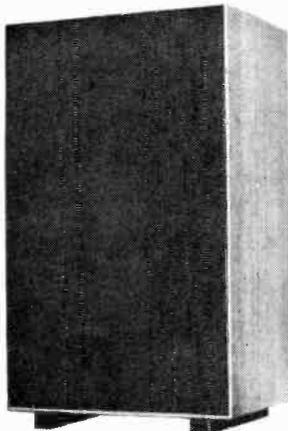
Available complete for only £49.00 £3.50 p. & p.

PRICES: SYSTEM 2

Viscount R102 amplifier	£24.20	£1 p 8 p
2 Duo Type III speakers	£32.00	£3.30 p 6 p
Garrard SP25 Mk III with MAG. cartridge plinth & cover	£18.00	£1.75 p 6 p
total	£74.20	

Available complete for £65.00 £4 p. & p.

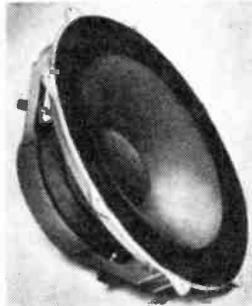
THE ULTIMATE COMPLETE SPEAKER SYSTEM EMI LE 315



Recommended retail selling price, £86.00.
Our price £45.00 —
£3.50 postage & packing.

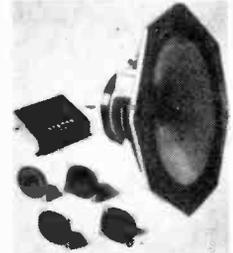
A professional standard five way speaker system with enclosure giving top quality performance.
Enclosure Dimensions approx. (3ft. x 2ft. x 1ft.).
Drive Units
 Hand built - 15" diameter bass with 3" voice coil, - two 5" diameter Mid Range units, - two 3 1/4" HF. units, plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.
Powder Handling
 Continuous rating 35 W rms., Peak power rating 70 W.
Frequency Response 20 Hz 20,000 Hz.

EMI SPEAKERS FANTASTIC REDUCTION



15" 14A/780. Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. Flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3" voice coil.

Recommended retail price **£40.80.**
OUR PRICE £18.70 + £1.50 p & p



950 Kit - Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19" 14 (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.

The four 10,000 gauss tweeters, each 3 1/2" dia approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2, others 0.5. Recommended list price £44.00.
OUR PRICE £25.00 + £1.50 p & p
Special Offer.



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H8/2	2-2µF	25V	4p	H7/6	100µF	25V	5p
H8/2A	3-3µF	25V	4p	H7/7	100µF	25V	4p
H8/3	3µF	50V	4p	H7/8	125µF	16V	5p
H8/3A	4µF	50V	4p	H7/8A	100µF	35V	8p
H8/4	4-7µF	25V	4p	H7/9	100µF	63V	8p
H8/4A	5µF	64V	4p	H7/10	125µF	25V	4p
H8/5	5µF	10V	4p	H7/10A	160µF	2-5V	3p
H8/5A	5µF	150V	4p	H7/11	160µF	25V	8p
H8/6A	10µF	10V	4p	H7/11A	150µF	16V	5p
H8/7	10µF	70V	4p	H7/13A	200µF	25V	8p
H8/8	16µF	35V	4p	H7/14	220µF	16V	8p
H8/8A	16µF	16V	4p	H7/14A	220µF	25V	5p
H9/9	20µF	6V	4p	H7/15	220µF	35V	10p
H8/9A	20µF	70V	4p	H6/1A	250µF	4V	3p
H8/10	22µF	50V	4p	H6/2	250µF	25V	3p
H8/10A	22µF	100V	4p	H5/3A	320µF	2-5V	3p
H9/11	25µF	12V	4p	H6/4	320µF	10V	4p
H8/11A	24µF	15V	4p	H6/5	330µF	16V	5p
H8/12	32µF	15V	4p	H6/5A	330µF	35V	10p
H8/12A	30µF	10V	4p	H6/8	470µF	25V	10p
H8/13A	32µF	50V	4p	H6/8A	470µF	35V	20p
H8/14	40µF	25V	5p	H6/9A	400µF	40V	20p
H8/14A	40µF	16V	4p	H6/13A	1000µF	25V	16p
H8/15	47µF	35V	4p				
H8/15A	40µF	50V	4p				
H7/1	50µF	6V	3p				
H7/1A	50µF	10V	4p				
H7/2A	64µF	2-5V	2p				
H7/3A	64µF	25V	4p				
H7/4	64µF	15V	4p				

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	072 15752	16	7500 + 7500	10-5 amps	3oz	37p
	072 15113	16	11000 + 11000	13-8 amps	4½oz	60p
	071 16472	25		5-4 amps	1½oz	20p
	072 16502	25	5000 + 5000	9-5 amps	3½oz	37p
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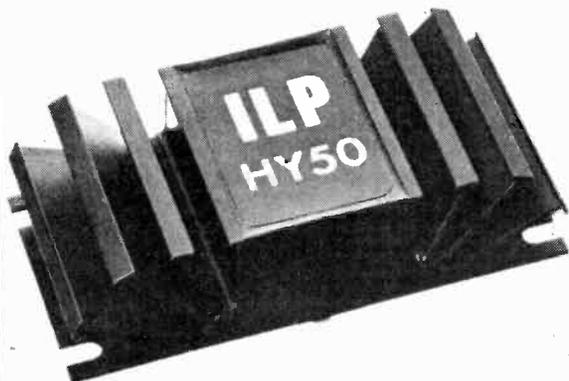


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SECOND GENERATION 25 WATT HYBRID



A brand new hybrid fabrication technique, recently perfected in our laboratories, has enabled us to achieve our latest range of completely integrated devices. We have now finally reduced the modular amplifier to a simple input/output device requiring only the addition of a basic unstabilized (split line) power supply. The HY50 takes medium power modules to their logical conclusion by incorporating with it a heatsink, which is designed in special high conductivity alloy, sufficient for normal audio use without additional chassis sinking. All this without significantly increasing the size of the module comparable in size to a packet of 'King-size' cigarettes.

Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

OUTPUT POWER: 25 watts RMS. 50 watts peak music power
LOAD IMPEDANCE: 4 16Ω into 8Ω
INPUT SENSITIVITY: 0db (0-775 volts RMS)
INPUT IMPEDANCE: 47KΩ
TOTAL HARMONIC DISTORTION: Less than 0.1% at 25 watts typically 0-05 better than 75db
SIGNAL/NOISE RATIO: 10Hz-50KHz ± 1db
FREQUENCY RESPONSE: ± 25 volts
SUPPLY VOLTAGE: 105 x 50 x 25 mm
SIZE:

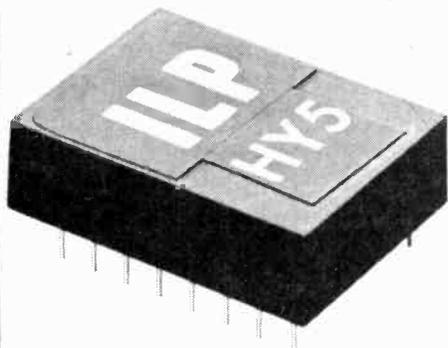
SPEC.

25 watts RMS. 50 watts peak music power
4 16Ω into 8Ω
0db (0-775 volts RMS)
47KΩ
Less than 0.1% at 25 watts typically 0-05 better than 75db
10Hz-50KHz ± 1db
± 25 volts
105 x 50 x 25 mm

Price £5.40 mono, £10.80 stereo

Price inclusive of VAT & P & P

NEW HY5 PRE-AMPLIFIER



Unchallenged for two years, the HY5, our unique multifunction preamplifier/tone hybrid, has been brought into line with the advancements in our power hybrids.

Like the HY50, the new HY5 has no external components & has been redesigned to run off a split power-line with improvements in signal/noise, overload, capability & reduced distortion. The output has been increased to match the power module (Odb), and to share the same power supply. Overall size is reduced by the use of a new thin film circuitry while the device still retains all the functions of the earlier device.

When combined with the HY50 & power supply only potentiometers are required to complete a simple mono amplifier with input & output facilities expected to be found on Hi-Fi amplifiers. The combination of two HY5's two HY50's sharing a common power supply (PSU50) are linked by a balance control to form a complete stereo system.

INPUTS
Magnetic Pick-up 3mV (within 1db RIAA curve)
Ceramic Pick-up up to 3mV
Microphone 10mV
Tuner 250mV
Auxiliary 3-100mV
Input impedance 47kΩ 1kΩ

SPEC.

25 watts RMS. 50 watts peak music power
4 16Ω into 8Ω
0db (0-775 volts RMS)
47KΩ
Less than 0.1% at 25 watts typically 0-05 better than 75db
10Hz-50KHz ± 1db
± 25 volts
105 x 50 x 25 mm

OUTPUTS
Tape 100mV.
Main output, 0db (0-775volts)

ACTIVE TONE CONTROLS

Treble ± 12db at 10kHz
Bass ± 12db at 100Hz

OVERLOAD CAPABILITY (equalization stage) 40db on most sensitive input

OUTPUT NOISE LEVEL (below 10mV magnetic input) 68db

DISTORTION 0.05% at 1kHz

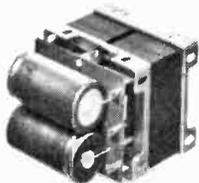
SUPPLY VOLTAGE ± 16-25 volts

SUPPLY CURRENT 15mA

Price £4.51 mono, £9.02 stereo

Price inclusive of VAT & P & P

POWER SUPPLY PSU50



The new PSU50 has a low profile look being only 2 1/2 inches high and can be used for either mono or stereo systems.

SPEC.
OUTPUT VOLTAGE ± 25 volts
INPUT VOLTAGE 210-240 volts
SIZE L. 70, D. 90, H. 60 mm

Price £5.23
Price inclusive of VAT & P & P

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A JOINT ANNOUNCEMENT FROM



Due to contractual commitments both at home and overseas Eddystone Receivers are in short supply. Whilst the manufacturers are doing their best to meet these requirements we would ask your forbearance and understanding of the present delivery situation. Limited supplies of the ever popular EC10 and EB37 will continue to be available. Apologies for the necessity to "DIM THE LIGHT" — normal brilliance will be resumed as soon as possible.

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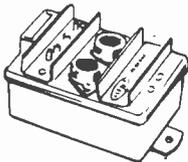


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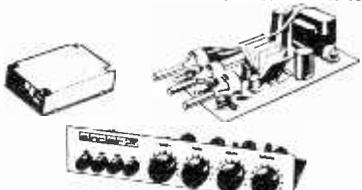
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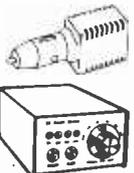


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SN7412AN	0 38 0	38 0	33 0	SN7466N	1 87 1	87 1	83 0	SN74164N	2 01 2	01 2	1 76
SN7413N	0 30 0	27 0	25 0	SN7467N	0 50 0	50 0	44 0	SN74165N	2 01 2	01 2	1 76
SN7414N	0 72 0	72 0	63 0	SN7468N	4 32 4	32 4	32 0	SN74166N	2 16 2	16 2	1 89
SN7414AN	0 30 0	27 0	25 0	SN7469N	0 75 0	70 0	63 0	SN74167N	4 18 4	18 4	3 59
SN7415N	0 30 0	27 0	25 0	SN7470N	0 75 0	70 0	63 0	SN74170N	2 88 2	88 2	2 52
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SN7422AN	0 38 0	38 0	33 0	SN7473N	0 85 0	80 0	75 0	SN74174N	1 86 1	86 1	1 45
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SN7442N	0 85 0	79 0	73 0	SN74123N	1 44 1	44 1	28 0	SN74194N	1 72 1	72 1	1 51
SN7443AN	1 50 1	27 1	13 0	SN74125N	0 69 0	69 0	60 0	SN74195N	1 44 1	44 1	1 28
SN7444N	2 18 2	18 2	1 89	SN74126N	0 89 0	89 0	80 0	SN74196N	1 58 1	58 1	1 38
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TBA800 5 WATT I.C.
 Suitable alternative to
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 With circuits and
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 Integrated circuit radio as
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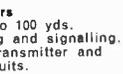


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ST2 (D32) DIAC 25p
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Ultrasonic Transducers
 Operate at 40Khz up to 100 yds.
 Ideal remote switching and signalling.
 Complete with data transmitter and
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3015F 7 SEG.
 I.C. size complete with
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100 42p	100 13p	500 12p	1000 10p
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ZENER DIODES
 400 m/w BZY88/
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 702C (T05) 75p
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Type	100v	90p
SC40A	200v	95p
SC40B	400v	£1-20
SC40E	500v	£1-50

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Type	100v	£1-05
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Impedance 8-15 ohms
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Fitted Tweeter Cone
Range 50-15,000 Hz

Rec. Retail Price

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15" 100 Watt 3" Pole Diam.



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Rec. Retail Price
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POP 55 12" 60 Watt

Impedance 8-15 ohms
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AN ALL PURPOSE UNIT OF HIGH SENSITIVITY

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With 48 see-through Drawers
Ideal for the Radio Constructor

As supplied by us to SCHOOLS, TECHNICAL COLLEGES, HOSPITALS, SHOPS and industry throughout the country. Silver grey stove enamelled steel cabinet with 48 transparent styrene drawers fitted with moulded handles and label slots. Dividers can be supplied at a small extra charge to enable each drawer to be sub-divided into six compartments. See-through drawers allow swift selection of contents at a glance. A really first-class time and space saving unit. Size of cabinet 21½" x 11½" x 6½", size of drawers 6½" x 2½" x 1½".

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ELECTROVALUE

CATALOGUE 7



An A to Z guide to component buying

On the index page of Catalogue 7, between "Aluminium Boxes" and "Zener Diodes" are over 200 references to contents amounting in all to thousands of items, classified, described, often illustrated, and priced. There is a wealth of technical diagrams and data. At 25p, Catalogue 7 is excellent value by any standard. With the 25p Refund Voucher it costs you virtually nothing when you order £5-worth or more.

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★ A SELECTION FROM EV CATALOGUE 7

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and semi-conductors of many types from simple diodes to ICs photo-sensitive devices, threshold switches, etc. etc.

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3015IF Seven segment filament, compatible with standard logic modules. 0-9 and decimal point; 9mm characters in 16 lead DIL (some alphabetical symbols available) £1 20
Suitable BCD decoder driver £1 15
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in cans, plastic sleeved
1000mF/25V 28p 1000/50 41p 1000/100 82p
2000mF/25V 31p 2000/50 57p 2200/100 £1 56
5000mF/25V 62p 5000/50 £1 18 5000/100 £2 91

POLYESTER CAPACITORS TYPE C.280

Radial leads for P.C.B. mounting. Working voltage 250V d.c.
0-01, 0-015, 0-022, 0-033, 0-047 ea. 3p
0-068, 0-1, 0-15 ea. 4p
0-22, 5p; 0-33 7p; 0-47 8p; 0-68 11p; 1-0 14p;
1-5 21p; 2-2 24p

SILVERED MICA CAPACITORS

Working voltage 500V d.c.
Values in pF—2 to 820 in 32 stages ea. 6p
1000, 1500 7p; 1800 8p; 2200 10p; 2700, 3600 12p;
4700, 5000 15p; 6800 20p; 8200, 10,000 25p

POTENTIOMETERS

ROTARY, CARBON TRACK. Double wipers for good contact and long working life.

P.20 SINGLE linear 100ohms to 2.2megohms, ea. 14p
P.20 SINGLE log. 4-7Kohms to 2.2megohms, ea. 14p
JP.20 DUAL GANG lin. 4-7Kohms to 2.2megohms, ea. 48p

JP.20 DUAL GANG log. 4-7Kohms to 2.2megohms, ea. 48p

JP.20 DUAL GANG Log/antilog 10L, 22K, 47K, 1 megohm only ea. 48p

JP.20 DUAL GANG antilog 10K only ea. 48p

2A DP mains switch for any of above 14p extra.

Decades of 10, 22 and 47 only available in ranges above.

Skeleton Carbon Presets Type PR, horizontal or vertical 6p each.

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Linear or log. 10K to 1 meg. in all popular values ea. 30p

Escutcheon plates, black, white or light grey, ea. 10p

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Full range E24 values: 400mW; 2-7V to 36V, 14p each;

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RESISTORS

Code	Watts	Ohms	1 to 9	10 to 99	100 up
(see note below)					
C	1/20	82-220K	9	8	7 5
C	1/3	4-7-470K	1-3	1	0 9 nett
C	1/2	4-7-10M	1-3	1	0 9 nett
C	3/4	4-7-10M	1-5	1-2	0 9 nett
C	1	4-7-10M	3-2	2-5	1-9 nett
MO	1/2	10-1M	4	3-3	2-3 nett
WW	1	0-22-3-9	9	9	8
WW	3	1-10K	9	9	8
WW	7	1-10K	9	9	8 nett

Codes:

C = carbon film, high stability, low noise.
MO = metal oxide, Electrofil TR5, ultra low noise.
WW = wire wound, Plessey.

Values: All E12 except C 1/2W, C 1/2W, and MO 1/2W.
E12: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.

E24: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

Tolerances:

5% except WW1 10% ±0.05Ω and MO 1/2W 2%.

Prices are in pence each for quantities of the same ohmic value and power rating. **NOT** mixed values. (Ignore fractions of one penny on total value of resistor order.) Prices for 100 up in units of 100 only.

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Copper clad 0.1 matrix—2.5 x 3.75 ins. 24p: 3.75 x 3.75 ins.—27p: 2.5 x 5 ins.—27p: 3.75 x 5 ins.—30p.

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0.040 pins (for 0.1 matrix) per 100—30p.

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As designed by P. J. Baxandall and described originally in "Wireless World." Simple to assemble, fantastically good results and a greater money saver. Carries 10 watts RMS, 15 ohms impedance. Size 18in x 12in x 10in. Complete kit, including pack-flat cabinet, £14 90.

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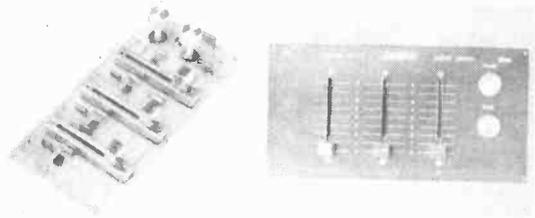
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INTRODUCING THE NEW DABAR MINI THREE CHANNEL MIXER KIT WITH THE FOLLOWING FEATURES:

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- ★ Uses advanced design with five Integrated circuits.
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- ★ Guaranteed top grade components with fibreglass printed circuit board, ready-drilled and tinned.
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- ★ Easy to follow assembly instructions (available separately 25p).
- ★ Attractive ready punched facia plate, available at extra cost, gives that professional finish to the unit.
- ★ Size: 9.5" x 4.8" x 2".

PRICE: KIT ONLY £11.00
FACIA PLATE £1.50
MANUAL AND ASSEMBLY INSTRUCTIONS 25p
AVAILABLE READY BUILT WITH FACIA £15.00

ALL PRICES INCLUDE V.A.T. & POSTAGE IN U.K.
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98, LICHFIELD STREET, WALSALL, STAFFS, WS1 1UZ.

TRANSISTORISED F.M. tuner head with A.M. gang, slow motion drive. 88—108Mcs, with circuit diagram. £2.30p.

P-C BOARDS (not computer panels)

- 1 off 6 transistors single wave band
- 1 off 4 transistor audio
- 1 off 3 transistor £1.60 the three.

LIGHT DEPENDENT RESISTORS (RCA sq3536) 30p each, 4 for £1.00.

All Transistor STEREOGRAM CHASSIS. Medium, Long and VHF/FM. 3 Watts per channel S/M rating. With circuit service manual. Less tuning scale which can be obtained from well known British manufacturer . . . £20.

Colour Translator panels, as used on well known British E.V.R. Teleplayer. All new panels and components. Type and contents of transistors listed below. Each panel £3.50 each.

X605 . . 14 off BC148. 2 RCA ca3054(ic). 1 crystal 4.433618MHz.

Z607 . . 12 off BC148. 1 BC158. 1 BC108. 1 RCA ca3046. 1 RCA ca3045(ic).

Z608 . . 23 off BC148. 2 BC158.

Z612 . . 12 off ME4102. 2 BC251B. 1 BFY50.

CRYSTAL CALIBRATOR (Second Hand) No. 10 crystal controlled heterodyne wave-meter covering 500KHz—10MHz (harmonics up to 30MHz) power required 300V DC 15mA. 12V 0.3A DC. Test equipment for 62T M/Rc. £2.50 each.

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CONDENSER-ELECTRET MIC INSERT incorporating FET Preamp 1½ volt Supply. Details of connections included £1.75.

AUDIO AMPLIFIER MODULE. Due to bulk purchase we can now offer the Audio Amplifier Module (Mullard LP1173) output power, nominal 10 watt. Supply voltage ± 24 volt, with reference data for £2.50.

ALL ITEMS INCLUDE VAT

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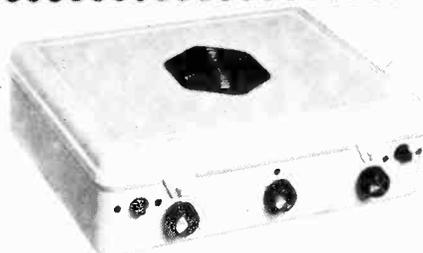
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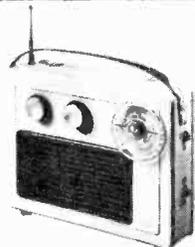


Total Building Costs
£7-23 P P & Ins. 44p
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Components Include: 24 Resistors • 21 Capacitors • 10 Transistors • 3 1/2" Loudspeaker • Earpiece • Mica Baseboard • 3 12-way connectors • 2 Volume controls • 2 Slider Switches • 1 Tuning Condenser • 3 Knobs • Ready Wound MW/LW/SW Coils • Ferrite Rod • 6 1/2 yards of wire • 1 Yard of sleeving etc. • Parts Price List and Plans 50p. (Free with parts).

NEW ROAMER NINE

WITH V.H.F. INCLUDING AIRCRAFT

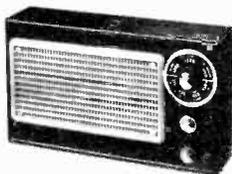


Nine Transistors, 9 Tuneable wavebands as Roamer Ten Built in ferrite rod aerial for MW/LW. Retractable chrome-plated telescopic aerial for VHF and SW. Push Pull output using 600mW transistors, 9 Transistors and 3 diodes, tuning condenser with V.H.F. section, separate coil for aircraft, moving coil loudspeaker, volume ON/OFF and wavechange controls. Attractive all white case with red grille and carrying strap. Size 9 1/2" x 7" x 3 1/4" approx. Parts Price List and Plans 30p (Free with parts).

Total Building Costs **£6-95** P P & Ins. 44p
(Overseas P & P £1.85)
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NEW Everyday Series

Build this exciting New series of designs



E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4 1/2 volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9 1/2" x 5 1/4" x 2 1/4" approx. Parts Price List and Plans 15p. Free with parts.

Total Building Costs **£2-73** P P & Ins. 30p
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E.V.6. Case and looks as above. 6 Transistors and 3 diodes. Powered by 9 volt battery. Ferrite rod aerial, 3" loudspeaker, etc., MW/LW coverage. Push Pull output. Parts Price List and Plans 15p. Free with parts.

Total Building Costs **£3-60** P P & Ins. 30p
(+ 10% VAT 36p)
(Overseas P & P £1-25)

E.V.7. Case and looks as above. 7 Transistors and 3 diodes. Six wavebands. MW/LW, Trawler Band, SW1, SW2, SW3, powered by 9 volt battery. Push Pull output. Telescopic aerial for short waves. 3" Loudspeaker. Parts Price List and Easy Build Plans 20p. Free with parts. Overseas P & P £1-65.

Total Building Costs **£4-08** P P & Ins. 31p
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NOW WITH VARIABLE TONE CONTROL

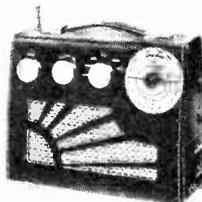


7 Tuneable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch, 8 transistors plus 3 diodes. Latest 4 1/2 watt ferrite magnet loudspeaker. Air spaced gauged tuning condenser. Volume on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4 1/2 in. approx. Easy to follow instructions and diagrams. Parts price list and plans 25p (FREE with parts).

Total building costs **£6-98** P P & Ins. 47p
(+ 10% VAT 69p)
(Overseas P & P £1-85)

ROAMER TEN

WITH VHF INCLUDING AIRCRAFT



10 Transistors, Latest 4 2 watt Ferrite Magnet Loudspeakers, 9 Tuneable Wavebands, MW1, MW2, LW, SW1, SW2, SW3, Trawler Band, VHF and Local Stations also Aircraft Band.

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors, Car Aerial and Tape Record Buckets, 10 Transistors plus 3 Diodes. Gauged Tuning Condenser with VHF section. Separate coil for Aircraft Band. Volume on/off. Wave Change and tone Controls. Attractive Case in black with silver blocking. Size 9 1/2" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

Total building costs **£8-50** P P & Ins. 52p
(+ 10% VAT 85p)
(Overseas P & P £1-85)

POCKET FIVE



3 Tuneable wavebands, MW, LW, and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive black and gold case. Size 5 1/4" x 1 1/4" x 3 1/4" approx. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2-28** P P & Ins. 26p
(+ 10% VAT 23p)
(Overseas P & P £1-25)

TRANSONA FIVE



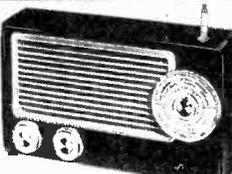
Wavebands, transistors and speaker as Pocket Five. Larger Case with Red Speaker Grille and Tuning Dial. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2-50** P P & Ins. 26p
(+ 10% VAT 25p)
(Overseas P & P £1-25)

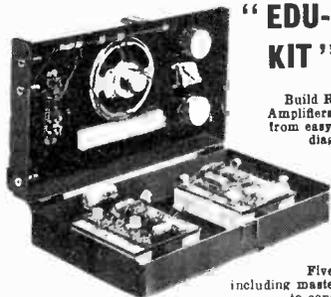
TRANS EIGHT 8 TRANSISTORS and 3 DIODES

6 Tuneable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for MW and LW. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/4 x 2 1/2 in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and plans 25p (FREE with parts).

Total building costs **£4-48** P P & Ins. 33p
(+ 10% VAT 44p)
(Overseas P & P £1-25)



"EDU-KIT"



Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone 3" Moving Coil Speaker: Terminal Strips: Ferrite Rod Aerial: 2 Plugs and Sockets: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three 4" Knobs. Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction. Parts price list and plans 25p (FREE with parts).

Total building costs **£5-50** P P & Ins. 33p
(+ 10% VAT 55p)
(Overseas P & P £1-85)

RADIO EXCHANGE LTD

★ Callers side entrance "Lavelis" shop.
★ Open 10-1, 2.30-4.30, Mon.-Fri. 9-12 Sat.

To RADIO EXCHANGE CO., 61a HIGH STREET, BEDFORD, MK40 1SA
Tel.: 0234 52387. Reg. No. 788372.

I enclose £..... for

Name

Address

(Dept. PW24.)

ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 Tuneable Wavebands: MW, LW, SW1, SW2, Trawler Band plus an extra Medium waveband for easier tuning of Luxembourg, etc.. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker 8 stages - 6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/4 x 2 1/2 in. approx. Plans and parts price list 25p (FREE with parts).

Total building costs **£3-98** P P & Ins. 31p
(+ 10% VAT 39p)
(Overseas P & P £1-85)

The largest selection

EX COMPUTER BOARDS

Packed with transistors, diodes, capacitors and resistors—COMPONENT VALUE £1.50. 3 for ONLY 55p + p & p 30p

SPECIAL ONE. As above PLUS Power Transistors ONLY 55p each + p & p 15p

STABILISED POWER MODULES

Complete with circuit diagrams, etc. 99p each + p & p 15p

PAXOLINE BOARDS 7 1/4" x 9" approx. 4 for 30p + p & p 20p.

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16 1/2" x 4" approx. 2 for 55p

DECON-DALO 33PC Marker

Etch resistant printed circuit marker pen 90p each

VEROBOARDS

Packs containing approx., 50sq. ins. various sizes, all 1 metric 55p

REPANCO CHOKES & COILS

RF Chokes
CH1. 2.5mH 25p CH2. 5.0mH 25p
CH3. 7.5mH 25p CH4. 10mH 25p
CH5. 1.5mH 25p

COILS

DRX1 Crystal set 81p DRR2 Dual range 45p

COIL FORMERS & CORES

NORMAN 1" Cores & Formers 7p
1" Cores & Formers 8p

SWITCHES

DP/DT Toggle 25p 8P/8T Toggle 18p

FUSES

1/2" and 20mm. 100mA, 200mA, 250mA, 500mA, 1A, 1.5A, 2A
QUICK-BLOW 4p ea. ANTI-SURGE 5p ea.

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Crystal 2.5mm plug 33p
Crystal 3.5mm plug 35p
8 ohms 2.5mm plug 22p
8 ohms 3.5mm plug 22p

DYNAMIC MICROPHONES

B1223. 200 ohms plus on/off switch and 2.5mm and 3.5mm plugs £1.80

3-WAY STEREO HEADPHONE JUNCTION BOX

H1012 £1.87

2-WAY CROSSOVER NETWORK

K4007. 80 ohms Imp. Insertion loss 3dB @ 212

CAR STEREO SPEAKERS

(Angled) £3.95 per pair.

BI-PAK

CATALOGUE AND LISTS
Send S.A.E. and 10p.

INSTRUMENT CASES



(Black Vinyl covered)

No.	Length	Width	Height	Price
BV1	8"	4 1/2"	2"	80p
BV2	11"	6"	3"	£1.20

ALUMINIUM BOXES

BA1	5 1/2"	2 1/2"	1 1/2"	42p
BA2	4"	4"	1 1/2"	41p
BA3	4"	2 1/2"	1 1/2"	41p
BA4	5 1/2"	4"	1 1/2"	47p
BA5	4"	2 1/2"	2"	41p
BA6	3"	2"	1"	34p
BA7	7"	5"	2 1/2"	66p
BA8	8"	6"	3"	84p
BA9	6"	4"	2"	64p

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18 BALDOCK ST., WARE, Herts. (A10)

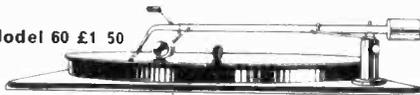
Open Mon.-Thurs. 9.15-6 p.m. Sat. 9.15-5.30. Late Night Shopping until 7 P.m. Tel. 61593

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen

Model 42 £1.84

Chrome Finish Model 60 £1.50



Ref. 36A. Record/Stylet Cleaning Kit 28p

Ref. 43. Record Care Kit £2.35

Ref. 31. Cassette Head Cleaner 54p

Ref. 32. Tape editing Kit £1.54

Model 9. Wire Stripper/Cutter 83p

Ref. P. Hi-Fi Cleaner 31p

Ref. 32A. Stylus Balance £1.38

Ref. J. Tape Head Cleaning Kit 61p

Ref. 34. Cassette Case £1.27

Ref. 56. Hi-Fi Stereo Hints & Tips 32p

ANTEX SOLDERING IRONS

X25. 25 watt £1.93

CEN 240. 15 watt £2.15

Model G. 18 watt £2.15

SK2. Soldering Kit £2.80

STANDS: ST1 £1.21. ST2 77p

SOLDER: 188WG Multicore 7oz 82p

22SWG 7oz 82p. 188WG 2oz 28p

22SWG Tube 22p

PLUGS AND SOCKETS

SOCKETS

PS 35 DIN 2 Pin (Speaker)	0.06
PS 36 DIN 3 Pin	0.10
PS 37 DIN 5 Pin 180°	0.10
PS 38 DIN 5 Pin 240°	0.10
PS 39 Jack 2.5mm Switched	0.09
PS 40 Jack 3.5mm Switched	0.10
PS 41 Jack 1" Switched	0.17
PS 42 Jack Stereo Switched	0.28
PS 43 Phono Single	0.06
PS 44 Phono Double	0.10
PS 45 Car Aerial	0.09
PS 46 Co-Axial Surface	0.09
PS 47 Co-Axial Flush	0.14

ANTEX BITS AND ELEMENTS

Bits No.

102 For model CN240 3/32"	38p
104 For model CN240 3/16"	38p
1100 For model CCN240 3/32"	38p
1101 For model CCN240 3/16"	38p
1102 For model CCN240 1"	38p
1020 For model G240 3/32"	38p
1021 For model G240 1/8"	38p
1022 For model G240 3/16"	38p
50 For model X25 3/32"	38p
51 For model X25 1/8"	38p
52 For model X25 3/16"	38p

ELEMENTS

ECN 240 £1.16	ECEN 240 £1.32
EG 240 £1.16	EX 25 £1.16

ANTEX HEAT SINKS 10p

V.A.T. included in all prices. Please add 10p P. & P. (U.K. only). Overseas orders—please add extra for postage.

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C1	250	Resistors mixed values approx. count by weight	0.55
C2	200	Capacitors mixed values approx. count by weight	0.55
C3	50	Precision Resistors 1%, 2% mixed values	0.55
C4	75	1/4 W Resistors mixed preferred values	0.55
C5	5	Pieces assorted Ferrite Rods	0.55
C6	2	Tuning Gangs, MW/LW VHF	0.55
C7	1	Pack Wire 50 metres assorted colours	0.55
C 8	10	Reed Switches	0.55
C 9	3	Micro Switches	0.55
C10	15	Assorted Pots & Pre-Setts	0.55
C11	5	Jack Sockets 3 x 3.5m 2 x Standard Switch Type	0.55
C12	40	Paper Condensers preferred types mixed values	0.55
C13	20	Electrolytics Trans. types	0.55
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc.	0.55
C15	4	Mains Slide Switches	0.55
C16	20	Assorted Tag strips & Panels	0.55
C17	10	Assorted Control Knobs	0.55
C18	4	Rotary Wave Change Switches	0.55
C19	3	Relays 6-24V Operating	0.55
C20	4	Sheets Copper Laminate approx. 10" x 7"	0.55

INLINE SOCKETS

PS 21 D.I.N. 2 Pin (Speaker)	0.13
PS 22 D.I.N. 3 Pin	0.17
PS 23 D.I.N. 5 Pin 180°	0.17
PS 24 D.I.N. 5 Pin 240°	0.17
PS 25 Jack 2.5mm Plastic	0.10
PS 26 Jack 3.5mm Plastic	0.12
PS 27 Jack 1" Plastic	0.24
PS 28 Jack 1" Screened	0.28
PS 29 Jack Stereo Plastic	0.22
PS 30 Jack Stereo Screened	0.32
PS 31 Phono Screened	0.14
PS 32 Car Aerial	0.15
PS 33 Co-Axial	0.17

PLUGS

PS 1 D.I.N. 2 Pin (Speaker)	0.11
PS 2 D.I.N. 3 Pin	0.12
PS 3 D.I.N. 4 Pin	0.16
PS 4 D.I.N. 5 Pin 180°	0.14
PS 5 D.I.N. 5 Pin 240°	0.15
PS 6 D.I.N. 6 Pin	0.15
PS 7 S.I.N. 7 Pin	0.18
PS 8 Jack 2.5mm Screened	0.10
PS 9 Jack 3.5mm Plastic	0.09
PS 10 Jack 3.5mm Screened	0.12
PS 11 Jack 1" Plastic	0.13
PS 12 Jack 1" Screened	0.18
PS 13 Jack Stereo Screened	0.29
PS 14 Phono	0.06
PS 15 Car Aerial	0.15
PS 16 Co-Axial	0.10

CABLES

CP 1 Single Lapped Screen	0.06
CP 2 Twin Common Screen	0.08
CP 3 Stereo Screened	0.08
CP 4 Four Core Common Screen	0.23
CP 5 Four Core Individually Screened	0.30
CP 6 Microphone Fully Braided Cable	0.10
CP 7 Three Core Mains Cable	0.07
CP 8 Twin Oval Mains Cable	0.06
CP 9 Speaker Cable	0.04
CP 10 Low Loss Co-Axial	0.10

CARBON POTENTIOMETERS

Log and Lin	
4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M	
VC 1 Single Less Switch	0.14
VC 2 Single D.P. Switch	0.28
VC 3 Tandem Less Switch	0.44
VC 4 1K Lin Less Switch	0.14
VC 5 100K Log anti-Log	0.44

HORIZONTAL CARBON PRESETS

0.1 watt 0.08 each
100, 220, 470, 1K, 2.2K, 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4.7M

BOOK BARGAIN BUNDLE

8 Books comprising
2 Transistor Equivalent Books
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1 Radio Valve Guide PLUS
3 other Constructional books on Receivers, FM Tuners, etc.
Also 1 General Constructional book

Value £3 Our Price £2 10p p & p

BP1 Handbook of Transistor Equivalents and Substitutes	40p
BP2 Handbook of Radio, T.V. and Industrial Tube & Valve Equiv.	40p
BP3 Handbook of Tested Transistor Circuits	40p
BP4 International Handbook of the Worlds Short Wave, Medium and Long Wave Radio Stations and FM/TV Listings	35p
BP5 Handbook of Simple Transistor Circuits	35p
BP7 Radio & Electronic Colour Codes and Data Chart	15p
BP8 Sound and Loudspeaker Manual	50p
BP9 38 Practical Tested Diode Circuits for the Home Constructor	35p
BP11 Practical Transistor Novelty Circuits	40p
129 Universal Gram-Motor Speed Indicator	8p
138 How to make FM & TV Aerials, Bands 1, 2 and 3	18p
141 Radio Servicing for Amateurs	20p
146 High Fidelity Loudspeaker Enclosures	87p
156 Transistor Circuits Manual No.1	15p
160 Coil Design & Constructional Manual	80p
161 Radio, TV and Electronics Data Book	25p
170 Transistor Circuits for Radio Controlled Models	40p
174 Transistor Subminiature Receivers	32p
175 Transistor Test Equipment and Servicing Manual	25p
176 Transistor Audio Amplifier Manual	40p
177 Modern Transistor Circuits for Beginners	40p
178 A Comprehensive Radio Valve Guide, Book 5	30p
183 How to Receive Foreign TV Programmes on your set by simple modifications	32p
185 Tested Shortwave Receiver Circuits using MAT's	80p
187 The T8L Mark '4' Valved FM Tuner and its construction	20p
196 Reactance-Frequency Chart for Audio & RF use	15p
Resistor Colour Code Disc Calculator	10p

CARTRIDGES

ACOS GP91-18C 200mV at 1-2cms/sec	£1.18
ACOS GP93-1. 280mV at 1cm/sec	£2.65
ACOS GP96-1. 100mV at 1cm/sec	£2.65
TTC J-2005. Crystal/Hi Output	95p
TTC J-20 10C Crystal/Hi Output Compatible	£1.10
TTC J-200 CS Stereo/Hi Output	£1.60
TTC J-2105 Ceramic/Mel. Output	£1.64

CARBON FILM RESISTORS

The E12 Range of Carbon Film Resistors, 1/8th watt available in PAKS of 50 pieces, assorted into the following groups—

R1 50 Mixed 100 ohms-820 ohms	40p
R2 50 Mixed 1K ohms-8.2K ohms	40p
R3 50 Mixed 10K ohms-82K ohms	40p
R4 50 Mixed 100K ohms-2 Meg. ohms	40p

THESE ARE UNREPEATABLE PRICES—LESS THAN 1p EACH INCL. V.A.T.

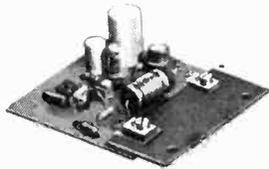
BI-PAK SUPERIOR QUALITY LOW - NOISE CASSETTES

C90. 32p C90, 41p C120, 52p

-the lowest prices!

BI-PAK QUALITY COMES TO AUDIO!

AL10/AL20/AL30 AUDIO AMPLIFIER MODULES



The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S. The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	P _o 3 WATTS f 1KHz	0.25%
LOAD IMPEDANCE		8 - 16 Ω
INPUT IMPEDANCE	f 1KHz	100 k Ω
FREQUENCY RESPONSE @ 3dB	P _o 2 WATTS	50 Hz - 25KHz
SENSITIVITY for RATED O/P	V _s = 25V R _L = 8 Ω f 1KHz	75mV RMS
DIMENSIONS		3" x 2 1/2" x 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (R _L = 8 Ω f 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.

AUDIO AMPLIFIER MODULES

AL 10. 3 watts RMS	£2.19
AL 20. 5 watts RMS	£2.59
AL 30. 10 watts RMS	£3.01

POWER SUPPLIES

PS 12. (Use with AL10 & AL20)	88p
SPM 80. (Use with also AL30 & AL50)	£3.25
FRONT PANELS SP 12 with Knobs	£1.10

PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20)	£4.35
PA 100. (Use with AL30 & AL50)	£13.15

TRANSFORMERS

T461 (Use with AL10)	£1.38 P & P 15p
T338 (Use with AL20)	£1.93 P & P 15p
BMT80 (Use with AL30 & AL50)	£2.15 P & P 25p

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with ceramic cartridges while the auxiliary input will suit most magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm x 84mm x 35mm.

Frequency response
20Hz - 20KHz (± 3dB)
Bass control -
± 12dB at 60Hz
Treble control
± 14dB at 14KHz
* Input 1. Impedance
1 Meg. ohm
Sensitivity 300mV
* Input 2. Impedance
30 K ohms
Sensitivity 4mV

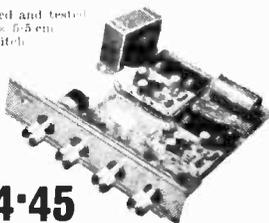
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SEMICONDUCTOR ADVERTISEMENTS in
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Wireless World
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Electronics Today

ALL PRICES INCLUDE V.A.T.

The STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm x 14 cm x 5.5 cm. This compact unit comes complete with on/off switch, volume control, balance, bass and treble controls. Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion - Bass control ± 12dB at 60Hz typically 0.25% at 1 watt. Treble con. ± 14dB at 14kHz.

£14.45



50W pk 25w (RMS)

0.1% DISTORTION!
HI-FI AUDIO AMPLIFIER

THE AL50

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

★ Load-3, 4, 8 or 16 ohms.

★ Distortion-better than .1% at 1 KHz.

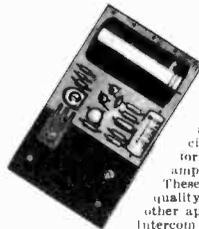
★ Signal to noise ratio 80dB.

ONLY
£3.58 each

★ Supply voltage 10-35 Volts.

★ Overall size 63mm 105mm x 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.P. amplification needs.
FULLY BUILT - TESTED - GUARANTEED



STABILISED POWER MODULE SPM80

SPM80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest component and circuit techniques incorporating complete short circuit protection. With the addition of the Main Transformer MT80, the unit will provide outputs of up to 1.5 amps at 35 volts. Size: 63mm x 105mm x 30mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including: Disc Systems, Public Address Intercom Units, etc. Handbook available 10p **PRICE £3.25**

TRANSFORMER BMT80 £2.15 p. & p. 28p

STEREO PRE-AMPLIFIER TYPE PA100

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

SPECIFICATION

Frequency Response: 20Hz - 20KHz ± 1dB
Harmonic Distortion: better than 0.1%
Inputs: 1. Tape Head 1.25 mV into 50K Ω
2. Radio, Tuner 35 mV into 50K Ω
3. Magnetic P.T. 1.5 mV into 50K Ω
All input voltages are for an output of 250mV. Tape and P.C. input equalised to RIAA curve within ± 1dB, from 20Hz to 20KHz.
Bass Control ± 15dB at 20Hz
Treble Control ± 15dB at 20 KHz
Filters: Rumble (High Pass) 100Hz
Scratch (Low Pass) 8KHz
Signal/Noise Ratio better than -65dB
Input overload ± 25dB
Supply + 35 volts at 20mA
Dimensions 292mm x 82mm x 35mm

ONLY £13.15
SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £25.30 FREE p. & p.

Giro No. 388-7006

Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 11p. Overseas add extra for airmail.

Minimum order 55p. Cash with order please.

Guaranteed Satisfaction or Money Back

SAVE MONEY

SO the winter's economic crunch has come as most realistic prophets have forecast. We have read, heard, seen and experienced at first hand some of the revivals of the immediate post-war social and economic problems, not forgetting that dreaded winter of 1947. We do not intend here to rub the salt further into the wound but rather to look at ways and means of making our lives just a little more bearable.

Practical Wireless showed foresight in the autumn of 1973 which paid off. The power crises ever looming in our midst, we grabbed at the expected misfortunes in the electricity supply industry by publishing at the right time an emergency lighting unit to operate from a car battery. This proved so popular that we are now short of copies for office use. For those of you who missed it we publish in this issue a slightly different version (suggested by a *P.W.* reader) that uses a ready-made oscillator coil.

If you have thoughts about visiting the SONEX or other hi-fi exhibitions in the vicinity of London Airport in March, but are seriously wondering where the money to buy is going to come from, because of the Chancellor's mini-budget restrictions, again take a crumb of comfort from *P.W.* For less than a pound you can have not only the widest variety of do-it-yourself designs over the next three months, but also the freedom to control your own spending over whatever period you choose. You can purchase components and build your own equipment at leisure without worrying about interest charges.

This month's issue sees the start of a new hi-fi project with a difference. We do not recall ever seeing a similar project before in a magazine that incorporates a cassette recorder. We could then be justified in claiming yet another first for the do-it-yourselfer. The result is that you can save on the cost of a system for the home that gives you a.m. and f.m. radio, tape record/playback, the playing of pre-recorded cassettes, and with an added pick-up you can play back stereo discs. This quality system is in stereo and the cassette machine is left to your choice to suit your requirements and, most important, your pocket. If you are seriously interested in quadrasonic sound there is ample room in the unit to include a second pair of amplifiers and an uprated mains transformer.

If you have your own hi-fi set-up already, but you could do with a useful piece of test gear to help you set it up or locate some of those obscure faults, you will be interested in the Trouble Tracer that we published in the last two issues and the Waveform Generator in this issue.

Finally, most of you will already be hooked on our *P.W.* Data-card system; numbers 7 and 8 in this issue are specially designed for those who require "finger-tip" information on local reception and guidance on aerial installations.

M. A. COLWELL—*Editor.*

The April issue will include a new unique portable 5-band radio receiver; a "short-wipe" unit for clearing April showers from your car windscreen; an article that explains impedance matching in audio equipment; a special tool kit arranged by *Practical Wireless* for its readers at a favourable price. Cut your costs again—order the April issue of *P.W.* now. See the footnote and further details on page 1075.

NEWS...

IMPORTANT MESSAGE TO ALL READERS

Readers of "*Practical Wireless*" and most other magazines will be aware of the restrictions imposed by the Government and as a result of Trades Union action in various industries. To ensure that you receive your copy of "*Practical Wireless*" at the earliest possible date, we have to rely on effective communications and delivery through the post and by railway. We also depend on the operation of electrical equipment and printing machinery. Petrol and diesel oil are vital to the needs of our job in quick and effective processing of editorial and advertising material.

We are sure that you will understand the many problems that confront all of us. We therefore request your patience and understanding during any temporary period when publication may be delayed.

We regret that due to the effects of the current industrial situation, the number of pages in this issue has had to be limited. We apologise to advertisers who were unable to insert their full allocation of product announcements and to those unable to appear at all in this issue. Such is the "pulling-power" of *Practical Wireless* and its advertisements that we recommend booking early for the next available issue.

Plessey IC book

P LESSEY Semiconductors has produced a comprehensive 235-page Databook giving details of its extensive range of silicon integrated circuits.

Continuous emphasis on the development of processes and circuits by Plessey has been demonstrated by the successful introduction of Bipolar Process III circuits and MNOS electrically-alterable non-volatile memories. The first products from these new processes are detailed in the Databook along with the wide range of both special and standard products currently available.

Copies of the Integrated Circuit Databook are available on application to *Plessey Semiconductors Limited, Cheney Manor, Swindon, Wiltshire.*

Sonex rival

H I-FIDELITY '74 is a rival exhibition which will run concurrently with Sonex at the Heathrow Hotel. More details next month.

ISB for broadcast radio?

WORK on the problems of a.m. broadcasting on medium and long waves has been carried out at Siemens laboratories in West Germany. The independent sideband (ISB) system, proposed by the Hamburg Institute of Radio Engineering is being seriously considered to overcome some of the problems of increasing mutual interference.

Siemens engineers are quick to point out that the review of broadcasting frequency allocation, due within the next eighteen months, should recommend ISB to enable expansion up to double the number of programme channels for the same number of transmitters. An added advantage is that ISB offers the equivalent to SSB in terms of interference, bandwidth and fading, and could be implemented locally without the need for international agreement.

The major drawback is that receiver design will have to be altered so that a phase shift network can be employed for the 150 to 4kHz band to separate the two side-bands by at least 40dB. ISB receivers would be capable of processing signals in the SSB and DSB modes, with improved reception on DSB by listener selection. Transmitters would probably handle signals with the dynamic range reduced by 30dB.

Modules and valves

AT a recent visit to the huge Mullard manufacturing complex at Blackburn recently, we were privileged to see the making of those "liquorice allsorts" coloured capacitors that are now familiar on printed circuit assemblies. Readers will also be pleased to learn that valves, mostly for television, are still being made in millions although the range of types has been rationalised to fit the economic needs of setmakers and servicemen.

We also saw the assembly of Mullard modules: the LP1185 f.m. i.f. strip; LP1186 d.c. voltage controlled tuner for Band II; LP1159 a.m. i.f. strip; LP1162 4 watt amplifier; LP1164/1 r.f./i.f. amplifier for a.m./f.m. radio; LP1402 f.m. tuner with capacitor tuning. Mullard are working on a modular design stereo decoder for release soon.

Our picture here shows the polyester foil type capacitor going through the colour code dip painting process. These are only a few of the vast activities on this 46 acre site employing approximately 4,000 people.

Radar pioneer dies

SIR Robert Watson-Watt, C.B., F.R.S. died on 5th December at the age of 81. Sir Robert will be one of those famous names in the U.K. associated with great electronic inventions and in his case radar.

Early in his career he worked on the use of radio to detect thunderstorms. Radio direction finding found fame for him in World War II. Civil applications include airlines and shipping; a fitting tribute being the recently opened computer assisted radar tower and communications system for shipping within a 20 mile range of Liverpool.

The communications system was installed by Decca Radar Limited.

Torbay A.R.S.

THE Torbay Amateur Radio Society, G3NJA, has produced its first magazine. One of the main features is that of v.h.f./u.h.f. conversions of commercial equipment for the Amateur. This has been written by E. Hayman, G3ABU.

The T.A.R.S. are willing to add any readers' names to their magazine mailing list. Alternatively readers may become Associate Members for the sum of 50p annual subscription. They would then receive a free copy.

The magazine will be produced on alternate months and further gen may be obtained by sending a s.a.e. to *Frederick J. E. Bolton, G3VTQ, Top Flat, 23 Waverley Road, Newton Abbot, Devon.*



A Versatile WAVEFORM GENERATOR

J. B. DANCE M.Sc

THE Signetics NE566 integrated circuit function generator can be used to construct a simple unit which will provide a variety of waveforms over a very wide frequency range.

The prototype unit will be described in detail. However, a number of variations will be discussed so that individual readers can make modifications which may make the unit more useful for their own particular purposes.

The basic waveform generator produces triangular waves and square waves, and it is especially suitable for use in audio amplifier testing. An additional circuit can be used to produce sine waves in addition to the other two waveforms. The circuit can be modified to produce rising or falling waveforms of high linearity instead of the triangular waveforms. In this case short rectangular pulses are available at the output which previously provided square waves.

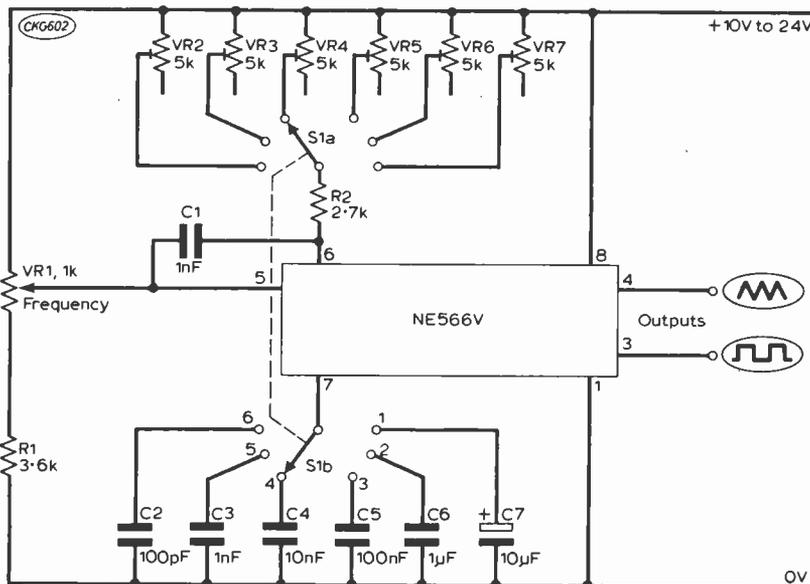
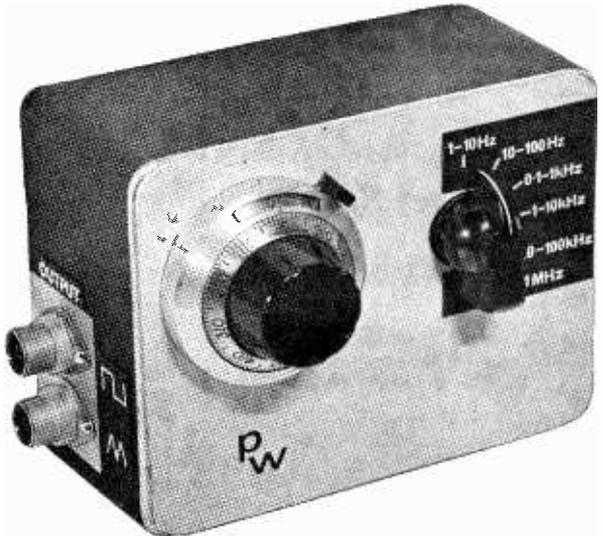
THE BASIC CIRCUIT

The circuit of the basic function generator is shown in Fig. 1. The voltage at the slider of VR1 is applied to pin 5 of the NE566V and also pin 6 via C1. The

current passing to this latter pin is determined by the value of the voltage at this pin and by the resistance between it and the positive line. This current is used to charge and discharge the capacitor selected by S1b.

A Beckman 'Helipot' precision ten-turn helical potentiometer is employed for VR1 together with a Beckman turns counting dial; this enables the frequency of oscillation to be set reasonably accurately. The value of R1 has been chosen so that the potential at pin 5 never falls below three-quarters of the positive power supply line potential (as recommended by the manufacturers of the integrated circuit).

The frequency of oscillation is proportional to the voltage between the positive power supply line and pin 5; this voltage is in turn proportional to the resistance of VR1 between the positive line and the slider. In the circuit of Fig. 1, the frequency of oscillation is set to 10Hz, 100Hz, 1kHz, 10kHz, 100kHz



▲ The finished waveform generator with its direct reading dial. The necessary components to produce a ramp waveform can be added to the circuit board. For converting triangular waveforms to sinewaves a separate unit is required.

◀ Fig. 1: Circuit of generator producing square and triangular waves over a wide range of frequencies.

or 1MHz (depending on the range) when the slider of VR1 is set at 10.0. At other settings of the dial, the frequency is closely proportional to the dial setting. For example, a dial setting of 5.67 on the 1kHz range produces an output of 567Hz.

Many types of capacitor (especially electrolytic types) have very wide tolerances in their capacitance value. It is therefore necessary to calibrate the frequency at one point on each range to obtain accurate frequency readings. In the circuit of Fig. 1 this is accomplished by the adjustment of a different trimmer potentiometer (VR2 to VR7) for each range used. The switch which selects the trimmer, S1a, is ganged with that which selects the range capacitor, S1b.

FREQUENCY COVERAGE

The frequencies available from the six adjustable ranges employed are shown in Table 1. The upper frequency limit of 1MHz is determined by the characteristics of the integrated circuit used. In the table it has been assumed that a frequency range of 20:1 may be covered using any one capacitor. However, more accurate frequency settings may be obtained by limiting the coverage of each range to 10:1, as was done in the prototype.

RANGE	CAPACITOR	FREQ. COVERAGE
1	10 μ F	0.5Hz-10Hz
2	1 μ F	5Hz-100Hz
3	100nF	50Hz-1kHz
4	10nF	500Hz-10kHz
5	1nF	5kHz-100kHz
6	100pF	50kHz-1MHz

TABLE 1. Total frequency coverage possible with six capacitors. In practice each range is reduced to a ratio of 10:1.

The writer has found that a frequency range of about 30:1 is about the limit with any one capacitor. At settings of the frequency dial of less than about 0.3 the output waveforms become distorted, whilst oscillation ceases at settings below about 0.25. It was noted that the square waveform at 1MHz was somewhat distorted. The lowest frequency range in the prototype was 0.5 to 10Hz and it is assumed that most readers will not require frequencies below this value. Extra ranges can easily be added if required. However, an additional trimming potentiometer must be included in the S1a circuit for each extra range. A 100 μ F capacitor in the S1b circuit can be used to produce a range of 0.05 to 1Hz, a 1000 μ F capacitor a range of 0.005 to 0.1Hz and a 10000 μ F capacitor a range of 0.0005 to 0.01Hz (0.0005Hz is one cycle in about 33 minutes).

When using very large capacitors, check that their leakage current is not excessive. The lowest possible frequency is probably about one cycle every few hours, but the writer has not tried to obtain frequencies quite as low as this. Some industrial applications may be found for generators of extremely low frequencies.

CONSTRUCTIONAL NOTES

The basic oscillator circuit of Fig. 1 was constructed in an Eddystone die-cast box of approximate dimensions 4 $\frac{1}{2}$ x 3 $\frac{1}{2}$ x 2 $\frac{1}{4}$ in. (Cat. 6908P). The Helipot VR1 and switch S1 are mounted in the base of the box and the circuit board along one of the

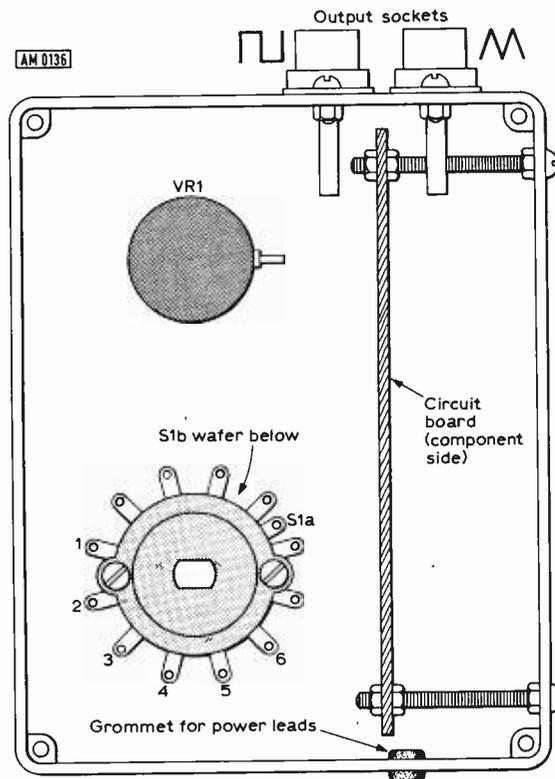


Fig. 2: General layout of components in the die-cast box.

longer sides Fig. 2. No components were mounted on the lid of the box since this procedure enables the lid to be removed without the inconvenience of having wires between it and the main part of the box.

The six miniature Beckman trimmer potentiometers are mounted on the circuit board Fig. 3, their connecting tags being inserted through holes in the board and bent over before the connecting wires are soldered. The integrated circuit socket is also mounted on the circuit board by passing the pins through holes in the board and soldering the connections to them.

C1 is mounted on the circuit board, but C2 to C7 are mounted around the switch S1. No power supply was included in the box, since it is generally more convenient to employ an external 12V battery. However, a mains power supply could be included if a rather larger box is employed.

If the circuits for the ramp and short pulse generator are required, they must be included in the basic oscillator unit itself. However, if the triangle-to-sine wave converter is made, it will probably be more convenient to construct it on a separate circuit board.

CALIBRATION

The best way of calibrating the frequency settings involves the use of a digital frequency meter which automatically counts the pulses from the oscillator over a timed period. Alternatively a pulse counter may be used with a manually operated stop watch.

Calibration may also be carried out using a good oscilloscope with a calibrated time base. Alternatively the calibration may be set by adjusting the

trimming potentiometers so that the output 'zero beats' with the signal from a calibrated generator. At higher operating frequencies harmonics of the square wave output may be allowed to beat with a radio signal, using a receiver.

If very low frequency ranges are incorporated in the unit, the operating frequencies are best determined by connecting a voltmeter across the square wave output and timing the movements of the meter needle.

It is normally best to calibrate the unit at a point near to the highest frequency on each range. The linearity of the resistance of VR1 with the dial setting is very good (better than 0.25%). However, the writer has found that the frequency of oscillation of the NE566V may depart from linearity by up to about $\pm 1\%$ at the lower frequencies in each range.

If a constructor does not like an instrument in which the oscillation ceases at the very low frequency end of each range, it is possible to set the dial so that it reads from 1.0 to 11.0. In this case a 100 ohm resistor, preferably of 0.5% tolerance, should be inserted between the upper end of VR1 and the positive supply line in Fig. 1 so that the readings are directly related to the frequency of oscillation. Operation in this way is likely to increase the errors in the frequency settings, since the percentage linearity tolerance of a precision helical potentiometer is typically about ten times better than the resistance value tolerance.

OUTPUTS

The circuit of Fig. 1 provides good square waves and also linear triangular waves, both at 50 ohm output impedance. These outputs are adequate for many applications, since the triangular waves can

often be used instead of sine waves when their harmonic content is not disadvantageous.

Both of these output waveforms are superimposed on steady positive potentials. The latter can be removed by capacitive coupling except at low frequencies where it is difficult to obtain an adequate time constant to preserve the waveform. The average potential of either of the output waveforms can be made equal to earth potential by employing a power supply consisting of suitable positive and negative supply voltages both isolated from earth.

TRIANGLE-TO-SINE CONVERSION

If a sine wave with a relatively low harmonic content is required, a diode-resistor shaping network may be employed. A fairly complex circuit is required if the shaping must be carried out reasonably accurately. A simpler solution involves the use of the conversion circuit described below.

At a fixed gate voltage, the first part of the drain characteristic of a junction field effect transistor (FET) approximates to half a sine wave. However, further increase of the drain voltage produces little effect on the drain current. The first part of this characteristic can be employed to shape a triangular wave into a reasonably good sine wave. If a triangular wave is applied to this circuit the positive going part of this waveform will produce a drain current of half a sine wave. In order that both the positive and negative parts of the triangular wave shall produce the corresponding parts of a sine wave, the type of circuit shown in Fig. 4 may be employed. This utilises the fact that the drain and source electrodes of an FET are essentially interchangeable.

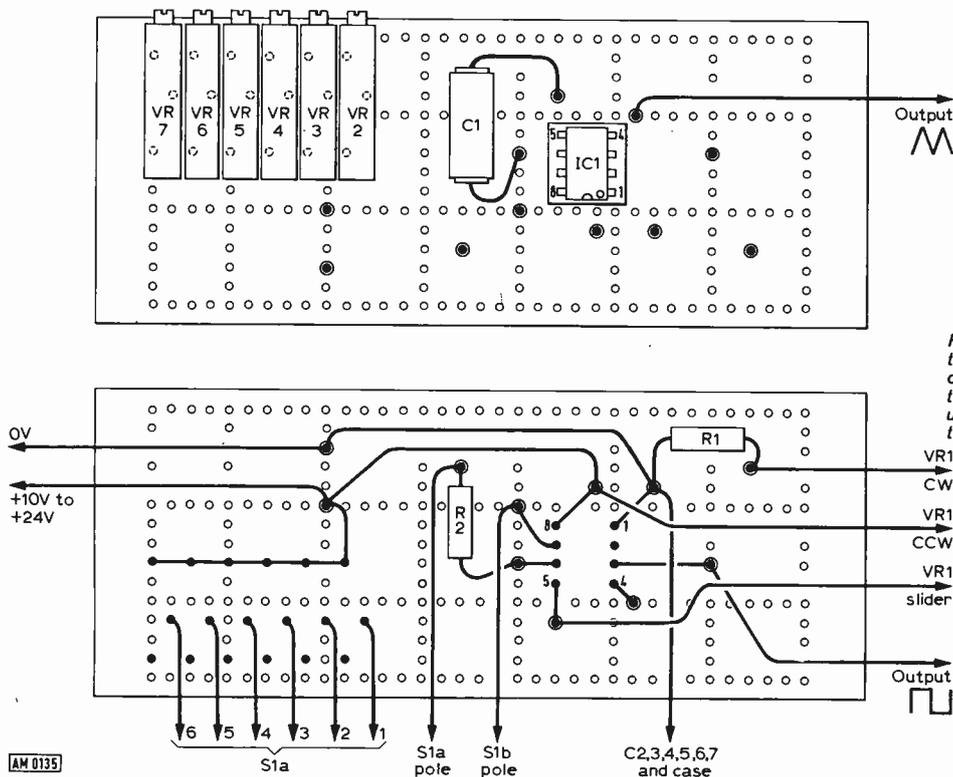


Fig. 3: Veroboard pins are used to support the few components on the circuit board. The trimmer potentiometers are used to adjust the calibration of the six frequency ranges.

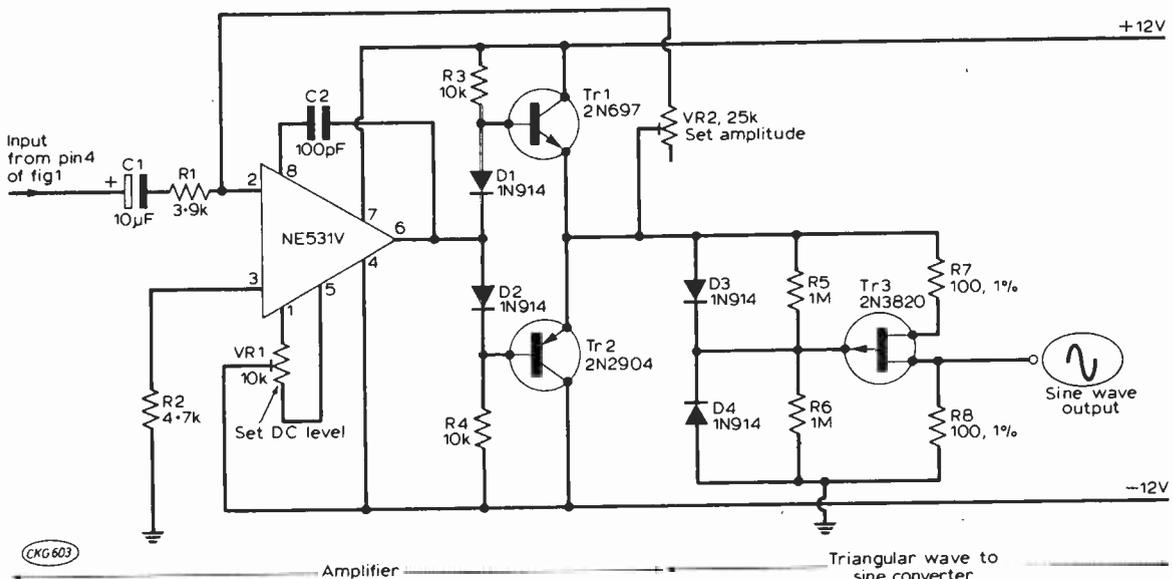


Fig. 4: Suitable circuit for converting a triangular wave to a sine wave.

PRACTICAL SINE CONVERTERS

It should be clear that the amplitude of the triangular wave applied to the circuit of Fig. 4 is quite critical if one requires a good sine wave output. If the input to this circuit is too large in amplitude, the output pulses will have fairly flat sections in place of the normal sine wave peaks. If the input amplitude is too small, the output will be approximately the same form of triangular wave as the input.

It must therefore be possible to alter the amplitude of the triangular wave fed to the circuit of Fig. 4. In addition, the output impedance of the source of the triangular waves must be small and there must be no steady voltage superimposed on the triangular waves. An amplifier of variable gain and of low output impedance is therefore employed between the output of the 566 circuit and the input of the triangle-to-sine converter.

CONVERTER CIRCUIT

The circuit of a practical triangle-to-sine wave converter is shown in Fig. 4. The triangular wave input from the circuit of Fig.1 is capacitively coupled to the input of a Signetics NE531V high slew rate operational amplifier; it therefore follows that this circuit is unsuitable for use at very low frequencies with the values shown, since the coupling time constant would be inadequate.

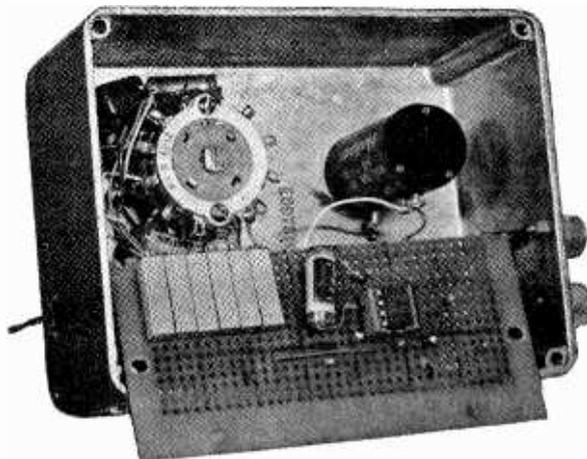
The complementary output transistors Tr1 and Tr2 provide a low impedance output to the converter circuit of Tr3. The preset potentiometer VR1 is set so that the potential at the emitters of Tr1 and Tr2 is zero volts when no input is applied to the circuit.

The voltage gain of the circuit of Fig. 4 from the input to the emitters of Tr1 and Tr2 is equal to the resistance of VR2 divided by R1. The amplified triangular wave is applied to the circuit of Tr3, the operation of which has already been discussed. The author found that the sine wave output voltage was of the order of 0.7V peak to peak and that it has no steady component superimposed on it.

The gain control, VR2, must be set carefully so that the output waveform shows minimum distortion, adjusting the gain whilst examining the output waveform by means of an oscilloscope. If, however, a waveform analyser is available, VR2 may be adjusted for minimum third harmonic distortion.

A satisfactory sine wave was obtained using fixed resistors for R7 and R8. However, one of these resistors may be replaced by a 50 ohm resistor in series with a 100 ohm preset trimmer so that the output may be adjusted for minimum second harmonic distortion (preferably using a waveform analyser). It should then be possible to obtain a sine wave output with very low distortion.

The writer tried replacing the NE531V integrated circuit with a μ A741V which has the same connections. It was found that the NE531V could operate at higher frequencies, but in neither case could satisfactory operation at 1MHz be obtained.



The secret of the direct frequency read-out lies in the use of the multi-turn Hellpot potentiometer, right centre.

A simple circuit using two cascaded emitter followers for driving an FET triangle-to-sine converter was published in the February 1973 issue of *Wireless World*. However, a circuit with voltage gain is required when the triangular wave output from a 566, operated from a 12V supply, is to be converted into a sine wave.

RAMP WAVEFORM GENERATORS

The circuit of Fig. 1 can be easily converted into a generator which produces either a rising or a falling linear ramp waveform. At the end of each ramp the output quickly returns to its initial level and another ramp commences.

In order to produce a rising ramp waveform, the capacitor connected to pin 7 is allowed to charge, but at the end of the charging period it is rapidly discharged. The ramp waveform appears at pin 3 of the 566 in place of the triangular wave. A falling ramp is produced in a similar way; at the end of the discharging period, the capacitor connected to pin 7 is rapidly re-charged.

RAMP CIRCUITS

Fig. 5 shows the components which must be added to the circuit of Fig. 1 to allow either rising or falling ramps to be produced. When the switch S2 is in position 1, the additional components shown dotted are not used and the circuit therefore provides the normal square and triangular output waveforms. When S2 is in position 2, a falling ramp waveform is generated, whilst in position 3 a rising ramp is formed. Short negative going pulses are available at pin 4 when S2 is in position 2 and short positive pulses when S2 is in position 3.

Let us now consider in detail the operation of the falling ramp generator when S2 is in position 2.

If the output from pin 4 is in its high voltage state, little current passes through D1 of Fig. 8. The base and emitter of Tr1 are therefore at about the same potential and this transistor passes little

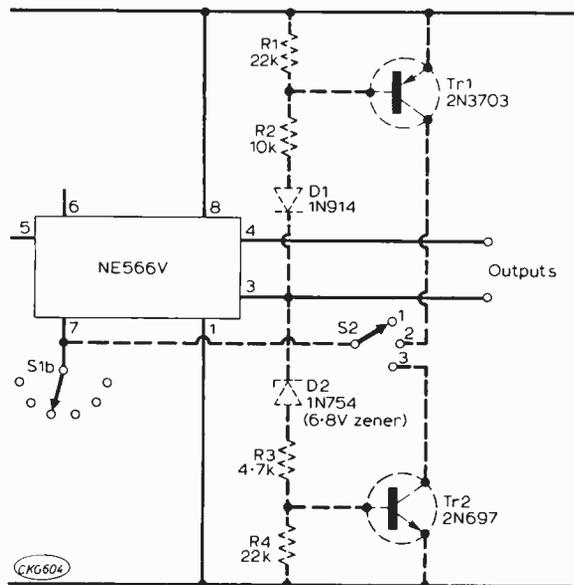


Fig. 5: Additional circuitry, shown dotted, to produce rising or falling ramp waveforms.

★ components list

R1 3.6kΩ 5% ½W R2 2.7kΩ 10% ½W
 VR1 1kΩ 0.25% linearity (Beckman 'Helipot' Type 7246)
 VR2-7 5kΩ trimmer pots (Beckman Type 89P)
 C1 1nF C2 100pF C3 1nF
 All 25V polystyrene
 C4 10nF C5 100nF C6 1μF
 All 25V polyester
 C7 10μF 24V electrolytic

Miscellaneous

IC1, NE566V (Low cost alternative is LM566—Ambit International), 8 pin DIL socket. S1, 2 pole, 6 way rotary switch. Turns counting dial for Helipot (Beckman Type RB). Die-cast box (Eddystone Type 6908P). Piece of plain veroboard. (Note: VR1 with dial and VR2-7 available from Athena SMC Ltd., 140 High Street, Egham, Surrey).

Basic Components for Triangular-Sine Wave Converter

R1 3.9kΩ R2 4.7kΩ R3 10kΩ
 R4 10kΩ R5 1MΩ R6 1MΩ
 All 10% ½W
 R7 100Ω R8 100Ω
 Both 1% ½W
 VR1 10kΩ VR2 25kΩ (Beckman Type 89P)
 C1 10μF 15V C2 100μF 15V
 D1-4 1N914 Tr1 2N697 Tr2 2N2904
 Tr3 2N3820 NE531V (Low cost alternative is LM318H—check leadout connections)

Basic Components for Ramp Wave Converter

R1 22kΩ R2 10kΩ
 R3 4.7kΩ R4 22kΩ
 All 10% ½W
 D1 1N914 D2 1N754 (6.8V)
 Tr1 2N3703 Tr2 2N697

current. The output from pin 3 therefore falls linearly with time, unaffected by the additional components.

When the output from pin 4 falls to its low voltage state, however, D1 conducts and the base of Tr1 becomes negative. This PNP transistor therefore conducts and rapidly charges the capacitor selected by S1b. The voltage at pin 3 therefore rises rapidly to its maximum value before a further falling ramp is generated.

The output from pin 4 consists of short negative going pulses which occur each time the ramp waveform at pin 3 rises to its maximum value. These waveforms are shown in Fig. 6. When the capacitor selected by S1b is small, the negative going pulses at pin 4 were found to be about 0.2μs in length.

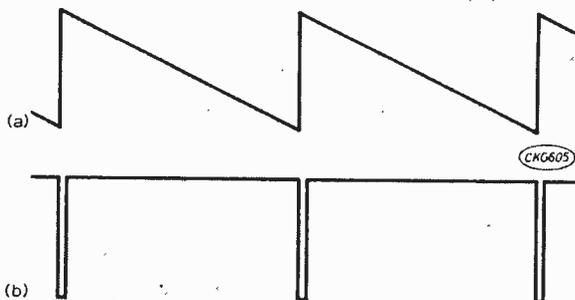


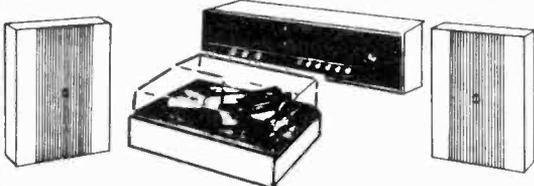
Fig. 6: Waveforms obtainable from the circuit of Fig. 5.

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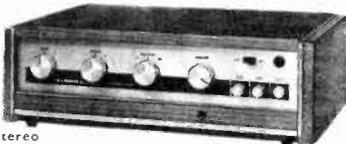
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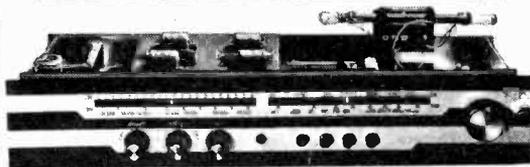
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When a large capacitor is in circuit, however, it takes longer to charge from the current passing through Tr1. Nevertheless, the time for which the waveform at pin 4 is in its low voltage state is a very small fraction of the total operating time.

The operation of the rising ramp generator, when S2 is in position 3, is rather similar. When the output at pin 4 is in its low voltage state, the zener diode D2 passes little current and Tr2 remains cut off. During this time the ramp waveform at pin 3 is rising.

When the voltage at pin 4 switches to its upper level, however, the zener diode conducts and Tr2 receives a positive bias at its base. This NPN transistor therefore conducts and rapidly discharges the capacitor selected by S1b. The potential at pin 3 therefore returns quickly to its lowest level and the ramp commences to rise again.

The output from pin 4 consists of short positive pulses which occur each time the ramp at pin 3 returns to its lowest level.

The rising ramp generator was found to give a poor waveform on the 1MHz range. However, the rising and falling ramp generators both operated satisfactorily on the other ranges and also at very low frequencies. The writer tried them at frequencies down to about 0.01Hz and at such frequencies the waveform takes a fraction of a second to return at the end of each ramp.

When either of the ramp generators is employed, the one half of the triangular waveform is eliminated. The frequency of oscillation of the 566 is therefore approximately doubled when S2 is in position 2 or 3. Constructors who intend to use the unit mainly for ramp waveform generation may wish to calibrate the unit so that the ramp frequency can be read directly from the Helipot dial. The dial reading must then be halved to obtain the frequency of the triangular or square wave.

APPLICATIONS

The fundamental frequencies from the waveform generator can be used to test the functioning of audio amplifiers; they also cover the long wave band and the low frequency end of the medium wave band. In addition, the outputs contain harmonics (mainly odd harmonics) which can be used to test the functioning of radio receivers throughout the medium wave band and also at somewhat higher frequencies.

Both the triangular waves and the ramp waveforms are very suitable for the detection of cross-over distortion in audio amplifiers, since these waveforms are essentially linear. If the triangular wave output is fed to the input of an audio amplifier which introduces cross-over distortion in its output stage, the type of waveform shown in Fig. 7a is obtained. The values of the resistors in the audio amplifier which control the quiescent current in the output stage may be altered so as to increase this current slightly; the cross-over distortion should disappear when the quiescent current is sufficient.

It is easier to detect cross-over distortion when using the triangular or ramp waveforms than when the more conventional sine wave is employed. A frequency in the mid-audio region is ideal for this test (perhaps 1kHz). The linearity of the waveform on the oscilloscope screen may be measured by placing a straight edge along the tips of the waveform.

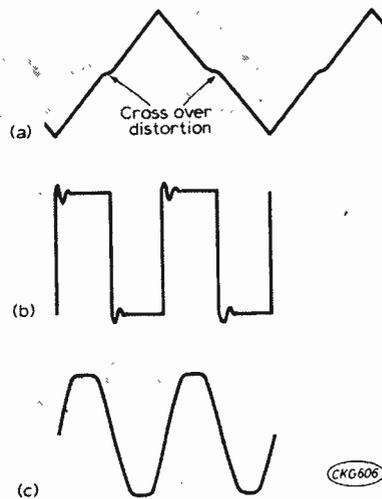


Fig. 7a-b-c. Waveforms at the output of an audio amplifier using input signals from the waveform generator.

The square wave output is also very useful for testing audio amplifiers. At fairly high frequencies one may examine the output from an amplifier for ringing of the type shown in Fig. 7b. Ideally there should be no overshoot or ringing. An audio amplifier which can faithfully reproduce a square wave at a frequency of about 10kHz must have a good frequency response in the high audio frequency region since square waves contain many harmonics and will be reproduced satisfactorily only if the amplifier has a fairly level response at frequencies of up to at least three times the fundamental frequency of the square wave.

If an audio amplifier has only a moderately good high frequency response, the corners of the output waveform will be rounded off at 10kHz, as shown in Fig. 7c. An approximate value for the frequency response of the amplifier may be obtained by estimating the time taken for the output waveform from the amplifier to rise from 10% to 90% of its final value. The maximum frequency at which the response is reasonably constant is of the order of $1/(3 \times \text{the rise time})$. If the rise time of a square wave is very short, one sees only the lines at the top and bottom of the oscilloscope display, the rising and falling parts of the waveform being so short that they are barely visible.

One can also use the square wave output from the 566 unit to examine the low frequency response of audio amplifiers. As one reduces the frequency of the square wave, the upper and lower parts of the output waveform do not remain horizontal, but develop a definite slope. At very low frequencies, a differentiated waveform will be obtained. The input of the oscilloscope marked 'DC' should be used for these low frequency tests, since the 'AC' input is connected to a series capacitor inside the oscilloscope which may distort the waveform.

In the audio amplifier tests discussed above, it has been assumed that the amplifier under test has a volume control at its input which can be adjusted to provide the required signal output level. At high levels it will be necessary to include a series capacitor in the input circuit to block the steady voltage at the 566 outputs. In this case care should be taken to ensure that the coupling time constant is adequate for the lowest frequency to be employed. ■

DRY BATTERY CHARGER

R.A.Butterworth

MOST of us either make or buy a mains supply unit to operate our battery tape recorders, receivers etc., when used at home to save the cost of dry batteries. However batteries are still needed around the home and unfortunately they seem to cost more each time. One could of course use rechargeable cells but they are expensive and need a rather special charging unit which is also expensive.

If we could get a few more hours out of our dry battery we could cut our costs considerably, even one more 'run' would be equivalent to cutting the cost by a half. With the charging units described here two, three or more 'lives' can be given to a set of batteries, perhaps not quite as long a period of operation as the first but certainly for periods long enough to make the building of a charger show an economical return for the effort involved.

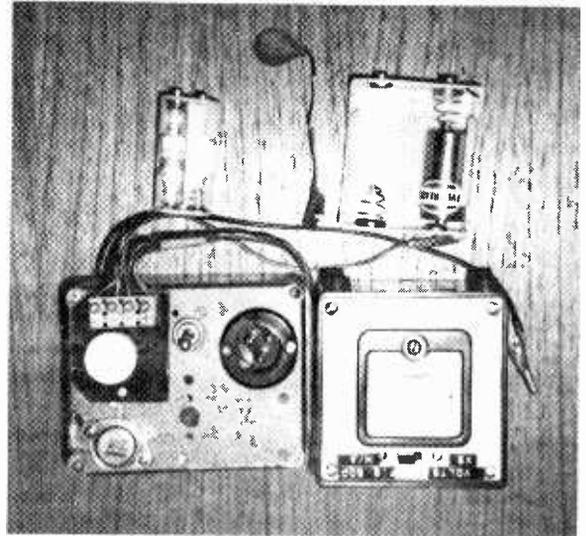
The idea of reforming dry cells is by no means new. Investigation of the possibilities were made as long ago as the early 1950's with encouraging results. With modern methods of manufacture and materials, the life of the primary cell can be considerably extended if a few basic rules are born in mind. These are:

- 1 The battery must be charged before its voltage (on load) drops from 1.5V to below 1V.
- 2 It must be put on charge as soon as possible after being removed from service and put into service as soon as possible after re-charge.
- 3 It is not economical to charge a single unit, a 1.5V 'pen light' HP7 for example. Therefore it is better to have one set of batteries in service and another on charge.
- 4 The charging rate should be adjusted to distribute the charge, in other words avoid heating up the cell by charging at too high a current.
- 5 If there is the slightest suspicion of battery leakage throw them away or you will have a horrible mess to clear up.

The cylindrical types like the U2, U11 and HP7, respond much better than the layer batteries, such as the PP3. The use/charge cycle is less than half that of the cylindrical types. The table gives details for popular zinc-carbon types which have responded successfully to several use/charge cycles with the equipment shown.

Battery holders

Standard battery holders can be used to hold the cells whilst charging in blocks of 2, 4, or 6. From experience it would appear that, after setting at the current shown, if after the first couple of hours there



is no drop in the charging current, then discard the battery as the electrolyte has probably dried out. If the batteries get appreciably warm or show signs of leaking throw them out. Different sets of batteries have given a different number of cycles. This, the author believes, is due to 'freshness' of the unit cells when first purchased; in other words how long they had been on the shelf in store.

DRY BATTERY CHARGING

Battery	Use	No. of Cells	Charging Current mA		Approx. hours of charging	No. of cycles
			Min.	Max.		
U2	Torches, Hand lamps, Radios	2	150	300	5	3
		4				
		6				
U7	Small Torches, Radios	1 or 2	100	150	4	4
		4				
U11	Cassette Tape Recorders	4	100	250	5	4

In the circuits shown in Figs. 1 and 2 it will be noted that very little smoothing of the d.c. output has been incorporated. This is deliberate; investigation has shown that it is advantageous to have a little a.c. present. This "dirty d.c." appears to shake up the electrolyte and therefore assists in the reforming.

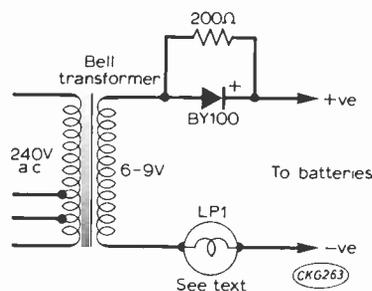


Fig. 1: Circuit shows a simple charging unit.

—continued on page 1061

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AD161/2	89p	OC71	20p	1N4001	6p
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BC108	10p	2N1711	24p	1N4003	7p
BC109	10p	2N2219	25p	1N4004	71p
BC147	10p	2N2648	45p	1N4005	8p
BC148	10p	2N2905	33p	1N4006	81p
BC149	12p	2N2907	25p	1N4007	9p
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15 63 6p	150 40 10p	10 4000 6p	100 4 6p
22 10 6p	100 25 6p	10 5000 6p	100 4 6p
22 25 6p	220 4 6p	10 10000 6p	100 4 6p
22 63 6p	220 10 6p	10 15000 6p	100 4 6p
33 6.3 6p	220 16 6p	10 20000 6p	100 4 6p
33 16 6p	220 25 10p	10 30000 6p	100 4 6p
33 40 6p	220 40 12p	10 40000 6p	100 4 6p
47 4 6p	220 63 15p	10 50000 6p	100 4 6p
47 10 6p	330 4 6p	10 75000 6p	100 4 6p
47 25 6p	330 10 6p	10 100000 6p	100 4 6p
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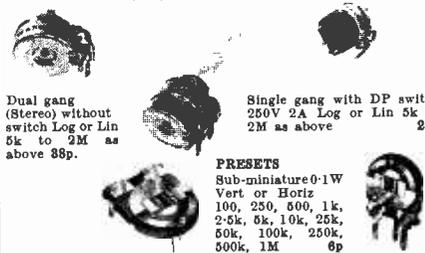
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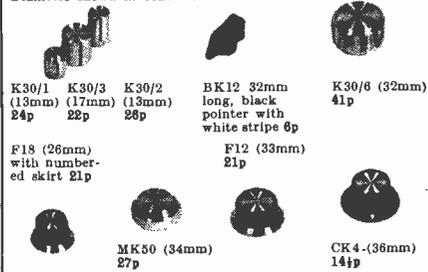
Carbon Film 1/4W 5% 1 Ω to 1M; 10% 1-2M to 10M E12 1p
Carbon Film 1/4W 5% 1 Ω to 10 Ω; 10% 1-2M to 10M E12 1p
Carbon Film 1/4W 5% 1 Ω to 910 Ω E12 & E24 1p
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Metal Oxide 1/4W 2% 10 Ω to 10M E12 & E24 4p
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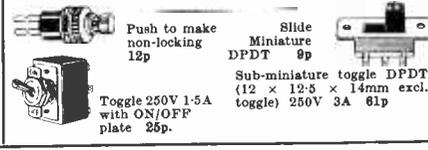
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Fig. 2 is a more elaborate unit and in the author's case serves two purposes; A dry battery charger and mains unit for various equipment used in the shack. Should additional smoothing be required then it is a simple matter to add this. It is advisable to install the meter permanently so that the charging current can be monitored. A d.p.d.t. switch with a suitable shunt series resistor would enable both voltage and the current to be monitored. Diode D6 provides for reversal protection and prevents the battery discharging through the 470Ω resistor.

Zinc-carbon batteries are very amenable to re-charging.

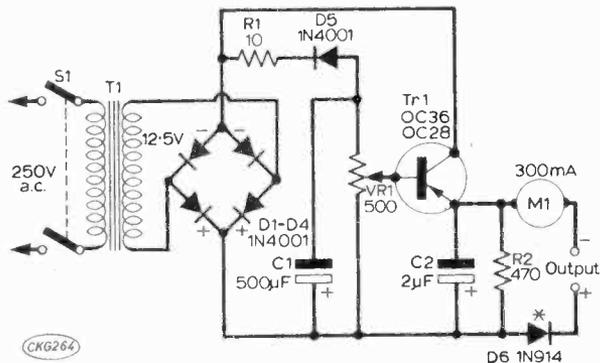


Fig. 2: A more elaborate design.

★ components list (Fig. 2)

R1	10Ω ½W
R2	470Ω 1W
VR1	500Ω 3 W linear wirewound
C1	500μF 20V
C2	2μF 20V
Tr1	OC36, OC28 or similar rating
T1	Mains transformer 12.5V 1A secondary
D1-D4	1N4001 diodes
D5	1N4001 diode
D6	1N914 diode (see text)
M1	Meter 300mA f.s.d.
S1	Double-pole on/off toggle switch
LP1	3.5V or 6.5V 0.1/0.2A (Fig. 1)

NEXT MONTH

An Automatic Battery Charger for 12 volt car batteries.

TELEVISION

IN THE MARCH ISSUE

ASSEMBLING A MODULAR COLOUR SET

There are various ways of going about building a colour receiver. One approach is to make use where possible of manufacturers' surplus units. David Robinson describes the set he built on this basis and how the various problems of interfacing different units not originally intended for use together were overcome.

LOG-PERIODIC SET-TOP AERIAL

A simple log-periodic set-top aerial can be made using printed circuit board. Full constructional details will be provided.

TV SET SAFETY

With the introduction of the BEAB television receiver testing system and BS415:1972 there has been a tightening up in safety requirements. It is essential that anyone handling TV sets should be aware of what is involved. A detailed account starts next month.

FAULT FINDING

John Law looks at the power supply and line timebase circuits used in BRC 15in. dual-standard portable models. These make excellent second sets.

PHASE IN COLOUR TV

The phase of the chrominance signal indicates the colour being transmitted; phase is thus the key to colour television. A special article next month describes the basic technique and PAL signal processing, paying particular attention to practical points that are not always made clear.

PLUS ALL THE REGULAR FEATURES

Details of the March issue are subject to the current national situation at the time of going to press.

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Please reserve/deliver the MARCH issue of TELEVISION (25p) and continue every month until further notice.

NAME

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PRODUCTION LINES

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JOSTY KITS

Our Advertisement Manager has asked me to point out that Swanley Electronics will not be supplying "Josty" kits as per their December advertisement.

HEATHKIT CATALOGUE

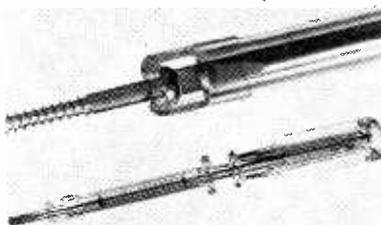
The latest catalogue from Heath (Gloucester) Limited contains details of the company's kits and some new models featured for the first time include the GR-990 12in. Black and White Television kit for either 12V or mains operation; the GD-39 Home Intrusion Alarm, disguised as an unobtrusive book — an ultrasonic burglar alarm/surveillance system; the CR-1008 a.m. Radio and the CM - 1045 Small Engine Tune - up Meter.

Also included are the 10-104 Solid State 15MHz Oscilloscope; IB-1103 180MHz Frequency Counter; the GC-1005 Electronic Digital Clock which incorporates a 'snooze' alarm; the CR9502 Push-Button a.m. Car Radio and the IC-2108 Desk Top Electronic Calculator.

Readers may obtain their free catalogue by writing to *Heath (Gloucester) Limited, Bristol Road, Gloucester, GL2 6EE.*



SCREW DRIVING BOON



Thunder Screw Anchors Ltd. announce an addition to their range of screwdrivers by the introduction of four screwholding screwdrivers. Two are suitable for slotted head screws and two for recessed head screws, their dimensions being 8½in. and 9¼in. overall length, 3/16in. and ¼in. blade diameter respectively. The screw is firmly held at the tip of the screwdriver by sliding the spring-loaded shank over the head of the screw, (see picture) leaving one hand free to hold the article to be fixed. It is possible to fix screws or bolts in the most difficult of places, where to hold a screw in the hand might normally be impossible.

Prices, excluding V.A.T. are 20372 and 20376 69p each, 20374 and 20378 79p each.

We understand that due to the shortage in the foreign plastics industry, supplies of these screwdrivers may be subjected to extended delay. However, this firm does have some further useful and novel tools that would be of interest to readers. Supplies are through retail outlets. *Thunder Screw Anchors Ltd., Victoria Way, Burgess Hill, Sussex, RH15 9NF.*

MICROELECTRONICS

We apologise to Microelectronics for being unable to include their advertisement in the Feb. issue. If readers refer to this month's issue, page 1028, they will see that the company markets the Minicomp 100 Random Number Selector. When the button

on the front panel is pressed, numbers are displayed at high speed on a Nixietube read-out before a random number is displayed—in effect a miniature "ERNIE".

The circuit includes 6 TTL logic i.c.'s and three transistors and the manufacturers say that typical applications include number selection for dice, roulette, bingo etc. Price of the Minicomp 100 kit is £42.50. A fully assembled version is available at £45.00.—*Microelectronics, 51 Mexfield Road, London, SW15 2RG. (Tel. 01-870 2368).*

ONE-HAND DESOLDERER

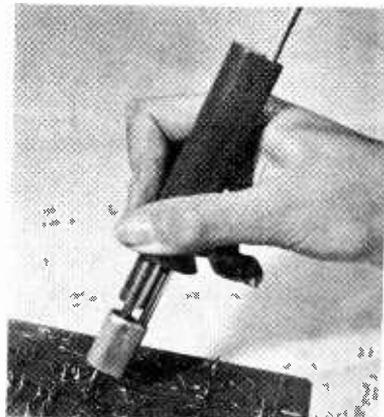
When desoldering, have you ever wished you had three hands? Well, here is something that will brighten your day!

Only one hand is required to operate the Picard soldering/desoldering iron. The whole body of the tool forms a suction tube which is pressed down towards the job during heating and released to produce suction.

The unit has a rating of 20W and uses an 8V supply, a transformer being available if required. For desoldering, it reaches a temperature of 340°C in four minutes. Only three minutes' heating is however required for soldering. The heating element is sealed with a ceramic insulating paste which, by preventing burning and corrosion, prolongs its life quite considerably.

The bit is made of alloy steel and molten solder is sucked through it by the release of the spring-loaded body. The faster the release, the stronger the suction. The solder collecting chamber is easy to clean out while the bit is still warm.

A soldering stand is supplied with every tool and the price of the complete unit is £6.49. *Henry Picard & Frere Limited, 357/359 Kennington Lane, London, S.E.11.*



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- H4 250 Mixed Resistors. Approx. quantity counted by weight P & P 15p 55p
- H35 100 Mixed Diodes, Germ. Gold bonded, etc. Marked and Unmarked. 55p
- H38 30 Short Lead Transistors, NPN Silicon Planar types 55p
- H39 6 Integrated Circuits. 4 Gates BMC 962, 2 Flip Flops BMC 945 55p
- H41 2 Sil Power transistors comp pair BD131/132 55p



Unmarked Untested Paks

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- B66 150 Germanium Diodes Min. glass type 55p
- B84 100 Silicon Diodes DO-7 glass equiv. to OA200, OA202 55p
- B86 100 Sil. Diodes sub. min. IN914 and IN916 types 55p
- H16 15 Experimenters' Pak of Integrated Circuits, Daja supplied 55p
- H20 20 BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts. 55p
- H34 15 Power Transistors, PNP, Germ. NPN Silicon TO-3 Can. 55p

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The 'TACHO BLOCK'. This encapsulated block will turn any 0-1mA meter into a linear and accurate rev. counter for any car with normal coil ignition system.

£1-10p each

Ex GPO Push Button Intercom Telephones

Exactly as internal telephone systems still in everyday use where automatic internal exchanges have not yet taken over. Available in 5, 10 or 15 ways. Complete with circuits and instructions. Necessary 24 pair cable 22p per yard. Price of each instrument is independent of the number of ways.

£2.75 p.p. 38 1/2p Per Instrument

Cable can be sent by Parcel Post. Post and Packing per 50 yds. 73 1/2p. Extension Telephones. 71 1/2p each. p.p. 27 1/2p. £1.37 1/2 for 2. P & P. 55p. These phones are extensions and do not contain bells.

A Cross Hatch Generator £3-85 post paid

A complete kit of parts including Printed Circuit Board. A four position switch gives X-hatch, Dots, Vertical or Horizontal lines. Integrated Circuit design for easy construction and reliability. A project in the Sept. '72 edition of Television.

New Paks

- TESTED & GUARANTEED**
- H63 4 2N3055 type NPN Sil. power transistors. Below spec. devices 55p
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 - H67 10 3819N Channel FETs plastic case type 55p

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TYPE "B" PNP Silicon, plastic encapsulation
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Plastic Power Transistors



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- Range 1. VCE. Min 15. HFE Min 15.
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 - 40 Watt 22p 20p 18p
 - 90 Watt 26 1/2p 24 1/2p 22p
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- 1-12 13-25 26-50
 - 40 Watt 33p 31p 29p
 - 90 Watt 38 1/2p 36 1/2p 33p

Complementary pairs matched to within 3 amps. 11p extra per pair. Please state NPN or PNP as reqd.

LM380 Audio I.C. as featured in *Practical Wireless* Dec. Issue, complete with application data £1-10p.

INTEGRATED CIRCUITS

We stock a large range of I.C.s at very competitive prices (from 11p each). These are all listed in our FREE Catalogue, see coupon below.

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This fantastically detailed conversion calculator carries thousands of classified references between metric and British (and U.S.A.) measurements of length, area, volume, liquid measure, weights etc.

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To meet demand, we have included a more powerful module in our well-established and proven range. All these power amplifiers are carefully assembled, tested and guaranteed. They offer superb value for reliability and versatility.



SA35 35 watts RMS. Uses 7 transistors and 7 diodes. Carr. paid. **£4.45**

SA50 50 watts RMS. 7 transistors, 7 diodes. Carr. paid. **£5.65**

SA100 makes an ideal unit in disco assemblies. A real glutton for work. Reliable, tough and compact, 11 transistors, 6 diodes. Carr. paid. **£10.90**

BRIEF SPEC. FOR ALL THREE MODULES

All modules incorporate OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in the SA.100.

Freq. response	15-40,000 Hz \pm 1dB
Distortion	0.2% at 1kHz
Loads	4 to 16 ohms
Quiescent current	15 mA
Noise	Better than -75dB
Supply voltage	SA35 45 volts SA50 45-65 volts SA100 40-70 volts
Size	4 1/2" x 4" x 1 1/2" (SA100) 4" x 3" x 1 1/2" (SA35/SA50)

Circuits, connecting instruction and application data are supplied free with all modules.

POWER SUPPLIES

FOR THE SA35, SA50 AND SA100 POWER AMPS. ABOVE

PU.45 Unstabilised supply for 2 SA35's **£4.90**

PU.70 Unstabilised supply for one or two SA50 or SA100 Carr. 40p **£7.75**

PS.45 Stabilised module for two SA35's or one SA50 Carr. free **£3.50**

MT.45 Transformer for above, heavy duty Carr. 20p **£2.85**

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TRADE & EXPORT ENQUIRIES INVITED

SAXON P/A MIXER CONTROL UNITS

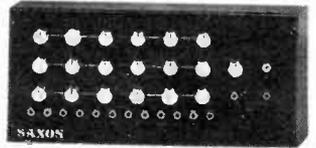
In extra slimline easy-fit case

Using grouped pairs of inputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master controls. These low-noise units will feed all makes of amplifiers, making them ideal for clubs, discos etc. Standard Jack sockets. Compact design. In strong metal cases. All units guaranteed for 3 years.

● **HIGH AND LOW IMPEDANCE INPUTS**

● **BASS/TREBLE/VOLUME ON EACH PAIR**

● **MASTER CONTROL ON OUTPUT**



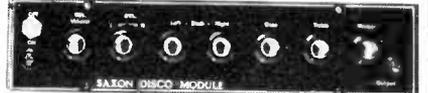
● **M4H** 4 high Z, 4 low Z inputs, 4 sets of controls. Case 10" x 8" x 2 1/2". Carr. paid. + V.A.T. **£18.50**

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Channel section modules, for building your own: gain-16 x (24dB). Tone controls-18dB swing. Carr. paid. + V.A.T. **£3.50**

CONTROL UNITS — Unbeatable for quality & value

EXCITING NEW STEREO VERSION. MK. II With Mic. override and case (carr. 30p) **£19.75**



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GENERAL PURPOSE DYNAMIC MIC. Professional quality. Special offer carr. paid **£9.90**

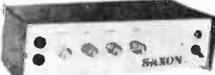
120 WATT HEAVY DUTY MODULE

Rugged class A driver stage. This module will run from all our mixers, etc., and most other makes. Delivers 120 watts into an eight ohm load and employs 4 TO3 can (t15 watt) output transistors.

SPECIFICATION Power output 120 watts into 8 ohms
Freq. response 20-20,000 Hz \pm 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.

Module & power supply (Carr. 40p) **£18.95**

● **160 watt version** with power supply **£27.90** (Carr. 50p)



3 CHANNEL UNIT

Includes bass, middle and treble as well as master controls. 2 amplifier sockets eliminate need for split leads. Up to 3kW lighting load. Smartly finished steel case. Carr. 30p. **£19.75**

SOUND AND LIGHT UNITS

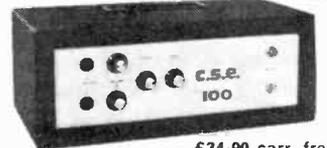
Our popular 3 channel model handles up to 3kW (3000 watts) of lighting and incorporates versatile sound control arrangement to enable professional standards to be achieved. Both units are excellent examples of Saxon quality and value.

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Operates from 5 to 100 watt amplifiers. Supplied for bass note operation, is easily adapted for treble or mid-range at a cost of about 5p. Carr. pd. **£7.50**

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The versatile unit is now available in a black vinylde 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.



£34.90 carr. free



SAXON 100

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. **£48.50** carr. free

LOUDSPEAKERS British made bargains!!

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J. ANDREWS

crystal

HARMONIC CALIBRATOR

CRYSTAL calibrators have always found wide application with radio amateurs and short wave listeners. They fill a need for low cost frequency measurement and now that the price of transistors and integrated circuits is at an all time low, may be constructed relatively cheaply, depending upon the source of components. The crystal, if purchased new, should cost no more than £1.50-£2.00.

The object was to design a unit which would provide 1MHz, 100kHz, 10kHz markers at good strength to at least 30MHz or higher. The calibrator to be described will, when used with the average receiver, provide strong frequency markers to above 30MHz and will give markers as high as 144MHz at reduced level.

OPERATION

The crystal oscillator runs at 1MHz and is based on the Colpitts circuit. In the design, good stability results in respect of both temperature variation and variation of supply rail voltage. In order to maintain this performance silver mica capacitors are specified for C2 and C3. The crystal in the prototype required about 40pF in series and this is made up by C1 plus TC1. If necessary, C1 can be altered to suit different crystals.

The output from the crystal oscillator is taken from the collector of Tr1. The waveform is roughly a sine wave and in order to drive the dividers must

be squared. Tr2 acts as a buffer amplifier and is biased into saturation on positive half cycles. This gives a square wave output of five volts peak to peak, which is used to drive the dividers.

The SN7490N (IC1-IC2) are TTL logic binary dividers and contain two gates and four bistables. They are used in this circuit to divide the 1MHz square wave by a factor of ten, giving in the first case 100kHz and in the second 10kHz. The output is a square wave of five volts (approx.).

The three outputs, one from each divider and the 1MHz waveform from Tr2 buffer are selected by S1 and are used to drive IC3 and Tr3. These stages form the harmonic generator.

HARMONIC GENERATOR

From a pulse rising at an infinite rate an infinite frequency spectrum could be derived, and if the pulse were to be repetitive at some frequency, say 1MHz, then the spectrum would be related to the repetition rate of the pulse. However after the rise the pulse amplitude must decay again in time for next transition. If the decay is fast and at half the pulse repetition time then obviously a square wave would result. This could be shown to contain, in a pure case only, odd harmonics of the basic repetition rate. Now if the decay point were to be shifted from the half repetition rate time, then the even harmonic content would become apparent. Therefore in generating both odd and even harmonics of a fre-

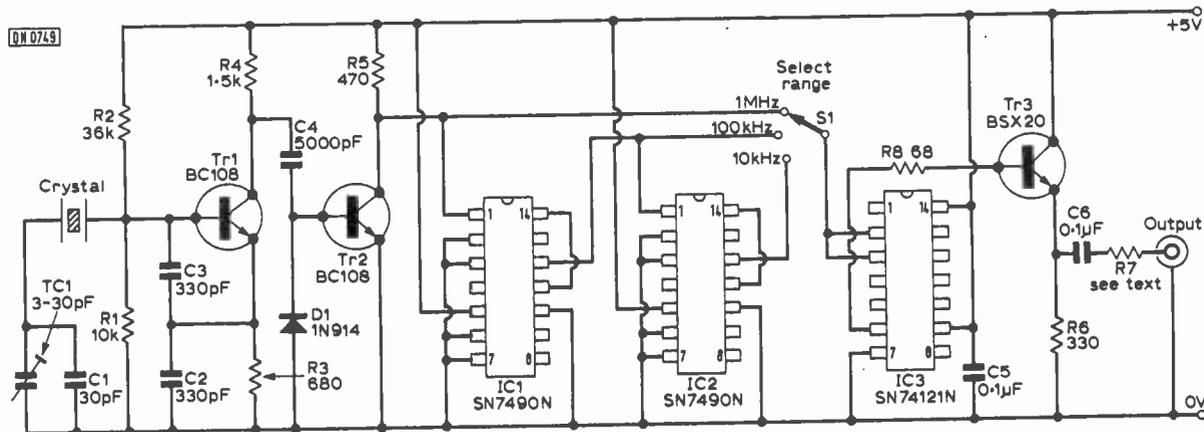


Fig. 1: Circuit of the calibrator

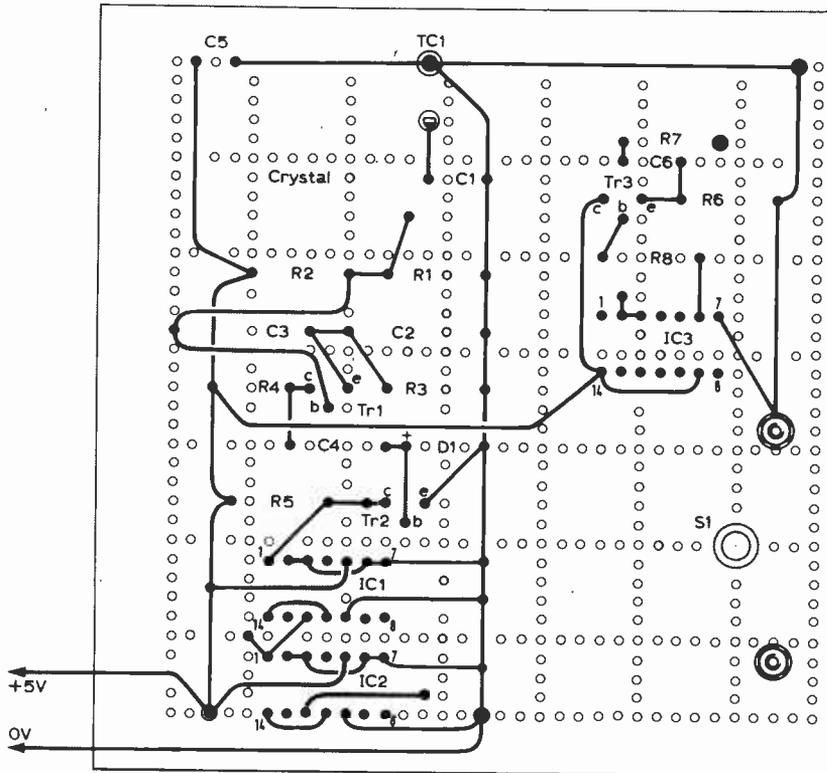
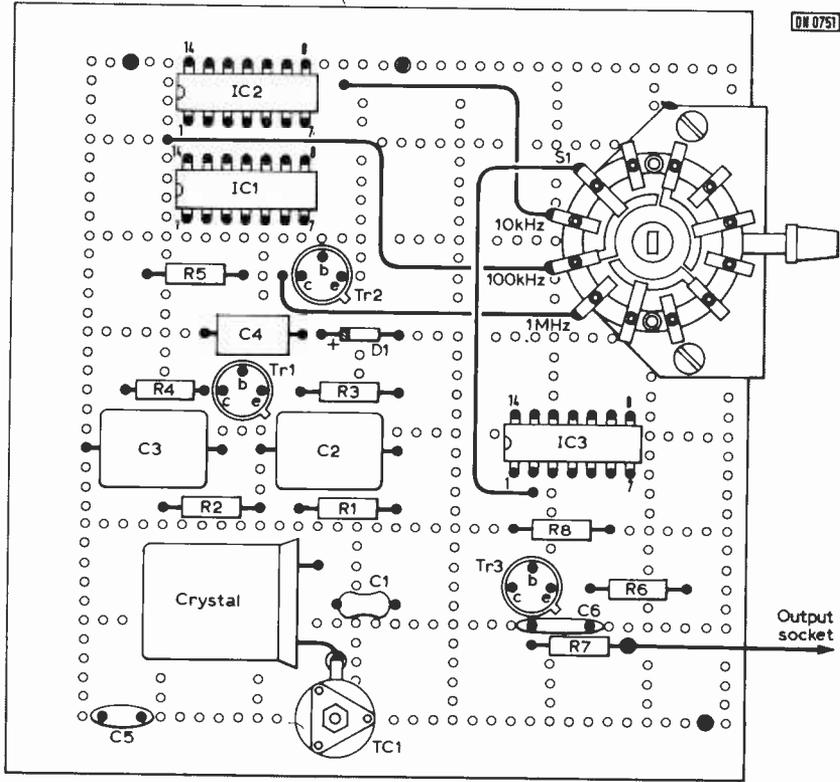


Fig. 2: Veroboard layout for the i.c. crystal harmonic calibrator

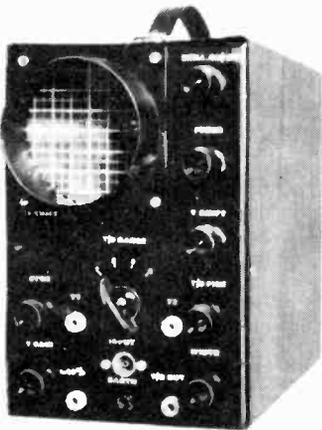
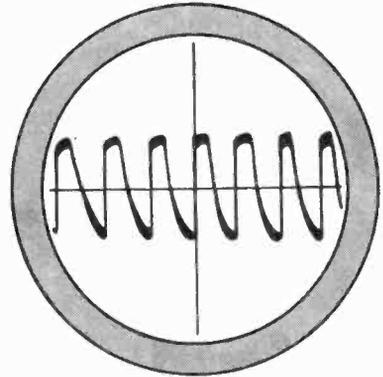
—continued on page 1069

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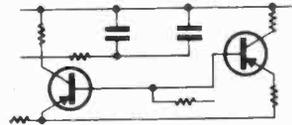
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This new style course will enable anyone to really understand electronics by a modern, practical and visual method—no maths, and a minimum of theory—no previous knowledge required. It will also enable anyone to understand how to test, service and maintain all types of electronic equipment, radio and TV receivers, etc.

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General purpose A.F. test osc. covering range sine and square 10c/s to 100Kc in 4 decade ranges, features include stabilised amplitude sine and sq. low o/p impedance, L.E.D. on indicator, both O/Ps fully variable and available simultaneously, fast sq wave rise time, all parts supplied and no special equipment required for construction and calibration, leaflet available on request. Requires PP9 batt. or 9v supply not supplied. Available in kit form only.
Price £18.20

Scope American Service Type TS.34

Portable general purpose scope uses 2" tube with magnifier single beam, uses 11 valves, Y amp 10c/s to 2 Mc/s, T.B. 20 Usec to 100 MII/Sec, as fine and coarse Y atten, supplied with leads in transit container, also copy of service manual, tested. Note these are for 115v 50c/s but are supplied with a 240/110 Auto trans. Few only.
Price £23.65

Signal Generators

Marconi type TF144G covers range 85Kc to 25Mc/s in 8 bands. O/P 1 Vv to 1 volt, fitted O/P meter to read RF and Modulation, supplied tested with circ and Inst book, for 200/250v mains. Note supplied less R.F. connecting lead (mains lead supplied).
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Variable O/P DC P.U.

O/P variable from 0 to 26v DC smoothed at up to 3 amps uses silicon rect and variac, supplied with circ. Note for use on 115v 50c/s supplied with 240/115v Auto trans, American surplus.
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V.H.F. Test OSC Type 210

Test osc covers range 20 to 88Mc/s in 4 bands, also as noise generator, 2 Mc/s xtal check, var pulse mod. complete in case with chart. Req 250v HT and 6.3v to operate.
Price £5.50

Batteries

Lead Acid type Aircraft batteries 24v 25 Amp/Hr made up of 2 12v units in carrying case, new with instructions.
Price £10.20

Altimeter T.S.

Modern unit contains mains P.U. giving 250v 60 Ma and 6.3v, 4x valves, 2 panel meters sq tube 100Ua FSD and centre reading type, 1600 Mc/s absorb W.M. ass, also large number of high grade parts inc 1% conds etc, good cond in case.
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Low Speed Motors

For use on 230v 50c/s have two stage g.b. to give O/P speed of 1.15 RPM, reversible, good quality enclosed motor, ex equip.
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Vidicon Camera Tubes

Standard type 1" Industrial grade by E.E. and E.M.I. supplied with data sheet graded according to scan marks.
Price type A £9, B £6

W.M. and OSC Type OAP

Radio Radar T.S. covers range 150 to 230 Mc/s as Osc and Absorb W.M. also as Int dummy load 50 ohms and provision for connection of scope. Supplied new boxed with Inst and spares kit. Note for use on 115v 240/115v Auto trans supplied, American surplus.
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quency or rate, the main functions governing them are the rise or transition time of the pulse and its duration with respect to repetition rate.

It can now be seen that the principal requirement for a harmonic generator is that it must generate a pulse with a rapid transition or rise time which is as narrow as possible with respect to the repetition rate.

A number of methods exist whereby a fast pulse may be generated, these include tunnel diodes, reverse recovery effect of diodes, fast switching transistors etc.

For ease and cheapness the method used here is a standard SN74121N monostable (IC3) which drives Tr3 the emitter follower into saturation. The SN74121N has provision for external timing components, but none are used here. This gives a pulse width of 30-40nS. The output rise time (transition time) is quoted as 10nS, but this is speeded up considerably by Tr3, which is a high speed switching device. Tr3 also provides a low output impedance.

The 75Ω resistor R7 is worth mentioning. The output impedance of the emitter follower (Tr3) is not governed directly by R6. It is in fact much lower than this and for matching purposes may be taken as zero. If it is desired to pass the signal along a coaxial line or to use an attenuator then R7 should be chosen to match the impedance of the cable in use, in the range of 50-300Ω. However, many people will simply want to connect receivers or to squirt the output into a few feet of wire in which case make R7 50Ω.

POWER SUPPLIES

The limiting factors here are the integrated circuits. The voltage required is five volts $\pm 10\%$. The design of the oscillator assures stability to within a few Hz for a $\pm 20\%$ change in supply potential. This should not however present too great a problem as many constructors now run some form of equipment from which a five volt supply could be borrowed to operate the calibrator.

Fig. 3 shows the circuit of a simple stabiliser for use with this calibrator.

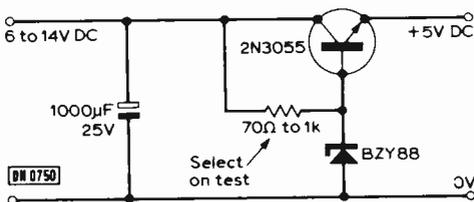


Fig. 3: Simple stabiliser

CONSTRUCTION

Building the calibrator should not present any problems, all components may be assembled on perforated board of suitable matrix. However in order to realise the best h.f. performance the leads around IC3 Tr3 should be kept as short as possible and the output socket wired direct to Tr3 emitter. In particular, ensure that the output lead from pin 6 of IC3 is short and direct to Tr3 base.

The crystal, if of a miniature type, may be fastened to the board and secured with a loop of wire. Solid

vibration free wiring in the crystal oscillator circuit will avoid microphony. If S1 cannot be wired direct to the board, all leads to it should be kept short. When completed and tested the board may be fitted in a small metal case or die-cast box.

★ components list

Resistors

R1	10kΩ	R5	470Ω
R2	36kΩ	R6	330Ω
R3	680Ω	R7	50-300Ω
R4	1.5kΩ	R8	68Ω

Capacitors:

C1	30pF silver mica
C2	330pF silver mica 2%
C3	330pF silver mica 2%
C4	5000pF polystyrene
C5	0.1µF ceramic
C6	0.1µF ceramic
TC1	3-30pF Philips trimmer

Semiconductors:

Tr1	BC108	
Tr2	BC108	Texas Instruments
Tr3	BSX20	

Integrated Circuits

IC1	SN7490N	
IC2	SN7490N	Texas Instruments
IC3	SN74121N	

Miscellaneous

S1	1 pole 3 way
	Crystal 1Mhz HC6U or similar

TESTING

Connect a suitable five volt supply to the calibrator and couple the output to a receiver (b.f.o. on) tuned to 1MHz. If all is in order a marker will be heard. Tune the receiver throughout its range and check that markers are present. Switch S1 to 100kHz and check that there are 100kHz markers present. Switch to 10kHz and carefully check that 10kHz markers are present.

If no markers are present on any range first check the oscillator circuitry. If markers appear only at 1MHz intervals check the dividers for a fault.

The simplest way of controlling the injection of markers to a receiver is to vary the coupling. Obviously the markers are less strong around 30MHz and the coupling may have to be increased. Direct coupling without the use of an attenuator is likely to overload the receiver and may introduce spurious responses. A little experiment will reveal the best method of operation.

Once the unit has been checked the frequency may be accurately set against WWV or MSF on either 2.5, 5.0 or 10MHz. The calibrator should be rechecked from time to time against the standard frequency services to maintain its accuracy. TC1 may be adjusted as necessary to maintain this accuracy. ■

**We regret that the
December 1973 issue
of Practical Wireless
is now out of print**

PORTABLE FLUORESCENT LAMP UNIT

A FURTHER DESIGN

PAUL COOPER

A 12 volt d.c. portable fluorescent lamp unit is a very useful piece of equipment to own—especially in these days of power cuts! This article describes an alternative to the unit described in the December 1973 issue of *Practical Wireless*. There is the bonus that it is easier to build the circuit on a standard piece of veroboard than to produce a special printed circuit board and, by using a ready made transformer, reduces the cost.

TRANSFORMER

A transformer specifically for 12 volt inverters to run fluorescent tubes from car batteries is available from G. F. Milward* for only 50p + post packing & VAT. It saves the time taken to wind the transformer, which is something which might put off the inexperienced amateur from building the project.

The revised circuit diagram is shown opposite.

The circuit is basically the same as in the original article except for the extra tertiary winding on the transformer which is connected in parallel with capacitor C3. The unit will work without this winding connected but in the circuit shown it tunes the transformer thus producing a better output.

It is most important that terminals 1, 2, 3 & 4 of the transformer are connected to the right points on the circuit diagram (as shown by the dots) since if, say, 3 and 4 are reversed the circuit will not oscillate. To cure this, should it occur, connections 3 and 4 should be interchanged and the circuit should then oscillate. (For the complete setting-up procedure see the original article.)

LAYOUT

The Veroboard layout is shown opposite for 0.1 inch matrix veroboard. The board size is the same as for the original printed circuit board so no problems should occur in mounting this board in the completed unit. Note that the fixing hole in this circuit board is in a different place to that of the original board, so a different hole will have to be drilled in the unit case.

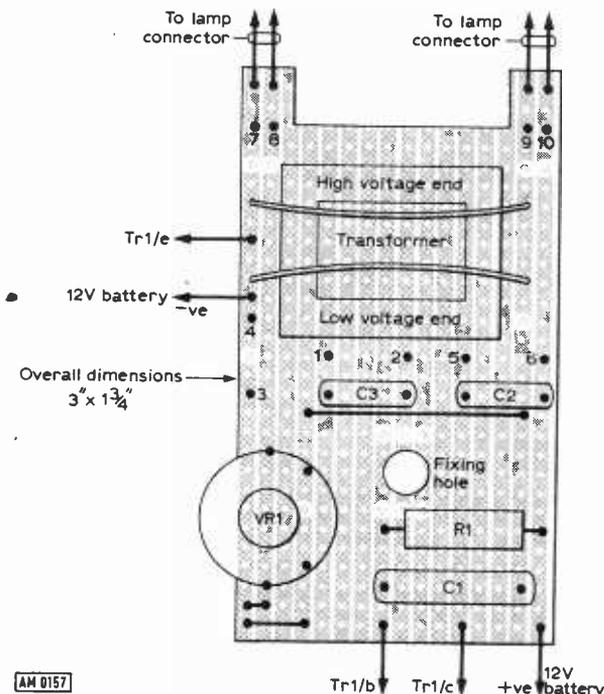
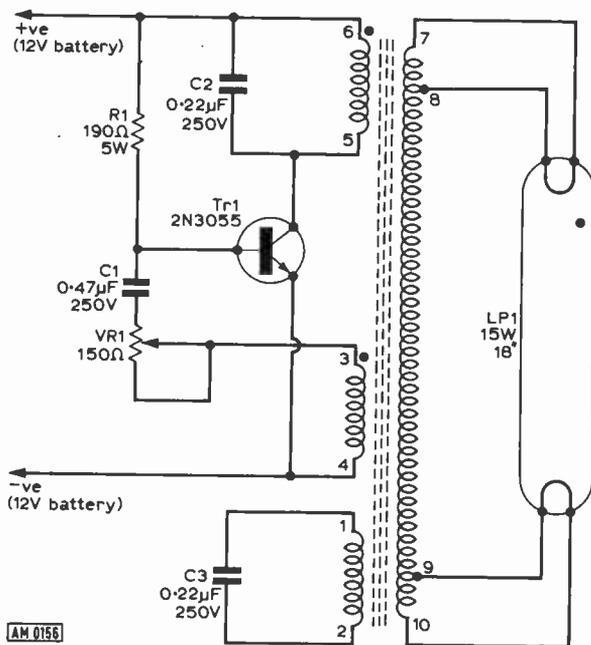
The transformer is fixed to the circuit board by two links of insulated copper wire as shown in the circuit board layout diagram.

Resistor R1 should be mounted about 1/4 in clear of the circuit board and clear from C1 as it gets hot! Since drilling of the holes for the legs of potentiometer VR1 cuts the circuit board tracks completely, care must be taken to ensure contact when soldering the legs in.

Exact values of R1 and VR1 are not very critical. Values were chosen because of availability.

As my unit was built primarily as an emergency light for use in power cuts, the case has been designed to stand on a table with the tube vertical, and it is made of wood.

* G. F. Milward, 369 Alum Rock Rd, Birmingham, B8 3DR.



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THE 'SLIMLINE' 5-BAND RECEIVER

This unusual receiver is designed to give five ranges from 160kHz to 27MHz, using simple plug-in coils to cover broadcast and amateur transmissions. Only eight transistors are used, and, with a telescopic aerial the "Slimline" becomes a versatile a.m. receiver to take almost anywhere.



The above details are subject to the current national industrial situation at the time of going to press.

1071

CASSETTE RECORDER AND TUNER... AMPLIFIER



THIS constructional feature describes a stereo-multiplex AM/FM tuner-amplifier providing 10 watts RMS output per channel into 8Ω loads with facilities for incorporating a cassette tape recorder. The integrated unit provides very good results which, although not to true high fidelity standards, will give satisfying listening for a moderate outlay.

Facilities on the prototype included full Band II FM coverage together with one preset AM station and an input for a ceramic cartridge. Additional circuitry and printed boards are shown in this article so that inputs for magnetic cartridge and tape heads can be accommodated, together with record/playback connections for a cassette or reel-to-reel tape recorder. Additional tuning capacitors may also be fitted along with a selector switch to provide more extensive AM coverage. The AM section uses an internal ferrite aerial, but an external aerial may be added if required. The stereo decoder incorporates automatic mono/stereo switching and stereo beacon lamp drive.

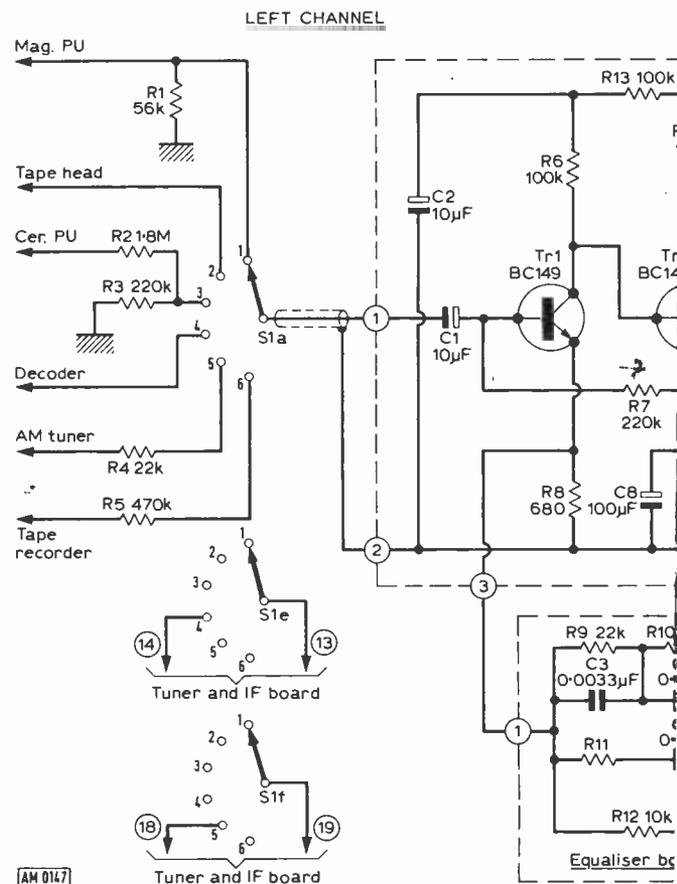
The complete unit is built up on five main circuit boards. The power supply is built directly onto the chassis which is constructed from aluminium angle and strip. The following unit numbers will be used as a prefix to identify components which are mounted off the circuit boards:—

- 1 Pre-amplifiers
- 2 Power amplifiers
- 3 Tuner and IF
- 4 Stereo decoder
- 5 Power unit and input/output sockets.

The front panel is fashioned from 3mm Perspex, using Letraset marking and gives a very professional finish to the unit.

The complete circuit uses 3 integrated circuits, 19 transistors and 7 semiconductor diodes. The FM tuner head is a Mullard module, simplifying construction and greatly reducing alignment problems.

PART 1





RICHARD COLLIN

★ Performance Specification

AMPLIFIER

- Power output:** 10 watts RMS per channel into 8Ω
- Frequency response:** 20Hz to 30kHz \pm 3dB at full power
50Hz to 20kHz \pm 1dB (power amplifier)
- Channel separation:** 54dB at 1kHz and 10 watts
- Noise:** -60dB at 10 watts (ceramic cartridge input)
- Total harmonic distortion:** < 0.2% at 1kHz and 10 watts
- Tone controls:** Bass \pm 16dB at 50Hz
Treble \pm 14dB at 15kHz

F.M. TUNER

- Frequency range:** 88 to 104MHz
- Channel separation:** 40dB

PRE-AMPLIFIER (UNIT 1)

The inputs from the various programme sources, attenuated and matched as necessary by R1-R5, are selected by S1a (S1c for the Right channel). Transistors Tr1 and Tr2 are connected as a high-gain pair and amplify the input signals to a level sufficient to drive the tone control circuit. The bias resistor R7 for the first stage may need to be selected for optimum operation. This will be dealt with in a later part of the article. Its final value should lie between 120 and 270kΩ.

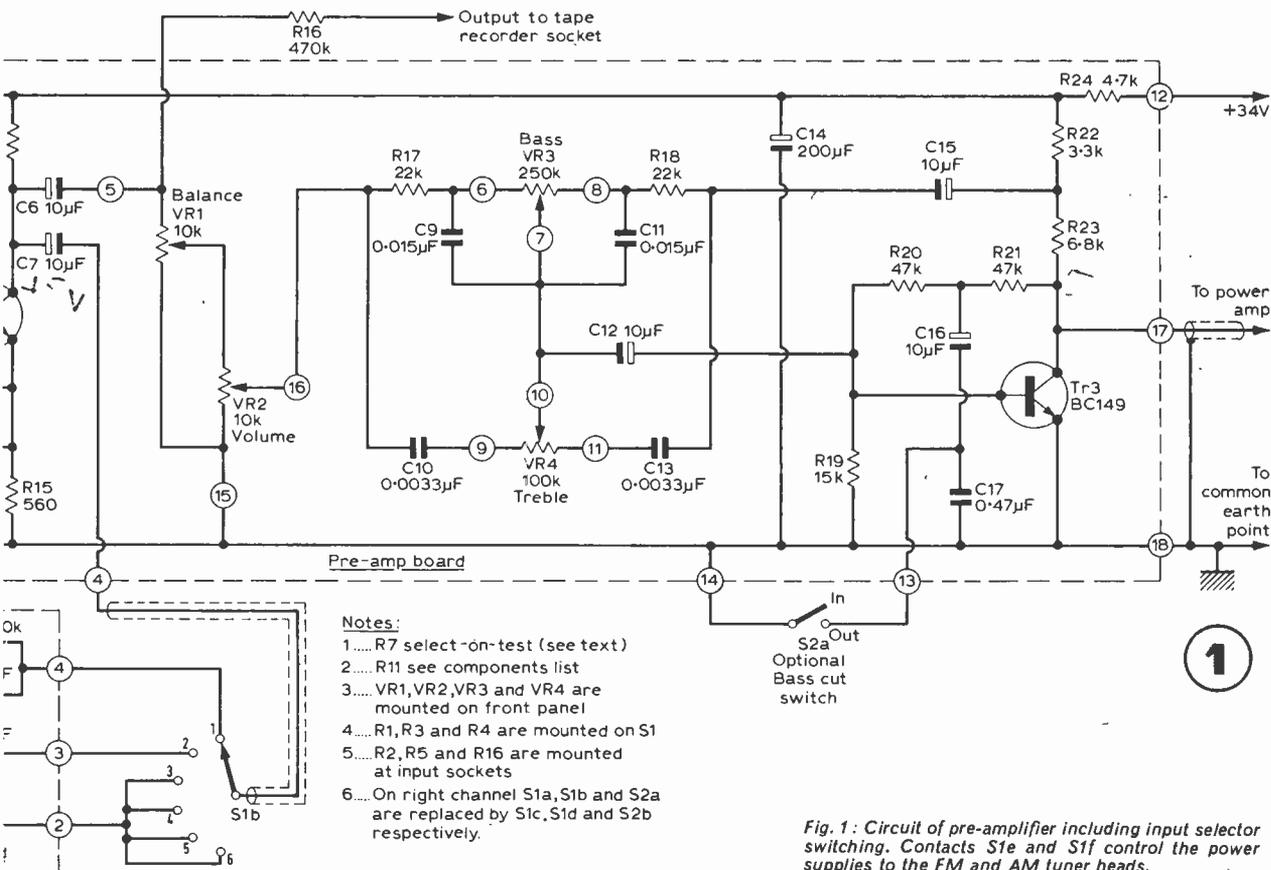


Fig. 1: Circuit of pre-amplifier including input selector switching. Contacts S1e and S1f control the power supplies to the FM and AM tuner heads.

★ components list

*1 1/2 move w/ly + 2 1/2 ...
fr the organ II = 2 1/2*

PRE-AMPLIFIERS

Resistors

R1 56kΩ	R10 560kΩ	R17 22kΩ
R2 1.8MΩ	R11 22kΩ for 1 1/2 ips	R18 22kΩ
R3 220kΩ	R12 12kΩ for 3 1/2 ips	R19 15kΩ
R4 22kΩ	R13 10kΩ	R20 47kΩ
R5 470kΩ	R14 12kΩ	R21 47kΩ
R6 100kΩ	R15 560kΩ	R22 3.3kΩ
R7 220kΩ*	R16 470kΩ	R23 6.8kΩ
R8 680Ω		R24 4.7kΩ
R9 22kΩ		

* See text

All resistors 1/2W 5% carbon film
 VR1 10kΩ dual lin VR3 250kΩ dual lin
 VR2 10kΩ dual log VR4 100kΩ dual lin

Capacitors

C1 10μF 16V	C7 10μF 16V	C13 3300pF
C2 10μF 16V	C8 100μF 10V	C14 200μF 30V
C3 3300pF	C9 0.015μF	C15 10μF 16V
C4 0.01μF	C10 3300pF	C16 10μF 16V
C5 0.01μF	C11 0.015μF	C17 0.47μF
C6 10μF 16V	C12 10μF 16V	

Non-electrolytic capacitors should be polyester or polystyrene

Semiconductors

Tr1 BC149 Tr2 BC148 Tr3 BC149

NOTE—With the exception of the four dual-ganged potentiometers, two sets of the above components are required for the two channels.

Miscellaneous

S1 6 pole, 6 way, 3 wafer rotary switch
 S2 DPST miniature toggle switch

Pre-amplifier printed circuit board
 Equaliser printed circuit board

POWER AMPLIFIERS

Resistors

R1 91kΩ	R6 10kΩ	R11 0.47Ω 2.5W w/w
R2 100kΩ	R7 47Ω	R12 0.47Ω 2.5W w/w
R3 22Ω	R8 100Ω 2.5W w/w	R13 10Ω
R4 470Ω	R9 100Ω 2.5W w/w	All 1/2W 5% Carbon
R5 470Ω	R10 10Ω	film unless stated otherwise

VR1 50kΩ
 VR2 100Ω miniature presets (horizontal mounting)

Capacitors

C1 25μF 25V	C4 0.01μF 100V	C7 200μF 30V
C2 47μF 40V	C5 0.22μF 100V	C8 1,500μF 25V
C3 1,000μF 25V	C6 0.001μF 750V	C9 0.047μF 100V

Semiconductors

Tr1 BC158 Tr4 2N6288 (RCA)
 Tr2 BC148 Tr5 2N6111 (RCA)

Tr3 2N6288 (RCA)
 Tr3, 4 and 5 are supplied with the necessary mounting hardware

NOTE—Two sets of the above components are required for the two channels.

Miscellaneous

Printed circuit board. Heat sinks and brackets (see Figs. 8 and 9)

NOTE—RCA Semiconductors for this project are available from E.C.S. (Windsor) Ltd., Thames Avenue, Windsor, Berks.

Total requirements are: 2 2N6111 at 50p
 5 2N6288 at 54p
 1 CA 3089 E at £1.96
 1 CA 3090 Q at £4.23

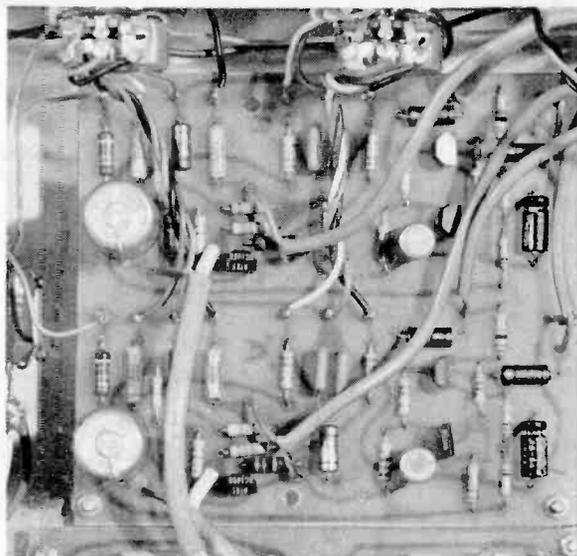
Add 40p post and packing per order and 10% VAT

Feedback around Tr1/Tr2 provides high stability and is also used to set the gain and, for the magnetic pick-up and tape-head inputs, the frequency response. The appropriate feedback path is selected by S1b (S1d for the Right channel). The value of R11, which with C5 provides equalisation for the tape-head input, must be chosen according to the tape speed to be used.

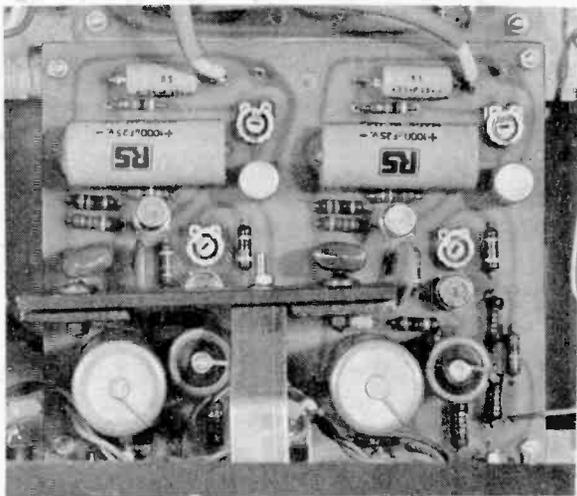
A constructor not requiring the full complement of input facilities may of course omit the unwanted circuitry and connectors.

An output is taken via R16 for connection to a tape recorder, allowing recording of a programme being played through the amplifier (subject to the provisions of the Copyright Act, 1956). The signal at this point is equalised but is unaffected by the Volume and Tone controls. Because of the high value of R16, the two channels can be paralleled at the input of a mono recorder with only slight worsening of stereo crosstalk within the amplifier.

The tone controls are in the familiar Baxandall configuration, providing both lift and cut at bass and treble frequencies. Transistor Tr3 is the active



Prototype boards for the pre-amplifier (above) and power amplifier (below)



element of this stage and also makes up for the losses incurred by the frequency selective circuits. A bass cut or rumble filter may be provided by removing the short circuit from across C17.

Ensure correct polarity of the electrolytic capacitors when assembling the circuit boards. In the R7 position fit 220kΩ resistors, leaving the wires long as the value may need to be changed later. Once

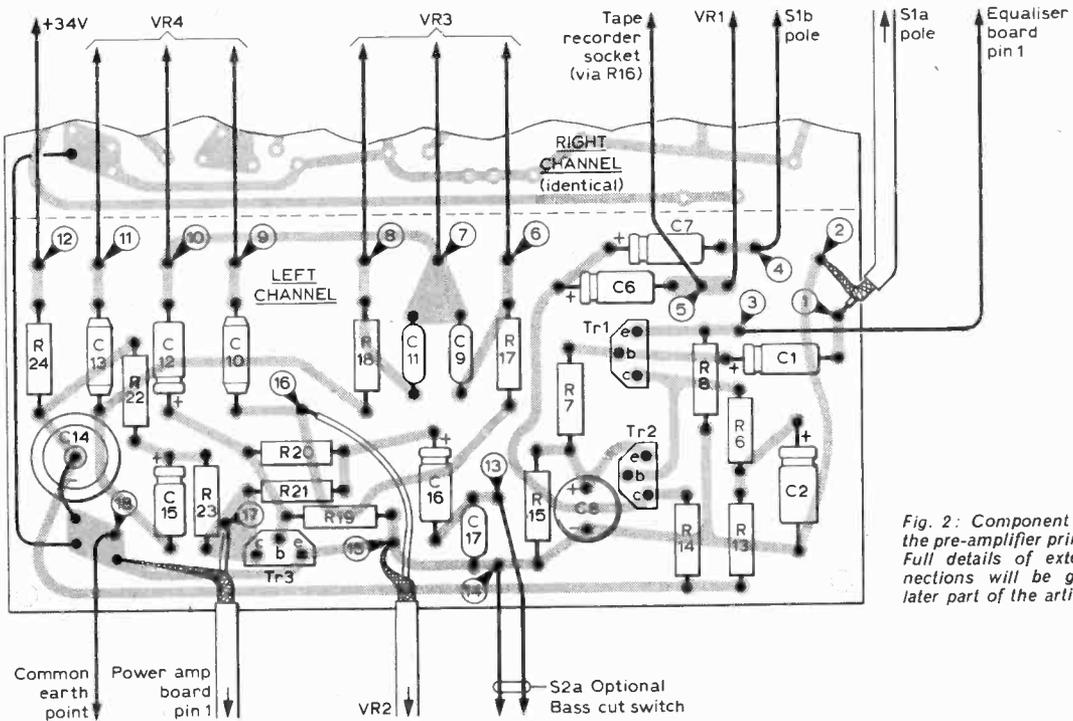


Fig. 2: Component layout for the pre-amplifier printed board. Full details of external connections will be given in a later part of the article

AM 0148

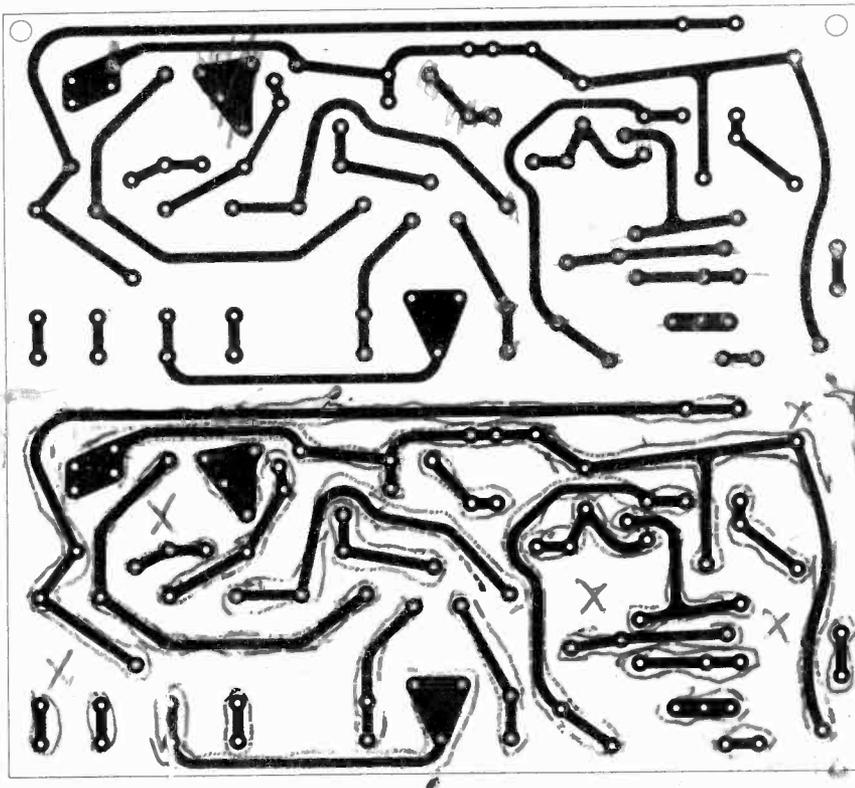


Fig. 3: Actual size layout for the pre-amplifier printed circuit board

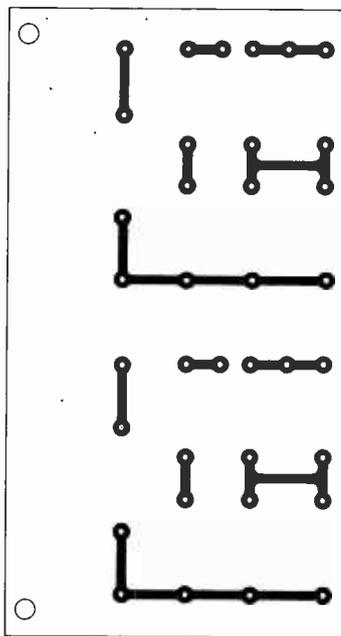
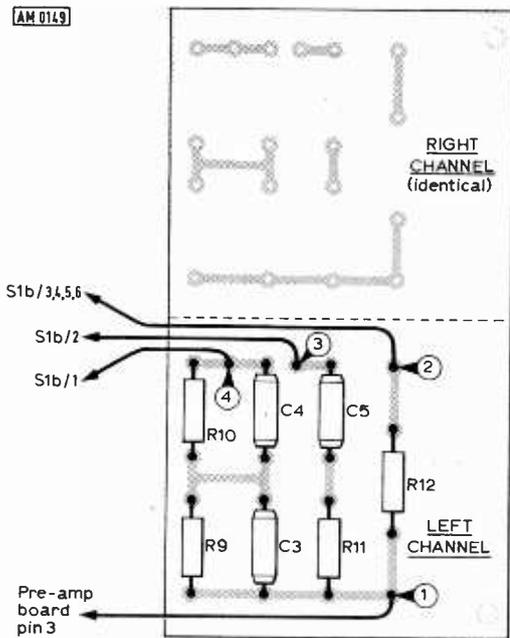
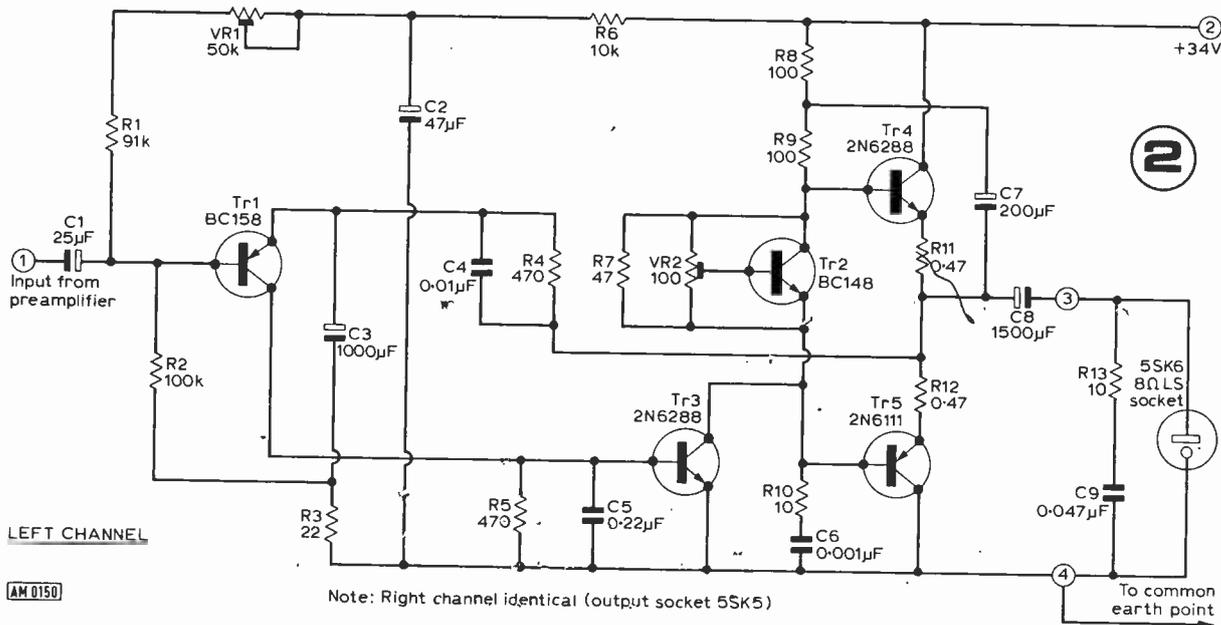


Fig. 4: Actual size layout of equaliser printed circuit board and location of components

Fig. 5: Circuit of the power amplifier. One channel only shown. The other channel is identical



Note: Right channel identical (output socket 5SK5)

complete, these boards may be placed in a safe place until the chassis and power unit are completed. A number of components included in the pre-amplifier circuit diagram are not mounted on the boards. These are dealt with in a subsequent part of the article.

POWER AMPLIFIER (UNIT 2)

The familiar complementary—symmetry configuration is used and designed around silicon transistors. Good low frequency response and stability is ensured by the use of DC coupling throughout the amplifier. The output pair, RCA plastic packaged 'Versawatt' devices, deliver 10 watts RMS into an 8Ω load. A similar device Tr3 operates as a class 'A' driver.

The small forward bias required to minimise crossover distortion is provided by a small signal transistor Tr2 connected between the bases of the output pair. The first stage Tr1 provides amplification of the input signal and in addition acts as a DC comparator, enabling the output stage to be set up for symmetrical clipping under overload conditions. The DC potential at the output mid-point is connected to the emitter of Tr1 via R4. The base potential of Tr1 is determined by the potential divider R1, R2, VR1 and R6. The high loop gain of the circuit keeps the small difference between V_b and V_e constant, so that the output mid-point voltage is defined by the base potential of Tr1 regardless of component tolerances. Negative feedback is provided by R4, C3 and R3.

Fig. 6: Component location for the power amplifier printed board

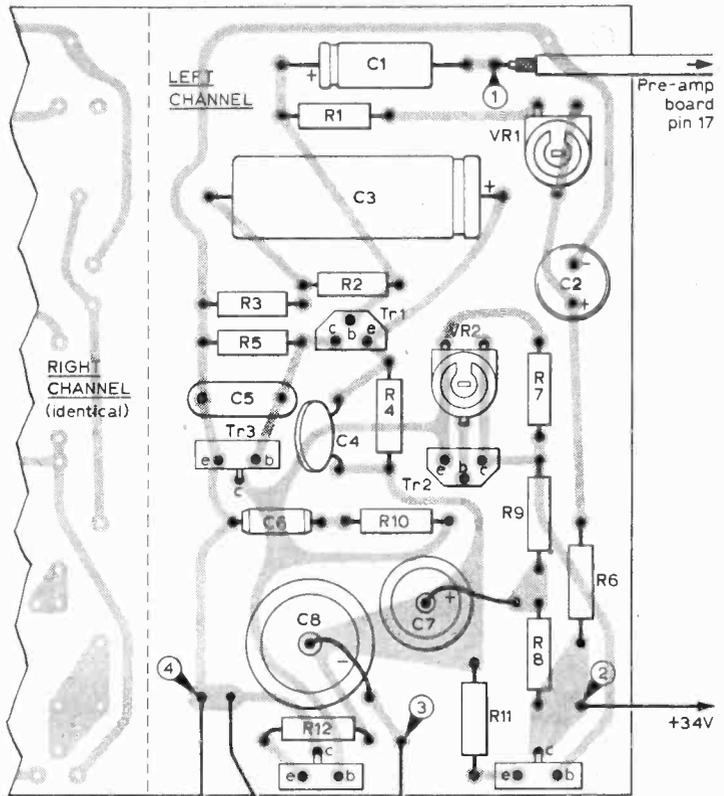
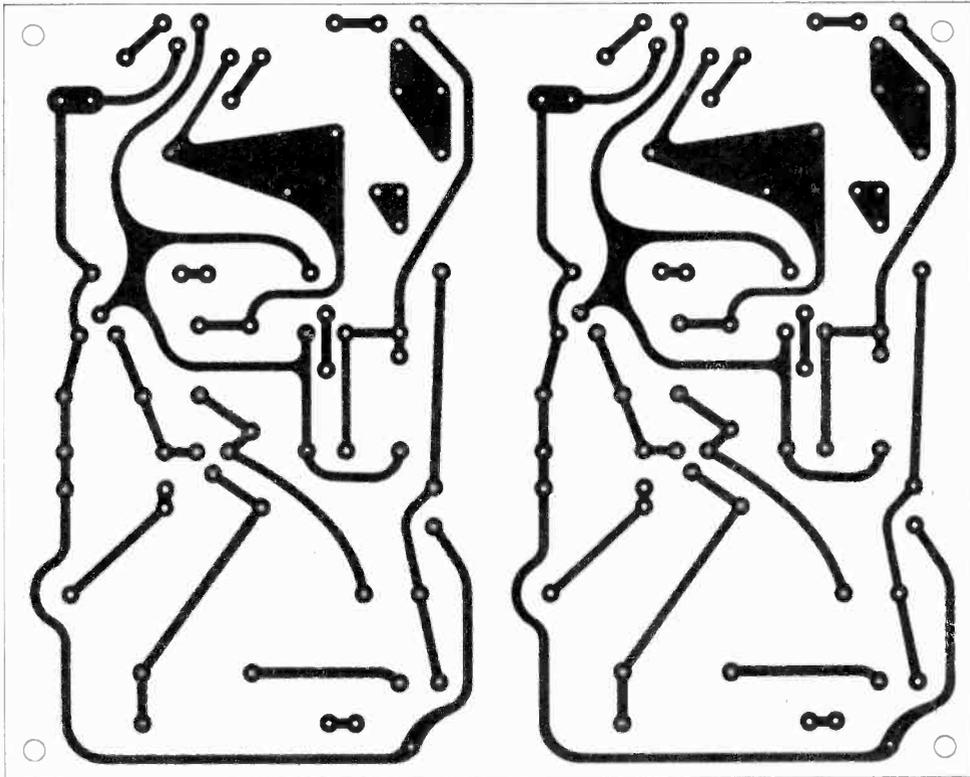


Fig. 7: Actual size layout for the power amplifier printed circuit board

AM 0151



—continued on page 1080

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- * Algebraic logic.
- * Four operators (+, -, x, ÷), with constant on all four.
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- * Calculates to 8 significant digits, with exponent range from 10^{-20} to 10^{79} .
- * Clear, bright 8-digit display.
- * Operates for weeks on four U16-type batteries. (MN 2400 recommended.)

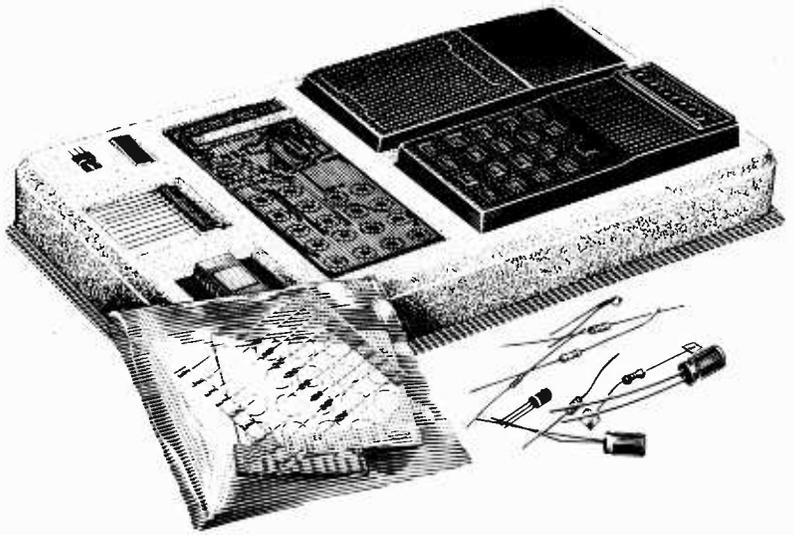


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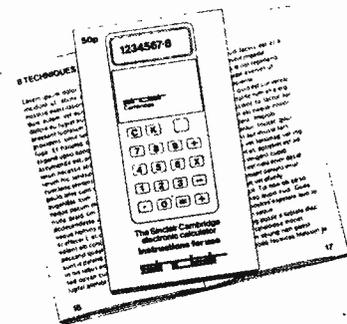
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HOTLINES

ON RECENT DEVELOPMENTS

WATCH IT!

I AM looking at a Swiss electronics journal. There's a circuit which uses two ICs, a readout chip, and a one-transistor oscillator. Connected together they form an electronic clock complete with digital readout. The only circuitry which needs "building" is the single transistor oscillator and this comprises five resistors, five capacitors, a crystal and one of the ICs mentioned. For the record, the two chips are the SCL5437F (oscillator) and SCL5424F which drives the liquid crystal readout direct.

UNIVERSITIES HELP

One of the major criticisms levelled at universities is that their experiments are all too often of academic value only. While this may be true in some instances, it certainly is not true in the case of the University of Utah in the U.S. This establishment has a section devoted to making blind people see again. Although in the experimental stages, blind people have been able to see light patterns which have been simulated by an external "eye" and fed into their brains by small electrodes.

The light images or patterns are called phosphenes and are stimulated (in these experiments) by the generation (and careful control) of pulses, in other words, the vision has been created by purely electronic means. The width of the pulse and its duration determined the intensity or "shades" of the image which the totally (otherwise) blind person can "see". Researchers see no reason why some form of imaging device (like a solid state t.v. camera) should be used and the impulses fed into the brain—after suitable processing, of course. This latter idea is well within the realms of readily available electronics which one can obtain today.

Embedded image sensors could even be controlled by the eye muscles themselves. Already,

computer-generated images have been drawn quite accurately by a totally blind person. The image was viewed on a c.r.t. so that a fair comparison could be made.

If you know of a blind person, it would be unkindly premature to mention these experiments with too great an enthusiasm because it may well take many years to perfect it into a practical device.

A TOOTHGRAPH?

Still in the realms of medicine—well, almost, is the latest use of lasers. Now, the dental profession have taken an interest. By using a small laser it is possible to take holographic photographs of a person's teeth. One interesting thing to emerge from this usage is not that it will offer an invaluable aid in dental practice (although this is very true) but its use for security purposes. Apparently no two peoples teeth are the same so instead of fingerprints one could have toothgraphs or teggypix.

Criminals of the future will do well to heed the old adage—when in doubt, keep your mouth shut. In any case the idea should give Scotland Yard something to get its teeth into.

LARGE-SCREEN COLOUR

Perhaps one of the most interesting battles currently being fought is the one for television screens/tubes/systems. All sorts of ideas are currently under examination including a flat screen solid state beastly. News has arrived about another contender. This one is called a Video-Beam projector and houses optics inside the colour tubes. It shows promise for large screen colour television and claims the advantages of doing away with colour dots, lattices and shadow masks.

Each electron beam (one for each of the three colours) is fired at a "target" which has the relevant colour phosphor. This beam is reflected back inside the tube to a concave mirror which in turn reflects the image out of the tube onto the screen. Extremely good results are reported, however,

there is a snag—the projection distance is fixed at eight feet and is unalterable. The company working on the device do not see this as a problem and claim that once the colour tube "projector" has been adjusted at the manufacturing facility, it requires no adjustment or fiddling by the user.

No mention is made of the power requirements but one presumes that they are considerably lower than the 25–30kV needed for the earlier black-and-white projection systems where many people expressed concern about radiation from such a set up.

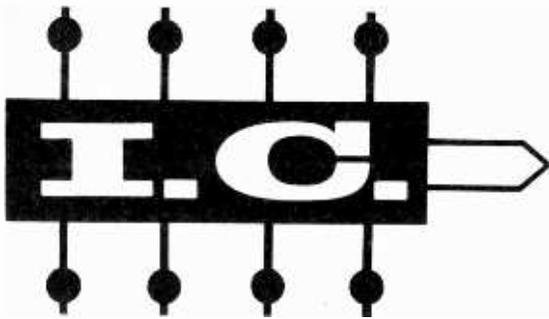
MULTI- CHIPS

A new IC chip, the 2240, is claimed by its makers to do just about anything. It is currently hailed as a programmable timer, binary counter, music synthesiser, A/D converter, ultra-long delay generator, digital sample and hold circuit, frequency synthesiser, pulse counter, binary pattern generator, precision oscillator . . . etc., all in one innocent looking sixteen-pin dual in-line package. I have contacted the company with a view to obtaining further information which I will pass on as and when it arrives. It may be possible to include some circuitry of the more practical applications for the home constructor.

BIG CHIPS!

Remember the days when semiconductor devices were fragile and sensitive to fluctuations in power. Contrast that with the latest beast from International Rectifier. This is a silicon controlled rectifier which handles 2,500 Amps r.m.s. at up to 1,200 volts. A 2,000V version is already planned. The wafer for this device is almost 2½ inches in diameter. This is probably the largest chip which has ever been employed in any semiconductor device.





OF THE MONTH

Number 44

National LM377N 2 + 2W AUDIO AMPLIFIER

THE LM377N is an IC, manufactured by the National Semiconductor Company, which contains two separate two-watt amplifiers in a single device. The connections are shown in Fig.1. A 14 pin dual-in-line encapsulation is employed which can be fitted into a socket or soldered into a printed circuit board. A similar device, the LM377N-10, has metal tab connections which may be soldered to a printed circuit board. Pins 3, 4 and 5 and also 10, 11 and 12 of Fig. 1 are replaced by metal tabs on each side of the device. These are very convenient for soldering to a heat sink.

- (ii) The LM377N contains internal circuits which protect it from overheating. If the silicon chip becomes too hot, the device switches itself off until it becomes cooler.
- (iii) Protective circuits prevent the device from being damaged by excessive current. Such currents are likely to flow if either of the outputs is accidentally shorted to earth.
- (iv) The input impedance is relatively high, $3M\Omega$, and this increases the versatility of the device.
- (v) Any hum on the power supply line is reduced by 80dB. The separation between the two channels is typically 70dB.

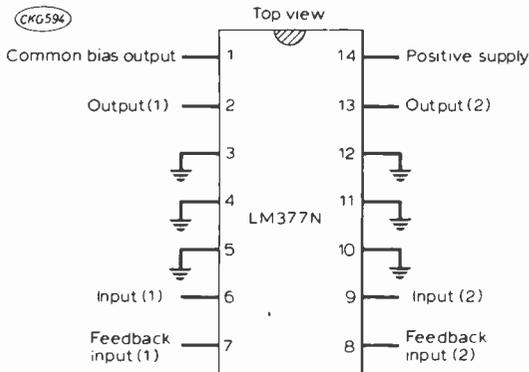


Fig. 1. Pin connections to the 14 pin DIL LM377N.

The LM377 devices are intended mainly for use in stereo equipment where the output power required does not exceed 2W. However, they can also be used in a bridge circuit where the two amplifiers in the device are used in push-pull to provide a monaural output of up to 4W.

Advantages

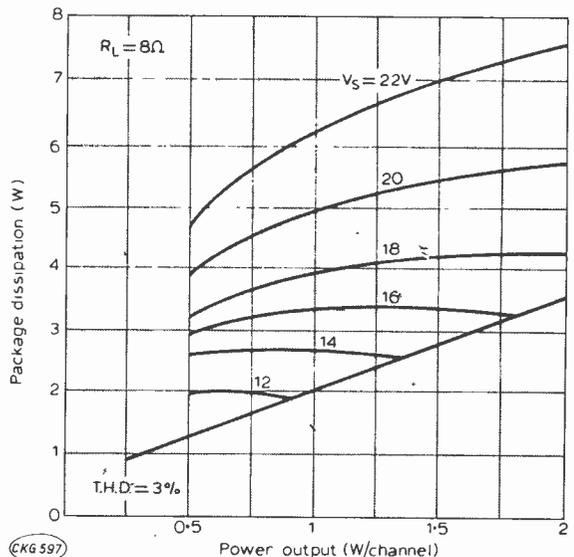
The following features make the LM377N especially attractive to the amateur constructor as well as to the professional circuit designer:—

- (i) The output stages are automatically centred at the correct bias so that the output voltage can swing an equal amount in either direction resulting in maximum power output at a given distortion level. (Some power amplifiers circuits require a preset potentiometer so that the bias can be adjusted manually.)

Circuits

In all circuits the inputs of both amplifiers should be biased by the voltage from pin 1. The bias current is typically $0.5\mu A$ to each amplifier.

In addition, feedback from each output should be applied to the feedback input of the same amplifier. The amount of feedback controls the gain.



Graphs relating supply voltage to output power for the LM377N.

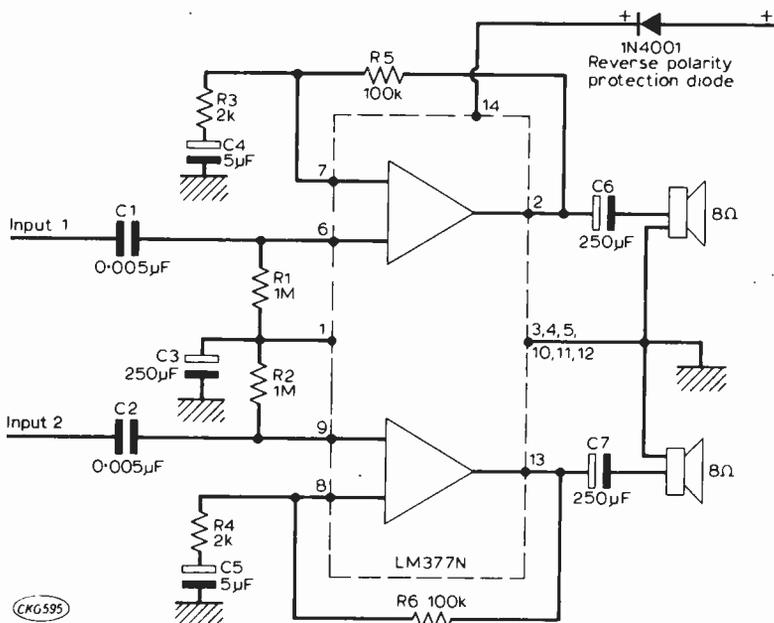


Fig. 2. Circuit of a practical stereo amplifier suitable for a record player. A volume control will be required on the input circuit.

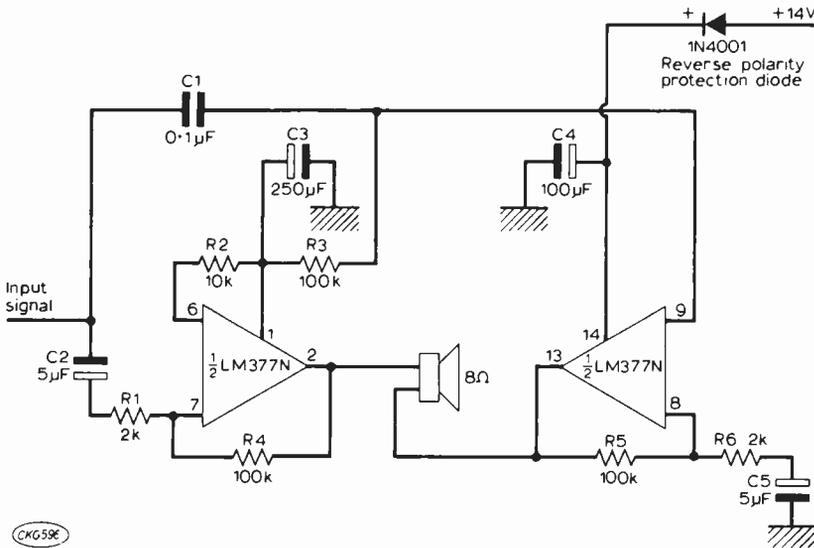


Fig. 3. This mono circuit utilizes both amplifiers to provide 4W output.

A typical circuit for the use of the LM377N as the two power amplifiers of a stereo system is shown in Fig. 2.

Bias from pin 1 is decoupled by C3 and applied to the inputs at pin 6 and 9 via R1 and R2. The input signals are capacitively coupled through C1 and C2 respectively in order to prevent the bias from being affected by the impedance of any previous stage. The input impedance of the LM377N is relatively high and therefore the coupling capacitors can be fairly small in value.

In the upper amplifier of Fig. 2, the feedback is taken from the output at pin 2 through R5 to pin 7. The voltage gain is equal to $R5/R3$ which is 50 times or 34dB. The gain may be increased by reducing R3 but the distortion will increase.

Similarly, the gain of the lower amplifier is $R6/R4=50$. The typical gain of an amplifier without any feedback is 30,000 (90dB). The mean output potential is equal to approximately half the supply voltage. An electrolytic capacitor (C6 and C7) must therefore be placed between the outputs of the device and each speaker so that direct current cannot flow. If the value of the capacitors is reduced, an inferior bass response will be obtained.

Mono Amplifier

A single LM377N device can be used in a single channel system to provide an output power of 4W, Fig. 3.

continued on page 1086

PRESELECTOR for 10-30 MHz

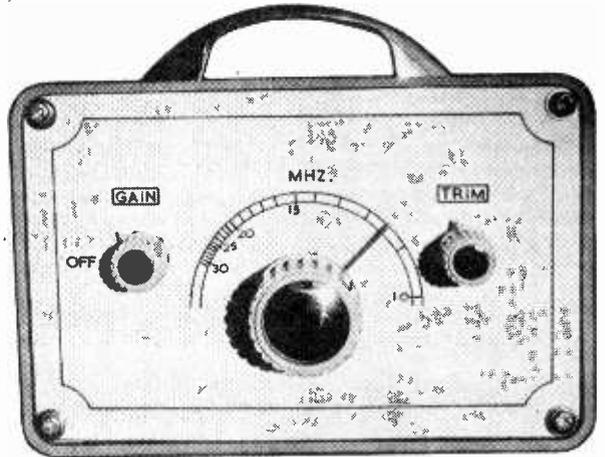
F. G. RAYER G30GR

MANY receivers are susceptible to second channel interference when working on the higher frequencies. This means that if the receiver employs an intermediate frequency of 470kHz, the oscillator is working at a frequency 470kHz higher than that of the wanted transmission and signals which are 470kHz higher than this, or 940kHz higher in frequency than the wanted transmission, can beat with the receiver oscillator frequency, to produce a signal which passes through the 470kHz amplifier, interfering with the wanted signal. On the lower frequencies, there is usually sufficient selectivity ahead of the mixer to avoid difficulty from this cause. But on higher frequencies, the receiver is unable to totally eliminate the offending signals which cause interference and whistles.

Even a well-designed receiver with one RF stage may not provide second channel rejection better than 15dB at 30MHz. If a signal strength scale of 6dB per S-point were used, as is quite usual, this would mean that if a wanted signal read S9, an unwanted signal of equal strength 940kHz higher in frequency would read S6+, which is a severe level of interference.

Such interference can be greatly reduced by raising the receiver intermediate frequency, or by increasing the second channel rejection ahead of the mixer. Changing the IF is probably impossible, but the unit here will enormously increase the second channel rejection.

The maximum benefit will be found with receivers which have no tuned RF stage, or only one RF stage, and employ a 455-470kHz intermediate



Completed preselector in its 6x4x4in cabinet.

frequency. With such receivers, 19m broadcasts may greatly mar reception of 20m amateur signals, for example. The unit can also be employed with other receivers including those with a 1.6MHz or other IF.

CIRCUIT

This is shown in Fig. 1. As second channel interference is not usually troublesome at signal frequencies lower than about 10MHz, the unit covers approximately 10MHz to 30MHz in a single band, thus avoiding any need for band switching. L2 and

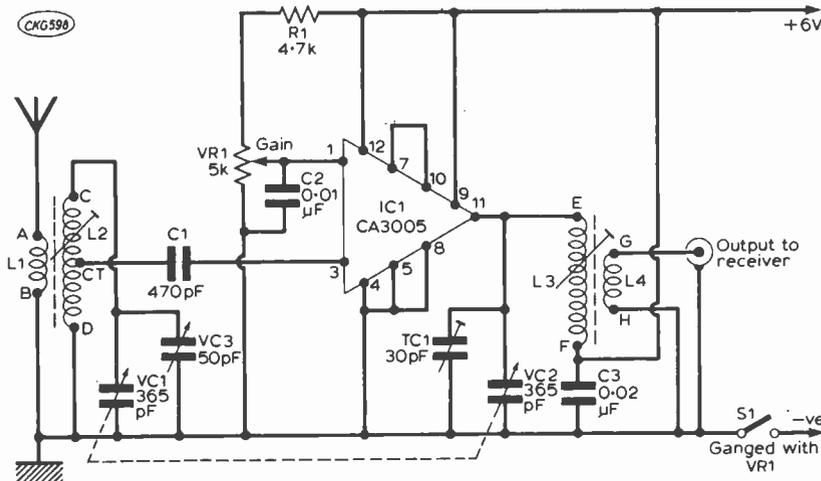


Fig. 1. Circuit of preselector using a single integrated circuit. Input, output and battery connections are at the rear. When placed between aerial and receiver useful gain will result as well as a reduction in second channel interference.

L3 are tuned with the ganged capacitor VC1/VC2 providing two extra tuned circuits before the receiver. In most cases this will almost completely eliminate second channel interference. VC3 is a panel trimmer to allow peaking the aerial circuit with almost any aerial.

The CA3005 IC operates with a 6V supply. It is listed as giving 20dB gain at 100MHz, but the full gain is not achieved here due to the circuit being arranged for operation from a single power supply, and because of the difficulty of matching the input and output impedances at all frequencies. The input is approximately matched by the centre tap on L2, while the transformer L3/L4 is arranged to give an output impedance suitable for most receivers.

Gain control is provided by VR1, to avoid overloading the receiver on strong signals.

IC BOARD

The board is wired as in Fig.2. Note that the projection on the IC corresponds to lead 12. Spread the leads slightly so that they may pass through the Veroboard holes as indicated.

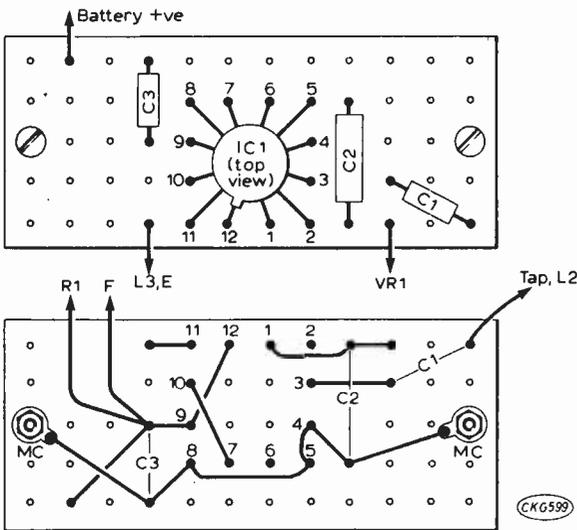


Fig. 2. Both sides of the small circuit board that carries the IC.

Two 6BA bolts with tags form the earthing points MC. Leave projecting leads from C1, for battery positive, VR1 and for VC2. Also solder on R1.

COILS

These use 24swg enamelled wire throughout, Fig. 3. For the aerial coil, begin at C as near the top of the former as possible, and wind on 4½ turns. Scrape the wire and twist the centre tap. Wind a further 4½ turns and finish at D. Leave a small space and beginning at A wind on 4 turns, finishing at B.

For the second coil, wind 9 turns from E to F, leave a space as before, and put on 5 turns from H to G.

The ends of the windings can be secured with a loop of cotton lightly smeared with quick-drying adhesive, and given a turn or two round the former. Fix one end by this means, wind on the turns mentioned, and secure the finish of the winding in the same way, pulling it tight by the cotton.

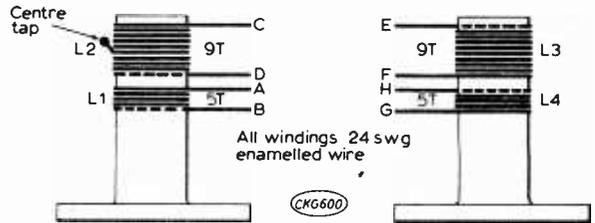


Fig. 3. Details for winding the two coils used in the preselector.

CHASSIS

The panel for the case listed is approximately 6 x 4in. Punch a clearance hole for the spindle of VC1/2. As this capacitor has an integral drive and the spindle cannot be cut shorter, it can be spaced back from the panel as in Fig. 4, to bring the knob nearer the front. This requires three 4BA bolts, each with two nuts, locked against panel and capacitor. VR1 and VC3 are also set back a little by extra nuts or washers.

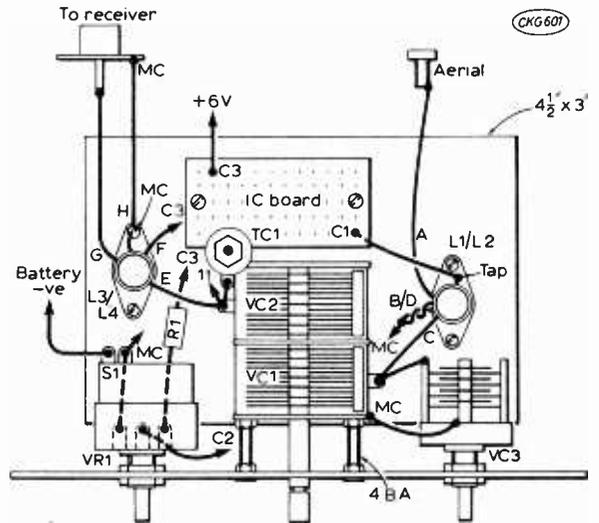


Fig. 4. Top view of the chassis showing position of the IC board and major components.

The chassis is a flat plate 4½ x 3in. It is secured by two short 4BA bolts which pass through it and into the threaded holes in the capacitor frame. Place a few washers between plate and capacitor.

★ components list

Resistors

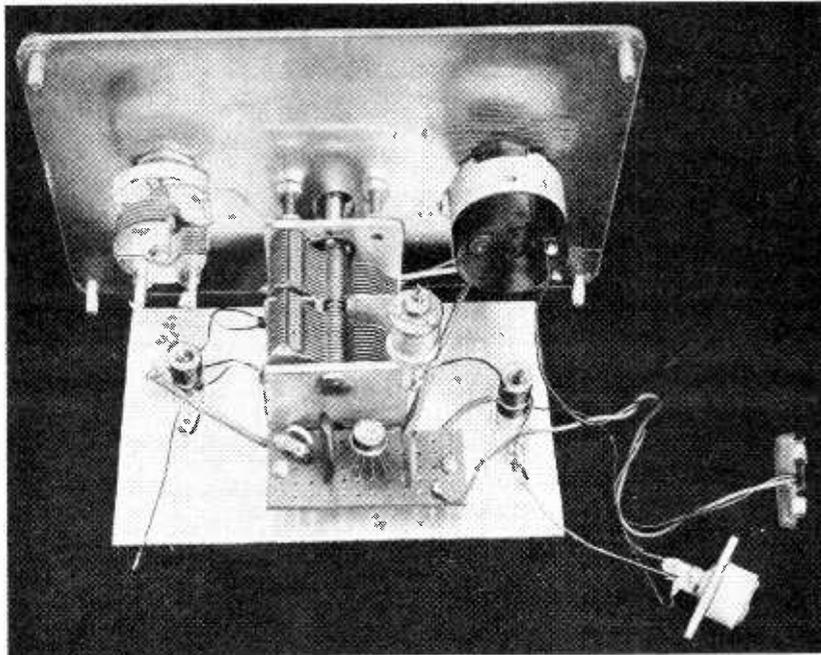
R1 4.7kΩ ½W VR1 5kΩ linear with switch S1.

Capacitors

C1 470pF, C2 0.01μF disc C3 0.02μF disc.
VC1/2 2 x 365pF with slow motion drive.
VC3 50pF (Jackson C804) TC1 30pF trimmer.

Miscellaneous

Formers for coils, ½in dia. with cores (2).
Knobs. IC1, CA3005. Aerial socket and output socket. Instrument case about 6 x 4 x 4in.



Finished preselector. Flexible connections are made to battery connector and output socket.

As the receiver employed a co-axial lead, a socket for this was provided as in Fig. 4. An earth circuit to the unit is then available through the co-axial outer conductor. If the receiver does not employ this type of aerial input lead, take a wire from G, L4, to the receiver aerial socket, and connect H and the chassis to the receiver earth terminal.

OPERATION

TC1 can be set at about half maximum capacitance. Tune in a transmission on about 10MHz, set VC1/2 nearly fully closed and rotate the cores of the coils for best reception.

Subsequently check that 30MHz signals peak with VC1/2 nearly fully open, and that VC3 also peaks up signals or background noise. If necessary, re-adjust TC1 to allow proper tuning with VC3, and check the core positions, so that little adjustment of VC3 is required, when tuning across the whole band.

Adjustments are best carried out by observing the receiver signal strength meter, or with the receiver AGC switched off, or by selecting weak signals which do not operate the receiver AGC. VR1 should be set for maximum gain when doing this. As an aid, a very short aerial may be temporarily taken to A. VC3 should then have quite a sharp peak, but this effect will be reduced with a long aerial when it may be preferable to place a small capacitor in the lead from aerial to A. ■

Holes are drilled to take the circuit board bolts which are locked with extra nuts. Wiring must be clear of the metal. The coils are held with 8BA bolts and nuts.

WIRING

Wiring is then completed as in Fig. 4. TC1 has its lower tag soldered directly to the frame of VC1/2, the second tag being connected to VC2, together with the lead from pin 11, IC1.

The coil leads are cut to length, scraped, and soldered to the points shown. Note that H goes to the chassis at a bolt securing L3/L4.

The battery consists of four HP7 or similar cells, in a 4-cell holder. The holder is secured in the back of the insulated case, near the top, by a small bolt.

IC of the Month—continued from page 1083

The two amplifiers are used in a 'bridge' or push-pull circuit. The input signal is fed through C2 and R1 to the feedback input (pin 7) of the first amplifier and the same signal also passes through C1 to the non-inverting input (pin 9) of the second amplifier.

When the voltage at the pin 2 output increases, that at pin 13 therefore decreases by the same amount and vice-versa. The speaker is thus driven by this push-pull signal. This circuit has the advantage that no capacitor is required in series with the speaker, since the mean potentials of pins 2 and 13 are almost identical.

The bias from pin 1 is decoupled by C3 and fed through R2 to pin 6. It also passes through R3 to pin 9.

The gain of each amplifier is equal to the ratio of the feedback resistors, namely $R4/R1 = R5/R6 = 50$. However, the push-pull action gives an effective overall gain of twice this value.

The LM377N is available from Athena Semiconductor Marketing Company Ltd., 140 High St., Egham, Surrey, at £2.70 plus VAT for small quantities, inclusive of p & p. ■

RADIO BY CABLE & SATELLITE

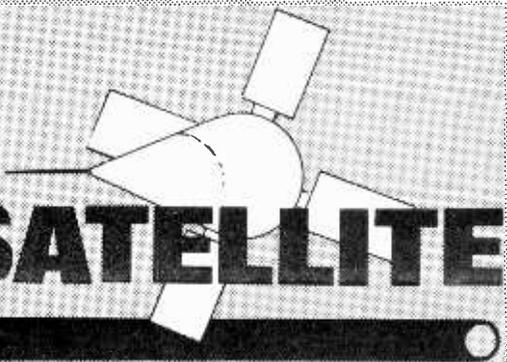
—continued from page 1087

Many countries have determined that this is unavoidable within the boundaries of the technical possibilities and it has been recognised by the UNO associated International Telecommunications Union in 1971 in Geneva. At the same time, however, it was established that the use of TV satellites is only possible by observing frequency, positioning and ground coverage plans which are to be drawn up at a special planning conference for this purpose which will take place in 1975/76. ■

EXPERIMENTAL WORKSHOP

We regret that due to pressure on editorial space this month, Part 6 of this series has been held over until the April issue.

RADIO by Cable & SATELLITE



ALTHOUGH it is a task of exchange technology to handle the signals, in connecting individual communications (telephone, telex), in such a way that the connection is made quickly and reliably, broadcasting must ensure that the primary signal is transported long distances without distortion, be they telephone signals or for telegraphy, music, TV, picture transmission, data transfer or remote control. But what are the problems that arise?

A modern carrier frequency system with 2700 channels for speech has an amplifier spacing of 4.5 km; at a distance of 4500 km as is found in the trade area between the USA and Canada, 1000 amplifiers are operated one after the other.

Assuming a medium amplification of 30dB (i.e. the signal output is increased each time by a factor of $10^3=1000$, the voltage by around a factor of 31.6) the overall amplification over the whole section amounts to the almost unbelievable figure of 10^{3000} . For comparison: the entire universe contains "only" around 10^{83} protons, since the creation of the earth approximately 15 billion years ago a total of "only" $5 \cdot 10^{17}$ seconds has passed.

Cables

To guarantee the necessary quality over so many stages, extremely high demands must be made, both on the technical equipment (amplifiers, converters, modulators etc.) as well as on the directions of transmission. With regard to the latter there are three "media" which have proved themselves and which are to be found predominantly or exclusively in long-distance traffic: cables, directional radio including satellites and—as a medium of the long-term future, suitably directed laser beams.

Cable, especially coaxial, is already considerably protected by its construction and laying against outside influences from space, the atmosphere and from technical installations, so that in cable transmission systems non-linearity and noise must be kept as low as possible.

Disregarding the "symmetrical" carrier frequency cables, used predominantly with up to 120 speech channels for regional systems, there is a whole series of coaxial types at an impedance of around 75 ohm. There are many various internal sizes, e.g. from 1.2 mm for 300 speech channels or 2.6 mm for a choice of 960,1260 or 2700 channels. If one is prepared to reduce the amplifier spacing even more, one could increase the basic bandwidth considerably (e.g. to 40 to 60MHz or even higher).

"Hollow" cable recently developed can theoretically provide a transmittable overall bandwidth of around 100,000MHz. It is, in fact, a radio wave guide which should be most suitable for the transmission of digital signals (e.g. for pulse code modulation). Technically hollow cables are well advanced although there are certain reservations with regard to their economic application.

Satellites

The directional radio line, widely used for the transmission of TV modulation (video band) but also for multi-channel speech bands, is physically an ideal transmission medium. However, it requires the application of special "noise reducer" procedures due to the influences of extra-terrestrial, tropospheric and industrial radio signals. Partial bandwidths of up to 30MHz have shown themselves to be the best for the transmission of television or telephone channels in various frequency ranges between 2 and 12GHz. Transmitter output is in the area of several watts.

Satellite paths are basically extended directional radio lines with fields of $2 \times 36\,000$ km length (to and from) with high transmitter outputs, extra large aerials and extremely sensitive receivers (maser) on the terrestrial stations. They are particularly suitable for trans-continental and trans-oceanic relays, operating at frequencies corresponding to those in directional radio technology.

A transmission medium of the future is the laser beam which is strictly monochromatic, polarised and coherent. In a free field of dissemination they are not practicable because of absorption as with normal light, but when suitably guided by lens conduction and glass fibre, it reveals its full potential.

In particular the glass fibre bundle cable, offering an extreme bandwidth even with individual fibres, combined with the multifarious operating possibilities of universal cable, promises to be an important transmitting medium, both in long distance communications and in local traffic in densely populated areas. All of this is of course dependent on a corresponding advance in the components and subsystems in the field of optronics—an advancing technology being fully exploited now.

Satellites providing a country with programmes via only one transmitter can of course be received across borders. Even with rays with a one degree focusing, whose focal area is accommodated within the boundaries of the country cannot prevent this.

—continued on page 1086

oscilloscope

PART 1

techniques ALAN AINSLIE

IN this series we shall be taking a close look at oscilloscopes of the kind likely to be used by the average electronics enthusiast. This leaves a large range of classes of instruments, but we shall not be too concerned with the developments incorporated in the brand new, four figure price oscilloscopes as these can generally be classed as purely professional in appeal and application.

The instruments to be considered will range from the simplest types of scope, through TV service scopes to the laboratory scopes of a few years ago, now available to the keen amateur—but at a price!

We shall consider design principles, the basis for modifications, and calibration. This last point is rather important as manufacturers can charge a lot for recalibration of their instruments, especially if not of current manufacture.

We shall also look at some oscilloscope applications and at a few pieces of additional equipment in order to carry out an increased range of tests and measurements.

Oscilloscopes fall broadly into four main classes:—

1. AUDIO FREQUENCY
2. TELEVISION AND PULSE
3. LABORATORY
4. SPECIAL PURPOSE

Ignoring the special purpose scopes for the time being, the oscilloscopes are grouped into a convenient scale of ascending bandwidth.

BANDWIDTHS

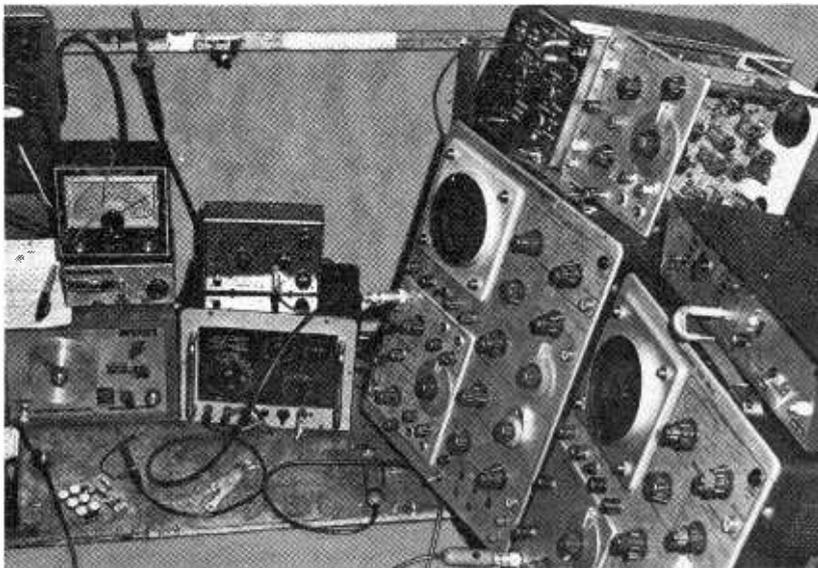
As most scopes have a low frequency limit of DC (DC coupled) or a few Hz, the bandwidth figure quoted is the upper frequency limit at 3dB down (or however else the manufacturer specifies).

The bandwidth information gives an indication of the highest frequency that the scope can predictably handle.

Considering the two curves in Fig. 1, both scopes would have a written bandwidth of 5MHz, but scope A would in fact perform quite well past this figure whilst scope B drops straight off. Scope A could be used but with loss of calibration up to perhaps 10MHz or so, scope B being totally useless at this frequency.

Incorporated in any statement concerning bandwidth is an implication of the rise time of the scope.

If we consider an oscilloscope amplifier displaying a 1MHz signal, and this signal is at the -3dB point, we can arrive at some justification for the rather mysterious equation used to express rise time in terms of bandwidth.



This imposing array of test equipment in just one corner of the author's workshop will serve to underline the fact that this series of articles on the oscilloscope contains much practical information as well as theoretical discussion.

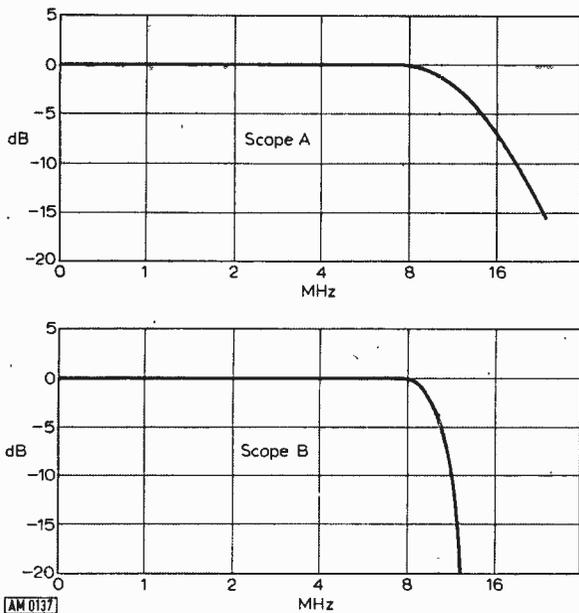


Fig. 1. The response curve of the Y amplifier in two different oscilloscopes, to illustrate the meaning of "bandwidth."

The time period of the 1MHz signal is $1\mu\text{sec}$. Thus for one half period the time is 500ns and for the rising portion 250ns. If now the slope of the upward going part of the cycle is taken to represent the step function applied to the scope, then the rise time of this 1MHz (3dB down) scope would appear to be 150ns.

But the 1MHz signal is not of 100% amplitude (it is 3dB down), and as rise time T_r is defined as the time to increase a step function from 10% to 90%, a correction is required, Fig. 2.

As 3dB down corresponds approximately to 30% down, i.e. the trace height at the -3dB point is only 70% of what it should be.

It is necessary to bring the 70% trace to 90% and in doing this T_r is increased by 90/70 giving a theoretical rise time of 322ns.

In practice the figure is found to be between 350 and 390ns, depending on the shape of the response. The response curve of Fig. 1, scope A would give a faster rise time than that of scope B, although both have the same bandwidth.

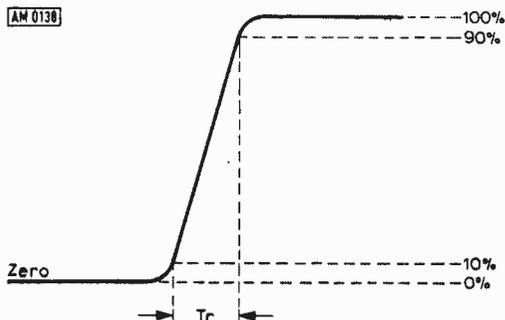


Fig. 2. First part of a response curve with a step function input to the scope. The rise time is a function of the bandwidth of the amplifier.

Taking the rise time to be 365ns for a 1MHz scope and applying the laws of proportion we get the expression:—

$$\text{Rise Time (ns)} \times \text{Bandwidth (MHz)} = 365$$

This expression holds true for the vast majority of cases, but more about that when we come to consider the Y amplifiers in more detail.

Returning to our classification of oscilloscopes it seems reasonable that the audio oscilloscope has but a limited bandwidth (1MHz or so) while the TV or pulse oscilloscope has a bandwidth of perhaps 10 or 15MHz and is capable of displaying more complex and more rapidly recurring waveforms. The laboratory scope on the other hand has a bandwidth extending from 15MHz and up and into the hundreds of MHz on the very latest real time oscilloscopes.

Using sampling techniques (imaginary or virtual time) bandwidths into the GHz region have been achieved but this type of scope belongs to the special purpose class. It is interesting to think of the real time response of say a 5GHz scope, 10% to 90% in 7×10^{-11} sec, quite fast!

Returning to earth, although it is convenient to classify a scope by bandwidth (or rise time) there are other, perhaps more striking, differences between the classes of scopes.

TIMEBASES

The uses of an audio oscilloscope are confined usually to periodic waveforms that can be adequately displayed by the use of a synchronised timebase without the need for complex and expensive trigger circuits. The difference between a sync or trig timebase will become clear when we come to consider more fully the numerous methods used to provide a timebase. Suffice to say that the sync timebase is a free running oscillator which is pushed along by a portion of the Y signal applied as sync, whereas the trig timebase waits for a suitable signal before commencing a sweep.

One consequence of the sync mode is that the input signal (Y) must have a repetition frequency higher than that of the timebase for a stable image to result, as in Fig. 3. If the timebase is run faster than the repetition rate of the waveform, in order to view detail the trace folds up into a jumble.

Applied to the audio scope this latter effect is not of too great a consequence as there is usually little detail lurking in a signal repeating at 10kHz. However in TV work we immediately become faced with complex waveforms to lock and also the possibility that the waveform may be required to be investigated more closely.

The triggered timebase becomes a necessity together with the improved Y amplifier bandwidth. The timebase speed ranges are also increased for greater versatility and various modes of timebase operation are employed, including the important addition of an "EXTERNAL TRIG" connection enabling the timebase to be controlled externally. This facility is invaluable in TV work as it enables the frame generator in the receiver to work as a delay timebase generator, the trig level control on the scope selecting the lines to be viewed in isolation on the screen.

This sort of facility necessitates yet another improvement to be made to the simple audio scope, namely the trace brightness.

Fig. 3. The top display occurs when the timebase runs faster than the repetition rate of the input waveform. The consequence of a timebase running slower than the repetition rate is shown in the lower display.

A recurring 1kHz sine wave may be bright enough, but when the trace is scanning say 10cm in 64 μ sec, and then only 25 or 50 times a second, the trace brilliance falls to almost vanishing point unless high CRT potentials are employed. Usually between 2 and 5kV are used on oscilloscopes of this nature, as opposed to possibly less than 1kV for the audio scope.

The TV or pulse oscilloscope then has, apart from an improved bandwidth, a fairly sophisticated timebase system and an improved display mechanism, together with a few other improvements such as DC coupling and the provision of calibrators.

Oscilloscopes intended for reasonably accurate measurement, but that are built to a price, usually incorporate some method of generating standard waveforms of precise voltage and/or time, this being cheaper than trying to stabilise the Y amplifier gain and timebase against variations.

A fairly typical example of the type of calibration provided is the Cossor 2000 oscilloscope, a 5MHz double beam scope suitable for general TV service and measurement.

The Y amplifiers are calibrated against an internally generated signal of 300mV. The Y amplifier control is set to give 3cm deflection with the input attenuator set at 0.1V/cm.

The 300mV signal is obtained from 50Hz from the scope mains transformer and a small neon is used to provide a reference level of about 70V from this high voltage AC. The resulting 70V square wave is then attenuated and is available as the 300mV calibration signal.

Time calibration is available as a 20MHz oscillator providing intensity modulation of the beam. This means that a display brightens up at every 50ns enabling accurate time measurements at the higher sweep speeds.

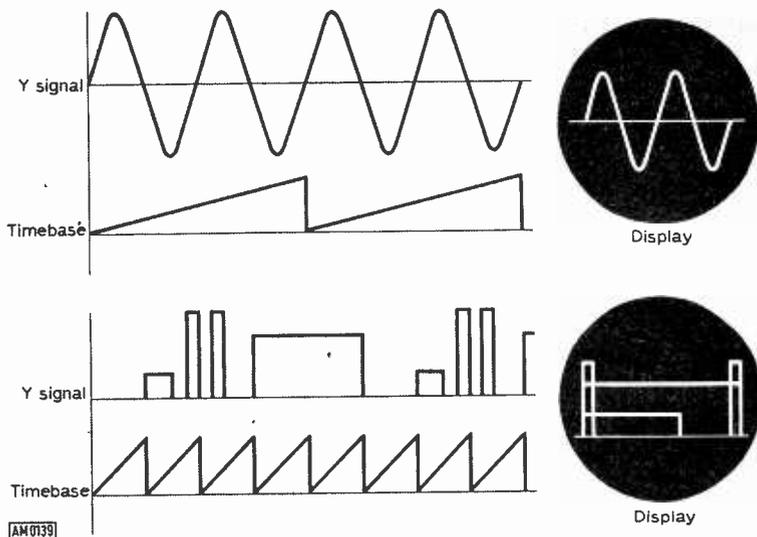
LABORATORY SCOPES

The final class of scope that we shall consider is the laboratory scope and in this class we can conveniently consider the special purpose oscilloscopes.

In general one expects to find that a laboratory scope has a good bandwidth, versatile timebase with fast sweep speeds, high tube voltage and is capable of long lasting calibration to within a few per cent, depending on the measurement methods employed.

Intended for use in research and for the investigation of complex waveforms, the laboratory oscilloscope needs to be versatile and has therefore rather a lot of controls and tends to be physically large.

As we shall see later, wide bandwidth deflection systems require a large number of valves passing



fairly high currents. This, together with the number of valves in the timebase (usually two are provided) and the supply regulator needed to maintain calibration, means that the valve count is sometimes over a hundred and a power consumption of almost 1kW is not uncommon. These big scopes are usually trolley mounted with a fan to keep the operating temperature at a reasonable level.

TEKTRONIX TRENDS

Pioneers in this field of scopes were undoubtedly the American firm Tektronix and many other manufacturers have done a lot of copying from the Tektronix design. The Tektronix format of tube in the top left corner, Y amplifier below, and timebase down the right-hand side is now familiar to users of laboratory scopes.

With the advent of Tektronix styling came another innovation, perhaps conceived initially by the same company and now copied by many, that of plug-in Y amplifiers, followed by plug-in almost everything! This means that a wideband (33MHz for Tektronix) main frame can be used for a number of special purposes just by changing plug-in units.

The main frame houses the CRT, power supplies, Y drive amplifier, X amplifier and the timebase if this is not plug-in. A range of Y plug-ins would then be used with the scope, providing double beam operation, differential inputs, very high sensitivity or a special function such as a spectrum analyser or four channel display. If plug-in timebases are provided these could be normal timebase, delay plus normal, very slow, or a straightforward amplifier plug-in for XY display.

Whilst appreciating that these plug-ins can cost a great deal of money it is fairly obvious that a selection of plug-ins is cheaper than a selection of scopes! The user is also able to keep in touch with current technology by the purchase of recent plug-ins offering such facilities as sampled inputs giving very high apparent bandwidths, although not in real time. One other advantage of plug-ins is that the Y amplifier controls probably get the hardest use on a scope and it is an easy matter to remove the plug-in for maintenance without having to disembody the whole scope.

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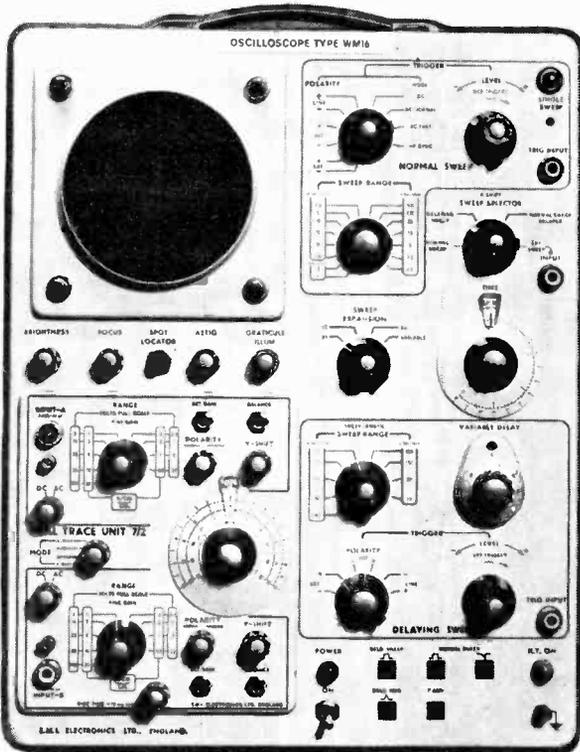


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SAMPLING TECHNIQUES

The group of scopes classed as "special purpose" can be extended to virtually any scope not corresponding to the norm, and, in a way, most scopes have a little something special since they have to appeal to buyers, just like motor cars.

Perhaps the most important special purpose scope, to be found in few amateur labs, is the sampling oscilloscope.



A close-up of the front panel of one of the author's scopes. This EMI WM16 has plug-in facilities, dual timebases and a bandwidth of better than 40MHz.

Considered on a real time basis the sampling scope has a bandwidth of a few tens of MHz. However, a special input circuit, usually contained in the probe, samples the instantaneous level of the signal at a rapid rate and the probe output when fed through the Y amplifier produces a display that builds up in a very short space of time to a continuous display.

Various manufacturers use different sampling techniques but the results obtainable represent bandwidths well into the hundreds of MHz and beyond.

A useful result of the development of sampling techniques has been the production of a circuit which when connected to an oscilloscope deflection amplifier's outputs, enables the trace on the screen, perhaps a 5MHz pulse, to be drawn by a mechanical plotter which takes about 10secs to complete one accurate scan. The technique used is similar to sampling oscilloscopes, the input to the XY plotter being sampled over say 10 seconds. The resulting XY plot is a faithful reproduction, within the plotter resolution, of the trace that was on the scope face, although not in real time as it takes 10 seconds to draw a signal of, say, 100ns width.

Other special oscilloscopes are designed to do specific jobs and there are such things as spectrum analyser scopes produced. In this scope the Y channel is narrow band, the precise band being determined by the X deflection voltage. Thus as the timebase sweeps, usually fairly slowly, the Y amplifier sweeps a certain range of frequencies, the Y deflection being proportional to the signal at that frequency. The X axis can be calibrated in frequency and such a scope can be used for investigating modulation sidebands etc.

Storage scopes also fall into the category of "special purpose" if only by virtue of the very high price. We shall consider storage tubes in the next section dealing with displays, but suffice it to say here that a special tube is employed which enables a trace to be retained after the scan is completed. These scopes are very useful for low speed servo work and in conjunction with spectrum analyser facilities, as mentioned above, flicker can be completely eliminated.

To be continued



EQUIPMENT WANTED

- ... Wanted urgently two octal plug and sockets, cash refund available.—Colin Machin, Pontson, Aberedu, Bullth Wells, Breconshire.
- ... Trio 9R59DS must be in good condition with handbook and working.—C. H. Brain, 7 Elverland Close, Ferris, Sussex BN12 5PL.
- ... Urgently required, Mazda valve, type AC/VP1; also any info, on massive, old Murphry set type A240. Info, or price required for that ancient valve to—N. Penny, "Nanook", The Creek, Sunbury-on-Thames, Middx.
- ... Tape head cover for Grundig Portable Battery TKE Tape Recorder and circuit diagram.—Lal Sal Kiew, 65A Union Funtul, Kuala Lumpur, Malaysia.
- ... Codar PR40 Pre-Selector in good condition wanted.—P. Dimpleton, 37 Mountview Avenue, Dunstable, Beds.

INFORMATION WANTED

- ... Technical details of, or the actual coil for the Mini Four, appearing in the March and April issues of P.W. for 1952. I have all the components except the coil type CT9 which was originally made by Stern Radio.—J. Cull, Sunnyside, 10 Ashdene Road, Southampton, Hants.
- ... Info wanted on Rx type 103A. RF unit 24 and circuit diagram of Rx type BC-453-B a U.S. Army job.—M. Bracewell, 26 Selwyn Crescent, Hatfield, Herts.
- ... borrow or buy circuit diagram for an Armstrong receiver Type A5105.—John King, 4 Eastbourne Road, Polegate, Sussex.
- ... Detailed instructions required for fitting new belt to Akai 4000D tape deck.—T. Fieldhouse, 100 Wortley Heights, Leeds LS12 1JF.
- ... Any info on BUSH EBS 4 RADIO all replies answered.—K. Eskriett, 63 Paley Road, Bradford, Yorks. BD4 7EL.
- ... For, AP61335 Freq. Swept Generator, CT202. Handbook BR1771(14) or circuit diagram. Buy loan of copy, any info welcome.—T. E. Wicks, 12 Kensington Ave, Watford, Herts. WD1 7RY.
- ... ang on the U.S.N. transceiver Type CR1-4344—a unit of Model TB5-8 made by Colonial Radio Corporation, Buffalo, N.Y. Even band-coverage gen would help.—H. W. Boyell, G8GZG, 66 Freshbrook Road, Lancing, Sussex BN15 8DA.
- ... can you please supply me with data and servicing instructions also circuit diagram for the Grundig TK120 Tape Recorder.—G. E. Simkin, 20 Wensleydale Drive, Forest Hill, Newcastle upon Tyne, NE12 0JH.
- ... Information required regarding the R107 will buy or borrow handbook or circuit also any details of possible conversions.—D. A. Douglas, 36 Allon Road, Leicester.
- ... Circuit and details of "Windsor Model 30A Cathode Ray Oscillograph.—J. Hollis, 15 Pickering Rise, Derby DE2 4ES.
- ... circuit diagram, manual, etc. wanted for Veritine Communication Receiver 150 buy or loan.—D. Jones, 12 Welby Place, Sheffield, S8 9DA.
- ... Instruction manual/handbook for RCA AR88D receiver.—P. Lawler, 34 Hanover Gardens, Hainault, Ilford, Essex IG6 2RA. Tel: 01-500 5107.
- ... any information, including circuit diagram on the American AR88 receiver.—L. Rainey, Wood Barton, Woodleigh, Kingsbridge, Devon.
- ... circuit diagram of "Beam Echo Ltd Avantic" Audio Amplifier Type PL6-21. Loan or purchase.—R. C. Warne, 16 Western Place, Penryn, Cornwall.
- ... handbook or information on Advance signal generator B4B.—W. H. Rees, Brendon, Carlton Road, South Godstone, Surrey RH9 8LD.
- ... Service sheet wanted for Sobell receiver (model no.) type 615. Data on the following valves, 5Z4G, K761, 6Q7G & 6K8G.—G. A. Hunt, 38 Garrick Close, Ingh Road Est., Hull, Yorkshire.
- ... I would be grateful to anyone of your readers who can let me have the serial number of the FOUR VALVES contained in the "UNICA" UNR 30 Communications Receiver as I need to replace same, and the existing numbers on the valves are unreadable.—G. Longstaff, 8 Meadow Lane, Northallerton, Yorkshire DL6 1RE.
- ... circuit diagram, alignment instructions or handbook for Lafayette receiver HE30 Will gladly refund postage.—P. Harston, 8 Burlington St., Bath BA1 25A.
- ... manual for CD711, for sale 13A' scope working.—T. Bailey, Chaucer Lodge, Maresfield Park, Uckfield, Sussex.
- ... Wanted, manual for R1155B. Sell or loan.—G. R. Christie, 9E Tallisman Avenue, Westcliffe, Dumbartonshire, Scotland.
- ... R.G.D. 1050C receiver, service manual or circuit. Buy or borrow.—Wilson, 39 Corporation Road, Darlington, Co. Durham.

TAKE 20

DAVID ANDREWS

No. 58 GRIP TESTER

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THE objective when using this piece of equipment is to hold a probe (made of aluminium foil folded round a piece of wooden broom handle) in each hand and squeeze the probes as hard as possible. The tighter the grip the more the lamps will become illuminated. But more than this; the lamps come on in a set sequence. A weak grip will make only one lamp glow faintly but a very strong grip could make all three lamps glow brightly. An intermediate grip may only illuminate two lamps. The circuit shown in Fig. 1 is designed to operate three lamps this way but can be extended to operate as many as are required if the instructions are followed.

is reached when it might be more economic to use a zener diode. For more than four indicating stages R2 ought to be reduced to 220 ohm. The sensitivity of the unit is controlled by VR1. Reducing its value lowers the sensitivity and requires a stronger grip to get the lamps to light up.

★ components list

R1 1kΩ ±W R2 470Ω ±W R3-5 1kΩ ±W
VR1 200kΩ linear potentiometer
D1-6 1N4148 Tr1-4 BC108 LP1-3 6V 40mA
Battery 9V Probes Veroboard

Circuit

Tr1 is an emitter follower and the potential at its emitter is set by the potential divider effect of R1, VR1 and the body's resistance between the palms of the hands and the probes. The lower the skin and body resistance the higher will be the emitter potential. Skin contact resistance can, to some extent, be controlled by the pressure of grip on the probes and this affects the emitter potential.

This potential is used to provide base current into each of the following grounded emitter lamp drivers but the silicon diodes in series with each of the bases ensures that in the case of Tr2 the output from Tr1 must be higher than 1.2V while for Tr3 it must be 1.8V and for Tr4 should exceed 2.4V. Thus, when the grip is weak the potential from Tr1 might only be 1.6V and in this case LP1 will be the only lamp illuminated but if it is 2.2V Tr3 will be starting to conduct and LP2 will start to glow while LP1 glows even more brightly. The diodes are there simply to provide potential increments for consecutive stages and the technique of adding one extra to each stage could be continued until some point

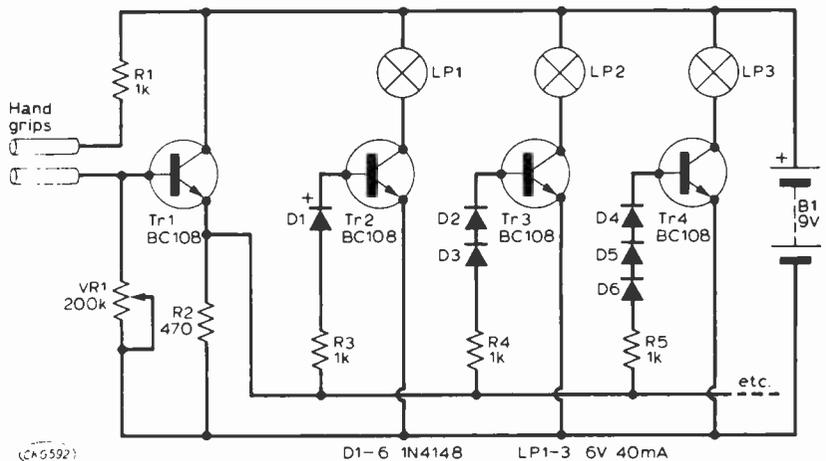
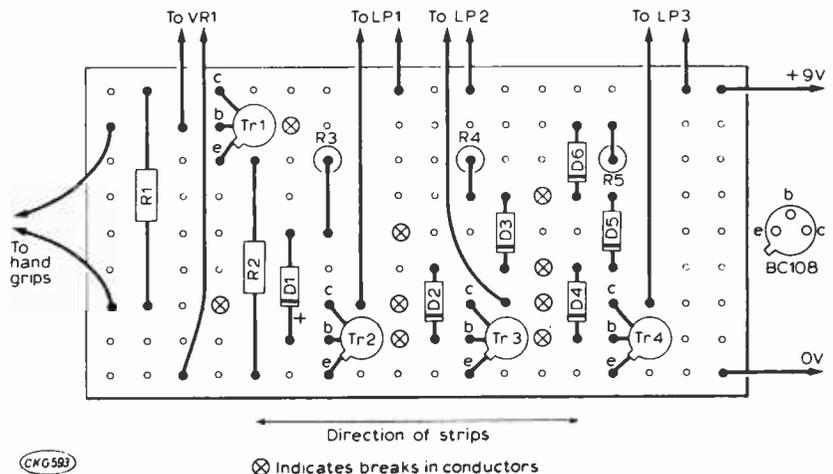


Fig. 1, above, is the circuit for a four stage tester and a suggested layout on plain veroboard is shown in Fig. 2, below.



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DY802	0.46	EF86	0.80	PC988	0.80	PL802	0.96	PCF805	0.90		
EABC80	1.00	EF89	0.81	PC988	0.85	PL802	0.96	30F5/F818	1.10		
EB91	0.98	EF91	1.30	PC1189	0.65	PL802	0.96				
EB91	0.75	EF92	1.40	PC180	0.51	PL802	0.96				
EBF80	0.60	EF95	1.25	PCF82	1.30	PL802	0.96				
EBF83	0.62	EF183	0.60	PCF86	0.65	PL802	0.96				
EBF89	0.58	EF184	0.80	PCF200	0.85	PL802	0.96				
EC86	0.75	EH90	0.56	PCF201	0.87	U26	1.50				
EC88	0.77	EL34	0.92	PCF801	0.85	U191	1.00				
EC81	0.45	EL36	1.05	PCF802	0.71	U193	0.90				
EC82	0.43	EL81	0.90	PCF806	0.68	UABC80	0.90				
EC83	0.45	EL84	0.47	PC1200	0.88	UBC81	0.70				
EC84	0.55	EL86	0.57	PCL82	0.54	UBF89	0.60				
EC85	0.53	EL86	0.95	PCL83	0.68	UC85	0.60				
EC88	0.75	EL96	0.70	PCL84	0.59	UC181	1.00				
ECC189	0.71	EL91	1.31	PCL85	0.63	UC182	0.70				
ECP80	0.86	EL180	1.30	PC1805/85	0.63	UC183	0.70				
ECF82	0.73	EM84	1.18	PCL805/85	0.63	UF89	0.80				
ECF86	1.01	EM87	1.18		0.63	U184	0.95				
ECH81	0.70	EY51	0.83	PD500	1.55	U85	0.55				
ECH83	1.00	EY86/87	0.42	PFL200	0.80	6/30L2/					
ECH84	0.78	EY88	0.84	PL36	0.88	ECC804	1.00				
ECL80	0.83	EZ80	0.51	PL81	0.75	6P23/EF817					
ECL82	0.81	EZ81	0.40	PL81A	0.88						
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CB1.31	1.20	EF86	0.30	PC97	0.50	T41	1.00	6J7G	0.40
CL33	1.50	EF89	0.28	PC900	0.48	U14	1.00	6K6GT	0.75
CY31	0.80	EF91	0.37	PC984	0.40	U25	0.85	6K7M	0.45
DAF91	0.50	EF92	0.50	PC988	0.55	U191	0.75	6K7G	0.30
DAF96	0.50	EF95	0.40	PC989	0.60	UABC80	0.40	6K8G	0.45
DCC90	1.35	EF98	0.75	PCC189	0.60	UAF24	0.75	6K25	0.75
DF91	0.30	EF183	0.30	PCF80	0.30	UBC41	0.75	6L6G	0.55
DF96	0.50	EF184	0.85	PCF82	0.35	UBC81	0.45	6Q7M	0.50
DK91	0.45	EL32	0.60	PCF86	0.60	UBF80	0.40	6Q7G	0.50
DK92	0.70	EL33	1.76	PCF81	0.50	UBF89	0.45	6SL7GT	0.48
DK96	0.60	EL34	0.50	PCF802	0.50	UC85	0.45	6SN7GT	0.48
DL92	0.40	EL36	0.50	PC1805	0.90	UCH42	0.75	68Q7GT	0.50
DL94	0.48	EL37	2.60	PCF805	0.75	UCH81	0.40	6U5G	0.75
DL96	0.55	EL41	0.90	PCF808	0.90	UCL32	0.35	6V6G	0.40
DY80/7	0.38	EL42	0.90	PCL82	0.35	UCL83	0.70	6V6GT	0.45
DY802	0.37	EL84	0.28	PCL83	0.68	UP41	0.75	6X4	0.40
EABC80	0.38	FL95	0.40	PCL84	0.45	UP89	0.40	6X5G	0.40
EAF24	0.75	EL180	1.00	PCL85	0.50	UL41	0.85	6X5GT	0.45
EB91	0.22	EM80	0.45	PCL86	0.45	UL84	0.48	7B6	0.75
EB93	1.00	EM81	0.60	PC1805/85		UY41	0.48	7T7	0.70
EB91	0.75	EM84	0.35		0.50	VY85	0.40	7C5	1.30
EB91	0.83	EM85	1.00	PD500	1.50	VR105-30	0.40	7C6	0.75
EBF80	0.40	EY61	0.40	PEN45	0.75	VR150-30	0.40	7H7	0.70
EBF83	0.40	EY86	0.40	PL36	0.55	OA2	0.40	7R7	0.75
EBF89	0.32	EZ40	0.75	PL81	0.50	OB2	0.40	787	2.25
EB1.31	1.50	FZ41	0.75	PL82	0.45	IR5	0.45	7Y4	0.75
RCC81	0.40	EZ80	0.28	PL83	0.45	IR5	0.30	12A76	0.40
ECC82	0.33	EZ81	0.29	PL84	0.45	IT4	0.30	12A77	0.45
ECC83	0.38	GZ501	0.75	PL500	0.75	IT4	0.40	12A78	0.45
ECC84	0.30	GZ30	0.45	PL504	0.75	IT4	0.40	12A79	0.45
ECC85	0.40	GZ32	0.50	PL508	0.90	IT4	0.40	12A79	0.45
ECC88	0.40	GZ34	0.65	PL509	1.55	IT4	0.40	12A79	0.45
ECH35	1.25	GZ37	1.25	PL802	0.95	IT4	0.40	12A79	0.45
ECH42	1.00	KT88	2.50	PY88	0.40	IT4	0.40	12A79	0.45
ECH81	0.30	KT81	1.75	PY25	3.50	IT4	0.40	12A79	0.45
ECH183	0.45	KT66	2.50	PY33	0.63	IT4	0.40	12A79	0.45
ECL80	0.55	KT81 (7C5)		PY81	0.80	IT4	0.40	12A79	0.45
ECL82	0.35		1.30	PY82	0.35	IT4	0.40	12A79	0.45
ECL83	0.70	KT81	1.75	PY83	0.38	IT4	0.40	12A79	0.45
ECL86	0.40	KT88	2.50	PY88	0.40	IT4	0.40	12A79	0.45
ECLL800	3.20	KT3051	1.00	PY500	1.00	IT4	0.40	12A79	0.45
EF37A	1.20	MU14	1.00	PY81/800	0.50	IT4	0.40	12A79	0.45
EF39	1.20	N7A	2.75	PY801	0.50	IT4	0.40	12A79	0.45

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AA119	0.7	BD132	0.50	OC16	1.00	ZTX500	0.15	2N2946	0.50
AA213	0.10	BF115	0.22	OC20	2.00	ZTX501	0.15	2N2904	0.20
AA215	0.10	BF167	0.25	OC23	1.25	ZTX503	0.16	2N2904A	0.25
AC107	0.35	BF173	0.28	OC25	0.40	ZTX531	0.25	2N2905	0.32
AC126	0.25	BF179	0.33	OC28	0.70	ZTX550	0.18	2N2905A	0.25
AC127	0.25	BF180	0.35	OC35	0.55	1N914	0.08	2N2906	0.20
AC128	0.20	BF181	0.35	OC36	0.65	1N4001	0.8	2N2926	0.10
AC176	0.25	BF194	0.13	OC42	0.40	1N4002	0.7	2N3053	0.20
AC187	0.20	BF195	0.13	OC45	0.18	1N4003	0.8	2N3055	0.80
AC188	0.20	BF197	0.25	OC45	0.18	1N4004	0.20	2N3055	0.80
AC189	0.22	BF200	0.32	OC71	0.10	1N4005	0.10	2N3061	0.30
ACY21	0.65	BF861	0.25	OC72	0.25	1N4006	0.12	2N3615	0.65
AD140	0.60	BF898	0.25	OC76	0.30	1N4007	0.12	2N3702	0.11
AD149	0.60	BFX29	0.28	OC77	0.55	1N4008	0.08	2N3703	0.12
AD161	0.39	BFX88	0.22	OC81	0.28	1N4148	0.08	2N3704	0.14
AD162	0.39	BFY50	0.20	OC81	0.28	1N4148	0.08	2N3704	0.14
AF115	0.25	BFY51	0.20	OC81	0.28	1N4148	0.08	2N3704	0.14
AF116	0.25	BFY52	0.20	OC81Z	0.45	18P203	0.10	2N3705	0.12
AF117	0.20	BFW10	0.61	OC83	0.25	18P203A	0.10	2N3707	0.13
AF186	0.40	BY100	0.15	OC140	0.65	18P200A	0.20	2N3708	0.07
AF239	0.44	BY126	0.14	OC170	0.25	18P201	0.25	2N3709	0.10
ABY27	0.30	BY127	0.15	OC171	0.30	2N699	0.15	2N3710	0.11
ABY28	0.25	BZX61 series		OC171	0.30	2N697	0.18	2N3711	0.11
BA107	0.23		0.20	OC200	0.55	2N697	0.18	2N3711	0.11
BA115	0.10	BZY88 series		OC201	0.60	2N706	0.10	2N3715	0.15
BC107	0.12		0.10	OC202	0.90	2N706A	0.12	2N3820	0.50
BC108	0.12	CR81-05	0.30	OC203	0.55	2N1131	0.25	2N3823	0.50
BC109	0.12	CR81-40	0.45	OC203	0.55	2N1131	0.25	2N3823	0.50
BC113	0.18	CR83-05	0.40	OC203	0.55	2N1131	0.25	2N3823	0.50
BC114	0.21	CR83-40	0.55	OC203	0.55	2N1131	0.25	2N3823	0.50
BC143	0.30	MJE340	0.80	OC203	0.55	2N1131	0.25	2N3823	0.50
BC147	0.12	MJE370	0.68	OC203	0.55	2N1131	0.25	2N3823	0.50
BC148	0.10	MJE520	0.65	OC203	0.55	2N1131	0.25	2N3823	0.50
BC169C	0.14	MJE2965	1.70	OC203	0.55	2N1131	0.25	2N3823	0.50
BC182	0.12	MJE3055	0.75	OC203	0.55	2N1131	0.25	2N3823	0.50
BC182L	0.12	MFP102	0.40	OC203	0.55	2N1131	0.25	2N3823	0.50
BC184L	0.13	MFP102	0.36	OC203	0.55	2N1131	0.25	2N3823	0.50
BCY32	1.20	MFP104	0.35	OC203	0.55	2N1131	0.25	2N3823	0.50
BCY33	0.38	MFP105	0.46	OC203	0.55	2N1131	0.25	2N3823	0.50
BCY34	0.45	NKT404	0.60	OC203	0.55	2N1131	0.25	2N3823	0.50
BCV70	0.15	OA5	0.60	OC203	0.55	2N1131	0.25	2N3823	0.50
BCV71	0.20	OA10	0.40	OC203	0.55	2N1131	0.25	2N3823	0.50
BCV72	0.15	OA79	0.10	OC203	0.55	2N1131	0.25	2N3823	0.50
BCZ11	0.65	OA81	0.10	OC203	0.55	2N1131	0.25	2N3823	0.50
BD121	1.00	OA91	0.7	OC203	0.55	2N1131	0.25	2N3823	0.50
BD124	0.80	OA200	0.80	OC203	0.55	2N1131	0.25	2N3823	0.50
BD131	0.45	OA202	0.10	OC203	0.55	2N1131	0.25	2N3823	0.50

8N7400	0.20	8N7425	0.37	8N7473	0.44	8N74107	0.51	8N74187	1.08
8N7401	0.20	8N74							

"SLO-SYN" 3-LEAD SYNCHRONOUS STEPPING MOTOR



MOTOR

Type SS15. These fine motors are easily reversed, starting and stopping in less than 5th without electrical or mechanical braking. Simple relay circuit can be applied to give DC, to winding for a maximum holding torque of 300oz.in with 35v at 0-35 amps through winding. For AC (synchronous) operation at 120v., 50Hz. Speed 60 rpm at 60Hz., 72 rpm. STEPPING. Holding torque at 50 steps per second—100 oz.in. Can be wired to give 100 or 200 steps per revolution with accuracy of 0.1% per step non-cumulative. Torque characteristics can be modified by simple R.C. circuits. Dimensions: dia. 4", body length 4 1/2", spindle length 2 1/2" x 3/8" dia. Weight 6 1/2 lbs. BRAND NEW in maker's packing. Offered at less than 1/2 maker's price. **OUR PRICE ONLY £15**

be applied to give DC, to winding for a maximum holding torque of 300oz.in with 35v at 0-35 amps through winding. For AC (synchronous) operation at 120v., 50Hz. Speed 60 rpm at 60Hz., 72 rpm. STEPPING. Holding torque at 50 steps per second—100 oz.in. Can be wired to give 100 or 200 steps per revolution with accuracy of 0.1% per step non-cumulative. Torque characteristics can be modified by simple R.C. circuits. Dimensions: dia. 4", body length 4 1/2", spindle length 2 1/2" x 3/8" dia. Weight 6 1/2 lbs. BRAND NEW in maker's packing. Offered at less than 1/2 maker's price. **OUR PRICE ONLY £15**

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240AC type MM4. 2lb. pull, 1 1/2" x 1 1/2" x 1 1/2". Travel 3/4" 70p each. P. & P. 10p. Quantity discounts: 10-50 10%, 50 upwards 25%.



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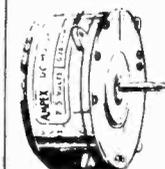
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A magnetically activated switch, vacuum sealed in a glass envelope. Silver contacts, normally closed. Rated 3amp at 120v. 1 1/2amp at 240v. Size: (approx.) 1 1/2" long x 1/2" dia. Ideal for burglar alarms, security systems etc., and wherever non-mechanical switching is required. 10 for £2.10; P. & P. 15p. 50 for £8. 100 for £16.50. FREE P. & P. over 10.

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Output V. & Amps	Ref. No.	Price
12V x 2.250mA x 2	MT111CS**	£1.55
12V x 2.500mA x 2	MT213**	£1.99
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12V x 2.2A x 2	MT190T	£3.06
12V x 2.3A x 2	MT170AT	£3.95
12V x 2.4A x 2	MT108AT	£4.49
12V x 2.5A x 2	MT 72AT	£5.28

30 Volts. All tapped at 0-12-15-20-30V.					
Output Amps	Ref. No.	Price	Output Amps	Ref. No.	Price
500mA	MT112T	£1.81	4A	MT21AT	£5.22
1A	MT190CT	£2.51	5A	MT31AT	£8.10
2A	MT 8AT	£3.77	8A	MT88AT	£9.88
3A	MT20AT	£4.31	10A	MT80AT	£11.97

50 Volts. All tapped at 0-10-25-33-40-50V					
Output Amps	Ref. No.	Price	Output Amps	Ref. No.	Price
500mA	MT102AT	£2.36	3A	MT105AT	£6.34
1A	MT103AT	£2.50	4A	MT106AT	£6.02
2A	MT104AT	£4.74	5A	MT107AT	£11.51

60 Volts. All tapped at 0-24-30-40-48-60V.					
Output Amps	Ref. No.	Price	Output Amps	Ref. No.	Price
500mA	MT124AT	£2.80	2A	MT127AT	£5.15
1A	MT126AT	£3.70	3A	MT125AT	£7.50

AUTO-WOUND RANGE

Power output	Winding tapped at	Ref. No.	Price
20VA	0-115-210-240	MT147T	£1.48
75VA	0-115-210-240	MT64AT	£2.85
150VA	0-115-200-220-240	MT44T	£3.61
200VA	0-115-200-220-240	MT65AT	£4.31

400V. Output at 50Hz.
C-I Ignition System by R. M. Marston. Equl. Wireless World.
Reference IT3AT £4.28

EQUIPMENT RANGE

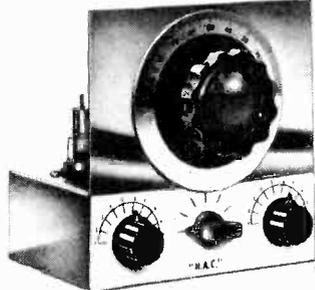
Sec. Output (trans.)	Ref. No.	Price
3-0-3V 200mA	MT238CS**	£1.39
0-0-9V 100mA	MT136CS**	£1.39
12-0-12V 500mA	MT239S**	£1.39
20-0-20V 300mA	MT241S**	£1.39
0-20 x 2 300mA x 2	MT214T**	£2.13
0-8-0 x 2 500mA x 2	MT207T**	£2.53
0-15-20 x 2 500mA x 2	MT205AT**	£3.39
0-15-27 x 2 500mA x 2	MT203AT**	£3.78
0-15-27 x 2 1A x 2	MT204AT**	£3.78
20-12-0-12-20 700mA (d.c.)	MT212AT**	£1.96

AT indicates open universal taping with tags; CT is open U-clamp taping with tags; CS is open U-clamp taping with P.C. splices; * with interwinding screen; ** untapped 240 primary; † tapped at 210-240V; † other primaries tapped at 200-220-240V.

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WORLD-WIDE RECEPTION

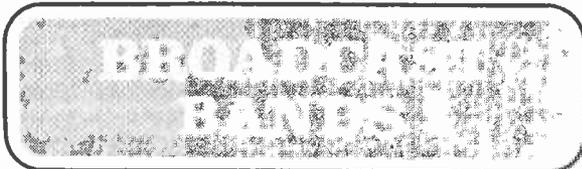


Famous for over 35 years for Short-Wave Equipment of quality, "H.A.C." were the Original suppliers of Short-Wave Receiver Kits for the amateur constructor. Over 10,000 satisfied customers—including Technical Colleges, Hospitals, Public Schools, R.A.F., Army, Hams, etc.

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"H.A.C." SHORT-WAVE PRODUCTS
29 Old Bond Street, London W.1



SHORT WAVE DX by MALCOLM CONNAH

THE receivers used by Broadcast Bands listeners vary enormously; they may be ex-government sets or brand-new commercial units; but all receivers have one thing in common: They will not give their best performance until they are used with a good aerial system.

When we talk of an aerial system we include any devices, such as aerial tuning units, which are placed between the aerial and the receiver.

In order to get optimum reception the aerial system must be resonant at the frequency of reception. Amateur Bands listeners, and operators, have an advantage here because their bands, with the exception of 15 metres, are closely related. These bands are 10, 20, 40, 80 and 160 metres. If an aerial system is resonant on 80 metres it is a relatively simple matter to get it to resonate on 40, 20 and 10 metres.

The Broadcast Bands, however, are completely unrelated being 11, 13, 16, 19, 25, 31, 41, 49, 60, 75, 90 and 120 metres. If one of these bands is of particular interest a half-wave dipole may be erected for that band. The only practical solution for all band reception is to use some form of end-fed aerial. It should be noted that the term 'long-wire' is often used incorrectly, a misuse of which I have been guilty, as this is strictly an end-fed aerial which is long in relation to the wavelength being received.

The length of aerial that can be erected depends on the amount of space available, but the usual compromise is between 50 and 100 feet long. Theory dictates that the aerial should be straight, but many people have had very good results with aerials that have been bent in order to fit them into the space available.

The aerial should, preferably, be an outdoor one erected at a reasonable height and located as far away as possible from such obstructions as buildings and trees. A very simple aerial tuning unit (such as that described by David Gibson in the January 1974 issue) should then be constructed in order to make the aerial system resonant on the desired bands.

Readers' Logs

David Kernick of Prescott, Lancashire used his Grundig TR600A portable with only just the built-in telescopic antenna to hear the following.

- 6070 *R. Sofia, Bulgaria* at 1930.
- 7145 *R. Kiev* in English at 0030.
- 7215 *All India Radio* in English at 2000.
- 9550 *R. Finland* noted at 1805.
- 9670 *Adventist World Radio* at 0930.
- 9695 *V. of Saudi Arabia*, Arabic at 0405.
- 9745 *R. Baghdad, Iraq* noted at 1945.
- 9770 *R. Australia*, English at 1605.
- 9833 *R. Budapest, Hungary* at 1615.
- 11920 *R. Algiers* noted at 1900.
- 11970 *R. Tunis* in Arabic at 0920.
- 15140 *R. Havana, Cuba* in French at 1935.
- 15165 *R. Denmark* in Danish at 1850.
- 15240 *R. Belgrade, Yugoslavia* at 1530.
- 15410 *United Nations Radio* at 1600.
- 17755 *HCJB, Quito, Ecuador* at 1930.
- 17780 *RSA, South Africa* noted at 1600.
- 17845 *WYFR* noted in English at 1730.
- 17865 *WINB, Red Lion*, music at 1930.
- 21630 *V. of Saudi Arabia*, testing at 1110.

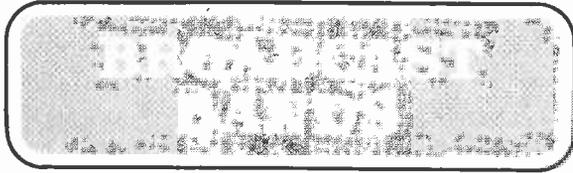
Richard Staples has found an Eddystone 680X in the loft (excuse me whilst I return my ladder to garage) and the addition of a 100 foot end-fed aerial produced:

- 3999 *R. Godthab, Greenland* in Danish at 0840.
- 4820 *Voz Evangelica, Honduras* at 1805.
- 4940 *R. Yaracuy, Venezuela*, Spanish at 1740.
- 5920 *R. Kiev*, news in English at 1800.
- 9590 *R. Australia* noted in English.
- 9610 *R. Canada* in English at 2115.
- 11720 *R. Nacional, Brazil*, Portuguese at 0705.
- 11935 *R. Pakistan*, news in English at 1715.
- 15200 *RSA, South Africa* in English at 0840.
- 21695 *Greek Military Radio, Athens* at 0905.

Christopher Hodgson of Sunderland reports that Radio WYFR (Family Radio Inc.) broadcasts in English to Europe at 1810 GMT on 15130kHz. The station replied to his report in about two weeks and the address for reports is: WYFR, 290 Hegenberger Road, Oakland, California 94621, U.S.A.

With his usual equipment; Codar Multiband 6, P.W. A.T.U. and 50 foot end-fed; Christopher also heard:

- 7080 *Voice of Vietnam, Hanoi* at 1820.
- 7210 *Red Cross Broadcasting* at 1700.
- 9505 *VOA, Tangier*, in Rumanian at 1930.
- 9525 *All India Radio* at 2010.
- 9540 *Radio Tashkent* noted at 1210.
- 9545 *Radio Ghana*, s/off at 2215.
- 11805 *WYFR—Family Radio* at 2100.
- 15130 *WYFR—Family Radio* at 1810.
- 15175 *RSA, South Africa*, s/off at 1850.
- 15185 *R. Finland* noted at 1830.
- 15290 *ORTF, Paris*, s/off at 1115.
- 15415 *Radio Kuwait*, s/on at 1730.
- 15420 *BBC, East Med.* relay noted at 1600.
- 17820 *R. Canada*, s/on in Polish at 1530.



VHF/FM

by SIMON DAVID

HOGMANAY was celebrated in Scotland in a different way than usual. No doubt the timing was deliberate for Radio Clyde, Scotland's first commercial radio station, broadcast on 95.1MHz on December 31st. The station started at 10.30 p.m. with news and introductions to the staff. The 4kW transmitter is at Black Hill.

The criticisms and doubts surrounding London Broadcasting, the London news stations, resulted in the resignations recently of the Managing Director and Chief Editor. Former Lord Mayor of London, Sir Charles Trinder, also walked out issuing an ad-

MEDIUM WAVE BROADCASTS by CHARLES MOLLOY

DAVE KERNICK (Prescot, Lancs) has a Grundig TR600A transistor portable with a built-in ferrite rod antenna, which he has found to be an excellent receiver for pulling-in distant stations. He reports hearing programmes in English from AFN Frankfurt 872kHz; Deutschlandfunk, West Germany 1268kHz at 1745hrs; Radio Norway 1578kHz at midnight; Radio Sweden 1178kHz at 2245hrs; Radio Tirana, Albania 1457kHz (additional frequency for the English Service) at 0330hrs; together with Sud Radio, Andorra in French at 2245hrs on 818kHz and Tripoli, Libya in Arabic at 0025hrs on 1250kHz. Dave asks if it is possible to hear North America on the medium waves using a portable receiver. This is unlikely as a ferrite rod aerial does not have enough pick-up to receive really distant stations. DXers who want to try for North Americans should use an external aerial or a medium wave loop such as the DXers MW Loop Aerial described in the April 1973 issue of *Practical Wireless*.

Readers' Logs

Roy Patrick (Derby) reports hearing the new Independent Broadcasting Authority (IBA) station at Manchester testing on 1151kHz at 1100hrs on December 1st and IBA Birmingham using test tones on the same channel. IBA stations in the provinces are expected to use 1151kHz for stations at Manchester, Birmingham and Glasgow (R. Clyde); 1169kHz for Swansea and 1546kHz for Liverpool and Edinburgh.

R. B. Callwood (Munich, West Germany) reports hearing BBC Radio 1 (1214kHz) at 1300hrs on his

mission that the finances had not lived up to expectations. One thing evident is the difference between some commercial and BBC local radio broadcasts from a technical standpoint and although both have severe financial restrictions, it is only to be expected that the latter has the advantage of drawing on the resources of its "great-auntie".

I have been informed that BBC Radio Derby is still operating on 96.5MHz from Sutton Coldfield using slant polarisation. The 94.2MHz transmitter that I mentioned recently is installed at the studio to fill-in the town centre area because of surrounding high ground. It uses a vertically polarised aerial and 10 watt transmitter.

The Radio Derby aerial at Sutton Coldfield is a 5-element Yagi array 500 feet above ground level. It provides a maximum e.r.p. of 5kW in the Derby direction.

Also from Derby, **Roy Patrick** reports that the Lichfield IBA transmitter for the Birmingham area is due on the air on 94.8MHz in February; the Manchester commercial station is due on 97.0MHz (2kW) in March; the Swansea station is expected to start transmitting on 95.1MHz (1kW), using the circular type of aerial, later on in the summer of 1974.

Last month I reported on the results of using the Antiference FM264T six-element aerial. Results since then have been repeated with the addition of Rouen on 96.6MHz. Unfortunately conditions have not favoured reception from Rheims.

car radio while driving on the autobahn between Munich and Frankfurt. Reception was on a single occasion only and he wonders if any other reader has received BBC Radio 1 in Germany.

Bill Thorne (London) asks for information about the French broadcasts on 584kHz (513m) which he listens to regularly. The station on this frequency produces programmes for the Paris area for the greater part of the day and has a power of only 5kW. The address is O.R.T.F., 116 Avenue du President Kennedy, Paris 16eme France.

Brian Murray has heard IBA Radio Clyde testing on 1151kHz at 1345hrs and he reports that this station is due on the air on December 31st, 1973. Brian has been busy again with his Astrad VEF 204 receiver using an old band 1 TV aerial as a medium wave antenna. His log includes programmes in English from Radio Warsaw 1502kHz at 0115hrs; Radio Sweden 1178kHz at 0025hrs; Manx Radio, Isle of Man 1295kHz at 1350hrs; Radio Eireann 1250kHz at 2120hrs; Trans World Radio, Montecarlo 1466 kHz at 2325hrs and Radio Portugal 755kHz at 2312hrs.

A last-minute phone call from **T. McCann** (Belfast) reports reception of Newfoundland on 930kHz (CJON in St. John's) with the comment "I was surprised at the strength of this station." Propagation on the North American path is rather variable with periods of a week or more when nothing can be heard. At other times, many stations in Canada and the United States can be heard, the limiting factor being interference from Europeans. During the winter listen around midnight on 600kHz, 640kHz, 710kHz, 930kHz, 940kHz, 950kHz, 1070kHz, 1130kHz. North Americans are easy to identify as all stations are allocated call-signs which are used frequently together with the name of the town or city where the studios are located.

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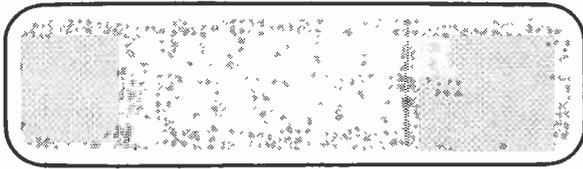
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SHORT WAVES

by **DAVID GIBSON, G3JDG**

A thank you to the many sharp-eared r.f. sleuths who sent in logs. Everyone seems to have bagged far more DX than I did—well done.

John Powell (Essex) sends in some useful information regarding “who’s where and when”. John says look out for VQ9HCS on Astove Island (look it up; I had to!). New Ham on Campbell Island is ZL4NJ/A.

A listening MUST. Havering Amateur Radio Club are running a station in Rutland from Saturday, March 30 to Monday April 1 1974. Listen on topband, eighty and v.h.f. Why? Because after that date there will be no County of Rutland, its being absorbed into the surrounding counties so this is your very last chance. Full marks for initiative to the Havering A.R.C.

Michael Watson (Kent) tells that a station in Teheran, EP2BQ, has put up an inverted V for topband. Listen for the EP2 callsign in the bottom 5kHz of 160 metres. Who will hear him first?

Several people have written taking me to task for omitting the list of Happenings in the radio world. It appears that we have a number of keen Contest types among us. The calendar for February is as follows: 9-10, 1.8MHz contest; 16-17, ARRL Contest (c.w.); 23-24, REF contest (phone); March 3-4, 144MHz Open and s.w.l. contest; March 3-4, ARRL DX contest (phone). National Field Day this year will be on June 1-2.

Robert Beebe (Derby) reports hoards of G stations on topband. He tells that members of the Derby club have worked some juicy DX around 1830kHz and quotes calls like W1, KV4, DJ and OK etc.

Vice Chairman (wonder what sort of vice?) **David Andrews** writes to tell of the Droitwich High School Radio Club. Ten members so far and all going in for the R.A.E. The Club has both Rx and Tx but no antenna up as yet. (How about a base-loaded Maths Master—a sure sine of success).

Keith Rowlings (Herts) has a UR1A, PR40, 75ft. long wire—and a problem. He’s heard N20 and L50 on 7MHz and wants to know where they are (and so do I). Anyone any information on these or are they Japanese postal districts?

Graham Nicholls (Oxon) has a homebrew 70cm converter feeding a homebrew 144MHz converter which feeds an R107 (not homebrew). His 15 element 70cm Parabeam rests in his bedroom, but it still heard the following; F1CTH, G3BA, G3COJ, G3DAH. G3YXN, G3KEQ, G3UHT, G3WSN, G3ZFP, G3ZMD. G3YC, G4ABF, G4AHU, G4BEL, G4BMP, G6XM, G8ADC, G8FMK, GW8AWS/P, HW6BQH/P, HW7FY, ON5FF, ON5HN. On two metres with a homebrew 6—ele Yagi (also in the bedroom) Graham logged; GW8HEZ, HW1CS, HW5SY, PA0ADY, PA0CIO, PA0EZR/A, PA0FHV, PA0PEP, PA0PRY, PA0TAR, SM7DT.

Ye fantastic logge has been sent in by **Stanley Sharred**. I note that it’s on IBM paper—it’s cheating if you get the computer to listen and log. No gear is mentioned (bet it’s a regenerative cats whisker feeding a 100 Watt light bulb) but the following are claimed for 160 metres; GM3ANO, GM4ALK, GM4ASY, GW3UCB, DK3BJ, EI8H, K2ANR, K3RUQ, KV4FZ, OE5KE, OK1AXD, OK1FCW, OK1KRS, OK1KPU, OK2BKT, OK5KWA, OL6AQJ, OL8CCS, PA0HIP, VE1CD, VE1MX, VE1ASJ, VO1KE, W1DX, W1MX, W2DED, W2LWI, W2UEZ, WA2WLN/2, WA8IJI, WB8APM. On 3.5MHz. Stanley excelled with; CT1ADV, CT2BG, EL7D, K2BT, VE1AIH, VO1FG, 7X2MD, 9Y4HR. An excursion to 7MHz revealed DX like; C3IMO, CR4BS, CR6TP, EP2TW, K4DX, PY4MA, PY6WF, PY6AOV, SV1CH, TY1ABE, YV1BI, 5U7BB, 9G1HE.

Eighty metres found **Martin Ward** listening with a JR500S and 60ft. end fed plus an “L-match device” (Oh L). Squeaks of s.s.b. reported from; CT1GC, LX1GC, KG4CB, VE1AIH, VO1FG, 9H1CE, 9J2AE, and a late arrival—CN8CG. Martin reports hearing the Panama City Radio Club on 21MHz with the callsign 3E1KC.

Stephen Day (Suffolk) made an “adjustment” to his R1155 and claims the signals went up by some 20dB. (You can come and make the same adjustment to my receiver—anytime). Antenna is 50ft. end fed and main interest is eighty metres. Stephen bagged mostly G stations but managed foreign signals from; ZK5AFZ and 9H4L.

John Turner says, “I have been giving the Pye Cambridge a rest”. What a thoughtful lad. This compassion for a trusty friend has not prevented John from listening with his homebrew t.r.f. (P.W. November 1963). The bandspread is the small tuning capacitor from the 235MHz section of an Ex 19 set. The t.r.f. 85ft. end fed and lots of patience produced; CT2BK, EA6CK, EA8IH, EL7C, HB0LL, HI3XCP, HK3AVK, HR1RSP, HZ1SH, JX4GN, JY6UMS, K4PWC/AM, KP4BBW, PY2ELV, PY4LW, PZ1DR, TF5TP, TG8KT, VE1AF, VE3AH/SU, VK2AHM, VK2LW, VK2SG, VK3AD, VK3AX, VK3XJ, VK5FH, VK6SB, VS9MJ, VU2GBG, YV4AGT, ZB2CS, ZB2DL, ZD7SD, ZD7SS, ZM3FO, 3A2CP, 4Z4MQ, 5B4F, 7X2MD. Think what could have been received if Stephen Day (above) had made an “adjustment”!

BROADCAST BANDS

Short Wave Reports by 15th of the month to Malcolm Connah, 59 Windrush, Highworth, Swindon, Wiltshire, SN6 7DT.

Medium Waves Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

VHF/FM Reports to Simon David, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD.

AMATEUR BANDS

Short Wave/VHF

Logs in alphabetical order please by 15th of the month to David Gibson, G3JDG, 12 Cross Way, Harpenden, Hertfordshire.



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46 ranges, mirror scale. 50kV/DC. 50kV/AC. V. Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. DC current 25/50uA/2.5/5/25/50/250/500mA/5/10A. Resistance: 10k/100k/1 Meg/10 Meg ohms. -20 to +81.5dB.



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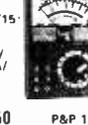
20,000opv. Simple unit with audio/1F oscillator. Suitable for general receiver tuning. Ranges: 0.5/2.5/10/50/250/500/1000V DC. 2.5/10/15/250/500/1000V AC. 0.05/0.5/5/50/500mA DC. Resistance 5/50/500 ohms/5/10/100k ohms/1 Meg. Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.



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30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/20uA/6mA/60mA/300mA/600mA. 0/8k/80k/800k/8 Meg ohms. -20 to +62dB.



OUR PRICE £7.50 P&P 15p

U4324 MULTIMETER

High sensitivity, overload protected. 20,000opv. Ranges: 0.5/1/2/5/10/50/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0/0.05/0.5/6/6/60/600mA/3A DC. 0.3/30/300mA/3A AC. Resistance: 25/500 ohms/0.5/5/500k ohms/5 Mohms. Decibels: -10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.



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U435 MULTIMETER

20,000opv. Overload protected. Ranges: 75mV/2.5/10/25/100/250/500/1000V DC. 2.5/10/25/100/250/500/1000V AC. Current: 50uA/1/5/25/100mA/0.5/2.5/5/10mA. 0.5/2.5A AC. Resistance: 0.3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.



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U4312 MULTIMETER

extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. Current: 0/30/150/300/600/900V AC. 0/300mA/1.5/15/150/150/600mA/1/1.5/6A DC. 0/1/5/6/15/60/150/600mA/1.5/6A AC. 0/200/3k/30k ohms. DC accuracy 1%. AC 1.5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions.



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High sensitivity. DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. ed. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.1m/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/100/1000 ohms. Decibels -20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.



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Input impedance 10 Megohms. Ranges: 0/25/125/10/50/100V DC. 0/2.5/10/50/250/1000V AC. 0/25uA/2.5/25/250 mA DC. 0/5k/50k/500k/5 M 500 Megohms



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370WTR MULTIMETER

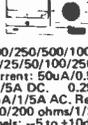
Features AC current ranges. 20,000opv. 0/0.5/2.5/10/50/250/500/1000V DC. 0/2.5/10/50/250/500/1000V AC. 0/50uA/1/10/100 mA/1/10A DC. 0/100mA/1/10A AC. 0/5k/50k/500k/5 Meg/50 Meg. Decibels: -20 to +62dB.



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U4317 MULTIMETER

High sensitivity instrument for field and laboratory work. Knife edge pointer. 86mm mirror scale. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000V DC. 0.5/2.5/10/25/50/100/250/500/1000V AC. Current: 50uA/0.5/1/5/10/50/250mA/1.5A DC. 0.25/0.5/1/5/10/50/250mA/1.5A AC. Resistance: 0.5/10/100/200 ohms/1/3/30/300k ohms. Decibels: -5 to +10dB. Battery operated. Size: 210 x 115 x 90mm. Supplied in carrying case complete with leads.



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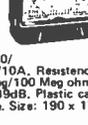
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Sensitivity 330 Ohms/Volt AC and DC. Accuracy 0.5% DC. 1% AC. Scale length: 165mm. 0/300/750uA/1.5/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A DC. 0/3/7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and certificates.



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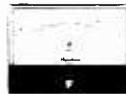
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1A DC	£3.20	20V DC	£3.20
5A DC	£3.20	50V DC	£3.20
10A DC	£3.20	300V DC	£3.20
5V DC	£3.20	15V AC	£3.30
		300V AC	£3.30
		VU Meter	£3.45



CLEAR PLASTIC MODEL SW100

Size: 100 x 80mm

50uA	£4.55		
100uA	£4.35		
500uA	£4.10		
50-0-50uA	£4.35		
100-0-100uA	£4.30		
1mA	£3.95		
1A DC	£3.95		
5A DC	£3.95		
100-0-100uA	£3.95		
50V DC	£3.95		
300V DC	£3.95		
		300V AC	£4.00
		VU Meter	£4.75



EDGEWISE MODEL PE70

Size: 90 x 34mm

50uA	£4.15		
100uA	£3.95		
200uA	£3.75		
500uA	£3.50		
50-0-50uA	£3.95		
100-0-100uA	£3.95		
1mA	£3.50		
300V AC	£3.50		
VU Meter	£4.25		



MODEL ED107 EDUCATIONAL METER

Size: 100 x 90 x 150mm including terminals
A range of high quality
moving coil instruments ideal
for school experi-
ments and other bench
applications. 3" mirror
scale. The meter move-
ment is easily accessible
to demonstrate internal
working.

50uA	£7.60		
100uA	£7.05		
50-0-50uA	£7.05		
1A DC	£6.55		
5A DC	£6.55		
5V DC	£6.55		
10V DC	£6.55		
15V DC	£6.55		
20V DC	£6.55		
50V DC	£6.55		
		300V DC	£6.55
		500mA/5A DC	£7.70
		5V/50V DC	£7.70
		5V/15V DC	£7.70
		1A/15A DC	£7.70



CLEAR PLASTIC MODEL 85P

Size: 120 x 110mm

50uA	£4.85		
100uA	£4.70		
200uA	£4.45		
500uA	£4.30		
50-0-50uA	£4.70		
100-0-100uA	£4.45		
500-0-500uA	£4.30		
1mA	£4.30		
1-0-1mA	£4.30		
5mA	£4.30		
10mA	£4.30		
50mA	£4.30		
100mA	£4.30		
500mA	£4.30		
1A DC	£4.30		
5A DC	£4.30		
15A DC	£4.30		
30A DC	£4.30		
10V DC	£4.30		
20V DC	£4.30		
50V DC	£4.30		
150V DC	£4.30		
		300V DC	£4.30
		15V AC	£4.35
		300V AC	£4.35
		1A AC	£4.30
		5A AC	£5.00
		15A AC	£4.30
		30A AC	£4.30
		5A AC	£4.30
		10A AC	£4.30
		20A AC	£4.30
		30A AC	£4.30



***Items with asterisk are Moving Iron
type, all others are Moving Coil**

CLEAR PLASTIC MODEL SD830

Size: 110 x 83mm

50uA	£3.75		
100uA	£3.70		
200uA	£3.65		
500uA	£3.45		
50-0-50uA	£3.75		
100-0-100uA	£3.70		
1mA	£3.40		
5mA	£3.40		
10mA	£3.40		
50mA	£3.40		
100mA	£3.40		
500mA	£3.40		
1A DC	£3.40		
10A DC	£3.40		
10A DC	£3.40		
5V DC	£3.40		
		10V DC	£3.40
		20V DC	£3.40
		50V DC	£3.40
		300V DC	£3.40
		15V AC	£3.65
		300V AC	£3.65
		VU Meter	£3.85



CLEAR PLASTIC MODEL 45P

Size: 50 x 50mm

50uA	£3.00		
100uA	£2.85		
200uA	£2.75		
500uA	£2.70		
50-0-50uA	£2.90		
100-0-100uA	£2.75		
500-0-500uA	£2.65		
1mA	£2.65		
5mA	£2.65		
10mA	£2.65		
50mA	£2.65		
100mA	£2.65		
1A DC	£2.65		
5A DC	£2.65		
10V DC	£2.65		
20V DC	£2.65		
50V DC	£2.65		
150V DC	£2.65		
5V AC	£2.70		
		300V AC	£2.70
		S Meter 1mA	£2.75
		VU Meter	£3.00
		1A AC	£2.65
		5A AC	£2.65
		10A AC	£2.65
		20A AC	£2.65
		30A AC	£2.65



CLEAR PLASTIC MODEL 38P

Size: 42 x 42mm

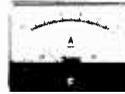
50uA	£2.80		
100uA	£2.70		
200uA	£2.65		
500uA	£2.50		
50-0-50uA	£2.75		
100-0-100uA	£2.65		
500-0-500uA	£2.50		
1mA	£2.50		
1-0-1mA	£2.50		
2mA	£2.50		
5mA	£2.50		
20mA	£2.50		
200mA	£2.50		
50mA	£2.50		
100mA	£2.50		
500mA	£2.50		
1A DC	£2.50		
2A DC	£2.50		
5A DC	£2.50		
10V DC	£2.50		
15A DC	£2.50		
20A DC	£2.50		
3V DC	£2.50		
10V DC	£2.50		
		15V DC	£2.50
		20V DC	£2.50
		50V DC	£2.50
		100V DC	£2.50
		500V DC	£2.50
		300V DC	£2.50
		500V DC	£2.50
		15V AC	£2.55
		50V AC	£2.55
		100V AC	£2.55
		300V AC	£2.55
		500V AC	£2.55
		S Meter 1mA	£2.85
		VU Meter	£2.90



CLEAR PLASTIC MODEL SD460

Size: 59 x 46mm

50uA	£3.10		
100uA	£3.05		
200uA	£3.00		
500uA	£2.80		
50-0-50uA	£3.05		
100-0-100uA	£3.05		
1mA	£2.85		
5mA	£2.85		
10mA	£2.85		
50mA	£2.85		
100mA	£2.85		
500mA	£2.85		
1A DC	£2.85		
5A DC	£2.85		
10V DC	£2.85		
		10V DC	£2.85
		50V DC	£2.85
		300V DC	£2.85
		15V AC	£3.00
		300V AC	£3.00
		VU Meter	£3.20



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0.115/250V. Step up or step down.
Fully shrouded.

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P&P 33p
P&P 38p
P&P 43p
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- 346 EDGWARE RD. W2 01-723 4453
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Reduce tape hiss by 3dB at 600Hz, 6dB at 1200Hz and 10dB for all frequencies above 3000Hz. Size: 460 x 203 x 79mm. AC 220/240V



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Instant recording and playing. Piano key controls. Automatic level control. Built-in speaker. Complete with remote control microphone, carrying case and shoulder strap.
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A beautifully styled four track stereo deck with an outstanding specification offered at a remarkably low price. Incorporates a host of features including switchable noise filter, normal/chrome tape selector, twin VU meter slider record/playback level controls, front panel headphone socket, recording indicator lamp, phono/Din time input sockets, 3.5mm microphone input sockets etc. Frequency response: 40-12kHz (40-16kHz CrO2), S/N: -45dB. Crosstalk 45dB. Separation: -35dB. Noise limiter -6dB at 10kHz. Complete with connecting leads.
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	5	10	25
C60	£1.37	£2.61	£6.16
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OVER 10 of either FREE.



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SKYFON 100mW
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For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on off side switch, stereo headphone socket.
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CARTRIDGE**

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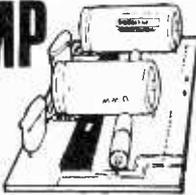
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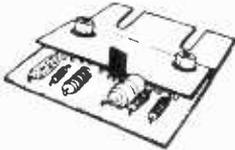
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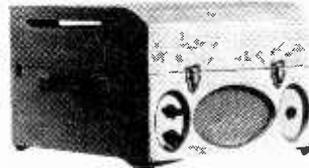
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7400	20p	18p	7447	£1.48	£1.37	74123	£2.85	£3.28	74123	£2.85	£3.28	74123	£2.85	£3.28	74123	£2.85	£3.28	74123	£2.85	£3.28	74123	£2.85	£3.28
7401	20p	18p	7448	£1.98	£1.81	74141	£1.10	99p															
7402	20p	18p	7449	£1.98	£1.81	74145	£1.65	£1.48	74145	£1.65	£1.48	74145	£1.65	£1.48	74145	£1.65	£1.48	74145	£1.65	£1.48	74145	£1.65	£1.48
7403	20p	18p	7450	£2.00	16p	74150	£3.80	£2.75	74150	£3.80	£2.75	74150	£3.80	£2.75	74150	£3.80	£2.75	74150	£3.80	£2.75	74150	£3.80	£2.75
7404	21p	19p	7451	£2.00	19p	74151	£1.21	£1.15	74151	£1.21	£1.15	74151	£1.21	£1.15	74151	£1.21	£1.15	74151	£1.21	£1.15	74151	£1.21	£1.15
7405	21p	19p	7452	£2.00	18p	74152	£1.32	£1.15	74152	£1.32	£1.15	74152	£1.32	£1.15	74152	£1.32	£1.15	74152	£1.32	£1.15	74152	£1.32	£1.15
7406	64p	49p	7453	£2.00	18p	74153	£1.32	£1.15	74153	£1.32	£1.15	74153	£1.32	£1.15	74153	£1.32	£1.15	74153	£1.32	£1.15	74153	£1.32	£1.15
7407	54p	49p	7454	£2.00	27p	74154	£2.20	£1.87	74154	£2.20	£1.87	74154	£2.20	£1.87	74154	£2.20	£1.87	74154	£2.20	£1.87	74154	£2.20	£1.87
7408	28p	24p	7455	£2.00	30p	74155	£1.65	£1.21	74155	£1.65	£1.21	74155	£1.65	£1.21	74155	£1.65	£1.21	74155	£1.65	£1.21	74155	£1.65	£1.21
7409	29p	24p	7456	£2.00	42p	74156	£1.54	£1.43	74156	£1.54	£1.43	74156	£1.54	£1.43	74156	£1.54	£1.43	74156	£1.54	£1.43	74156	£1.54	£1.43
7410	20p	18p	7457	£2.00	40p	74157	£2.18	£2.05	74157	£2.18	£2.05	74157	£2.18	£2.05	74157	£2.18	£2.05	74157	£2.18	£2.05	74157	£2.18	£2.05
7411	23p	21p	7458	£2.00	57p	74158	£2.18	£2.05	74158	£2.18	£2.05	74158	£2.18	£2.05	74158	£2.18	£2.05	74158	£2.18	£2.05	74158	£2.18	£2.05
7412	40p	33p	7459	£2.00	51p	74159	£2.18	£2.05	74159	£2.18	£2.05	74159	£2.18	£2.05	74159	£2.18	£2.05	74159	£2.18	£2.05	74159	£2.18	£2.05
7413	31p	27p	7460	£2.00	99p	74160	£2.18	£2.05	74160	£2.18	£2.05	74160	£2.18	£2.05	74160	£2.18	£2.05	74160	£2.18	£2.05	74160	£2.18	£2.05
7414	49p	47p	7461	£2.00	99p	74161	£2.18	£2.05	74161	£2.18	£2.05	74161	£2.18	£2.05	74161	£2.18	£2.05	74161	£2.18	£2.05	74161	£2.18	£2.05
7415	57p	58p	7462	£2.00	£1.28	74162	£2.18	£2.05	74162	£2.18	£2.05	74162	£2.18	£2.05	74162	£2.18	£2.05	74162	£2.18	£2.05	74162	£2.18	£2.05
7416	20p	18p	7463	£2.00	£1.28	74163	£2.18	£2.05	74163	£2.18	£2.05	74163	£2.18	£2.05	74163	£2.18	£2.05	74163	£2.18	£2.05	74163	£2.18	£2.05
7417	57p	58p	7464	£2.00	£1.28	74164	£2.18	£2.05	74164	£2.18	£2.05	74164	£2.18	£2.05	74164	£2.18	£2.05	74164	£2.18	£2.05	74164	£2.18	£2.05
7420	60p	58p	7465	£2.00	£1.28	74165	£2.18	£2.05	74165	£2.18	£2.05	74165	£2.18	£2.05	74165	£2.18	£2.05	74165	£2.18	£2.05	74165	£2.18	£2.05
7422	60p	58p	7466	£2.00	£1.28	74166	£2.18	£2.05	74166	£2.18	£2.05	74166	£2.18	£2.05	74166	£2.18	£2.05	74166	£2.18	£2.05	74166	£2.18	£2.05
7423	60p	58p	7467	£2.00	£1.28	74167	£2.18	£2.05	74167	£2.18	£2.05	74167	£2.18	£2.05	74167	£2.18	£2.05	74167	£2.18	£2.05	74167	£2.18	£2.05
7425	60p	53p	7468	£2.00	£1.28	74168	£2.18	£2.05	74168	£2.18	£2.05	74168	£2.18	£2.05	74168	£2.18	£2.05	74168	£2.18	£2.05	74168	£2.18	£2.05
7426	35p	31p	7469	£2.00	£1.28	74169	£2.18	£2.05	74169	£2.18	£2.05	74169	£2.18	£2.05	74169	£2.18	£2.05	74169	£2.18	£2.05	74169	£2.18	£2.05
7427	55p	51p	7470	£2.00	£1.28	74170	£2.18	£2.05	74170	£2.18	£2.05	74170	£2.18	£2.05	74170	£2.18	£2.05	74170	£2.18	£2.05	74170	£2.18	£2.05
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7429	85p	81p	7472	£2.00	£1.28	74172	£2.18	£2.05	74172	£2.18	£2.05	74172	£2.18	£2.05	74172	£2.18	£2.05	74172	£2.18	£2.05	74172	£2.18	£2.05
7430	20p	18p	7473	£2.00	£1.28	74173	£2.18	£2.05	74173	£2.18	£2.05	74173	£2.18	£2.05	74173	£2.18	£2.05	74173	£2.18	£2.05	74173	£2.18	£2.05
7432	42p	38p	7474	£2.00	£1.28	74174	£2.18	£2.05	74174	£2.18	£2.05	74174	£2.18	£2.05	74174	£2.18	£2.05	74174	£2.18	£2.05	74174	£2.18	£2.05
7433	97p	91p	7475	£2.00	£1.28	74175	£2.18	£2.05	74175	£2.18	£2.05	74175	£2.18	£2.05	74175	£2.18	£2.05	74175	£2.18	£2.05	74175	£2.18	£2.05
7437	77p	74p	7476	£2.00	£1.28	74176	£2.18	£2.05	74176	£2.18	£2.05	74176	£2.18	£2.05	74176	£2.18	£2.05	74176	£2.18	£2.05	74176	£2.18	£2.05
7438	77p	74p	7477	£2.00	£1.28	74177	£2.18	£2.05	74177	£2.18	£2.05	74177	£2.18	£2.05	74177	£2.18	£2.05	74177	£2.18	£2.05	74177	£2.18	£2.05
7440	20p	18p	7478	£2.00	£1.28	74178	£2.18	£2.05	74178	£2.18	£2.05	74178	£2.18	£2.05	74178	£2.18	£2.05	74178	£2.18	£2.05	74178	£2.18	£2.05
7441	81p	76p	7479	£2.00	£1.28	74179	£2.18	£2.05	74179	£2.18	£2.05	74179	£2.18	£2.05	74179	£2.18	£2.05	74179	£2.18	£2.05	74179	£2.18	£2.05
7442	81p	76p	7480	£2.00	£1.28	74180	£2.18	£2.05	74180	£2.18	£2.05	74180	£2.18	£2.05	74180	£2.18	£2.05	74180	£2.18	£2.05	74180	£2.18	£2.05
7443	£1.40	£1.32	7481	£2.00	£1.28	74181	£2.18	£2.05	74181	£2.18	£2.05	74181	£2.18	£2.05	74181	£2.18	£2.05	74181	£2.18	£2.05	74181	£2.18	£2.05
7444	£1.57	£1.52	7482	£2.00	£1.28	74182	£2.18	£2.05	74182	£2.18	£2.05	74182	£2.18	£2.05	74182	£2.18	£2.05	74182	£2.18	£2.05	74182	£2.18	£2.05
7445	£2.31	£2.18	7483	£2.00	£1.28	74183	£2.18	£2.05	74183	£2.18	£2.05	74183	£2.18	£2.05	74183	£2.18	£2.05	74183	£2.18	£2.05	74183	£2.18	£2.05
7446	£2.31	£2.18	7484	£2.00	£1.28	74184	£2.18	£2.05	74184	£2.18	£2.05	74184	£2.18	£2.05	74184	£2.18	£2.05	74184	£2.18	£2.05	74184	£2.18	£2.05

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Designed for use when working or re-working P.C. Boards. Permits removal of molten solder from Multi-leg components, enabling easy extraction. The solder is 'sipped' through the nozzle, and automatically ejected when the instrument is next used. A Swiss precision instrument manufactured to a high degree of accuracy. The anti-corrosive outside casing has a knurled finish for more positive grip, and encases plated internal parts. The Maxi-Super has been designed with a 3.5 kg. spring action recoilless plunger, whilst the Maxi-Mini with its conveniently shaped operating button, has a 2.5 kg. spring action plunger, protected by a channel guard. Both models have been designed with an easy-to-replace 'dupont' teflon screw-in nozzle.

PLEASE FORWARD without obligation further details. PLEASE SUPPLY Maxi-Super HT 1810 at £6.60 PLEASE SUPPLY Maxi-Mini HT 1800 at £4.95

I enclose cheque value £ _____

NAME _____ POSITION _____

COMPANY _____

ADDRESS _____

SIGNED _____

Prices include VAT Reg. England 68496

AMAZING MINI-DRILL

Indispensable for precision drilling, grinding, polishing, etching, gouging, shaping. Precision power for the enthusiast. Shockproof. Completely portable power from 4 1/2 volt external battery. So much more scope with MINI-DRILL. Super Kit (extra power, interchangeable chuck) £6 35 p.p. 13p. De-Luxe Professional Kit with 17 tools £9 40 p.p. 33p. Prices include V.A.T.

FOR PRECISION MODEL WORK

+ 6 TOOLS

Money ref. g'tee **MERLIN SUPPLY CO.**
Dept. PW 374 Nailsea, Bristol BS19 2LP

INTER-LOCKING PLASTIC STORAGE DRAWERS

Newest, neatest system ever devised for storing small parts and components: resistors, capacitors, diodes, transistors, etc. Rigid plastic units, interlock together in vertical and horizontal combinations. Transparent plastic drawers have label slots. 1D, 2D have removable space dividers. Build up any size cabinet for wall, bench or table top.

DISCOUNT PRICES

SINGLE UNITS (5" x 2 1/2" x 2 1/2") £1.40 Dozen
DOUBLE UNITS £2.30 Dozen
TREBLE (3D) £2.50 for 8

5 SIZES ALL INTERLOCK

DOUBLE TREBLE 2 drawers in one outer case (6D2) £3.60 for 8 EXTRA LARGE SIZE (6D1) £3.40 for 8. Carriage 35p. Orders over £10 post free. QUANTITY DISCOUNTS 15% in £1 for orders over £10, 10% over £20, 10% over £50. Quotations for large quantities. PLEASE ADD 10% VAT TO TOTAL REMITTANCE.

FLAIDLINE SUPPLIES (Dept. PW3), 124 CRICKLEWOOD BROADWAY, LONDON N.W.2 01-450 4844

YATES ELECTRONICS

(FLITWICK) LTD.

ELSTOW STORAGE DEPOT
KEMPSTON HARDWICK
BEDFORD

C.W.O. PLEASE. POST AND PACKING
PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the
components listed will be sent free on request.
10p stamp appreciated.

Callers Welcome Mon. to Sat. 9 a.m. 5 p.m.

PLEASE ADD 10% VAT

RESISTORS

1W Iskra high stability carbon film—very low noise—capless construction.
1W Mullard CR25 carbon film—very small body size 7.5 x 2.5 mm.
1W 2% ELECTROSIL TRS.

Power watts	Tolerance	Range	Values available	Price
1	5%	4.7Ω-2.2MΩ	E24	1-99 100+
1	10%	3.3MΩ-10MΩ	E12	1p 0-8p
1	5%	10Ω-1MΩ	E24	3-5p 3p
1	10%	1Ω-3.9Ω	E12	1p 0-8p
1	5%	4.7Ω-1MΩ	E12	1p 0-8p
4	10%	1Ω-10Ω	E12	6p 5-5p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0.5 watt 5% Iskra resistors 5 off each value 4.7Ω to 1MΩ.
E12 pack 325 resistors £2.40. E24 pack 650 resistors £4.70.

POTENTIOMETERS

Carbon track 5kΩ to 2MΩ, log or linear (log ±W, lin ±W).
Single, 12p. Dual gang (stereo), 40p. Single D.P. switch, 24p.

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C.
mounting (0-1 matrix).
Sub-miniature 0-1W, 5p each. Miniature 0-25W, 7p each.

TRANSISTORS

AC107	15p	AFI26	20p	BF115	25p	OC42	12p	2N3707	12p
AC126	12p	AFI39	32p	BF173	20p	OC44	12p	2N3708	10p
AC127	15p	AFI78	32p	BF177	28p	OC45	12p	2N3709	11p
AC128	15p	AFI80	40p	BF178	32p	OC70	12p	2N3710	11p
AC131	12p	AFI81	40p	BF179	32p	OC71	12p	2N3711	11p
AC132	12p	BC107	12p	BF180	32p	OC72	12p	2N3819	32p
AC176	15p	BC108	12p	BF181	32p	OC81	12p	2N4062	12p
AC187	22p	BC109	12p	BF194	14p	OC82D	12p	2N4286	20p
AC188	22p	BC147	12p	BF195	14p	2N2646	60p	2N4289	20p
AD140	50p	BC148	12p	BF197	15p	2N2904	20p	40361	35p
AD149	45p	BC149	12p	BF200	32p	2N2926	10p	40362	35p
AD161	33p	BC157	14p	BFY50	20p	2N3054	58p	40363	35p
AD162	36p	BC158	14p	BFY51	20p	2N3055	60p	40408	40p
AF114	20p	BC159	14p	BFY52	20p	2N3702	13p	ZTX108	15p
AF115	20p	BC187	22p	BUY105	225p	2N3703	12p	ZTX300	15p
AF116	20p	BD131	75p	OC26	45p	2N3704	13p	ZTX302	20p
AF117	20p	BD132	75p	OC28	18p	2N3705	12p	ZTX300	15p
AF118	38p	BD133	75p	OC35	50p	2N3706	11p	ZX7503	20p

ZENER DIODES

400mW 5%, 3-3V to 30V, 12p. | WIRE WOUND POTS. 3W, 10, 25,
50Ω and decades to 100kΩ, 35p.

DIODES RECTIFIER

BY127	1250V	1A	12p
IN4001	50V	1A	8p
IN4002	100V	1A	8p
IN4004	400V	1A	8p
IN4006	800V	1A	10p
IN4007	1000V	1A	10p

SIGNAL

OA85	7p
OA90	5p
OA91	7p
OA202	7p
IN4148	8p
BA114	8p

SLIDER POTENTIOMETERS

86mm x 9mm x 16mm, length of track 59mm.

SINGLE 10K, 25K, 100K log, or lin. 40p.
DUAL GANG, 10K + 10K etc. log, or lin. 60p.
KNOB FOR ABOVE, 12p.
FRONT PANEL, 65p.

18 Gauge panel 12in x 4in with slots cut for use
with slider pots. Grey or matt black finish com-
plete with fixings for 4 pots.

BRUSHED ALUMINIUM PANELS

12in x 6in, 25p
12in x 2 1/2in, 10p
9in x 2in, 7p

THYRISTORS

2N5060 50V 0-8A 30p
2N5064 200V 0-8A 47p
106F 50V 4A 40p
106D 400V 4A 55p

ALUMINIUM BOXES

AB7	2 1/2" x 5 1/2" x 1 1/2"	50p	AB14	7" x 5" x 2 1/2"	84p
AB8	4" x 4" x 1 1/2"	50p	AB15	8" x 6" x 3"	108p
AB9	4" x 2 1/2" x 1 1/2"	50p	AB16	10" x 7" x 3"	122p
AB10	4" x 5 1/2" x 1 1/2"	50p	AB17	10" x 4 1/2" x 3"	108p
AB11	4" x 2 1/2" x 2"	60p	AB18	12" x 5 1/2" x 3"	120p
AB12	3" x 2" x 1"	44p	AB19	12" x 8" x 3"	160p

HEATSINKS—REDPOINT

2W	24p	4W	45p	TO5	Clip	5p	TO1	Single	5p
3W	36p	6W	60p	TO18	Clip	5p	TO1	Double	8p

TRANSFORMERS All have 240V primary

MT30/2	0-12-15-20-24-30V	2A	£2 85
MT50/1	0-19-25-33-40-50V	1A	£1 90
MT50/1	0-19-25-33-40-50V	1A	£2 55
MT50/2	0-19-25-33-40-50V	2A	£3 50
MT60/1	0-24-30-40-48-60V	1A	£2 10
MT60/1	0-24-30-40-48-60V	1A	£2 80
MT60/2	0-24-30-40-48-60V	2A	£3 80

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 0.0068μF, 0.01μF,
0.015μF, 0.022μF, 0.033μF, 3p, 0.047μF, 0.068μF, 0.1μF, 4p, 0.15μF, 6p, 0.22μF,
7 1/2p, 0.33μF, 11p, 0.47μF, 13p.
160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 0.1μF, 3p, 0.15μF, 3 1/2p, 0.22μF,
4 1/2p, 0.33μF, 5p, 0.47μF, 6p, 0.68μF, 7 1/2p, 0.68μF, 11p, 0.10μF, 13p.

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0.01μF, 0.015μF, 0.022μF, 3p, 0.033μF, 0.047μF, 0.068μF,
3 1/2p, 0.1μF, 4p, 0.15μF, 0.22μF, 5p, 0.33μF, 6 1/2p, 0.47μF, 8 1/2p, 0.68μF, 11p, 0.10μF,
13p, 1.5μF, 20p, 2.2μF, 24p.

MYLAR FILM CAPACITORS 100V

0.001μF, 0.002μF, 0.005μF, 0.01μF, 0.02μF, 100pF to 10,000pF, 2p each.
0.04μF, 0.05μF, 0.068μF, 0.1μF, 3 1/2p.

CERAMIC DISC CAPACITORS

100pF to 10,000pF, 2p each.

ELECTROLYTIC CAPACITORS

(μF/V) 1/63, 1/5.63, 2/2.63, 3/3.63, 4/7.63, 6/8.40, 6/8.63, 10/25, 10/63, 15/16, 15/40,
15/63, 22/10, 22/25, 22/63, 33/16, 33/40, 47/4, 47/10, 47/25, 47/40, 68/6.3,
68/16, 100/4, 100/10, 100/25, 150/6.3, 150/16, 220/4, 220/6.3, 220/16, 330/4, 6p, 47/63,
100/40, 150/25, 220/25, 330/10, 470/6.3, 7p, 68/63, 150/40, 220/40, 330/16, 1000/4, 10p,
470/10, 680/6.3, 11p, 100/63, 150/63, 220/63, 1000/10, 12p, 470/25, 680/16, 1500/6.3, 13p,
470/40, 680/25, 1000/16, 1500/10, 2200/6.3, 18p, 330/63, 680/40, 1000/25, 1500/16,
2200/10, 3300/6.3, 4700/4, 21p.

SOLID TANTALUM BEAD CAPACITORS

0.1μF	35V	2.2μF	35V	22μF	16V	12p
0.22μF	35V	4.7μF	35V	33μF	10V	
0.47μF	35V	6.8μF	25V	47μF	6.3V	
1.0μF	35V	10μF	25V	100μF	3V	

VEROBOARD

0.1	0.15
2 1/2 x 3 1/2	22p
2 1/2 x 5	24p
3 1/2 x 3 1/2	24p
3 1/2 x 5	27p
17 x 2 1/2	75p
17 x 3 1/2	78p
17 x 3 1/2 (plain)	—
17 x 3 1/2 (plain)	—
17 x 2 1/2 (plain)	—
2 1/2 x 5 (plain)	—
2 1/2 x 3 1/2 (plain)	—
Pin insertion tool	32p
Spot face cutter	42p
Pkt. 50 pins	20p

JACK PLUGS AND SOCKETS

Standard screened	18p	2.5mm insulated	8p
Standard insulated	12p	3.5mm insulated	8p
Stereo screened	35p	3.5mm screened	13p
Standard socket	15p	2.5mm socket	8p
Stereo socket	18p	3.5mm socket	8p

D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin
Plug 12p, Socket 8p.
4 way screened cable, 12p/metre.
6 way screened cable, 12p/metre.

BATTERY ELIMINATOR

9V mains power supply. Same size as PP9 battery. £1.50

LARGE (CAN) ELECTROLYTICS

1600μF 64V	74p	2500μF 64V	80p	4500μF 16V	50p
2500μF 40V	74p	3800μF 100V	£2.60	4500μF 25V	£1.68
2500μF 50V	58p	3200μF 16V	50p	5000μF 50V	£1.10

HIGH VOLTAGE TUBULAR CAPACITORS—1,000 VOLT

0.01μF	10p	0.047μF	13p	0.22μF	20p
0.022μF	12p	0.1μF	13p	0.47μF	22p

POLYSTYRENE CAPACITORS 160V 2 1/2%

10pF to 1,000pF E12 Series Values, 4p each.

SMOKE AND COMBUSTIBLE GAS DETECTOR—GDI

The GDI is the world's first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector.
Detector GDI, £2. Kit of parts for detectors including GDI and P.C. board but excluding case. Mains operated detector £5-20. 12 or 24V battery operated audible alarm £7-30. As above for PP9 battery, £6-40.

PRINTED BOARD MARKER

97p
Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

METERS

1 1/2" Scale-500uA, 1mA, 10mA, 100mA £1.90

BULGIN MAINS CONNECTORS

3 Pin 1 1/2A	Chassis Plug	10p	3 Pin 1 1/2A	Chassis Socket	18p
	Line Socket	13p		Line Plug	13p
3 Pin 3A	Chassis Plug	10p	3 Pin 3A	Chassis Socket	21p
	Line Socket	14p		Line Plug	23p
3 Pin 5A	Chassis Plug	16p	2 Pin 5A	Line Plug	20p
	Line Socket	15p			

THERMISTORS

VA1005	15p
VA1026	15p
VA1033	15p
VA10555	15p
VA10665	15p
VA1077	15p
R53	£1 35

ROTARY MAINS SWITCH

D.P. 2A 32p

709	14 pin DIL	40p
741	8 pin DIL	40p
741	14 pin DIL	38p
723	14 pin DIL	95p
747	14 pin DIL	85p
748	8 pin DIL	45p

WAVECHANGE SWITCH 23p

1p 12W, 3p 4W, 2p 2W, 2p 6W, 4p 3W

DIL Sockets 14 pin and 16 pin 16p

**Fully guaranteed
Individually packed
VALVES**

B12H	£3.00	ECL86	60p	N7K	£2.75
CY31	45p	EF36	40p	OB2	40p
DAF96	45p	EF37A	£1.00	OB2	40p
DF96	45p	EF40	62p	PAB390	35p
DK96	60p	EF41	65p	PC97	41p
DL92	35p	EF80	25p	PC980	45p
DL94	45p	EF82	£1.00	PC984	45p
DL96	55p	EF85	31p	PC885	40p
DM70	60p	EF86	27p	PC888	55p
DY86	35p	EF89	25p	PC889	45p
DY87	30p	EF91	37p	PC1189	50p
DY802	30p	EF92	40p	PC870	25p
E88CC/01	£1.08	EF95	25p	PC882	35p
E180CC	65p	EF184	31p	PC886	55p
E182CC	£1.15	EF180	20p	PCF200	75p
E450	18p	EL34	50p	PCF201	75p
EABC80	38p	EL36	47p	PCF801	50p
EAF42	50p	EL41	55p	PCF802	45p
EB91	20p	EL61	55p	PCF805	90p
EB33	60p	EL82	52p	PCF806	65p
EB41	65p	EL84	21p	PCF808	85p
EBF80	40p	EL85	44p	PCF200	70p
EBF80	40p	EL86	38p	PCF181	50p
EBF83	40p	EL90	31p	PCF182	35p
EBF89	27p	EL95	35p	PCF183	65p
EC81	30p	EL500	70p	PCF184	35p
EC82	25p	EL504	70p	PCF186	45p
EC83	35p	EM31	60p	PCF1805	50p
EC84	27p	EM80	45p	PD500	£1.30
EC85	35p	EM84	35p	PF1200	65p
EC88	80p	EM87	70p	PL36	55p
EC88	30p	EM81	40p	PL38	65p
EC180	65p	EY81	40p	PL81	40p
ECF80	31p	EY86	40p	PL82	40p
ECF82	55p	EY88	40p	PL83	45p
ECF83	67p	EZ40	50p	PL84	30p
ECF801	55p	EZ41	75p	PL80	15p
EC142	70p	EZ80	25p	PL504	75p
EC181	30p	EZ81	27p	PL508	90p
EC183	40p	EY601	70p	PL509	£1.10
EC184	40p	OZ24	60p	PL802	85p
ECL80	40p	GZ37	63p	PY33	65p
ECL82	31p	KT96	£2.30	PY80	35p
ECL83	70p	KT98	£2.90		

TRANSISTORS, ZENER DIODES etc.

AC 07	35p	BC118	20p	NKT222	30p	OC75	25p	ORP61	45p	2N2411	55p
AC113	15p	BC182A	11p	OA5	60p	OC76	25p	ORP90	95p	2N2646	45p
AC126*	20p	BC212A	13p	OA10	40p	OC77	45p	ORP93	£1.10	2N2904	20p
AC 27	20p	BCY72	15p	OA70	10p	OC78	25p	RAE32JAF		2N2989	24.00
AC128	20p	BD138	45p	OA71	10p	OC78D	35p			2N3053	20p
AC132	25p	BF115	25p	OA73	15p	OC81	25p	RD94	21p	2N3054	45p
AC176	25p	BF167	25p	OA74	15p	OC81D	25p	VA05A	25p	2N3055	55p
AC187	25p	BF173	25p	OA79	10p	OC81MD	20p	ZR11	50p	2N3646	30p
AC188	25p	BF173	25p	OA81	08p	OC82	25p	ZR21	30p	2N3730	65p
AC177	35p	BF177	20p	OA91	07p	OC82MD	30p	ZR22	25p	2N3731	70p
AC132	25p	BF180	35p	OA200	07p	OC83	25p	ZT20	£1.00	2N3819	25p
AD139	40p	BF200	30p	OA202	10p	OC84	25p	ZT83	60p	2N3903	70p
AD149	50p	BFY51	20p	OAZ200	50p	OC122	£1.00	ZT84	£1.00	2N3904	50p
AD161	35p	BFY52	20p	OAZ201	45p	OC138	25p	ZT91	£2.00	2N3907	£1.80
AD162	35p	BFY90	75p	OC16	£1.00	OC140	65p	ZT202	50p	2N708	75p
AF118	25p	BBY29	30p	OC22	£1.00	OC141	60p	ZT203	50p	40594	65p
AF127	30p	BYZ13	35p	OC25	40p	OC170	25p	ZTX302	20p	40895	75p
AF139	30p	BYZ16	60p	OC26	35p	OC171	30p	1N923A	65p	40636	£1.00
AF178	45p	CR81/10	30p	OC28	65p	OC200	40p	1N4785	75p	40669	90p
AF180	48p	CR81/20	40p	OC29	65p	OC201	75p	2N918	37p		
AF181	48p	CR81/40	48p	OC35	50p	OC202	60p	2N987	43p		
AF186	40p	CR83/40AF	60p	OC36	65p	OC203	65	2N1304	22p		
AF212	£1.00	CR25/025	75p	OC44	12p	OC204	65	2N1305	22p		
ASY26	25p	OC70	12p	OC205	£1.00	OC205	£1.00	2N1306	22p		
ASY28	25p	OC71	12p	OC206	£1.00	OC206	£1.00	2N1307	25p		
BC107	10p	GET115	75p	OC71	12p	OCPT1	£1.00	2N1308	27p		
BC108	10p	GET116	85p	OC72	20p	ORP1	55p	2N1309	27p		
BC113	18p	GET116	£1.50	OC73	30p	ORP60	50p	2N2147	75p		
BC118	20p	UY41	45p	3Q4	60p	6A47	45p	6BA6	25p	6X30	40p
BC182A	11p	UY85	35p	3S4	35p	6AH6	50p	6BE6	32p	6X30GT	45p
BC212A	13p	VR105/30	40p	3V4	45p	6AK6	35p	6BG6	70p	6Y6G	75p
BCY72	15p	Z800U	£2.00	5B/254M	£3.00	6AK8	38p	6BY6	55p	6Z4	40p
BD138	45p	Z801U	£2.00	Z801U	£2.00	6AL5	20p	6BQA	55p	6Z6	40p
BF115	25p	Z802U	£1.25	5B/255M	£3.00	6AL5W	50p	6BR7	£1.00	7B7	70p
BF167	25p	Z900T	£1.10	Z900T	£1.10	6AM6	35p	6BWR	90p	7Y4	60p
BF173	25p	IL4	20p	5R4G	75p	6AN8	60p	6BW7	90p	816	40p
BF177	25p	IL5	45p	5U4G	35p	6AQ5	42p	6C4	30p	11E2	24.90
BF180	35p	1B4	30p	5V4G	45p	6AQ5W	65p	6C6	40p	12AT6	35p
BF200	30p	1B5	30p	5Y3GT	45p	6A86	50p	6CH6	55p	12AT7	35p
BFY51	20p	1T4	30p	5Y4G	35p	6AT6	38p	6CL6	50p	12AT7	35p
BFY52	20p	1X2A	80p	5Z3	70p	6AT6	30p	6D6	35p	12AV6	50p
BFY90	75p	1X2B	60p	5Z4	75p	6AX4GT	75p	6EA8	70p	12AX7	30p
OC16	£1.00	1X28	25p	5Z5	25p	6AX5GT	80p	6F23	80p	12BE6	50p
OC22	£1.00	3A4	50p	5Z4GT	80p	6AD7	45p	6B7	55p	6F33	£3.25
OC25	40p	6AD7	45p	6B7	55p					12BH7	50p

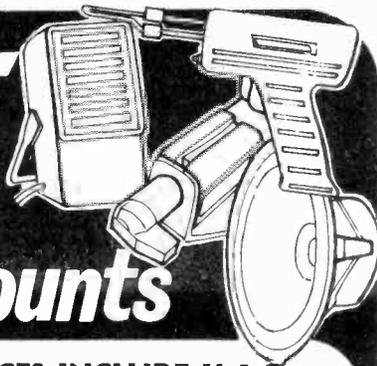


ALL valves guaranteed

ZENER DIODES

10W/1V	45p	68K7	40p	68Q7	40p
10W/2V	45p	68K7GT	45p	68Q7GT	45p
10W/3V	45p	68K8	40p	68Q8	40p
10W/4V	45p	68K9	40p	68Q9	40p
10W/5V	45p	68K10	40p	68Q10	40p
10W/6V	45p	68K15	40p	68Q15	40p
10W/7V	45p	68K20	40p	68Q20	40p
10W/8V	45p	68K25	40p	68Q25	40p
10W/9V	45p	68K30	40p	68Q30	40p
10W/10V	45p	68K35	40p	68Q35	40p
10W/15V	45p	68K40	40p	68Q40	40p
10W/15V	45p	68K45	40p	68Q45	40p
10W/15V	45p	68K50	40p	68Q50	40p
10W/15V	45p	68K55	40p	68Q55	40p
10W/15V	45p	68K60	40p	68Q60	40p
10W/15V	45p	68K65	40p	68Q65	40p
10W/15V	45p	68K70	40p	68Q70	40p
10W/15V	45p	68K75	40p	68Q75	40p
10W/15V	45p	68K80	40p	68Q80	40p
10W/15V	45p	68K85	40p	68Q85	40p
10W/15V	45p	68K90	40p	68Q90	40p
10W/15V	45p	68K95	40p	68Q95	40p
10W/15V	45p	68K100	40p	68Q100	40p
10W/15V	45p	68K110	40p	68Q110	40p
10W/15V	45p	68K120	40p	68Q120	40p
10W/15V	45p	68K130	40p	68Q130	40p
10W/15V	45p	68K140	40p	68Q140	40p
10W/15V	45p	68K150	40p	68Q150	40p
10W/15V	45p	68K160	40p	68Q160	40p
10W/15V	45p	68K170	40p	68Q170	40p
10W/15V	45p	68K180	40p	68Q180	40p
10W/15V	45p	68K190	40p	68Q190	40p
10W/15V	45p	68K200	40p	68Q200	40p
10W/15V	45p	68K210	40p	68Q210	40p
10W/15V	45p	68K220	40p	68Q220	40p
10W/15V	45p	68K230	40p	68Q230	40p
10W/15V	45p	68K240	40p	68Q240	40p
10W/15V	45p	68K250	40p	68Q250	40p
10W/15V	45p	68K260	40p	68Q260	40p
10W/15V	45p	68K270	40p	68Q270	40p
10W/15V	45p	68K280	40p	68Q280	40p
10W/15V	45p	68K290	40p	68Q290	40p
10W/15V	45p	68K300	40p	68Q300	40p
10W/15V	45p	68K310	40p	68Q310	40p
10W/15V	45p	68K320	40p	68Q320	40p
10W/15V	45p	68K330	40p	68Q330	40p
10W/15V	45p	68K340	40p	68Q340	40p
10W/15V	45p	68K350	40p	68Q350	40p
10W/15V	45p	68K360	40p	68Q360	40p
10W/15V	45p	68K370	40p	68Q370	40p
10W/15V	45p	68K380	40p	68Q380	40p
10W/15V	45p	68K390	40p	68Q390	40p
10W/15V	45p	68K400	40p	68Q400	40p
10W/15V	45p	68K410	40p	68Q410	40p
10W/15V	45p	68K420	40p	68Q420	40p
10W/15V	45p	68K430	40p	68Q430	40p
10W/15V	45p	68K440	40p	68Q440	40p
10W/15V	45p	68K450	40p	68Q450	40p
10W/15V	45p	68K460	40p	68Q460	40p
10W/15V	45p	68K470	40p	68Q470	40p
10W/15V	45p	68K480	40p	68Q480	40p
10W/15V	45p	68K490	40p	68Q490	40p
10W/15V	45p	68K500	40p	68Q500	40p
10W/15V	45p	68K510	40p	68Q510	40p
10W/15V	45p	68K520	40p	68Q520	40p
10W/15V	45p	68K530	40p	68Q530	40p
10W/15V	45p	68K540	40p	68Q540	40p
10W/15V	45p	68K550	40p	68Q550	40p
10W/15V	45p	68K560	40p	68Q560	40p
10W/15V	45p	68K570	40p	68Q570	40p
10W/15V	45p	68K580	40p	68Q580	40p
10W/15V	45p	68K590	40p	68Q590	40p
10W/15V	45p	68K600	40p	68Q600	40p
10W/15V	45p	68K610	40p	68Q610	40p
10W/15V	45p	68K620	40p	68Q620	40p
10W/15V	45p	68K630	40p	68Q630	40p
10W/15V	45p	68K640	40p	68Q640	40p
10W/15V	45p	68K650	40p	68Q650	40p
10W/15V	45				

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SONOTONE		STYLI for above cartridges	
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		P. & P.	.05

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240v Input 6, 7.5 or 9 300mA	2.20	lighter socket) 6, 7.5 or 9	
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5"	Std.	LP	DP	7"	Std.	LP	DP
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For 5" Reels	18p	CASSETTE CASES	10p
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BIB ACCESSORIES

Tape Editing Kit Ref. 23	1.30	SPECIAL OFFER	
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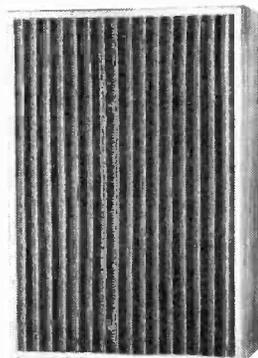
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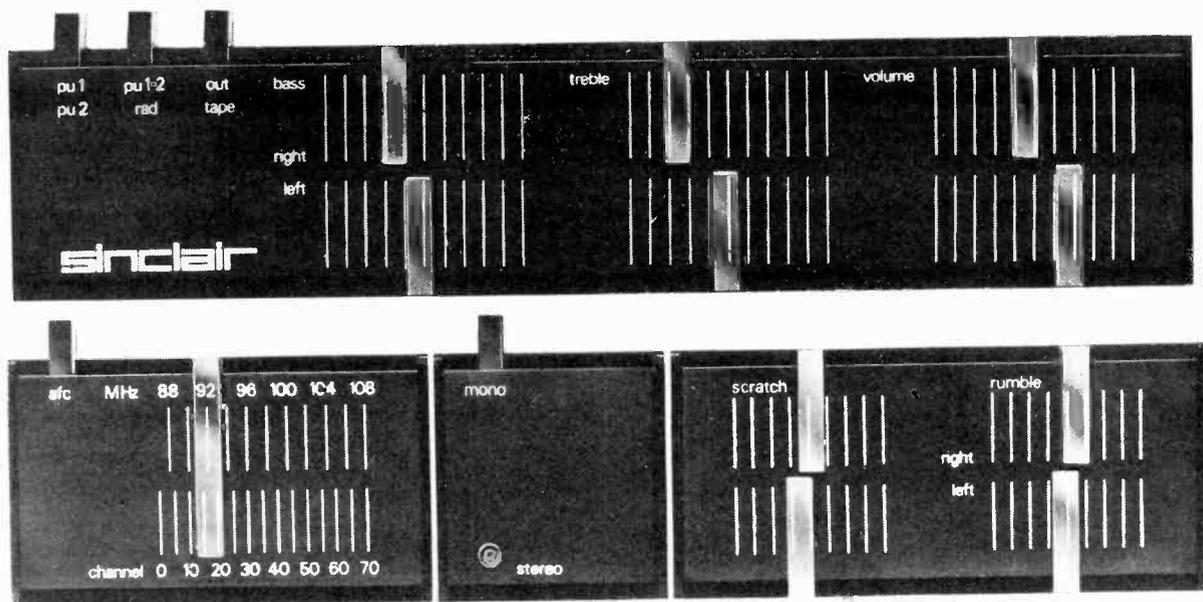


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Sinclair Project 80

exciting



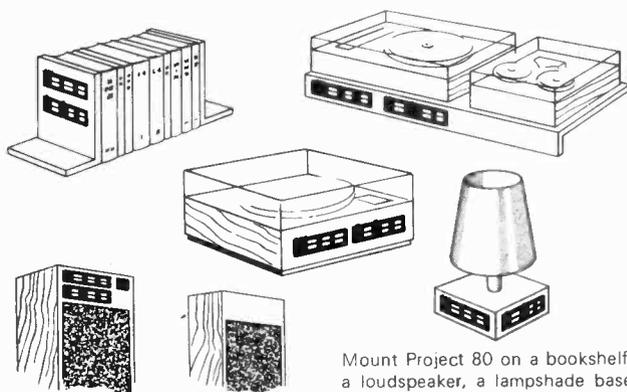
only $\frac{3}{4}$ " deep x 2" high

Living with hi-fi takes on new meaning with Sinclair Project 80. The electronics of these revolutionary new modules are all contained within elegantly designed matching cases no more than three-quarters of an inch deep. They are designed for mounting on any appropriate flat surface by means of 6BA bolts extending from the rear of each module and which pass through suitably drilled holes. Connections are taken away out of sight in a similar manner. The possibilities opened up by Project 80 are endless – superb hi-fi systems can be installed in ways hitherto only dreamed about and never before made practical. No more cutting out and shaping to put modules in position. A few holes drilled with the aid of templates supplied and the job is done. Now you need never again be faced with problems of keeping the hi-fi from clashing with carefully thought-out furnishing schemes. (That will surely please wives!) Slider controls have been introduced in place of knobs and all modules in the range incorporate new up-dated circuitry with emphasis on performance standards and built-in protection against overload and shorting. The aim was to re-think modular construction completely – to make it infinitely more versatile, even simpler and more reliable – the result – Project 80 – another triumph for Sinclair, and the most exciting construction modules ever.

the slimmest, most elegant hi-fi modules ever made

Typical Project 80 applications

System	The Units to use	Units cost
Simple battery record player	Z.40	£5 45 +54p V.A.T.
Mains powered record player	Z.40, PZ.5	£10 43 +£1.04 V.A.T.
30W. RMS continuous sine wave stereo amp.	2 x Z.40s, Stereo 80; PZ.6	£30 83 +£3.08 V.A.T.
50W (8 Ω) RMS continuous sine wave de luxe stereo amp.	2 x Z.60s, Stereo 80; PZ.8	£33 83 +£3.38 V.A.T.
Indoor P.A.	Z.60, PZ.8	£14 93 +£1 49 V.A.T.

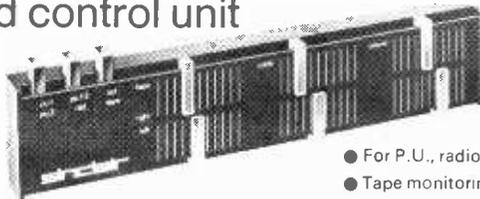


Mount Project 80 on a bookshelf, a loudspeaker, a lampshade base, a false wall with two Q.16 loudspeakers... almost anywhere.

Project 80 FM tuner, decoder, and A.F.U. may be added as required

new thinking in modular hi-fi

Stereo 80 pre-amplifier and control unit



- For P.U., radio and tape
- Tape monitoring switch
- Simplest ever fixing

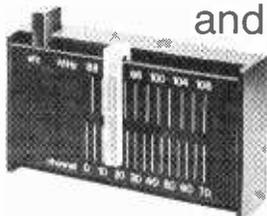
Each channel has its own separate tone and volume controls operated by sliders, enabling ideal environmental matching to be obtained. A virtual earth input stage forms part of the up-dated circuitry that ensures the finest possible quality from all signal sources. Generous overload margins are allowed on all inputs. Clear instructions with template are supplied.

TECHNICAL SPECIFICATIONS

Size - 260 x 50 x 20mm (10 1/2 x 2 x 3/4 ins)
 Finish - Black with white indicators and transparent sliders
 Inputs - Magnetic pick-up 3mV RIAA corrected, Ceramic pick-up 300mV
 Radio 300mV; Tape 30mV
 Signal/noise ratio - 60dB
 Frequency range - 20Hz to 15KHz ± 1dB, 10Hz to 25KHz ± 3dB
 Power requirements - 20 to 35 volts
 Outputs - 100mV - AB monitoring for tape
 Controls - Press button for tape radio and P.U. Sliders for volume, bass (-12dB to -14dB at 100Hz) treble (+11dB to -12dB at 10KHz)

R.R.P. £11.95 + £1.19 V.A.T.

Project 80 FM tuner and stereo decoder



- Twin dual varicap tuning: 4 pole ceramic filter: switchable A.F.C.
- On the decoder, solid state stereo indicating beacon.

Making the Project 80 F.M. tuner and decoder available separately gives a wider choice of systems and saves money where stereo reception may not be required. The tuner is a triumph of electronic design and assures excellent performance. The decoder gives a 40dB channel separation with 150mV output per channel. Both units may be used with other than Project 80 systems.

TECHNICAL SPECIFICATIONS OF TUNER

Size - 85 x 50 x 20mm (3 1/2 x 2 x 3/4 ins)
 Tuning range - 87.5 to 108 MHz
 Detector - I.C. balanced coincidence for good A.M. rejection
 One I.C. equal to 26 transistors
 Distortion - 0.2% at 1 KHz for 30% modulation
 4 pole ceramic filter in I.F. section
 Aerial impedance - 75 Ω or 240-300 Ω
 Sensitivity - 4 microvolts for 30dB quieting
 Output - 300 mV for 30% modulation
 Power requirements - 23 to 33 volts

DECODER

Size - 47 x 50 x 20mm (1 7/8 x 2 x 3/4 ins)
 One 19 transistor I.C.

R.R.P. £11.95 + £1.19 V.A.T.

R.R.P. £7.45 + 0.74 V.A.T.

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If, within 3 months of purchasing any product direct from us, you are dissatisfied with it, your money will be refunded on production of receipt of payment. Many Sinclair appointed stockists also offer this guarantee. Should any defect arise in normal use, we will service it without charge. For damage arising from mis-use a charge (typically £1.00) will be made.

sinclair

Sinclair Radionics Ltd. London Road, St. Ives, Huntingdon PE17 4HJ
 Telephone St. Ives (0480) 64646

Z.40 & Z.60 power amplifiers totally short-circuit proof



Z.40



Z.60

Intended for use in Project 80 installations, these modules readily adapt to an even wider range of applications. Both incorporate built-in protection against short circuiting and risk of damage from mis-use is greatly reduced.

Z.40 TECHNICAL SPECIFICATIONS

Size - 55 x 80 x 20mm (2 1/8 x 3 1/8 x 3/4 ins) 9 transistors
 Input sensitivity - 100mV
 Output - 15 watts RMS continuous into 8 Ω (35V)
 Frequency response - 10Hz - 100KHz ± 1dB
 Signal/noise ratio - 64dB
 Distortion - at 10 watts into 8 Ω less than 0.1%
 Power requirements - 12 to 35 volts

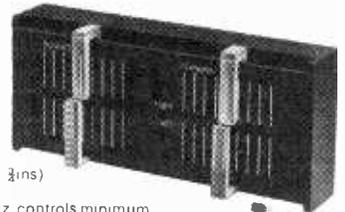
Z.60 TECHNICAL SPECIFICATIONS

Size - 55 x 98 x 15mm (2 1/8 x 3 7/8 x 3/4 ins) 12 transistors
 Input sensitivity - 100-250mV
 Output - 25 watts RMS continuous into 8 Ω (45V).
 Distortion - typically 0.03%
 Frequency response - 10Hz to more than 200KHz ± 1dB
 Signal/noise ratio - better than 70dB
 Built-in protection against transient overload and short circuiting
 Load impedance - 4 Ω min; max safe on open circuit

Z.40 R.R.P. £5.45 + 0.54 V.A.T. Z.60 R.R.P. £6.95 + 0.69p V.A.T.

Project 80 active filter unit

Makes a highly desirable part of any worthwhile system where inputs may be from record, radio or tape. As with Stereo 80, separate controls applied to each channel make it easier to obtain ideal stereo balance.



TECHNICAL SPECIFICATIONS

Size - 108 x 50 x 20mm (4 1/4 x 2 x 3/4 ins)
 Voltage gain - minus 0.2dB
 Frequency response - 36Hz to 22KHz controls minimum
 Distortion - at 1 KHz - 0.03% using 30V supply
 HF cut off (scratch) - 22KHz to 5.5KHz, 12dB/oct. slope
 L.F. cut off (rumble) - 28dB at 20Hz, 9dB/oct. slope

- For scratch and rumble control
- Transistorised active circuitry

R.R.P. £6.95 + 0.69 V.A.T.

Power supply units

PZ.8

Stabilised. Re-entrant current limiting makes damage from overload or even direct shorting impossible. Normal working voltage (adjustable) 45V.

R.R.P. £7.98 + 0.79p V.A.T.
 Without mains transformer

PZ.5 30V unstabilised
 R.R.P. £4.98 + 0.49p V.A.T.

PZ.B 35V, stabilised
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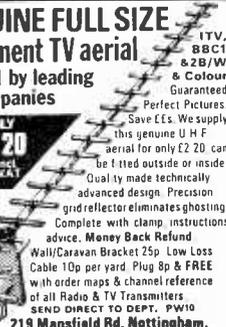
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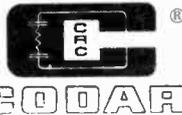
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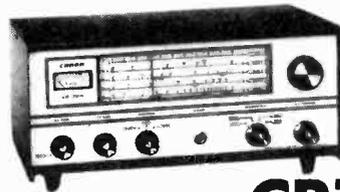


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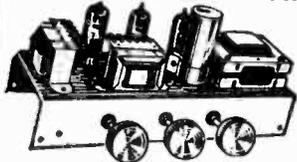


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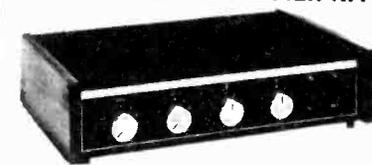
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 10µF 16V 6p 220µF 10V 6p
 10µF 25V 6p 220µF 16V 8p
 10µF 63V 6p 220µF 63V 21p
 15µF 16V 6p 330µF 16V 12p
 15µF 63V 6p 330µF 63V 25p
 16µF 40V 6p 470µF 6.4V 6p
 22µF 25V 6p 470µF 40V 20p
 22µF 63V 6p 680µF 16V 25p
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 5 x 3½" (Plain) — 22p
 Insertion tool 59p 59p
 Track Cutter 44p 44p
 Pins, Pkcs. 25 10p 10p
TRANSISTORS
 AC127 16½p BC212L 12p
 AC128 22p BC213L 12p
 BC107 11p BC214L 17p
 BC108 12p OC44 15p
 BC109 13p OC71 13p
 BC148 12p OC81 16p
 BC149 12p OC170 23p
 BC182L 12p T1543 33p
 BC183L 12p 2N2926 11p
 BC184L 13p 2N3702 11p

POTENTIOMETERS
 Carbon Track 5KΩ to 2MΩ, log or lin. Single, 16½p Dual Gang 46p. Log Single with switch 26p
 Slider Pots. 10K, 100K, 500K, 30mm, 34p. 45mm, 47p. 60mm, 55p.
DIODES
 IN4001 6½p DIN 2 Pin 12p
 IN4002 7p DIN 3 Pin 13p
 IN4003 7p 5 Pin 180° 15p
 IN4004 9½p Std. Jack 14½p
 IN4005 12p 2.5mm Jack 11p
 IN4006 14p Photo 5½p
SOCKETS
 IN914 7p DIN 2 Pin 10p
 IN916 7p 3 Pin 10p
 BA100 10p
 OA5 42p
 OA47 9p
 OA81 11p 2.5mm Jack 11p
 OA200 8p Photo 5½p
Integrated Circuits
 µA709C 50p
 µA741C 55p
 µA723C 1£
 µL914 35p

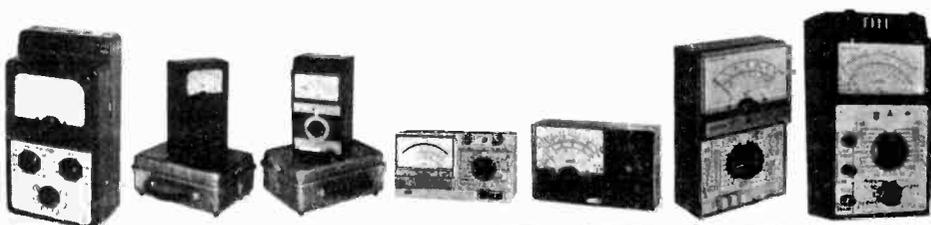
ELECTROLYTIC CAPACITORS. Tubular & Large Cans
 (µF/V): 2.2/25, 2.2/63, 4.7/10, 4.7/25, 4.7/63, 22/10, 22/25, 22/63, 5p. 2/10, 2/10, 50/10, 100/10, 10/25, 50/25, 10/50, 5½p. 200/10, 100/25, 50/50, 6½p. 500/10, 200/25, 100/50, 9p. 1000/10, 500/25, 200/50, 11p. 2000/10, 1000/25, 500/50, 16½p. 1000/50, 39p. 1000/100, 66p. 2000/25, 27p. 2500/12, 17p. 2500/25, 33p. 2500/50, 62p. 3000/50, 72p. 5000/25, 66p. 5000/50, 94p. 7000/50, 60p. 25,000/25, 74p. Hi-VOLT: 8/350, 14p. 16/350, 19p. 32/350, 25p. 50/250, 18p. 100/500, 33p.
METALLISED PAPER CAPACITORS
 250V: 0.05µF, 0.1µF 4½p, 0.25µF, 5½p, 0.5µF, 6½p, 1µF, 9p.
 500V: 0.025µF, 0.05µF, 4½p, 0.1µF, 5½p, 0.25µF, 6½p, 0.5µF, 9p.
 1000V: 0.01µF, 10p, 0.022µF, 12p, 0.047µF, 0.1µF, 16p, 0.22µF, 31p, 0.47µF, 39p.

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