PRACTICAL WIRELESS

MARCH 1974

25p

FREE INSIDE

CRATA: Cassette Recorder And Tuner Amplifier

Australia 50c
New Zealand 50c
South Africa 45c
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Nigeria X40
Malaysia $1.80
Sweden Kr 3.50
Malta 22c5
Norway Kr 3.10

also: I C WAVEFORM GENERATOR
CRYSTAL HARMONIC CALIBRATOR

PRACTICAL WIRELESS

VOL. 49 NO. 11
ISSUE 805
MARCH 1974

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.

● NEWS & COMMENT

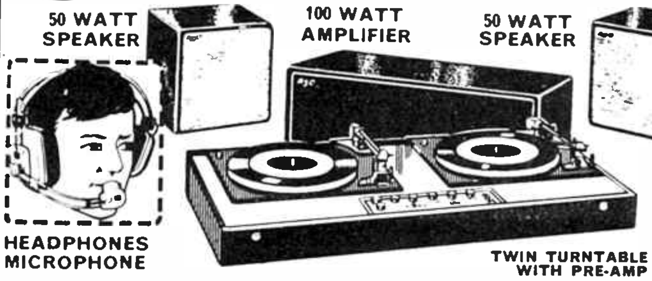
● CONSTRUCTIONAL

● OTHER FEATURES

● EXTRA WITH THIS ISSUE

INSET P. W. DATACARDS in COLOUR
No. 7 F.M. Aerial Systems
No. 8 BBC VHF Radio Stations.

RSC DISCO SYSTEM



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" × 18" × 8"
(e) RSC TDI DISCO CONSOLE

(a) (b) (c) (d) & (e) Carr. £3·00 **£149·95**

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

RSC TDI DISCO CONSOLE

Incorporating twin Garrard SP25 or BSR MP60 type turntables and Sonotone or Acos Cartridges with diamond stylii. Separate Vol. controls for each turntable. Also MONITORING FACILITIES, plus Treble and Bass Controls. Separate input for 'mike' with vol. control switch. Black Vynide covered Cabinet with lid, see illustration on left. Or Dep. £23·50 and 12 mthly pymts £4·54 (Total £77·98) **£69·95** Carr. £1·50

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 howl characteristic high flux 13" x 8" 20 watt speakers. Terms: Dep. £3·95 and 8 m'thly payments £2·67 (Total £25·31) Carr. 65p. **£21·95**

TYPE C318 50 WATTS Low feedback characteristic. Fitted three 13" × 8" deep cone high flux speakers with high power voice coils. Size approx. 54" × 14" × 11". Dep. £4·72 & 8 mthly pymts £4·15 (£37·92) Carr. 85p **£32·72**

TYPE C4100 100 WATTS inc. four 12" 50 watt speakers for conservative rating. Extra heavy construction. Size approx. 58 × 16 × 10" Acoustically filled and pressurised. Terms: Dep. £22·00 & 12 mthly. pyts. £4·29 (Total £73·48). 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 18" 100 Watt 14,000 gauss 8/15 Ω **£27·50** Dep: £3·32 and 8 mthly payments £3·32 (Total £29·88)

'POP' 60 15" 60 Watt 14,000 gauss 8/15 Ω **£15·75** Dep. £1·92 and 8 monthly payments. £1·92 (Total £17·28)

FOR BASS GUITAR, ELECT. ORGAN, ETC.

'POP' 50 12" 50 Watt 13,000 gauss 15 Ω **£12·75** Dep £1·61 and 8 monthly payments £1·61 (Total £14·49) 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**

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).

ALL RSC PRICES INCLUDE VAT

MINSTREL 8W GUITAR AMP.

Incorporating Tremolo and 13" × 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**

FANE CRESCENDO SPEAKERS

Full range available at ALL BRANCHES

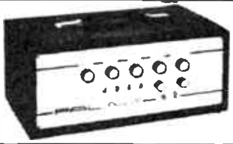
GROUP EQUIPMENT PACKAGE OFFERS

F.A.L. PHASE 50 MK.III AMPLIFIER £39·93
PR. FANE POP 25/2 25W L/SPEAKERS £17·50
Terms: Deposit £17·32 and 12 monthly payments of £3·38 (Total £57·88) £57·43
PACKAGE PRICE **£51·95** carr. £1·10

F.A.L. PHASE 50 MK.III AMPLIFIER £39·93
PR. FANE POP 50 L/SPEAKERS £23·98
Terms: Deposit £19·19 and 12 monthly payments of £4·00 (Total £67·99) £63·91
PACKAGE PRICE **£59·99** carr. £1·10

F.A.L. PHASE 50 AMPLIFIER £39·93
PAIR L12/20 SPKRS (in Cabinets) £26·30
Terms: Deposit £20·00 and 12 monthly payments £3·90 (Total £66·80) £66·23
PACKAGE PRICE **£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/s 3 to 30 ohms. Size 17" × 7" × 7½" 200-250v. A.C. mains. Output 50 watts music rating. Or deposit £9·93 & 8 monthly payments £4·31. Total £44·41. **£39·93**

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**
Or deposit £5·95 and 8 monthly payts. of £4·72. Total £43·71

L12/20 12" 20-25 WATT 13,000 lines 15 ohms Dep £4·15 & 8 mthly pymts £1·42 (Total £15·51) **£13·15** Carr. 55p.

L12/10 10-15 Watt veneer finish cabinet 12" unit 8-15 ohm. Size approx. 14" × 14" × 9". Carr. 50p. Dep. £2·25 & 8 mthly pymts £1·04 (Total £10·57) **£8·25**

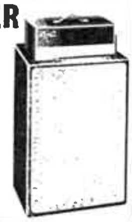
RSC PHANTOM '50'

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 £3·90 (Total £66·80). Carr. £1·50 UK Mainland
SAE for leaflet
ONLY £59·95

CREDIT INTEREST CHARGES REFUNDED if account cleared in 3 months

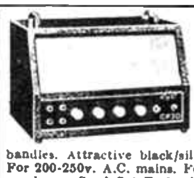
REGENT 50 AMPLIFIER



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 £80·66.) Carr. £2·50 **£72·50**

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 valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/silver P.V.C. fascia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Terms: Deposit £4·40 and 8 monthly payments of £3·09 (Total £29·12). **£25·85** Carr. 75p

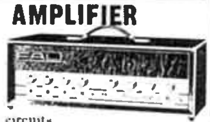
FAL TWIN CHANNEL AMPLIFIERS

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 Terms: Dep. £19·85 & 12 mthly. payments £3·90 (Total £66·65) **£59·50** Post free

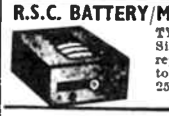
FAL 'SUPER 100' 100 WATTS MUSIC RATING. Terms: Dep. £26·65 & 12 mthly. pymts. £5·17 (Total £88·95). Prices include protective dust cover. **£79·95** Post free

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

R.S.C. BATTERY/MAINS CONVERSION UNITS



TYPE BM1. An all-dry battery eliminator. Size 5½ × 4½ × 2½in. approx. 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**

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

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

MIDGET CLAMPED TYPE 2½ × 2½ × 2½in.

250v., 60mA, 6·3v. 2a	£1·10
250-0-250v., 60mA 6·3v 2a	£1·16

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·55
250-0-250v. 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. For Mullard 510 Amplifier	£2·95
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
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	£5·45
425-0-425v. 200mA, 6·3v. 4a., Twice 5v. 3a.	£5·60
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	£6·00

TOP SHROUDED DROP-THRO' TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6 3v. 2a.	£1·49
250-0-250v. 100mA, 6·3v. 3·5a.	£1·71
250-0-250v. 100mA, 6·3v. 2a., 6·3v. 1a.	£1·75
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	£1·81
250-0-250v. 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. Suitable for Mullard 510 Amplifier	£2·85
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.	£2·85

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 55p; 6·3v. 2a. 60p; 6·3v. 3a. 85p; 6·3v. 6a. £1 45; 12v. 1a. 61p; 12v. 3a. or 24v. 1·5a £1·50; 0-9-18v 1½a £1·25; 0-12-25-42v 2a £1·95.

CHARGER TRANSFORMERS 0-9-15v. 1½a. £1·10, 2½a. £1·25; 3a. £1·40; 5a. £1·60; 6a. £1·85; 8a. £2·20

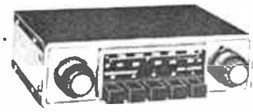
AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v. 50-80 watts £1·25. 150 watts, £2·10 250 watts £3·00; 500 watts £6·40

OUTPUT TRANSFORMERS

Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	95p
Push-Pull 10 watts 6V6, ECL86 to 3-5-8-15 Ω	£1·55
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	£1·50
Push-Pull Ultra Linear for Mullard 510, etc.	£2·45
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	£2·20
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	£3·65

SELENIUM RECTIFIERS
F. W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 18v.
1a, 28p. 2a, 39p. 3a, 55p 4a, 72p. 6a, 88p.

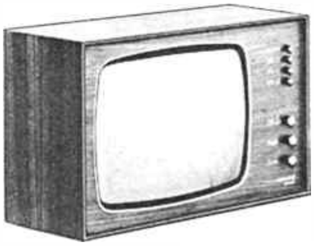
SMOOTHING CHOKES
150mA, 7-10H, 250 Ω 77p; 100mA, 10H, 200 Ω 66p; 80mA, 10H, 350 Ω 55p; 60mA, 10H, 400 Ω 28p.



Car Radio.
Kit K/CR-9502.

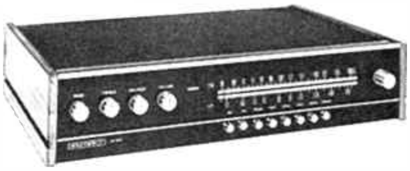
Metal
Locator.
Kit K/GD-348

Electronic
Calculator.
Kit K/IC-2108.



Black and White
Portable Television.
Kit K/GR-9900.

Hi-Fi Stereo
Receiver.
Kit K/AR-1214



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ELECTRONIC IGNITION SYSTEM

This Capacitor-Discharge Electronic Ignition System was recently described in Practical Wireless and has proved extremely popular. We are able to offer the kit in two forms; the standard kit containing the electronic components only, enabling the customer to tailor these to his own layout, or the de-luxe version containing a ready-drilled roller-tinned printed-circuit board and fully machined die-cast case with A.M.P Electrical Spade Connector Block. Each kit is supplied with a custom wound transformer, first grade components and full constructional details.

The original circuit employed Germanium Power Transistors for the negative earth version. **WE NOW SUPPLY SILICON P.N.P. POWER DEVICES AT NO EXTRA COST!** All components available separately. Case size 4½" x 3½" x 2". Complete assembly and wiring manual 25p, supplied with de-luxe kit only, refundable on purchase of kit.

Suitable for 12v systems with Pos. or Neg. earth.

Price: Standard Kit ....£7·97 U.K. Post Free
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Build something completely out of the ordinary: Build the fascinating MINICOMP* the miniaturised ERNIE.
The MINICOMP employs sophisticated LOGIC techniques and brilliant NIXIE tubes to display truly RANDOM NUMBERS. At the mere touch of a button the neon numbers "WHIP" round spectacularly at high speed, before a random number within a pre-set range is selected and displayed.

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Includes four range selections within 00–99.
* DICE : 1–6 * ROULETTE : 00–36 * POOLS : 00–59 * BINGO : 00–99
Kit includes 7 latest LOGIC I.C.'s, 3 transistors, 2 NIXIES, fibreglass P.C. board, the power supply and various other components.

MINICOMP 1000

After tremendous popularity of MINICOMP 100 we are now pleased to introduce MINICOMP 1000, which has all the original features of MINICOMP 100 but in addition it provides two higher ranges:
* QUARTO : 000–399 * KILO : 000–999
Kit includes 9 latest LOGIC I.C.'s 3 transistors, 3 NIXIES, 2 P.C. boards, the power supply and various other components.
The MINICOMP is extremely easy to build as the P.C. boards are supplied with I.C.'s fully assembled and tested. The illustrated instructions include an introduction to the LOGIC techniques employed in the MINICOMP. Attractive NYLON coated and elegantly sized case, approx. 7", 4½", 3" and silk aluminium panel.
APPLICATIONS: The MINICOMP simulates electronically all phenomenon in nature or activity in daily life with random occurance. RANDOM PULSE TRAINS are found useful in medical and statistical research. Digital LOGIC makes possible a modern and exciting means of playing any number of NUMBER GAMES the human mind can conjure up.
A PROFOUND ATTRACTION FOR PARTY GAMES, FETES, RAFFLE AND POOLS DRAWS. A purely random selection of the draws could well contribute to your winning combination.
U.K. PRICES: Overseas and quantity prices on request.
240V, 50 HZ. OR 110V, 60 HZ. mains operated.
MINICOMP100, KIT: £42·50 Built & Guaranteed Units: £45·00
MINICOMP1000, KIT: £56·00 " " " : £59·00
All prices include V.A.T. and P&P.
TERMS: C.W.O., MAIL ORDER ONLY.

* Patent applied for.

MICROELECTRONICS MICRO
51 Mexfield Road, London SW15 2RG. Tel: 01-870 2368

TRANSFORMERS

SAFETY MAINS ISOLATING TRANSFORMERS

Pri. 120/240 V Sec. 120 240 V Centre Tapped and Screened

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	P & P £	p
07	20	1	8	7·0 × 6·0 × 6·0	2·32	30
149	60	3	12	9·9 × 7·7 × 8·6	3·45	36
150	100	5	8	9·9 × 8·9 × 8·6	3·79	52
151	200	8	0	12·1 × 9·3 × 10·2	6·45	52
152	250	13	12	12·1 × 11·8 × 10·2	8·41	67
153	350	15	0	14·0 × 10·8 × 11·8	11·22	82
154	500	19	8	14·0 × 13·4 × 11·8	16·25	–
155	750	29	0	17·2 × 14·0 × 14·0	22·10	
156	1000	38	0	17·2 × 16·6 × 14·0	29·87	–
158	2000	60	0	21·6 × 15·3 × 18·1	49·25	–

PLEASE NOTE NEW ADDRESS AS BELOW

AUTO TRANSFORMERS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	P & P £	p
113	20	1	0	5·8 × 5·1 × 4·5	0-115-210-240	1·22	22
64	75	2	4	7·4 × 6·7 × 6·1	0-115-210-240	2·40	30
4	150	3	4	8·9 × 7·7 × 7·7	0-115-200-220-240	2·89	36
66	300	6	4	9·9 × 9·6 × 8·6	.. ..	5·63	52
67	500	12	8	12·1 × 11·2 × 10·2	.. ..	8·36	67
84	1000	19	8	14·0 × 13·4 × 14·3	.. ..	15·19	82
93	1500	30	4	14·0 × 15·9 × 14·3	.. ..	21·99	–
95	2000	32	0	17·2 × 16·6 × 14·0	.. ..	28·70	•
73	3000	40	0	21·6 × 13·4 × 18·1	.. ..	39.17	•

CASED AUTO TRANSFORMERS

115V 500W enclosed transformer, with mains lead and two 115V outlet sockets. £9·49. P & P 67p. 20 Watt version £2·02 P & P27p

TRANSFORMERS

PRIMARY 240-250 VOLTS 12 AND OR 24 VOLT RANGE

Ref. No.	Amps. 12V	24V	Weight lb	oz	Size cm.	Secondary Windings	P & P £	p
111	0·5	0·25		8	4·8 × 2·9 × 3·5	0-12V at 0·25A × 2	1·22	22
213	1·0	0·5	1	4	6·1 × 5·8 × 4·8	0-12V at 0·5A × 2	1·44	22
71	2	1	1	12	7·0 × 6·4 × 6·1	0-12V at 1A × 2	1·90	22
18	4	2	2	12	8·3 × 7·7 × 7·0	0-12V at 2A × 2	2·68	30
70	6	3	3	8	8·9 × 8·0 × 7·7	0-12V at 3A × 2	3·20	42
108	8	4	5	8	9·9 × 8·9 × 8·6	0-12V at 4A × 2	3·60	52
72	10	5	6	4	9·9 × 9·6 × 8·6	0-12V at 5A × 2	4·25	52
116	12	6	6	12	9·9 × 10·2 × 8·6	0-12V at 5A × 2	5·10	52
17	[illegible]	0	8	12	12·1 × 9·9 × 10·2	0-12V at 8A × 2	6·56	52
115	20	10	11	8	14·0 × 9·6 × 11·8	0-12V at 10A × 2	8·36	67
187	30	15	15	8	14·0 × 12·1 × 11·8	0-12V at 15A × 2	15·40	82
226	60	30	32	0	17·2 × 15·3 × 14·0	0-12V at 30A × 2	28·44	•

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
112	0·5	1	4	6·1 × 5·8 × 4·8	0-12-15-20-24-30V	1·42	22
79	1·0	2	4	7·0 × 6·7 × 6·1	.. ..	1·92	36
3	2·0	3	4	8·9 × 7·7 × 7·7	.. ..	2·90	36
20	3·0	4	8	9·9 × 8·3 × 8·6	.. ..	3·58	42
21	4·0	6	4	9·9 × 9·6 × 8·6	.. ..	4·25	52
51	5·0	6	12	12·1 × 8·6 × 10·2	.. ..	5·30	52
117	6·0	8	0	12·1 × 9·3 × 10·2	.. ..	6·31	52
88	8·0	12	0	12·1 × 11·8 × 10·2	.. ..	8·18	67
89	19·0	13	12	14·0 × 10·2 × 11·8	.. ..	10·33	67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
102	0·5	1	12	7·0 × 6·4 × 6·1	0-19-25-33-40-50V	1·90	30
103	1·0	2	12	8·3 × 7·4 × 7·0	.. ..	2·80	36
104	2·0	5	8	9·9 × 8·9 × 8·6	.. ..	3·87	42
105	3·0	6	12	9·9 × 10·2 × 8·6	.. ..	5·26	52
106	4·0	10	0	12·1 × 10·5 × 10·2	.. ..	6·99	52
107	6·0	12	0	14·0 × 10·2 × 11·8	.. ..	10·35	67
118	8·0	18	0	14·0 × 12·7 × 11·8	.. ..	13·51	97
119	10·0	25	0	17·2 × 12·7 × 14·0	.. ..	16·93	•

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	P & P £	p
124	0·5	2	4	7·0 × 6·7 × 6·1	0-24-30-40-428-69C	1·93	36
126	1·0	3	4	8·9 × 7·7 × 7·7	.. ..	2·70	36
127	2·0	6	4	9·9 × 9·6 × 8·6	.. ..	4·25	42
125	3·0	8	12	12·1 × 9·9 × 10·2	.. ..	6·46	52
123	4·0	13	12	12·1 × 11·8 × 10·2	.. ..	8·36	67
40	5·0	12	00	14·0 × 10·2 × 11·8	.. ..	9 85	87
120	6·0	15	8	14·0 × 12·1 × 11·8	.. ..	12·14	82
121	8·0	25	00	14·0 × 14·7 × 11·8	.. ..	13·65	•
122	10·0	25	0	17·2 × 12·7 × 14·0	.. ..	20·09	•
189	12·0	29	00	17·2 × 14·0 × 14·0	.. ..	22·49	•

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Ref.	MA.	Weight lb	oz	Size cm	VOLTS	P & P £	p
238	200		2	2·8×2·6×2·0	3-0-3	1·31	10
212	1A 1A	1	4	6·1×5·8×4·8	0-6 0-6	1·52	22
13	100		4	3·9×2·6×2·9	9-0-9	1·12	10
235	330,330		4	4·8×2·9×3·5	0-9, 0-9	1·52	10
207	500, 500	1	00	6·1×5·4×4·8	0-8-9, 0-8-9	2·03	22
208	1A, 1A	1	12	7·0×6·4×6·1	0-8-9,0-8-9	2 73	30
236	200, 200		4	4·8×2·9×3·5	0-15, 0-15	1·52	10
214	300, 300	1	4	6·1×5·8×4·8	0-20, 0-20	1·60	22
221	700 (D.C.)	1	8	7·0×6·1×6·1	20-12-0-12-20	1·41	30
206	1A, 1A	2	12	8·3×7·7×7·0	0-15-20, 0-15-20	3·08	36
203	500, 500	2	4	8·3×7·0×7·0	0-15-27, 0-15-27	2·82	38
204	1A, 1A	3	4	8·9×7·7×7·7	0-15-27, 0-15-27	2·86	38

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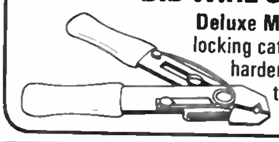

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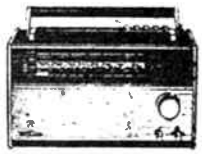

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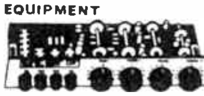

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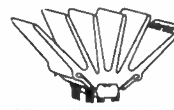

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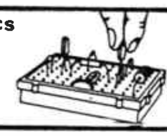

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ACY17	25p	BCY39	£1·00	MJE371	90p	OC72	20p	ZTX500	16p	2N2907	25p
ACY18	30p	BCY55	£1·60	MJE520	65p	OC75	25p	ZTX501	20p	2N2926	12p
ACY19	30p	BCY70	22p	MJE2955	£1·95	OC76	25p	ZTX504	50p	2N3053	25p
ACY20	25p	BCY71	22p	MJE3055	85p	OC77	40p	ZTX531	30p	2N3054	65p
ACY39	55p	BCY72	25p	MM1613	43p	OC81	25p	ZTX550	25p	2N3055	50p
ACY21	30p	BD121	75p	MM1712	60p	OC83	25p	1N659	8p	2N3232	70p
AD140	60p	BD123	75p	MPF102	45p	OC84	25p	1N914	8p	2N3525	95p
AD149	65p	BD124	80p	MPF103		OC139	30p	1N916	8p	2N3702	14p
AD161	40p	BD131	75p	(2N5457)	35p	OC140	30p	1N4001	8p	2N3703	12p
AD162	40p	BD132	75p	MPF104		OC170	25p	1N4002	9p	2N3704	12p
ADZ11	£1·60	BD153	75p	(2N5458)	35p	OC171	30p	1N4003	9p	2N3705	12p
AF114	25p	BD156	75p	MPF105		OC200	50p	1N4004	10p	2N3706	12p
AF115	25p	BDY11	£1·40	(2N5459)		OC201	60p	1N4005	12p	2N3707	12p
AF116	25p	BDY17	£1·60	MPSA06	35p	OC202	75p	1N4006	15p	2N3708	12p
AF117	25p	BDY19	£1·95	MPSA16	30p	TIP29A	49p	1N4007	18p	2N3709	12p
AF118	60p	BF152	20p	MPSA56	35p	TIP30A	58p	1N4148	7p	2N3771	£2·70
AF172	30p	BF194	14p	MPSO06	75p	TIP31A	62p	2N696	25p	2N3772	£2·75
ASY28	30p	BF195	15p	MPSO56	70p	TIP32A	74p	2N697	20p	2N3773	£2·95
ASZ21	60p	BFX29	30p	NKT135	35p	TIP33A	£1·05	2N698	25p	2N3819	35p
BA102	33p	BFX84	30p	NKT222	25p	TIP34A	£1·55	2N706	12p	2N3820	55p
BA112	50p	BFX85	30p	NKT401	85p	TIP35A	£3·35	2N706A	15p	2N3866	85p
BA114	16p	BFX86	30p	NKT404	80p	TIP36A	£2·65	2N708	15p	2N3904	22p
BA156	15p	BFX88	30p	NKT773	30p	TIP41A	75p	2N930	20p	2N3905	25p
BC107	12p	BFY10	35p	NKT774	25p	TIP42A	90p	2N1132	25p	2N4058	12p
BC108	12p	BFY44	50p	OA5	20p	TIP29B	58p	2N1302	16p	2N4059	12p
BC109	12p	BFY50	25p	OA10	20p	TIP30B	66p	2N1303	16p	2N4060	12p
BC147	12p	BFY51	25p	OA47	10p	TIP31B	70p	2N1304	25p	2N4061	12p
BC148	12p	BFY52	25p	OA70	12p	TIP32B	82p	2N1305	25p	2N4126	17p
BC149	12p	BFY53	25p	OA79	12p	TIP33B	£1·12	2N1306	25p	2N4286	15p
BC153	15p	BFY90	66p	OA81	10p	TIP34B	£1·68	2N1307	25p	2N4287	15p
BC157	14p	BSW63	65p	OA90	10p	TIP35B	£2·81	2N1308	25p	2N4288	15p
BC158	15p	BSW68	80p	OA91	10p	TIP36B	£3·64	2N1309	25p	2N4289	15p
BC159	15p	BSY95A	12p	OA200	10p	TIP41B	83p	2N1613	25p	2N4290	15p
BC169C	14p	C111	50p	OA202	10p	TIP42B	98p	2N1711	25p	2N4444	£1·90
BC182	14p	C426	40p	OA210	35p	TIP29C	71p	2N2147	70p	2N4871	35p
BC183	14p	BY100	15p	OA211	35p	TIP30C	78p	2N2160	65p	2N4920	60p
BC184	14p	BY122	65p	OC16	90p	TIP31C	85p	2N2217	25p	2N5191	96p
BC212	14p	BY126	20p	OC19	85p	TIP32C	£1·05	2N2218	25p	2N5194	£1·10
BC213	14p	BY127	20p	OC22	55p	TIP33C	£1·30	2N2219	25p	40360	50p
BC214	14p	BY164	65p	OC26	65p	TIP34C	£1·90	2N2222	20p	40361	50p
BC238	12p	IS100	15p	OC28	65p	TIP35C	£3·20	2N2222A	25p	40362	55p
BC239	12p	IS103	20p	OC35	60p						

DIGITAL INTEGRATED CIRCUITS

						SN7491AN		SN74145	£1·50	SN74176	£1·60
SN7400	20p	SN7422	48p	SN7450	20p		£1·00	SN74150	£3·35	SN74177	£1·00
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SN7402	20p	SN7425	48p	SN7453	20p	SN7495	75p	SN74153	£1·35	SN74181	£7·00
SN7403	20p	SN7427	42p	SN7454	20p	SN7494	80p	SN74154	£2·00	SN74182	£2·00
SN7404	20p	SN7428	50p	SN7460	20p	SN7495	80p	SN74155	£1·55	SN74184	£2·45
SN7405	20p	SN7430	20p	SN7470	30p	SN7496	£1·00	SN74156	£1·55	SN74185A	
SN7406	30p	SN7432	42p	SN7472	30p	SN7497	£6·25	SN74157	£1·80		£2·40
SN7407	30p	SN7433	70p	SN7473	40p	SN74100	£2·50	SN74160	£2·00	SN74190	£1·85
SN7408	20p	SN7437	65p	SN7474	40p	SN74104	£1·45	SN74161	12·00	SN74191	£1·95
SN7409	45p	SN7438	65p	SN7475	55p	SN74105	£1·45	SN74162	£3·40	SN74192	£2·00
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SN7412	42p	SN7442	75p	SN7481	£1·25	SN74118	£1·00	SN74165	£4·00	SN74195	£1·85
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S.C.R.

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- 3·3-33V. 5% .. 15p
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CA3036	£1·00
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AD557	WM7
CD513.2	WM8
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THOUSANDS OF BARGAINS

Test Equipment ★ Oscilloscopes ★ Signal Generators ★ Counters Cabinets ★ Bridges ★ Meters ★ Transmitters ★ Receivers ★ Power Supplies ★ Laboratory Equipment ★ Galvanometers ★ Audio Equipment ★ Video Equipment ★ Meters ★ Battery Chargers ★ Motors ★ Etc. ★ Etc.

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17, TURNHAM GREEN, TERRACE, CHISWICK W4.

VALVE AMPLIFIERS

5 Watt	£12·50	50 Watt	£36·25
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FAL Phase 50W .... £39·93 | FAL Phase 100W ...... £69·95

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FAL Disco Mk 2 ...... £82·99 | FAL Power Disco .... £123·75 (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

15in. 70W E.M.I. 8 ohm .... £19·50

SPEAKER CABINETS

Suitable for any 12in. speaker covered in rexine and vynair. Size: 18in x 18in x 8in approx. £9·90

DISCO LIGHTING

Sound-lighting module	£7·90
3 channel sound-light	£22·50
Oilwheel 6in dia.	£5·25
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Single flash box (100W Red, Blue, Gn. Yel.)	£7·50
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TEAK VENEERED SPEAKER CABINETS

For 8 x 5in speaker	£3·50 each
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ALSO: Audio Connecting Leads, Tape, Cassettes, Stereo Systems, Mixers, Mic. Stands, Speaker Cloth, Turntables, Plynths, Covers, etc., etc.

SGS EA1000 3W AMPLIFIER MODULE £2·45. Handbook 10p

Solidev 15W Class B Audio Amp thick film Circuit £3·65. Handbook 15p.

TBA 800 5W Audio I.C. £1·50. Data 10p.

UA041 5W Amplifier Module £3·75.

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1. 500 Carbon resistors, ¼, ½, 1, 2 watt
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5. 25 Potentiometers, assorted
6. 250 High-stab, 1%, 2%, 5% resistors.
7. 50 Assorted Tagstrips
8. 1lb Assorted nuts, bolts, washers, spacers, etc.
9. 25 Assorted switches, rotary, lever, micro, toggle, etc.
10. 50 Preset Potentiometers.

ALL COMPONENTS NEW AND UNUSED

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

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TEKTRONIX Type 109 Pulse Generator	£75
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H P Sweep Oscillator, HO1-686C, 7-11 GHz	£120
H P Sweep Oscillator, 684C, 4-8 GHz	£150
MARCONI VHF-SHF Signal Generator, TF 105B	£200

KLYSTON POWER SUPPLIES

Large selection in stock. £20 each.

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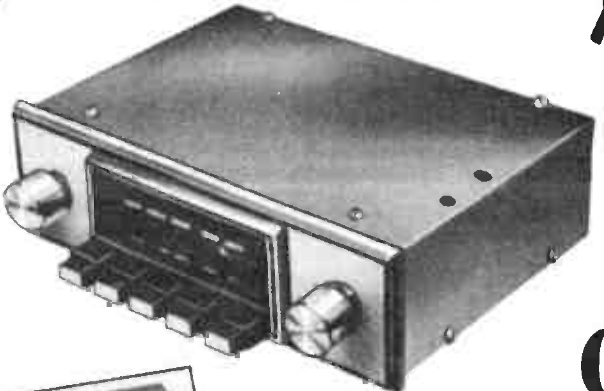
RTVC



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 $\frac{7}{16}$ 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. 15½" × 8" × 4". Complete deck and cover in closed position approx. 15½" × 12" × 6". Complete only **£18.45.** + 16p. p & p

Extras if required.
Optional Diamond Styli **£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. 12½ ins × 6 ins × 3½ 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

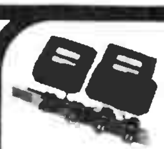
Technical specification.

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 5¾ 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. 13¾" × 9" × 3¼".
Garrard SP. 25 Mk III deck with magnetic cartridge, plinth and cover.
Two Duo Type II matched speakers - Enclosure size approx. 17" × 10½" × 6½" in simulated teak. Drive unit 13" × 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. 23½" 11½" 9". Finished in teak veneer. Drive units approx. 13½" 8½" with 3¼" HF speaker. Max. power 20 watts, 8 ohms. Freq. range 20Hz to 20kHz.

Complete System £65·00

PRICES: SYSTEM 1

Viscount III R 102 amplifier	£24 20	£1 p & p
2 Duo Type II speakers	£14 00	£2 20 p & p
Garrard SP25 Mk III with MAG cartridge plinth & cover	£18 00	£1 75 p & p
total	£56 20	

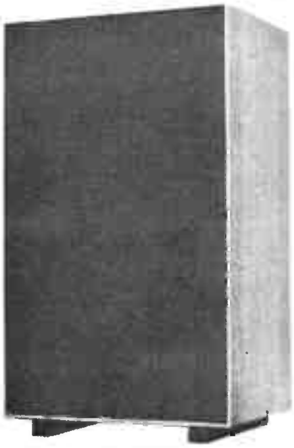
Available complete for only £49 00 £3 50 p & p.

PRICES: SYSTEM 2

Viscount R 102 amplifier	£24 20	£1 p & p
2 Duo Type III speakers	£32 00	£3 30 p & p
Garrard SP25 Mk III with MAG. cartridge plinth & cover	£18 00	£1 75 p & p
total	£74 20	

Available complete for £65 00 £4 p. & p.

THE ULTIMATE COMPLETE SPEAKER SYSTEM EMI LE 315



A professional standard five way speaker system with enclosure giving top quality performance.
Enclosure Dimensions
approx. (3ft. × 2ft. × 1ft.).
Drive Units
Hand built - 15" diameter bass with 3" voice coil,
- two 5" diameter Mid Range units,
- two 3¼" 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.

Recommended retail selling price, £86·00.
Our price £45·00 + £3.50 postage & packing.

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 3¼" 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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*No leaflet available on Reliant Mk IV Mono Amplifier

R T V C

Radio and TV Components (Acton) Ltd.
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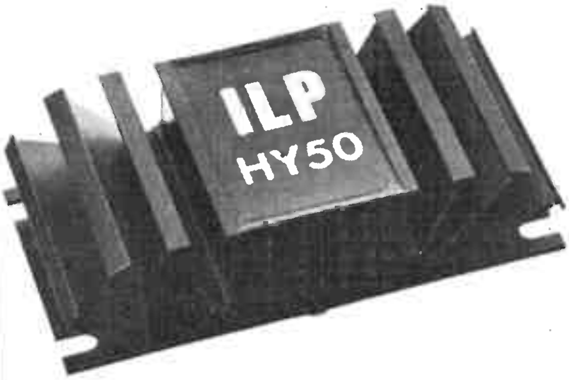
Edgware: 9 a.m.-5.30 p.m. Half day Thurs.
Acton: 9.30 a.m.-5 p.m. Closed all day Wed.

I.L.P. (Electronics) Ltd

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.

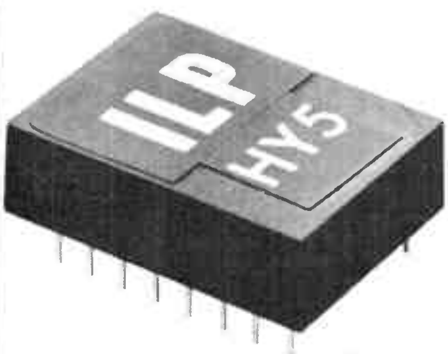
Consistent with modern thinking a triple rated output circuit with a load fuse allows for peak transient response without distortion but ensures the necessary protection.

	SPEC.
OUTPUT POWER:	25 watts RMS. 50 watts peak music power
LOAD IMPEDANCE:	4·16Ω into 8Ω
INPUT SENSITIVITY:	Odb (0·775 volts RMS)
INPUT IMPEDANCE:	47KΩ
TOTAL HARMONIC DISTORTION:	Less than 0·1% at 25 watts typically 0·05
SIGNAL/NOISE RATIO:	better than 75db
FREQUENCY RESPONSE:	10Hz-50KHz ± 1db
SUPPLY VOLTAGE:	± 25 volts
SIZE:	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 tears, 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 **SPEC.**
Magnetic Pick-up 3mV (within 1db RIAA curve)
Ceramic Pick-up up to 3mV
Microphone 10mV
Tuner 250mV
Auxiliary 3–100mV
Input Impedance 47kΩ 1kHz

OUTPUTS
Tape 100mV.
Main output, Odb (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 2¼ 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

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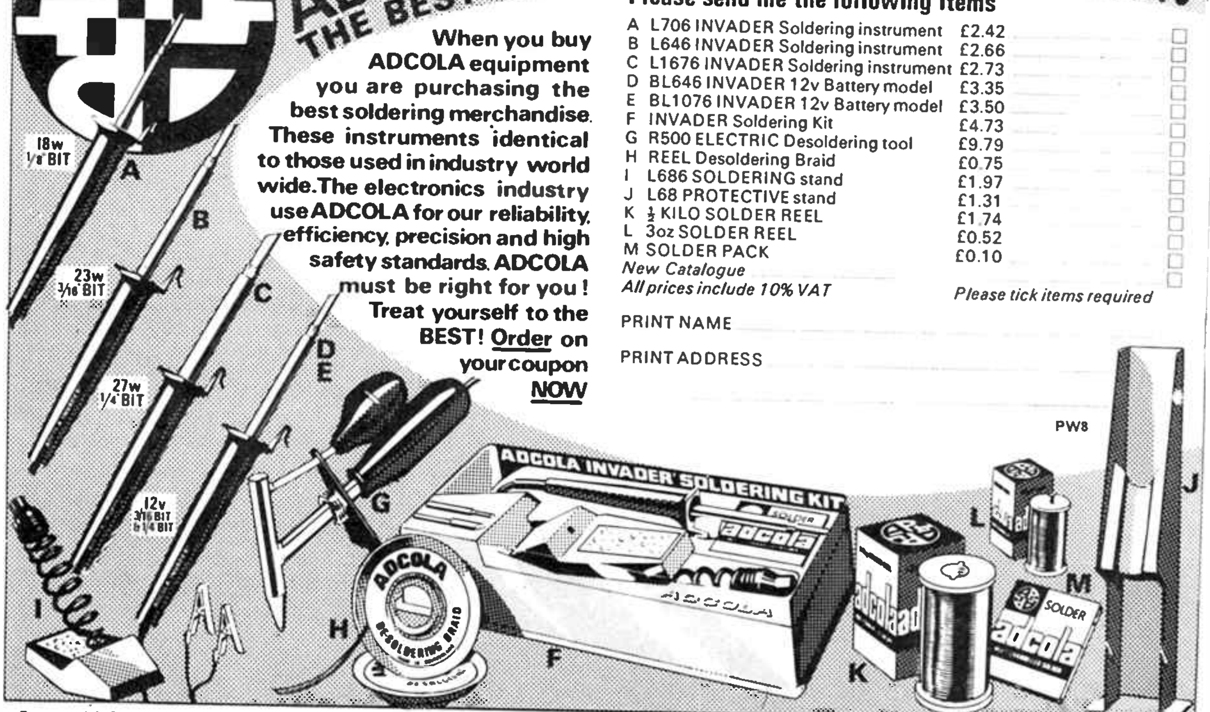

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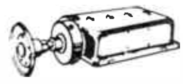

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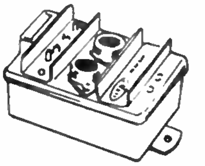

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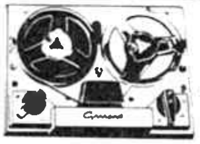

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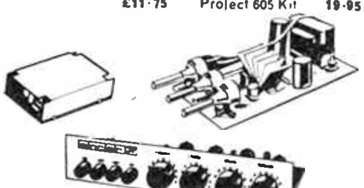

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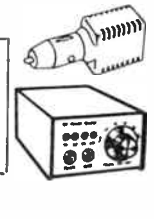

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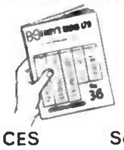

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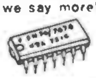 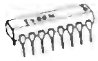 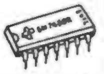

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SN7403N	0·20	0·18	0·16
SN7403AN	0·38	0·38	0·33
SN7404N	0·24	0·21	0·18
SN7405N	0·20	0·18	0·16
SN7405AN	0·44	0·44	0·38
SN7406N	0·40	0·38	0·35
SN7407N	0·40	0·38	0·35
SN7408N	0·25	0·22	0·19
SN7409N	0·33	0·33	0·28
SN7409AN	0·44	0·44	0·38
SN7410N	0·20	0·18	0·16
SN7411N	0·25	0·23	0·21
SN7412N	0·28	0·28	0·25
SN7412AN	0·38	0·38	0·33
SN7413N	0·30	0·27	0·25
SN7414N	0·72	0·72	0·63
SN7416N	0·30	0·27	0·25
SN7417N	0·30	0·27	0·25
SN7420N	0·20	0·18	0·16
SN7422N	0·28	0·28	0·25
SN7422AN	0·38	0·38	0·33
SN7423N	0·37	0·34	0·32
SN7425N	0·37	0·37	0·32
SN7427N	0·37	0·37	0·32
SN7428N	0·43	0·43	0·37
SN7430N	0·20	0·18	0·16
SN7432N	0·37	0·37	0·32
SN7433N	0·43	0·43	0·38
SN7433AN	0·57	0·57	0·50
SN7437N	0·43	0·43	0·37
SN7438N	0·43	0·43	0·37
SN7438AN	0·57	0·57	0·50
SN7440N	0·20	0·18	0·16
SN7441AN	0·85	0·79	0·73
SN7442N	0·85	0·79	0·73
SN7443N	1·50	1·27	1·13
SN7444N	1·50	1·27	1·13
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Type	1/11 £ p	12/29 £ p	30/99 £ p
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SN7450N	0·20	0·18	0·16
SN7451N	0·20	0·18	0·16
SN7453N	0·20	0·18	0·16
SN7454N	0·20	0·18	0·16
SN7460N	0·20	0·18	0·16
SN7470N	0·33	0·30	0·27
SN7472N	0·38	0·38	0·34
SN7473N	0·44	0·41	0·37
SN7474N	0·48	0·48	0·42
SN7475N	0·59	0·55	0·51
SN7476N	0·45	0·36	0·32
SN7480N	0·80	0·70	0·50
SN7481N	1·25	1·10	0·95
SN7482N	0·87	0·80	0·72
SN7483N	1·20	1·10	1·00
SN7485N	1·87	1·87	1·63
SN7486N	0·50	0·50	0·44
SN7489N	4·32	4·32	3·78
SN7490N	0·75	0·70	0·63
SN7491AN	1·10	1·00	0·90
SN7492N	0·75	0·70	0·63
SN7493N	0·75	0·70	0·63
SN7494N	0·85	0·80	0·75
SN7495N	0·85	0·80	0·75
SN7496N	1·00	0·90	0·83
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SN74104N	0·60	0·53	0·45
SN74105N	0·60	0·53	0·45
SN74107N	0·51	0·51	0·45
SN74110N	0·57	0·57	0·50
SN74111N	0·86	0·86	0·75
SN74116N	2·16	2·16	1·89
SN74118N	1·00	0·90	0·83
SN74119N	1·92	1·92	1·68
SN74120N	1·05	1·05	0·92
SN74121N	0·57	0·57	0·50
SN74122N	0·80	0·80	0·70
SN74123N	1·44	1·44	1·26
SN74125N	0·69	0·69	0·60
SN74126N	0·69	0·69	0·60
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SN74148N	2·01	2·01	1·63
SN74150N	2·30	2·30	2·01
SN74151N	1·15	1·15	1·00
SN74153N	1·09	1·09	0·95
SN74154N	2·30	2·30	2·01
SN74155N	1·15	1·15	1·00
SN74156N	1·09	1·09	1·00
SN74157N	1·09	1·09	0·95
SN74159N	2·44	2·44	2·14
SN74160N	1·58	1·58	1·38
SN74161N	1·58	1·58	1·38
SN74162N	1·58	1·58	1·38
SN74163N	1·58	1·58	1·38
SN74164N	2·01	2·01	1·76
SN74165N	2·01	2·01	1·76
SN74166N	2·16	2·16	1·89
SN74167N	4·10	4·10	3·59
SN74170N	2·88	2·88	2·52
SN74172N	5·76	5·76	5·04
SN74173N	1·66	1·66	1·45
SN74174N	1·80	1·80	1·57
SN74175N	1·29	1·29	1·13
SN74176N	1·44	1·44	1·26
SN74177N	1·44	1·44	1·26
SN74180N	1·44	1·44	1·26
SN74181N	5·18	5·18	4·53
SN74182N	1·44	1·44	1·26
SN74184N	2·16	2·16	1·89
SN74185AN	2·16	2·16	1·89
SN74188N	6·48	6·48	5·67
SN74190N	2·30	2·30	2·01
SN74191N	2·30	2·30	2·01
SN74192N	2·30	2·30	2·01
SN74193N	2·30	2·30	2·01
SN74194N	1·72	1·72	1·51
SN74195N	1·44	1·44	1·26
SN74196N	1·58	1·58	1·38
SN74197N	1·58	1·58	1·38
SN74198N	3·16	3·16	2·77
SN74199N	2·88	2·88	2·52

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AC187	20p	BCY55	2·50	GET115	75p	OC71	15p	ZTX500	15p	2N3790	2·25
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ACY39	65p	BCY71	20p	LM309K	1·87	OC77	55p	2N697	15p	2N3866	75p
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AD161	39p	BD124	80p	MJE340	50p	OC83	25p	2N930	20p	2N4002	14p
AD162	39p	BD131	45p	MJE520	65p	OC140	65p	2N987	45p	2N4126	15p
AF117	20p	BF115	22p	MJE3055	75p	OC170	25p	2N1132	25p	2N4871	35p
AF118	50p	BF180	33p	MPF105	46p	OC200	55p	2N1304	22p	2N5457	36p
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AF186	40p	BFX13	20p	NKT404	60p	OCP71	1·00	2N1671	1·00	28026	8·90
AF239	44p	BFX34	55p	OA5	60p	ORP12	55p	2N2147	75p	28303	70p
ASY27	30p	BFX88	22p	OA81	10p	ORP60	45p	2N2160	69p	40250	45p
BA115	10p	BFY50	20p	OA200	8p	P346A	20p	2N2926	10p	40361	45p
BAX13	5p	BFY51	20p	OA202	10p	TIL209	25p	2N3053	20p	40362	40p
BC107	15p	BFY64	45p	OC16	85p	TIP29A	49p	2N3054	45p	40408	50p
BC108	15p	BFY90	75p	OC20	1·25	TIP30A	58p	2N3055	45p	40486	75p
BC109	15p	BLY36	6·25	OC28	65p	TIP31A	61p	2N3440	50p	40636	1·00
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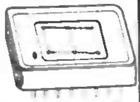

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3 Amp T048

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½H x ½L x ³⁄₁₆" dia.

1 AMP P.I.V.

B1/05	50v	25p
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B1/20	200v	28p
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CRS 1/20AF	200v	35p
CRS 1/40AF	400v	45p
CRS 1/60AF	600v	55p
THREE AMP (T048)		
CRS 3/05AF	50v	40p
CRS 3/10AF	100v	40p
CRS 3/20AF	200v	45p
CRS 3/40AF	400v	55p
CRS 3/60AF	600v	65p
FIVE AMP		
CRS 5/400	400v	60p
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CRS 7/100	100v	60p
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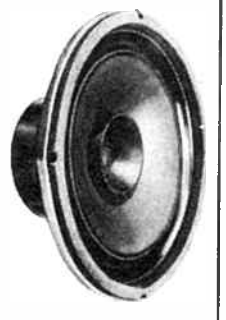

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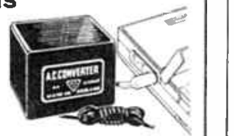

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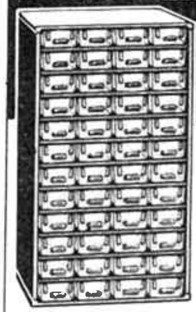

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C	1/3	4·7–470K	1·3	1·1	0·9	nett
C	1/2	4·7–10M	1·3	1·1	0·9	nett
C	3/4	4·7–10M	1·5	1·2	0·9	nett
C	1	4·7–10M	3·2	2·5	1·9	nett
MO	1/2	10–1M	4	3·3	2·3	nett
WW	1	0·22–3·9	9	9	8	
WW	3	1–10K	7	7	6	
WW	7	1–10K	9	9	8	nett

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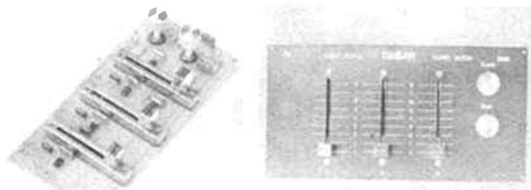
ICS

DABAR MN3 MIXER KIT



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

★ Three inputs easily adjustable to suit users input requirements, e.g., Mic., Tape, Disc., etc.
★ Uses advanced design with five integrated circuits.
★ Slider fader volume controls mount directly on P.C. board.
★ Full range bass and treble controls.
★ Guaranteed top grade components with fibreglass printed circuit board, ready-drilled and tinned.
★ Battery operated (2 x PP3) not supplied with kit.
★ 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.

S.A.E. ALL ENQUIRIES.

DABAR ELECTRONIC PRODUCTS

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.**

WIRE-WOUND RESISTORS. Our selection of mixed Ohms and Watts. 25 for **£1·50**, 50 for **£2·50**, parcel of 1,000 **£30·00.**

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
All items post paid in **GREAT BRITAIN**

SURPLECTRONICS

216 LEAGRAVE ROAD, LUTON, LU3 1JD, BEDS.

NEW EDU-KIT MAJOR

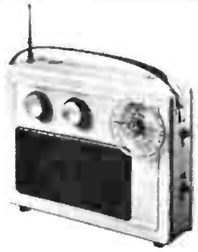
Completely Solderless Electronic Construction Kit
Build these projects without soldering iron or solder

- ★ 4 Transistor Earpiece Radio.
- ★ Signal Tracer.
- ★ Signal Injector.
- ★ Transistor Tester NPN-PNP.
- ★ 4 Transistor Push Pull Amplifier.
- ★ 5 Transistor Push Pull Amplifier.
- ★ 7 Transistor Loudspeaker Radio MW/LW
- ★ 5 Transistor Short Wave Radio.
- ★ Electronic Metronome.
- ★ Electronic Noise Generator
- ★ Batteryless Crystal Radio.
- ★ One Transistor Radio.
- ★ 2 Transistor Regenerative Radio.
- ★ 3 Transistor Regenerative Radio.
- ★ Audible Continuity Tester.
- ★ Sensitive Pre-Amplifier.

Total Building Costs
£7·23 P P & Ins. 44p (Overseas P & P £1·85)
(+ 10% VAT 72p)

Components Include: 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" 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 ● 6½ yards of wire ● 1 Yard of sleeving etc. ● Parts Price List and Plans 50p. (Free with parts).

NEW ROAMER NINE

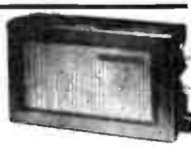


WITH V.H.F. INCLUDING AIRCRAFT

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 600 mW 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 9½" × 7" × 2½" approx. Parts Price List and Plans 30p (Free with parts).

Total Building Costs **£6·95** P P & Ins. 44p (Overseas P & P £1·85)
(+ 10% VAT 69p)

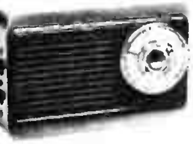
POCKET FIVE



3 Tunable wavebands, M.W. L.W. and Trawler Band, 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, moving coil loudspeaker, attractive black and gold case. Size 5½" × 1¼" × 3½" approx. Plans and Parts Price List 15p (Free with parts).

Total Building Costs **£2·28** P P & Ins. 26p
(+ 10% VAT 22p)
(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)

NEW Everyday Series

Build this exciting New series of designs

E.V.5. 5 Transistors and 2 diodes. MW/LW. Powered by 4½ volt Battery. Ferrite rod aerial, tuning condenser, volume control, and loudspeaker. Attractive case with red speaker grille. Size 9" × 5½" × 2½" approx. Parts Price List and Plans 15p. Free with parts.

Total Building costs **£2·73** P P & Ins. 30p (+ 10% VAT 27p) (Overseas P & P £1·25)

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 £1·05.

Total Building Costs **£4·08** P P & Ins. 31p Overseas P & P £1·85 (+ 10% VAT 40p)

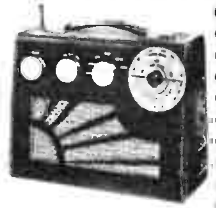
ROAMER EIGHT Mk I

NOW WITH VARIABLE TONE CONTROL

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

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

ROAMER TEN



WITH VHF INCLUDING AIRCRAFT

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

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mW Transistors. Car Aerial and Tape Record Sockets. 10 Transistors plus 3 Diodes. Ganged 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" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and plans 30p (FREE with parts).

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

"EDU-KIT"

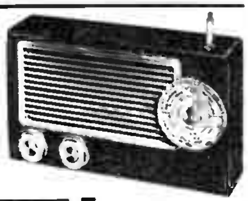
Build Radios, Amplifiers, etc., from easy stage diagrams.

Five units including master unit to construct.

Components include:
Tuning Condenser: 2 Volume Controls: 2 Slider Switches: Fine Tone 3" Moving Coil Speaker: Terminal Strip: Ferrite Rod Aerial: 2 Plugs and Sockets: Battery Clips: 4 Tag Boards: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ¼" 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 (Overseas P & P £1·85)
(+ 10% VAT 55p)

TRANS EIGHT 8 TRANSISTORS and 3 DIODES



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

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

ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 Tunable 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 × 5½ × 2½in. approx. Plans and parts price list 25p (FREE with parts).

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

RADIO EXCHANGE LTD

★ Callers side entrance "Lavells" 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 52367. Reg. No. 788372.

I enclose £.................... for ....

Name ....

Address ....

(Dept. PW24.)

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 7½ × 9" approx. 4 for 30p + p & p 20p.

FIBRE-GLASS PRINTED CIRCUIT BOARDS

16½ × 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 matric 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 31p DRR2 Dual range 45p

COIL FORMERS & CORES

NORMAN ¼" Cores & Formers 7p
1" Cores & Formers 8p

SWITCHES

DP/DT Toggle 25p   SP/ST Toggle 18p

FUSES

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

EARPHONES

Crystal 2·5mm plug 33p
Crystal 3·5mm plug 33p
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 £1·60

3-WAY STEREO HEADPHONE JUNCTION BOX

H1012   £1·87

2-WAY CROSSOVER NETWORK

K4007. 80 ohms Imp. Insertion loss 3dB £1·21

CAR STEREO SPEAKERS

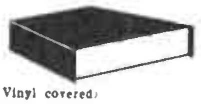
(Angled) £3·85 per pair.

BI-PAK

CATALOGUE AND LISTS

Send S.A.E. and 10p.

INSTRUMENT CASES



(Black Vinyl covered)

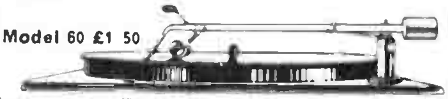
No.	Length		Width		Height	Price
BV1	8"	×	5¼"	×	2"	90p
BV2	11"	×	6"	×	3"	£1·20

ALUMINIUM BOXES

BA1	5¼"	×	2¼"	×	1½"	42p
BA2	4"	×	4"	×	1½"	41p
BA3	4"	×	2¼"	×	1½"	41p
BA4	5¼"	×	4"	×	1½"	47p
BA5	4"	×	2¼"	×	2"	41p
BA6	3"	×	2"	×	1"	34p
BA7	7"	×	5"	×	2½"	66p
BA8	8"	×	6"	×	3"	84p
BA9	6"	×	4"	×	2"	54p

BIB HI-FI ACCESSORIES

De Luxe Groov-Kleen
Model 42 £1·84
Chrome Finish Model 60 £1 50



Ref. 36A. Record/Stylus 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 88p
Ref. P. [illegible] 31p
Ref. 32A. Stylus Balance £1 36
Ref. J. Tape Head Cleaning Kit 51p
Ref. 34. Cassette Case £1·27
Ref. 56. Hi-Fi Stereo Hints & Tips 32p

ANTEX SOLDERING IRONS

X25. 25 watt £1·93
CCN 240. 15 watt £2·15
Model G. 18 watt £2 15
SK2. Soldering Kit £2·86
STANDS: ST1 £1·21. ST2 77p
SOLDER: 18SWG Multicore 7oz 82p
22SWG 7oz 82p. 18SWG 22ft 28p
22SWG Tube 22p

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 3/8"	38p
1102	For model CCN240 ¼"	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   ECCN 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	⅛th 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-Sets	0·55
C11	5	Jack Sockets 3 × 3·5m 2 × 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" × 7"	0·55

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 ¼" Switched	0·17
PS 42	Jack Stereo Switched	0·26
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

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 ¼" Plastic	0·24
PS 28	Jack ¼" 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	0·15
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	0·15
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 ¼" Plastic	0·13
PS 12	Jack ¼" 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	0·26
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   0·06 each
100, 220, 470, 1K, 2·2K, 4·7K, 10K, 22K, 4K7, 100K, 220K, 470K, 1M, 2M, 4·7M

BOOK BARGAIN BUNDLE

8 Books comprising
2 Transistor Equivalent Books
1 Radio and Electronic Colour Code and Data Chart
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	37p
156	Transistor Circuits Manual No.1	15p
160	Coil Design & Constructional Manual	30p
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	30p
187	The TSL 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 GP91-1SC. 200mV at 1·2cms/sec £1·16
ACOS GP93-1. 280mV at 1cm/sec £1·65
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/Med. 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–1 Meg. ohms	40p

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

BI-PAK SUPERIOR QUALITY LOW - NOISE CASSETTES

C60, 32p   C90, 41p   C120, 52p

VISIT OUR COMPONENT SHOP

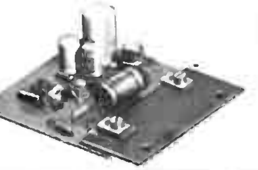
18 BALDOCK ST., WARE, Herts. (A10)

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

-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	Po 3 WATTS f 1KHz	0·25%
LOAD IMPEDANCE		8 16Ω
INPUT IMPEDANCE	f 1KHz	100 kΩ
FREQUENCY RESPONSE Œ 3dB	Po 2 WATTS	50 Hz 25KHz
SENSITIVITY for RATED O/P	Vs 25V Rl 8Ω f 1KHz	75mV. RMS
DIMENSIONS		3" × 2¼" × 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	AL80
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D (RL 8Ω 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

PRE-AMPLIFIERS

PA 12. (Use with AL10 & AL20) £4·35
PA 100 (Use with AL30 & AL50) £13·15

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

TRANSFORMERS

T461 (Use with AL10) £1·38 P & P 15p
T538 (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 × 84mm × 35mm.

Frequency response 20Hz 50KHz (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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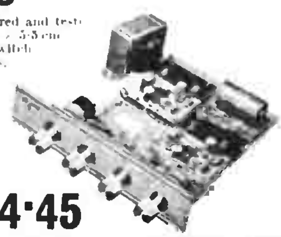
The STEREO 20

The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm × 14 cm × 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



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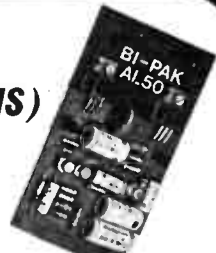
50W pk 25w (RMS)



0·1% DISTORTION! HI-FI AUDIO AMPLIFIER

THE AL50

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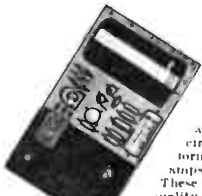
★ Frequency Response 15Hz to 100,000—1dB.
★ Load—3, 4, 8 or 16 ohms.
★ Distortion—better than 1% at 1 KHz.
★ Signal to noise ratio 80dB.
★ Supply voltage 10–35 Volts.
★ Overall size 63mm 105mm × 13mm.

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

STABILISED POWER MODULE SPM80



AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1½ amps at 35 volts. Size 63mm × 105mm × 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including: Disco Systems, Public Address Intercom Units, etc. Handbook available 10p **PRICE £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.U	1 5 mV into 50K Ω

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

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

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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 quadraphonic 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

PLESSEY 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

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

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

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.

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.*

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.

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.

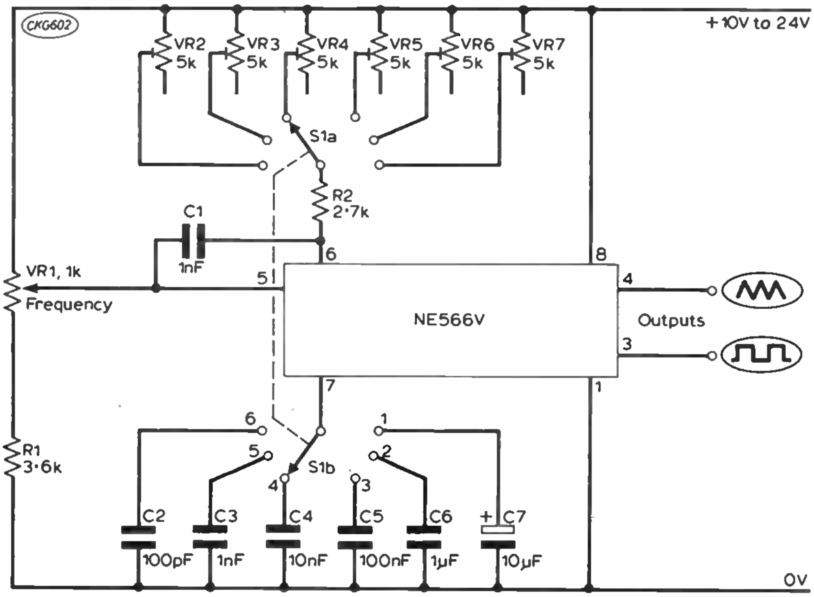
THE BASIC CIRCUIT

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	10μF	0·5Hz– 10Hz
2	1μF	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 100μF capacitor in the S1b circuit can be used to produce a range of 0·05 to 1Hz, a 1000μF capacitor a range of 0·005 to 0·1Hz and a 10000μF 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 $4\frac{1}{2} \times 3\frac{1}{2} \times 2\frac{1}{4}$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 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.

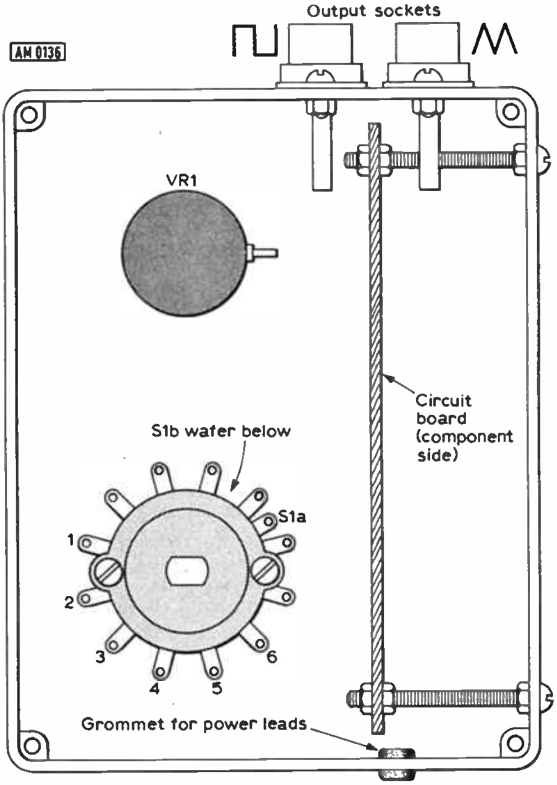


Fig. 2: General layout of components in the die-cast box.

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 ±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.

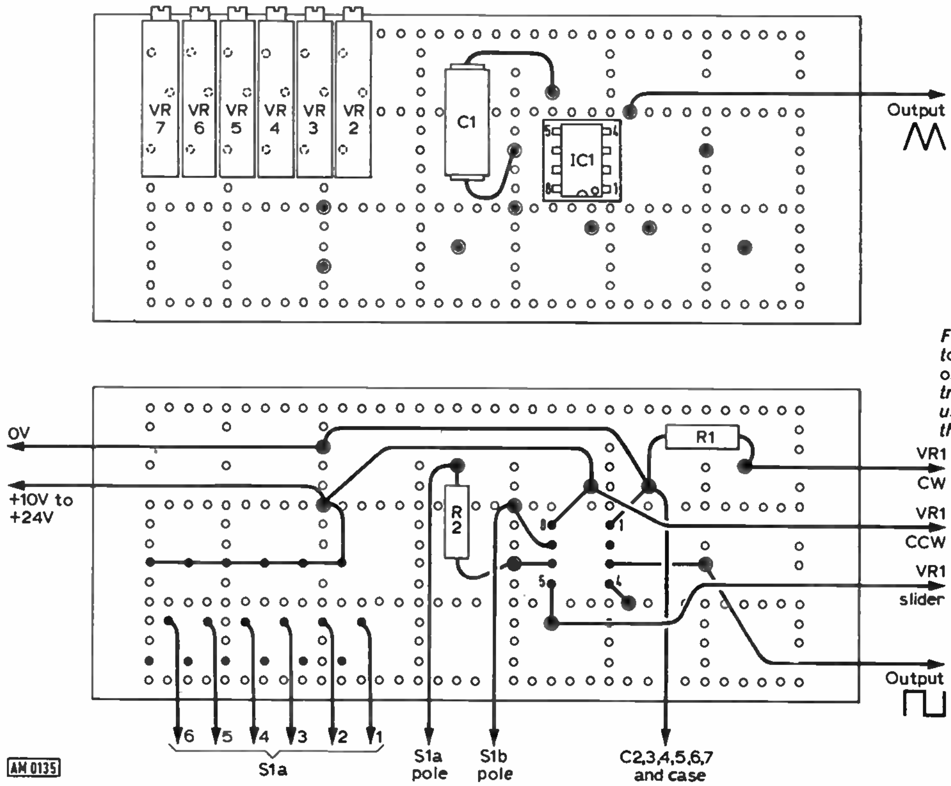


Fig. 3: Veroboard pins are used to support the few components on the circuit board. The trimmer potentiometers are used to adjust the calibration of the six frequency ranges.

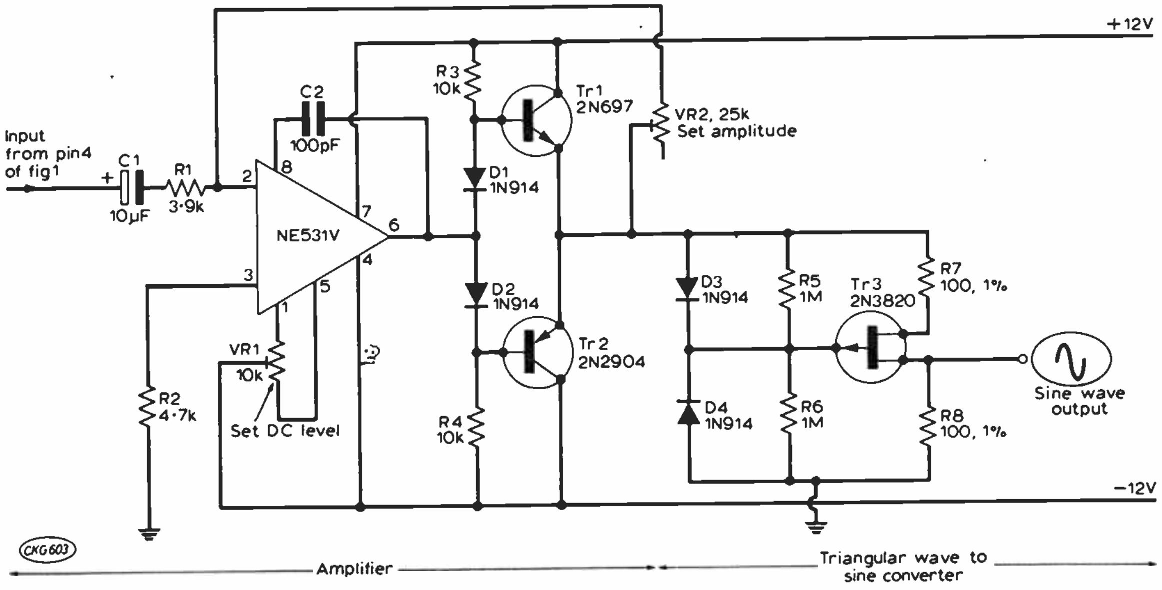


Fig. 4: Suitable circuit for converting a triangular wave to a sine wave.

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.

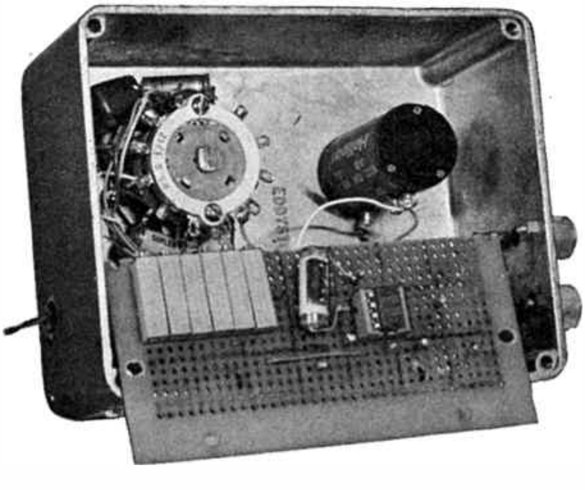
The complementary output transistors Tr1 and Tr2 provide a low impedance output to the converter circuit of Tr3. The preset potentiometer VR1 is set so that the potential at the emitters of Tr1 and Tr2 is zero volts when no input is applied to the circuit.

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 μA741V 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 Helipot 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 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 $0{\cdot}2\mu s$ in length.

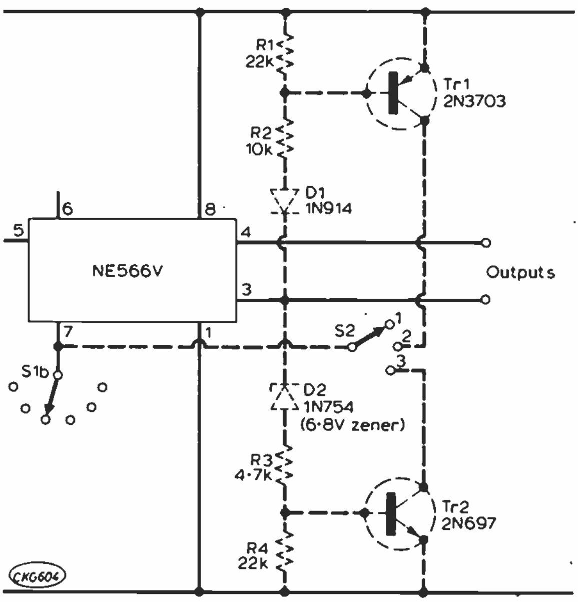


Fig. 5: Additional circuitry, shown dotted, to produce rising or falling ramp waveforms.

★ components list

R1 3·6kΩ 5% ¼W R2 2·7kΩ 10% ¼W
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% ¼W
R7 100Ω R8 100Ω
Both 1% ¼W
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% ¼W
D1 1N914 D2 1N754 (6·8V)
Tr1 2N3703 Tr2 2N697

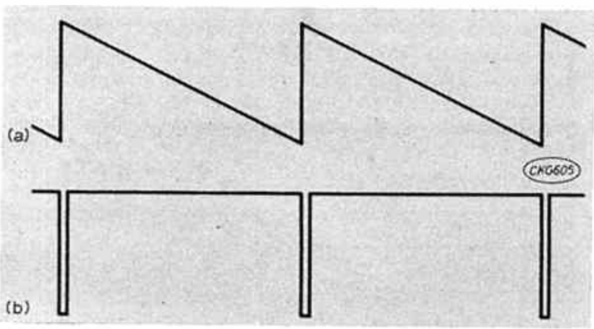


Fig. 6: Waveforms obtainable from the circuit of Fig. 5.

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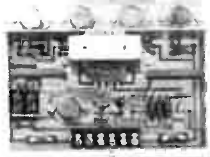

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- ★Compact size: 5 x 5 x 3 in.

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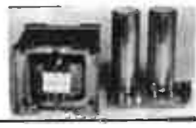

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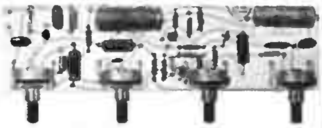

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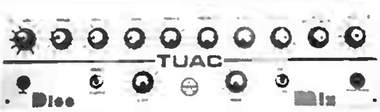

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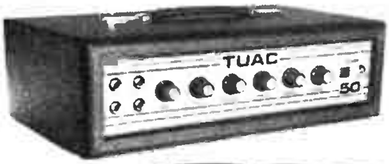

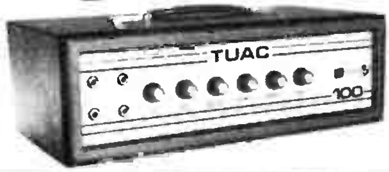

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When a large capacitor is in circuit, however, it takes longer to charge from the current passing through Tr1. Nevertheless, the time for which the waveform at pin 4 is in its low voltage state is a very small fraction of the total operating time.

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.

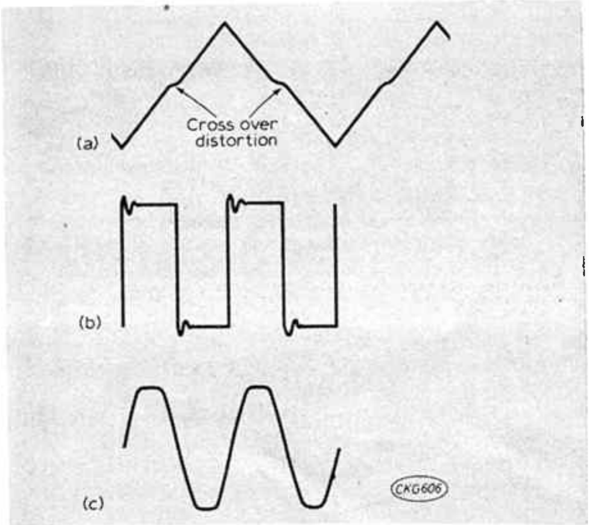


Fig. 7a-b-c: Waveforms at the output of an audio amplifier using input signals from the waveform generator.

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 x 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.

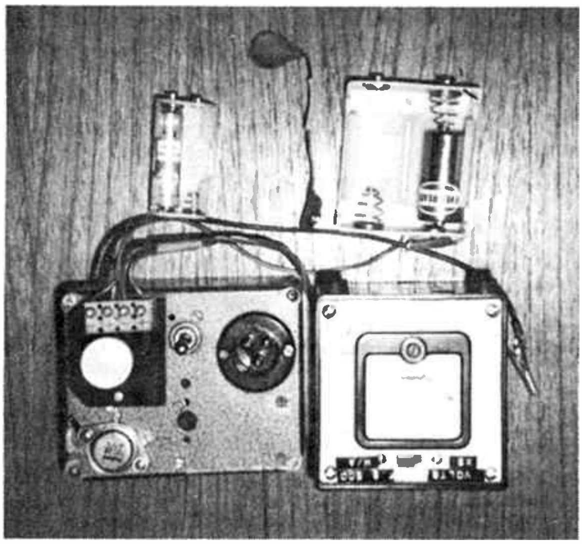
The idea of reforming dry cells is by no means new. Investigation of the possibilities were made as long ago as the early 1950's with encouraging results. With modern methods of manufacture and materials, the life of the primary cell can be considerably extended if a few basic rules are born in mind. 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 Min.	Charging Current mA Max.	Approx. hours of charging	No. of cycles
U2	Torches, Hand lamps Radios	2 4 6	150	300	5	3
U7	Small Torches, Radios	1 or 2 4	100	150	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.

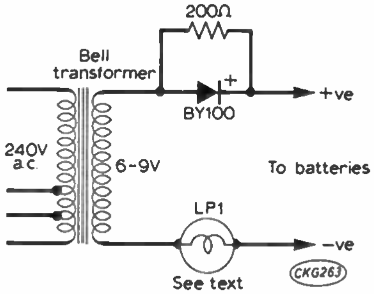


Fig. 1: Circuit shows a simple charging unit.

—continued on page 1061

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Charger units

Fig. 1 shows a simple unit which can be easily put together and used to try out the idea. A good quality bell transformer, BY100 diode, m.e.s. lamps, lamp holder and a 220Ω 1W resistor and you are in business. The writer found this unit successful but it lacked flexibility. If the bell transformer shown in Fig. 1 has various outputs then the number of cells to be charged can be varied and by changing the lamp the charging current can be varied within limits.

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.

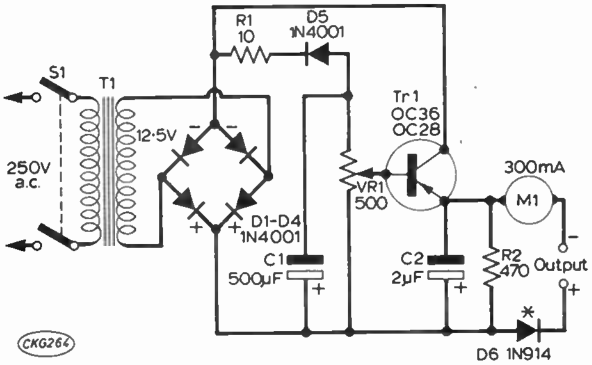

Fig. 2: A more elaborate design.

★ 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)

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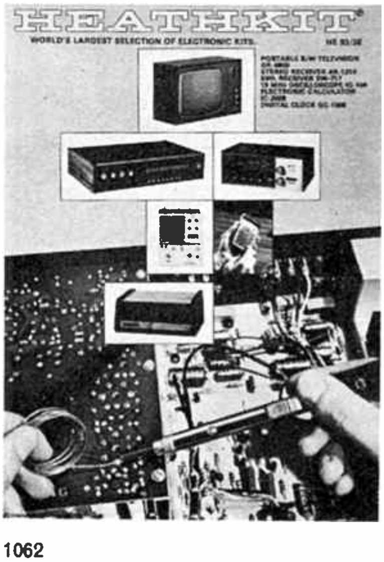
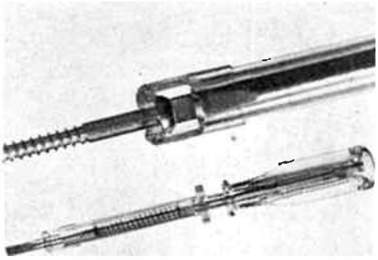


SCREW DRIVING BOON



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.

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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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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, Data supplied	55p
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H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	55p

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H63	4	2N3055 type NPN Sil. power transistors. Below spec. devices	55p
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H66	4	40362 Type PNP Sil. transistors TO-5 can comp to H65	55p
H67	10	3819N Channel FETs plastic case type	55p

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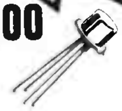

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40 Watt	22p	20p	18p
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Loads	4 to 16 ohms
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Noise	Better than 75dB
Supply voltage	SA35 45 volts SA50 45-65 volts SA100 40-70 volts
Size	4½" x 4" x 1" (SA 100) 4" x 3" x 1" (SA35/SA50)

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

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

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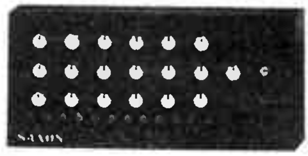

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SPECIFICATION

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

Low distortion parallel push-pull output stage.

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

●160 watt version with power supply **£27·90** (Carr. 50p)

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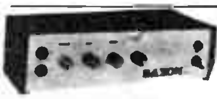

Our popular 3 channel model handles up to 3kW (3000 watts) of lighting and incorporates versatile sound control arrangement to enable professional standards to be achieved. Both units are excellent examples of Saxon quality and value.

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J. ANDREWS

I.C. 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 plis 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-

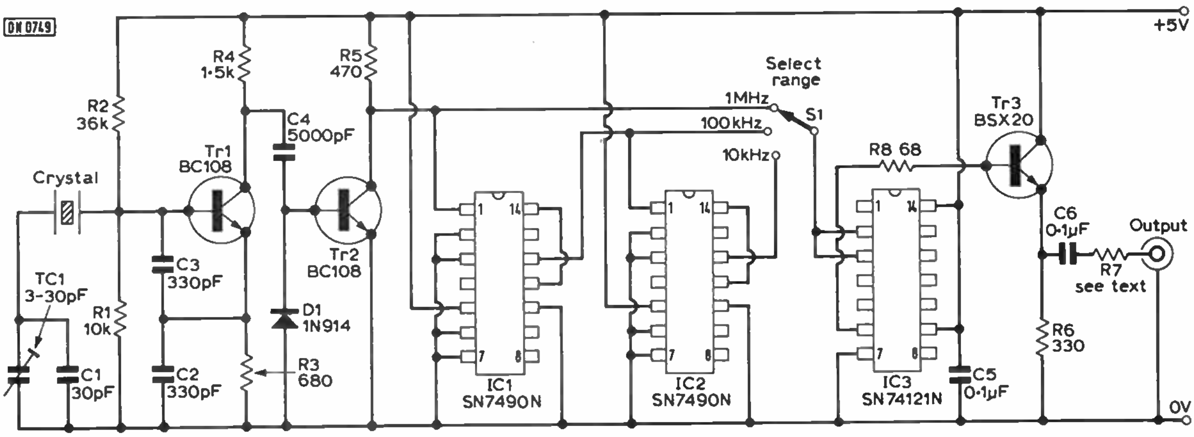


Fig. 1: Circuit of the calibrator

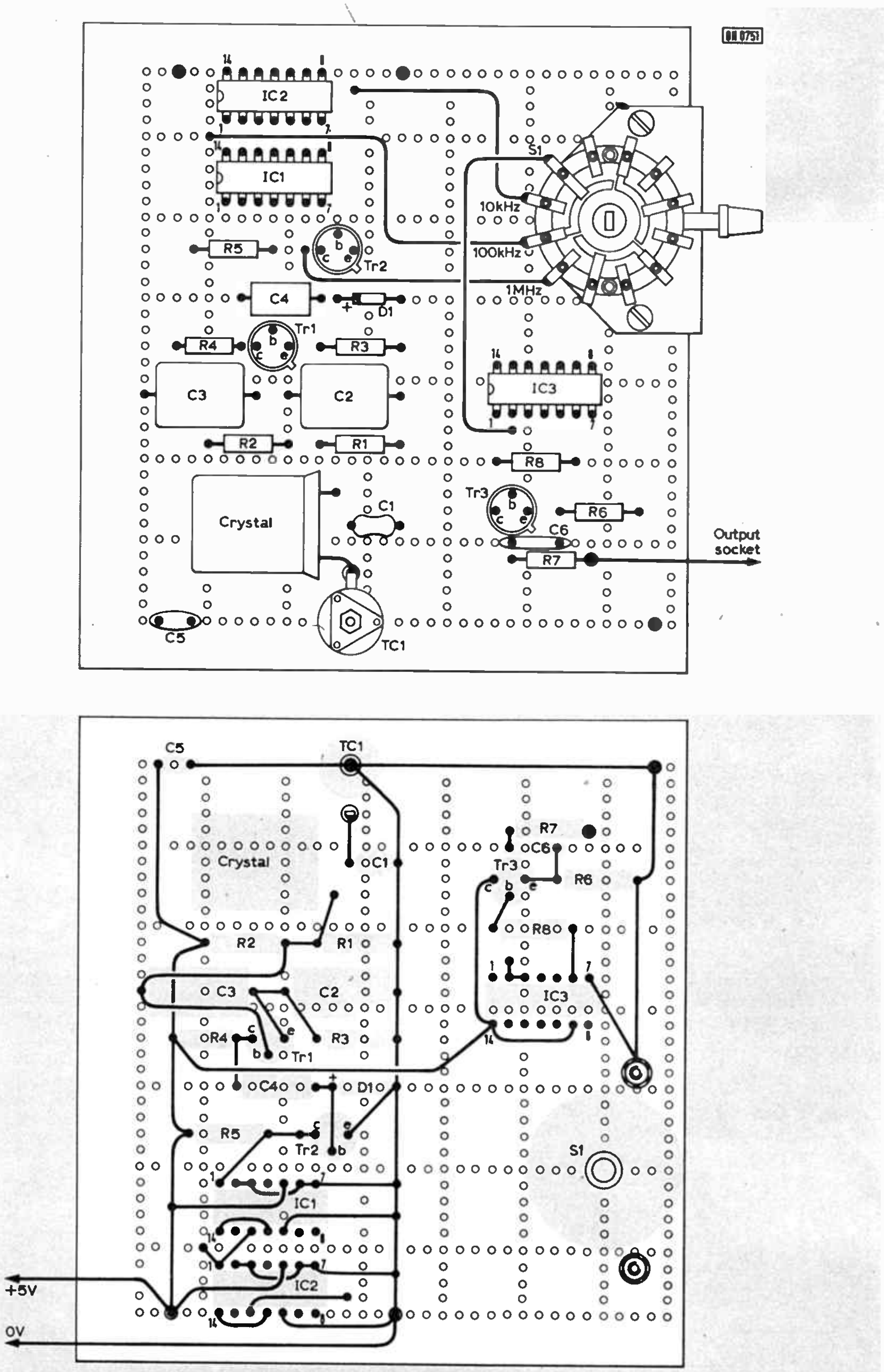


Fig. 2: Veroboard layout for the i.c. crystal harmonic calibrator

—continued on page 1069

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 repitition 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 ±10%. The design of the oscillator assures stability to within a few Hz for a ±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.

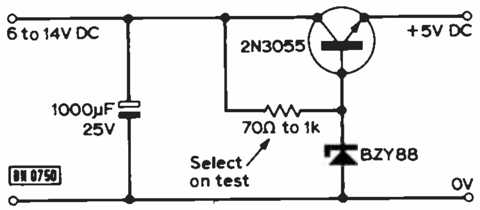


Fig. 3: Simple stabiliser

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 1C3 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 1C3 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 of 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 12volt d.c. portable flourescent 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 flourescent 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.

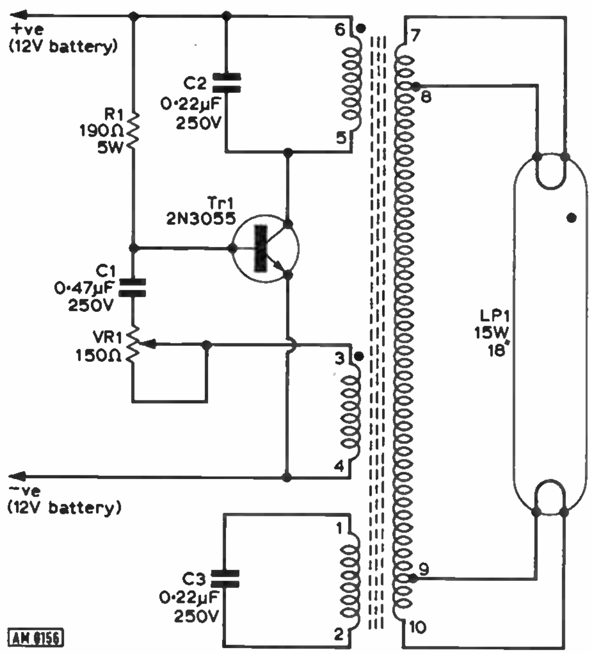
The transformer is fixed to the circuit board by two links of insulated copper wire as shown in the circuit board layout diagram.

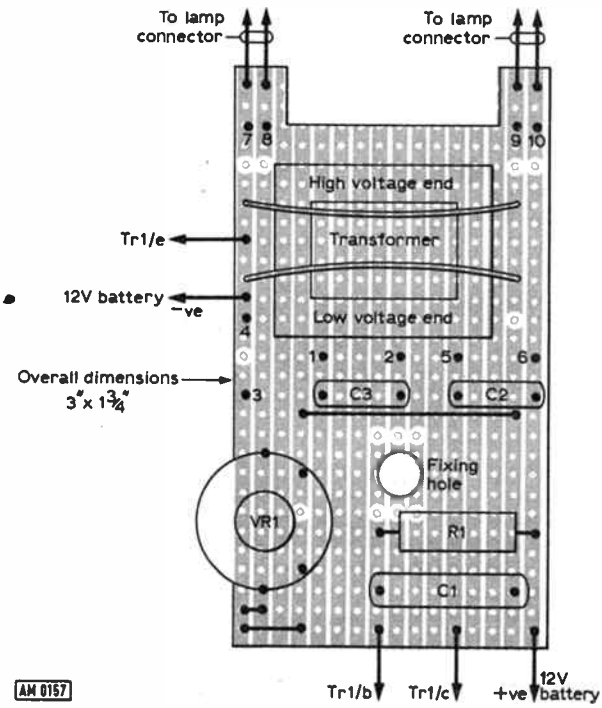
Resistor R1 should be mounted about ¼in clear of the circuit board and clear from C1 as it gets hot! Since drilling of the holes for the legs of potentiometer VR1 cuts the circuit board tracks completely, care must be taken to ensure contact when soldering the legs in.

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.*





IN NEXT MONTH'S PRACTICAL WIRELESS

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SAVE on your tools. Get this exclusive **TOOL-KIT OFFER** at reduced price when you buy the April issue of Practical Wireless. The kit contains soldering iron kit, wire cutters, wiring pliers with wire stripper blades, small screwdriver with neon tester, large screwdriver for cabinet and chassis work. All these tools are of high quality and of well established manufacture. They are available to Practical Wireless readers at a special low price. Use the coupon in the April issue.

SAVE your Windscreen Wiper blades by making the "Quick-Wipe" to give a quick clearance of April showers from your car windscreen.

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.

ALSO:-

GUIDE TO MULTI-RANGE TEST-METERS: IMPEDANCE MATCHING

Supplies of Practical Wireless are limited. Don't be disappointed—order early from your newsagent.

APRIL ISSUE ON SALE IN MARCH

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

Cassette Recorder And Tuner Amplifier

PART 1

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.

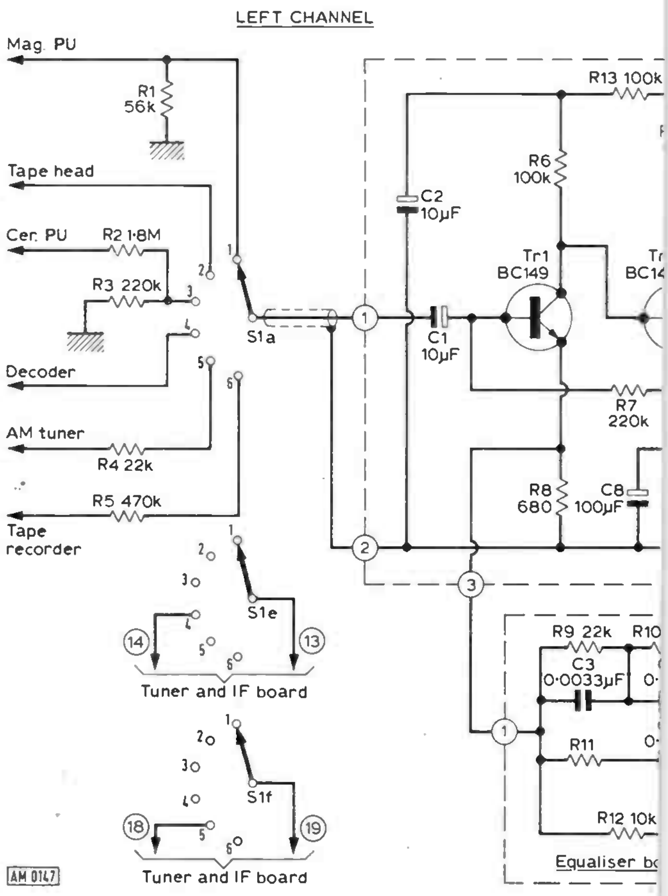
Facilities on the prototype included full Band II FM coverage together with one preset AM station and an input for a ceramic cartridge. Additional circuitry and printed boards are shown in this article so that inputs for magnetic cartridge and tape heads can be accommodated, together with record/playback 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.



★ Performance Specification

AMPLIFIER

Power output: 10 watts RMS per channel into 8Ω
Frequency response: 20Hz to 30kHz ± 3dB at full power
50Hz to 20kHz ± 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 ± 16dB at 50Hz
Treble ± 14dB at 15kHz

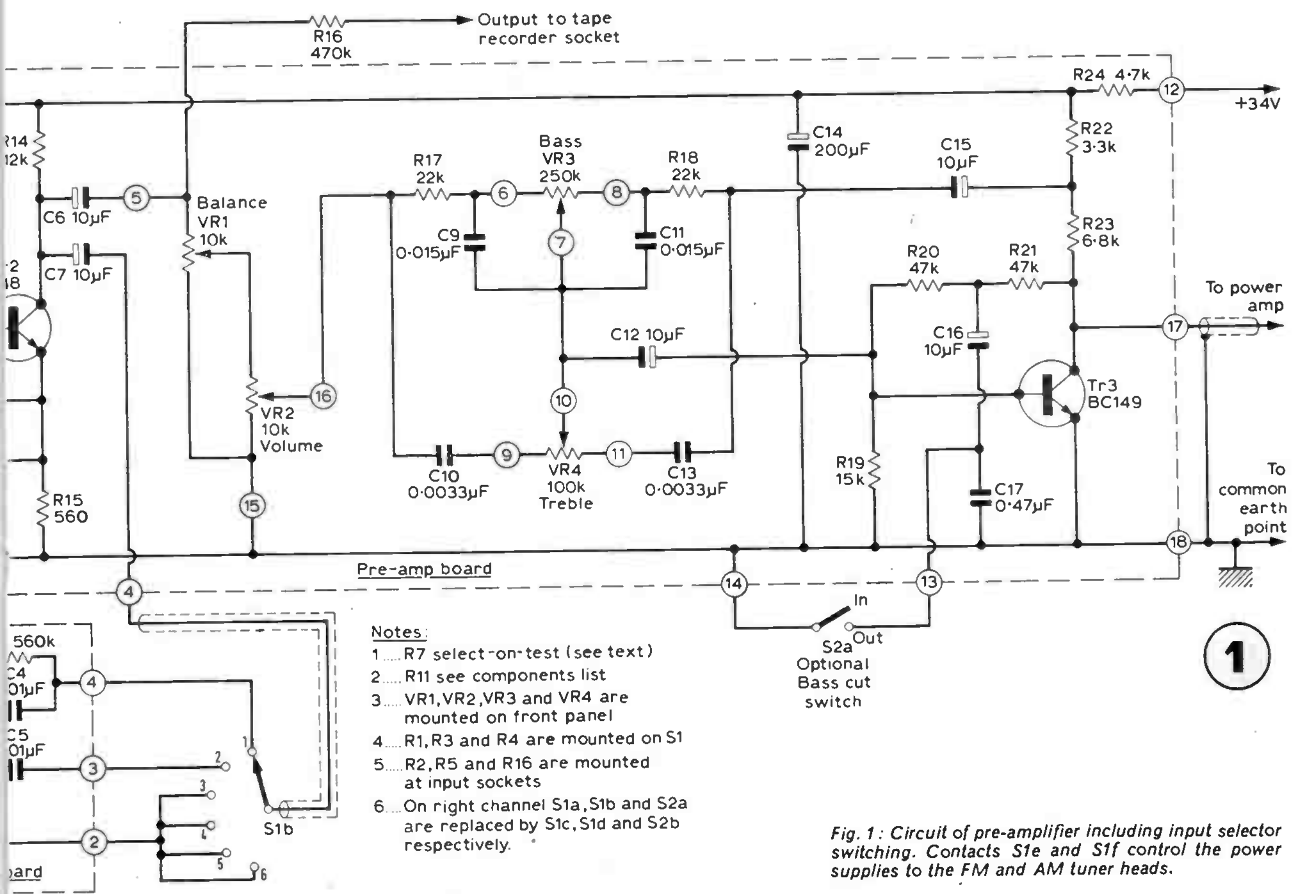
F.M. TUNER

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

RICHARD COLLIN

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.



Notes:
1 ..... R7 select-on-test (see text)
2 ..... R11 see components list
3 ..... VR1, VR2, VR3 and VR4 are mounted on front panel
4 ..... R1, R3 and R4 are mounted on S1
5 ..... R2, R5 and R16 are mounted at input sockets
6 ..... On right channel S1a, S1b and S2a are replaced by S1c, S1d and S2b respectively.

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

PRE-AMPLIFIERS

Resistors

R1	56kΩ	R10	560kΩ	R17	22kΩ
R2	1·8MΩ	R11	22kΩ for $1\frac{7}{8}$ips	R18	22kΩ
R3	220kΩ		12kΩ for $3\frac{3}{4}$ips	R19	15kΩ
R4	22kΩ		6·8kΩ for $7\frac{1}{2}$ips	R20	47kΩ
R5	470kΩ	R12	10kΩ	R21	47kΩ
R6	100kΩ	R13	100kΩ	R22	3·3kΩ
R7	220kΩ*	R14	12kΩ	R23	6·8kΩ
R8	680Ω	R15	560Ω	R24	4·7kΩ
R9	22kΩ	R16	470kΩ	* See text	

All resistors $\frac{1}{4}$W 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 $\frac{1}{4}$W 5% Carbon film unless stated otherwise	
R5	470Ω	R10	10Ω		

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

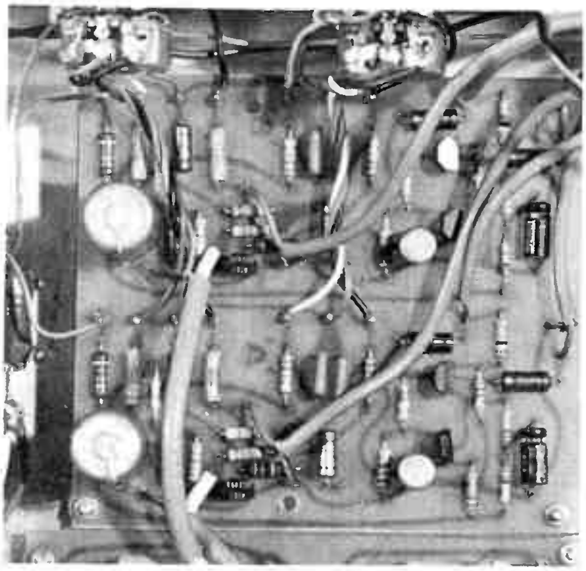
Add 40p post and packing per order and 10% VAT

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.

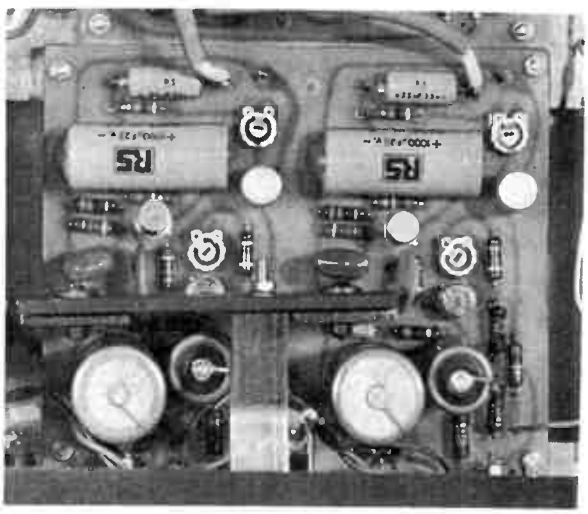
A constructor not requiring the full complement of input facilities may of course omit the unwanted circuitry and connectors.

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

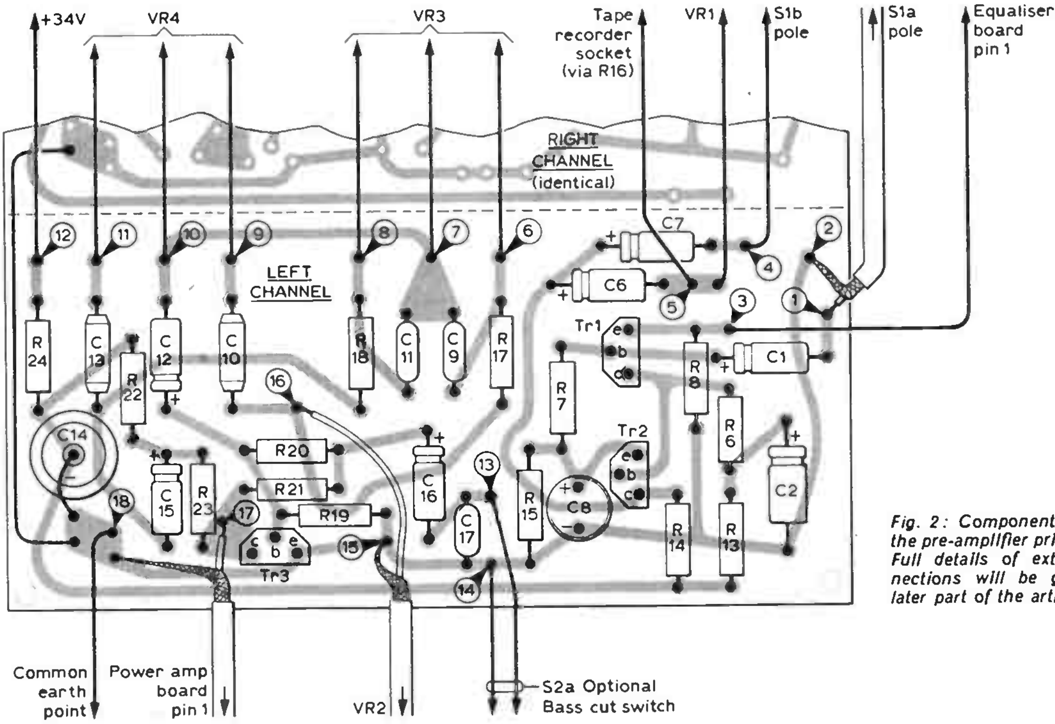


Fig. 2: Component layout for the pre-amplifier printed board. Full details of external connections will be given in a later part of the article

AM 0148

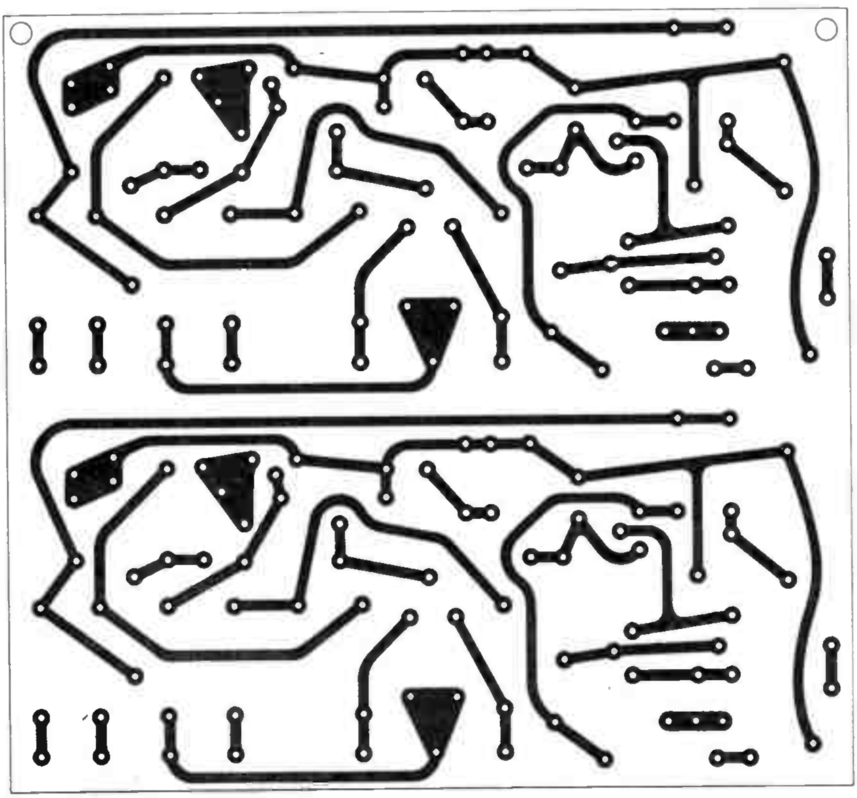


Fig. 3: Actual size layout for the pre-amplifier printed circuit board

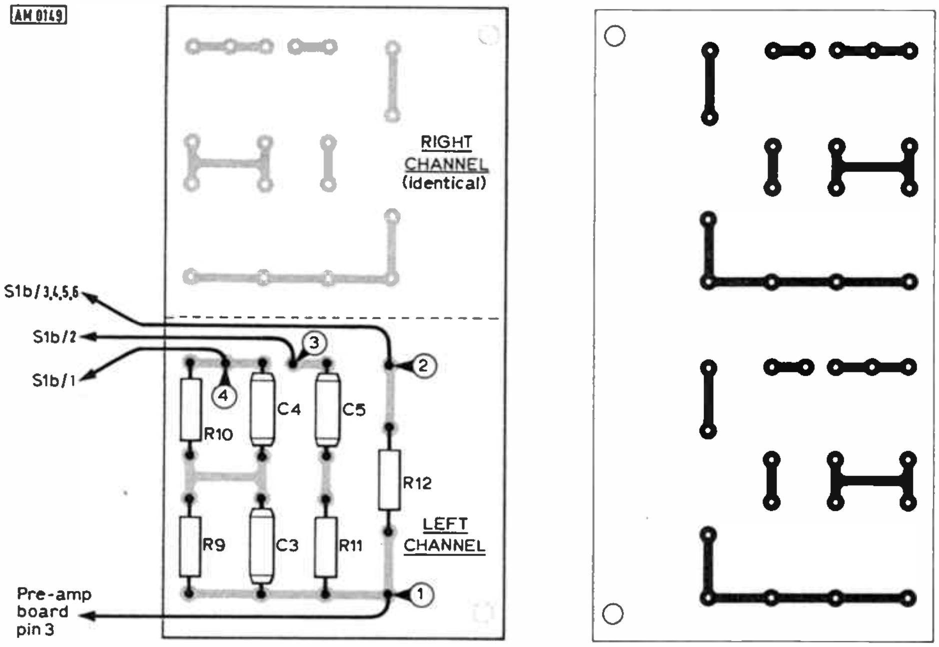
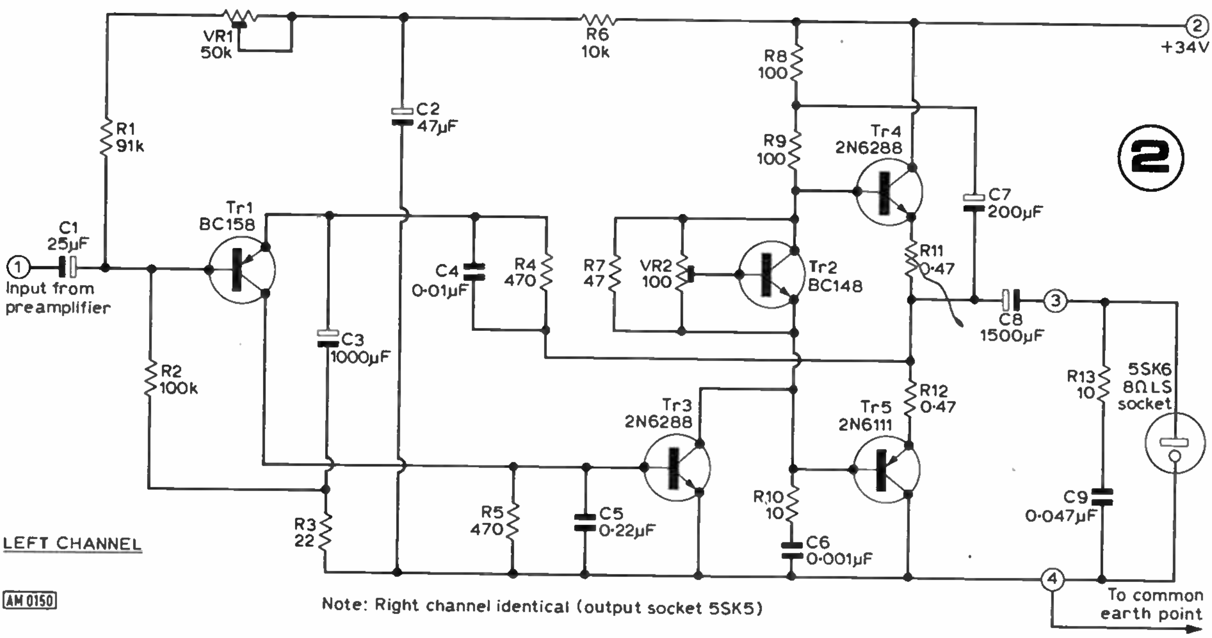


Fig. 4: Actual size layout of equaliser printed circuit board and location of components ◀

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



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 cross-over 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 Vb and Ve 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

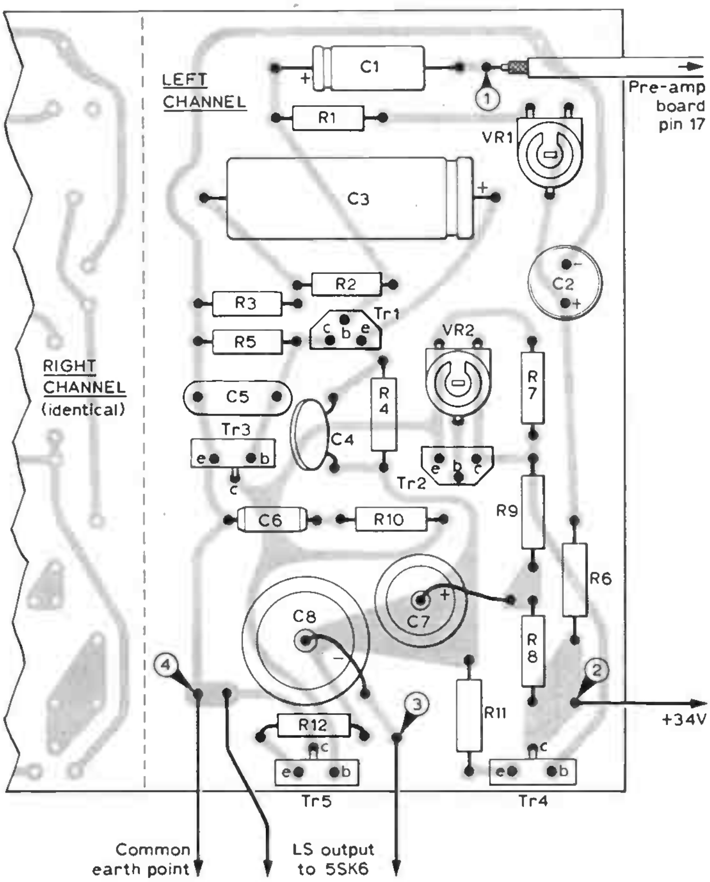
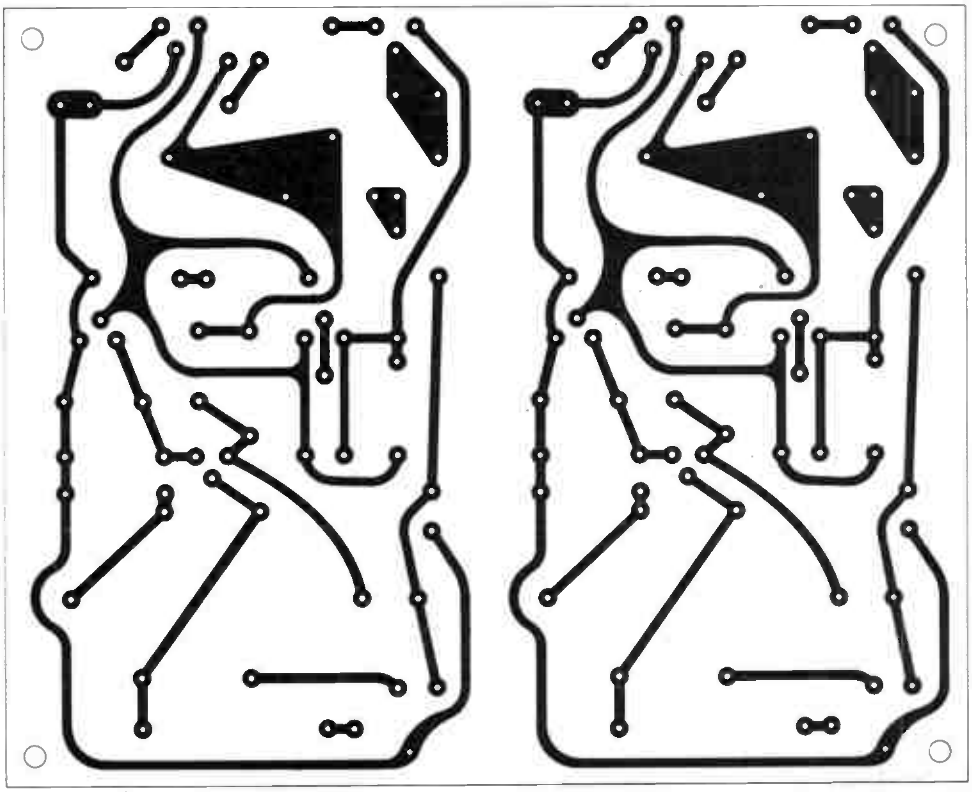


Fig. 7: Actual size layout for the power amplifier printed circuit board

AM 0151



—continued on page 1080

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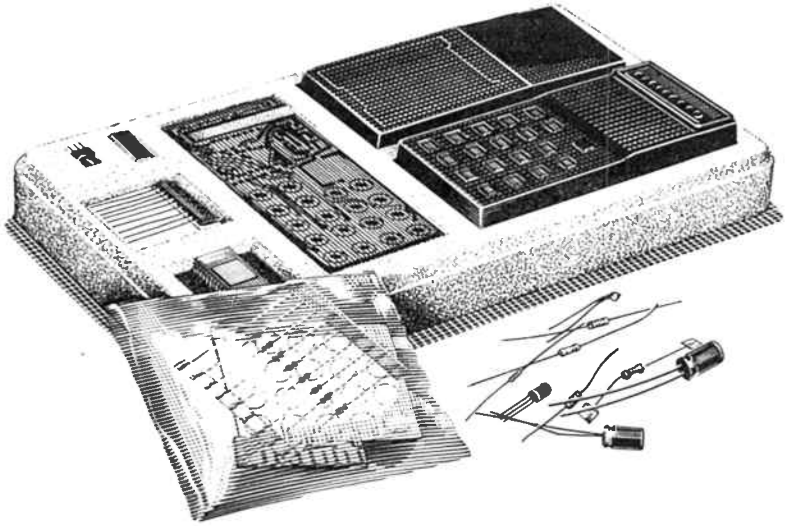
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.



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CRATA—*continued from page 1077*

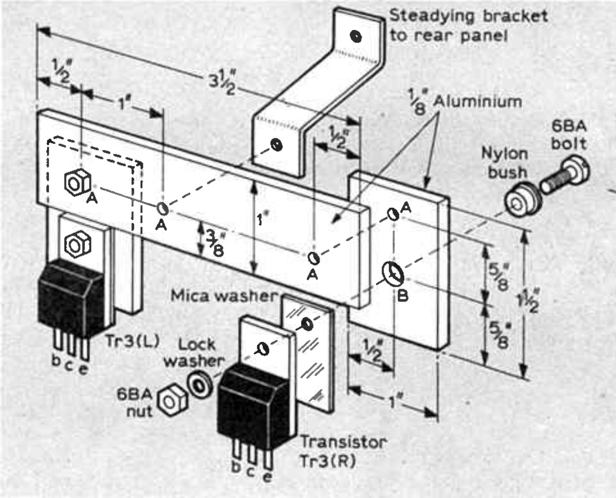


Fig. 8: *Design and assembly of driver transistor heatsink*

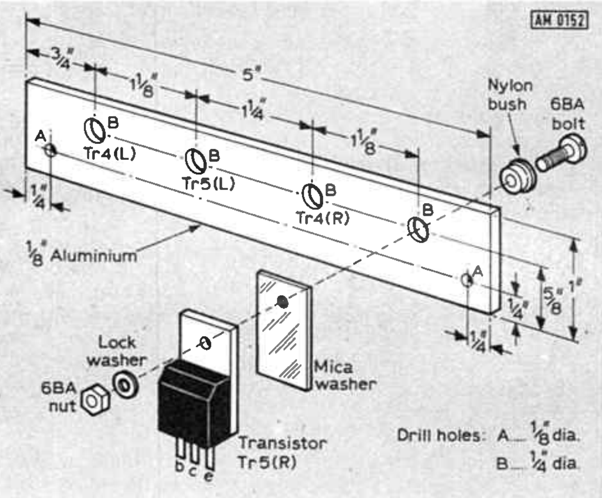
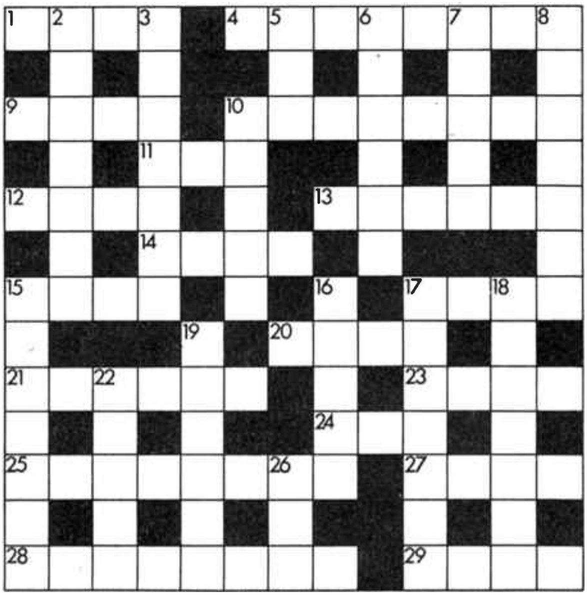


Fig. 9: *Design and assembly of output transistor heatsink*

A Zobel network C9/R13 is connected across the output terminals. The purpose of this network is to ensure that the loudspeaker load always appears essentially resistive to the output transistors. This means that the output stage is protected against inductive transients which could exceed the breakdown voltage of the transistors.

PART 2 next month will describe the Tuner/IF and FM Decoder units

PW TECHNICROSS PUZZLE No.3



ACROSS

1 Employs a coupling of ferrous esters (4)
4 A shaker in the transformation scene (8)
9 A stick-up in the rockery (4)
10 Radio engineers meet with such resistance? (8)
11 Come back to fix a little drink (3)
12 The Spanish miss her in the end (4)
13 Already fixed on the wavelength? (3-3)
14 A key piece of mechanism (4)
15 As familiar as Liz (4)
17 Bell's slowest ringing tone (4)
20 Basso loudspeakers amplify this single? (4)
21 How to dispense with an earth! (6)
23 You talk nonsense about defeat (4)
24 Dipole once connected with him! (3)
25 If about to bewail a valve component! (8)
27 Not so hot in acoustic editing (4)
28 Salty type's crystallization at the mike! (8)
29 Collections of old wirelesses (4)

DOWN

2 Land in court with such maintenance? (7)
3 Glass in pieces from these transmissions? (7)
5 Jim pleased about the little rascal (3)
6 The longest-ever tape? (6)
7 They're well up about antennae (5)
8 A composed musical performance (7)
10 Such a charge about a cathode? (5)
15 The more hearty kind of con-man (7)
16 Birds do such load-shedding? (5)
17 Do riots break such coils? (7)
18 Told Sue about being so noisy! (7)
19 More I'd swap for a position in golf (6)
22 Classification of a crystal-set? (5)
26 Nickel-coating is zero-rated? (3)

FOR AMUSEMENT ONLY
ANSWERS NEXT MONTH

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 useage 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 addage—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 beasty. 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 2¼ inches in diameter. This is probably the largest chip which has ever been employed in any semiconductor device.

Ginsberg

I.C. 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.

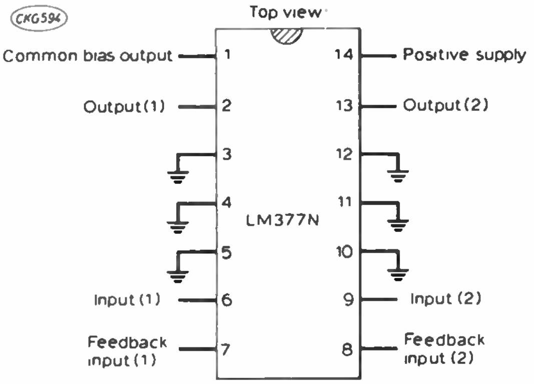


Fig. 1. Pin connections to the 14 pin DIL LM377N.

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.)

(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.

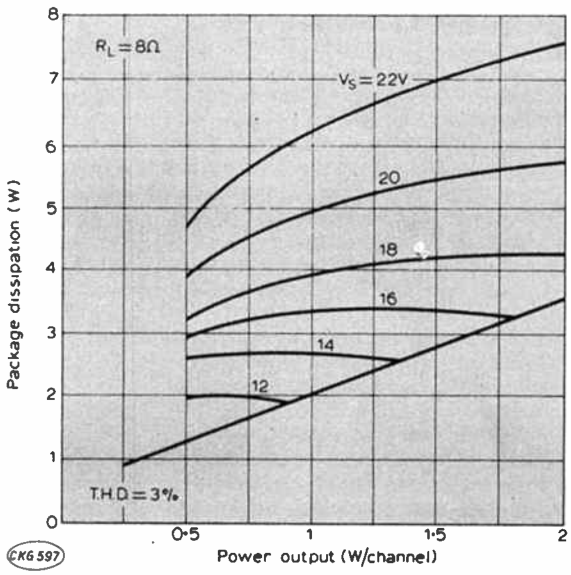
(iv) The input impedance is relatively high, 3MΩ, and this increases the versatility of the device.

(v) Any hum on the power supply line is reduced by 80dB. The separation between the two channels is typically 70dB.

Circuits

In all circuits the inputs of both amplifiers should be biased by the voltage from pin 1. The bias current is typically $0{\cdot}5\mu A$ 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.

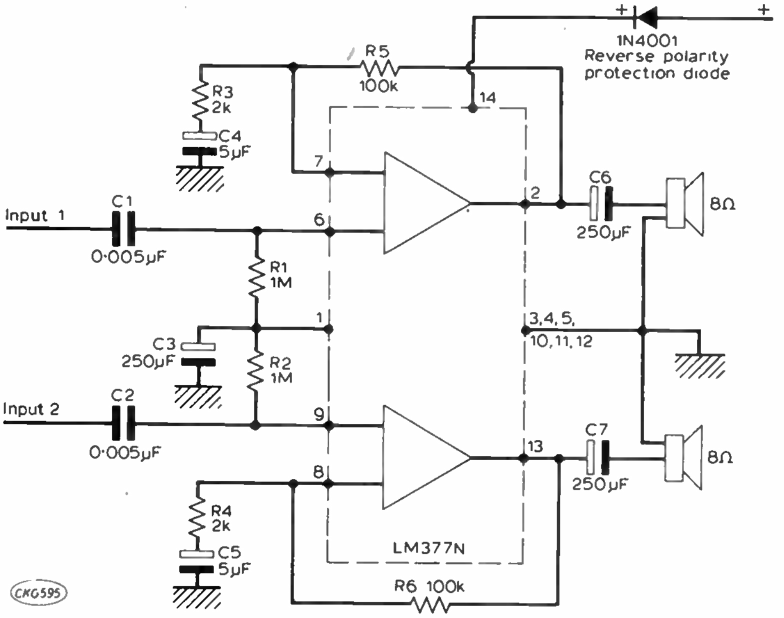


Fig. 2. Circuit of a practical stereo amplifier suitable for a record player. A volume control will be required on the input circuit.

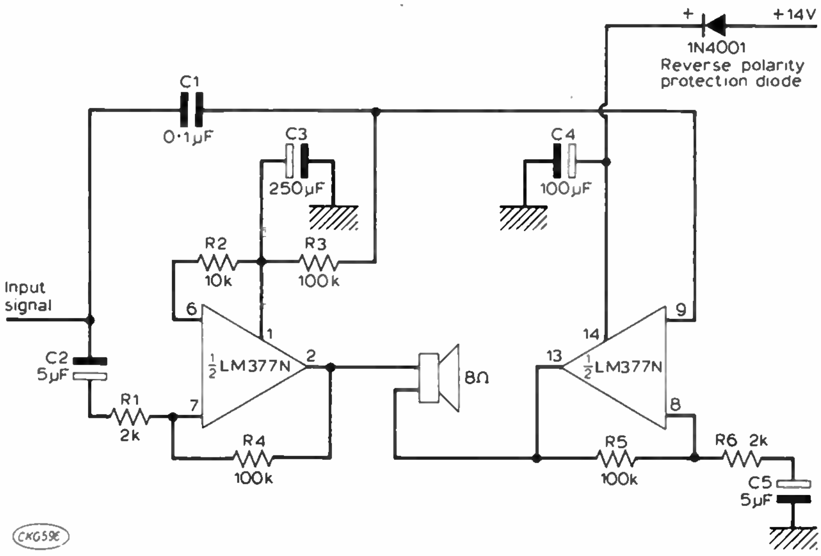


Fig. 3. This mono circuit utilises both amplifiers to provide 4W output.

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.

Power supply

The LM377N can be fed from a supply line having any value between 10V and 22V. The absolute maximum supply voltage is 26V, but one should always allow a safety margin to avoid the risk of damage to the device.

A current of about 15mA is taken from a 20V supply when no signal is applied to either input, but the current rises towards 1A when full output power is being delivered to the speakers.

The maximum output power which can be obtained from each channel depends on the supply voltage used and also by the speaker impedance. A typical LM377N provides 2·5W per channel when fed from a 20V supply into 8Ω speakers, whilst all devices should provide a minimum of 2W per channel under these conditions.

The LM377N can dissipate up to about 2·5W continuously without a heat sink, but if the centre pins of the device are soldered to 2·5 sq. in of copper on a printed circuit board, the maximum dissipation is increased to about 4·2W. Some form of heat sink seems required when an 8Ω speaker is employed, unless the power supply voltage does not exceed about 14V. In practice, however, the device is seldom operated at maximum power level for more than a moment (unless one likes to listen to sine waves!). Normally one is not likely to require a heat sink when using supply voltages of up to 18V provided that the speaker impedance is not less than 8Ω.

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—30MHz

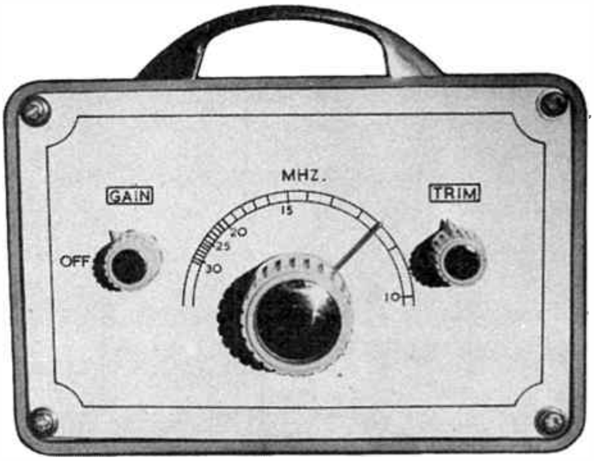
F. G. RAYER G3OGR

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 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.



Completed preselector in its 6x4x4in cabinet.

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

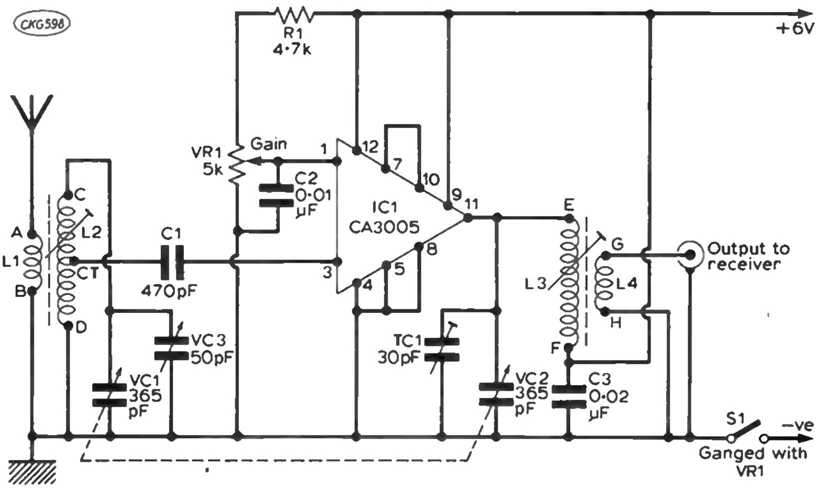


Fig. 1. Circuit of preselector using a single integrated circuit. Input, output and battery connections are at the rear. When placed between aerial and receiver useful gain will result as well as a reduction in second channel interference.

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.

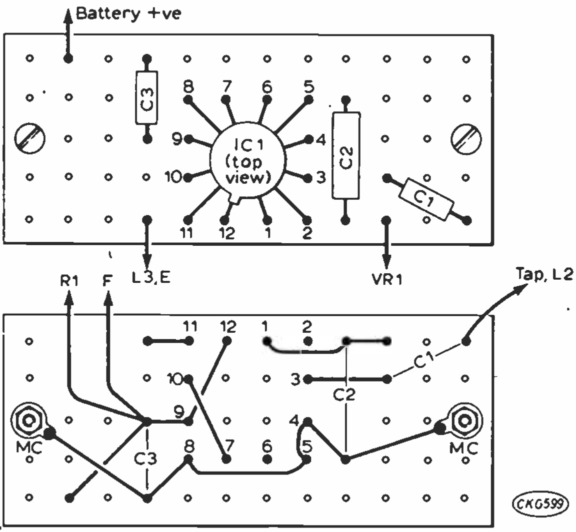


Fig. 2. Both sides of the small circuit board that carries the IC.

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 $4\frac{1}{2}$ turns. Scrape the wire and twist the centre tap. Wind a further $4\frac{1}{2}$ 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.

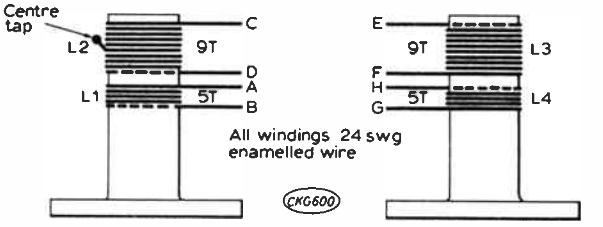


Fig. 3. Details for winding the two coils used in the preselector.

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.

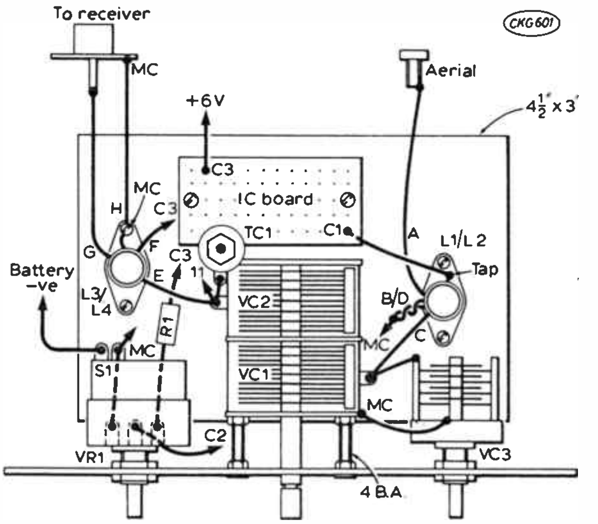


Fig. 4. Top view of the chassis showing position of the IC board and major components.

The chassis is a flat plate $4\frac{1}{2}$ 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

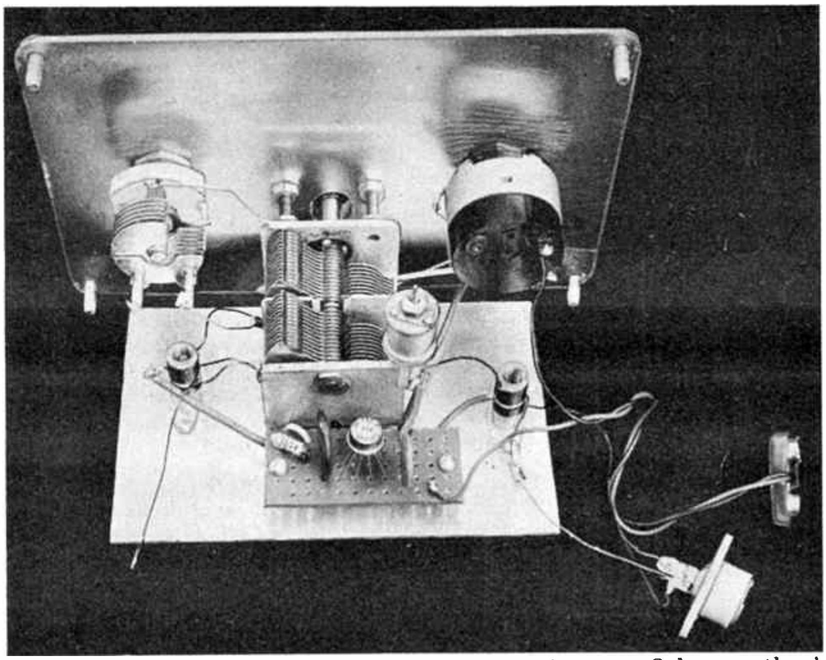
R1 4·7kΩ ¼W VR1 5kΩ linear with switch S1.

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, $\frac{3}{16}$in dia. with cores (2).
Knobs. ICI, 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.

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.

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. ■

IC of the Month—*continued from page 1083*

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

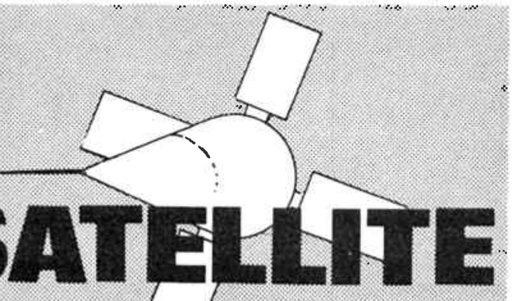
—*continued from page 1087*

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 x 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 techniques

PART 1

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

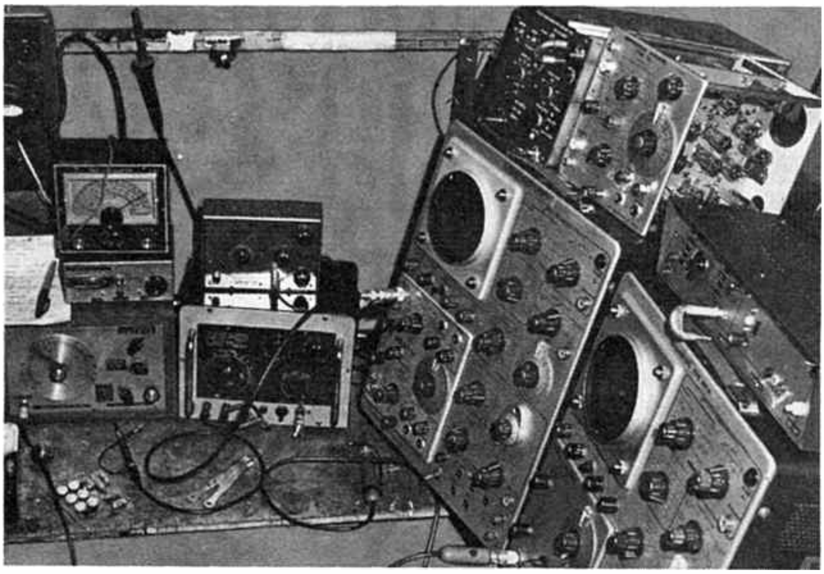
As most scopes have a low frequency limit of DC (DC coupled) or a few Hz, the bandwidth figure quoted is the upper frequency limit at 3dB down (or however else the manufacturer specifies).

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.

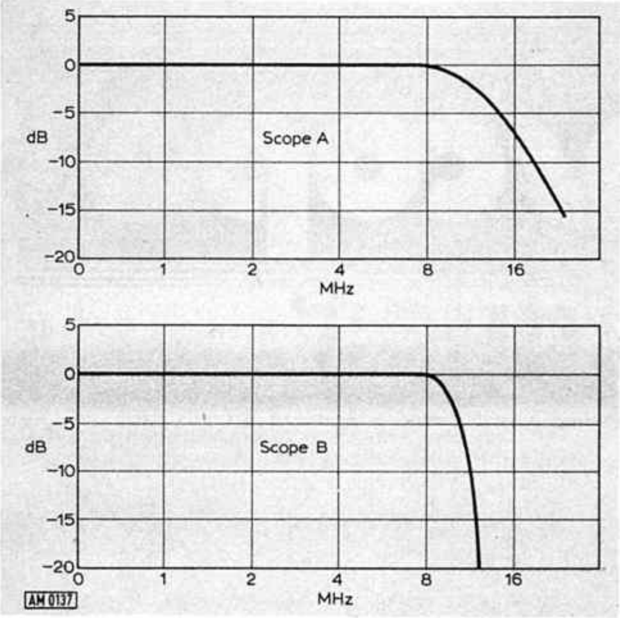


Fig. 1. The response curve of the Y amplifier in two different oscilloscopes, to illustrate the meaning of "bandwidth."

The time period of the 1MHz signal is 1μsec. 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 Tr 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 Tr 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.

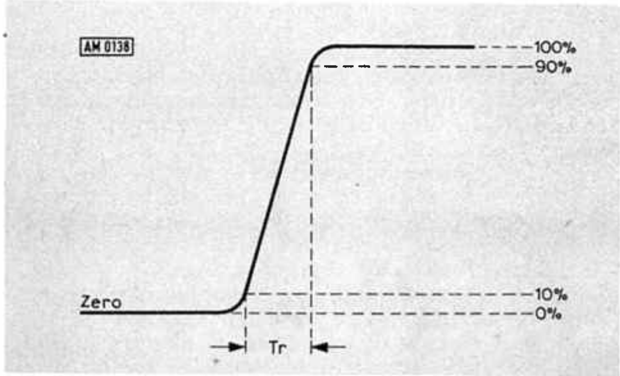


Fig. 2. First part of a response curve with a step function input to the scope. The rise time is a function of the bandwidth of the amplifier.

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

Rise Time (ns) × 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.

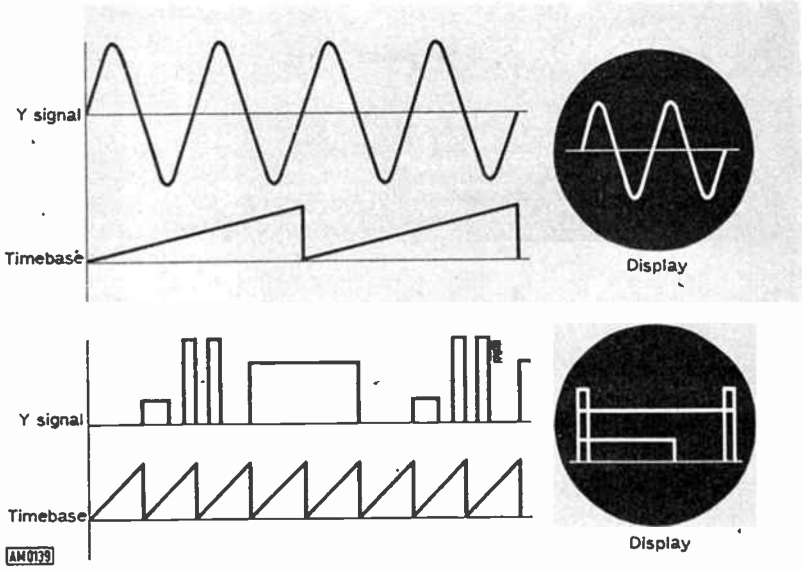
One consequence of the sync mode is that the input signal (Y) must have a repetition frequency higher than that of the timebase for a stable image to result, as in Fig. 3. If the timebase is run faster than the repetition rate of the waveform, in order to view detail the trace folds up into a jumble.

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 64μsec, 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.

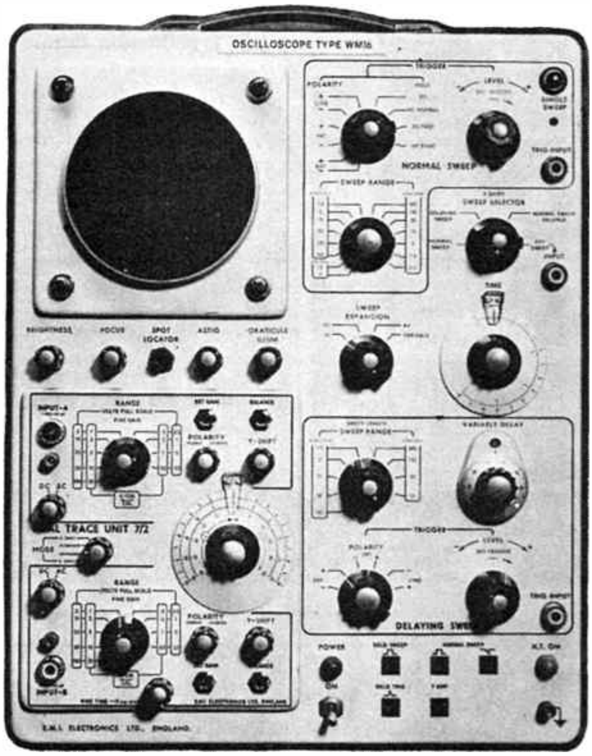
The main frame houses the CRT, power supplies, Y drive amplifier, X amplifier and the timebase if this is not plug-in. A range of Y plug-ins would then be used with the scope, providing double beam operation, differential inputs, very high sensitivity or a special function such as a spectrum analyser 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.

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

CQ!CQ!CQ!CQ!

EQUIPMENT WANTEO

.. Wanted urgently two octal plug and sockets, cash refund available.—Colin Machin, Pontsion, Aberedu, Builth Wells, Breconshire.

...Trio 9R59DS must be in good condition with handbook and working.—C. H. Brain, 7 Elverlands Close, Ferring, Sussex BN12 5PL.

...Urgently required, Mazda valve, type AC/VP1; also any info. on massive, old Murphy 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.—Lai Sai Kiew, 65A Union Flats, Jalan Sentul, Kuala Lumpur, Malaysia.

...Codar PR40 Pre-Selectorin 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 gen on the U.S.N. transceiver Type CR1-4344—a unit of Model TBY-8 made by Colonial Radio Corporation, Buffalo, N.Y. Even band-coverage gen would help.—H. W. Boyett, G6GZG, 66 Freshbrook Road, Lancing, Sussex BN15 6DA.

...can you please suoolv me with data and servicing instructions also circuit diagram for the Grundig TK120 Tape Recorder.—G. E. Simkin, 20 Wensleydale Drive, Forest Hall, 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 Alton Road, Leicester.

...Circuit and details of Windsor Model 30A Cathode Ray Oscillograph.—J. Hollis, 15 Pickering Rise, Derby DE2 46S.

...circuit diagram, manual, etc. wanted for Veritine Communication Receiver 150 buy or loan.—D. Jones, 12 Welby Place, Sheffield, S6 9DA.

...Instruction manual/handbook for RCA AR88D receiver.—P. Lawler, 34 Hanover Gardens, Hainault, Ilford, Essex 1G6 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.—P 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 6LD.

.. Service sheet wanted for Sobell receiver (model no.) type 615. Data on the following valves, 5Z4G, KT61, 6Q7G & 6K8G.—G. A. Hunt, 38 Garrick Close, Ings 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, 6 Meadow Lane, Northallerton, Yorkshire DL6 1RE.

.. circuit diagram, alignment instructions or handbook for Lafayette receiver HE30 Will gladly refund oostage.—P. Harston, 6 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 Talisman 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

A series of simple transistor projects, using not more than twenty components.

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.

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 plus contact 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 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 ¼W	R2 470Ω ¼W	R3-5 1kΩ ¼W
VR1 200kΩ linear potentiometer		
D1-6 1N4148	Tr1-4 BC108	LP1-3 6V 40mA
Battery 9V	Probes	Veroboard

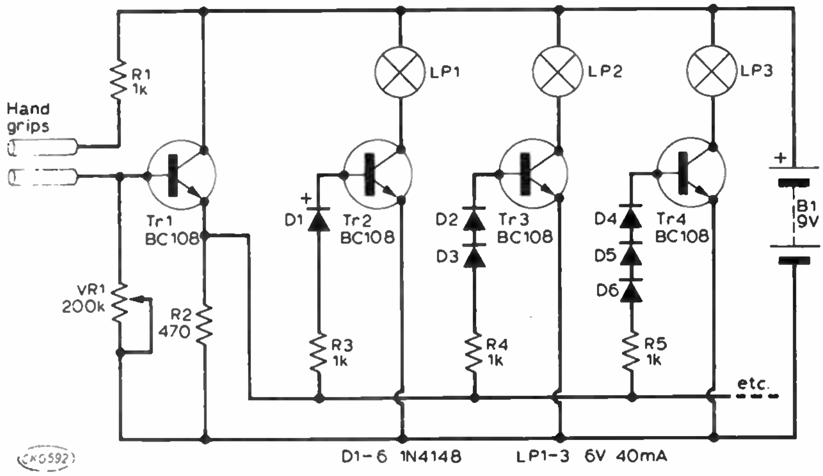
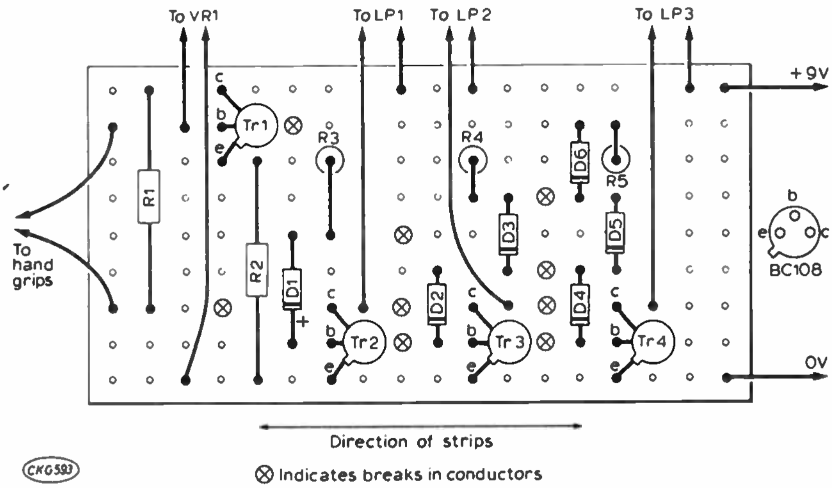


Fig. 1, above, is the circuit for a four stage tester and a suggested layout on plain veroboard is shown in Fig. 2, below.



ON THE AIR

BROADCAST BANDS

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 Prescot, 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.

ON THE AIR

BROADCAST BANDS

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 admission 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.

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 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.

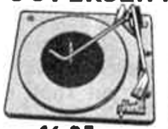
Brian Murray has heard IBA Radio Clyde testing on 1151kHz at 1345hrs and he reports that this station is due on the air on December 31st, 1973. Brian has been busy again with his Astrad VEF 204 receiver using an old band 1 TV aerial as a medium wave antenna. His log includes programmes in English from 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.

ALL OUR PRICES INCLUDE V.A.T.

BSR LATEST SUPERSLIM

STEREO AND MONO



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80 Ohm Coax 4p. yd.

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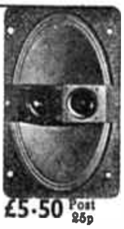
E.M.I. 13½ × 8in. SPEAKER SALE!



With twin tweeters and crossover, 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4·50** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 c/s. Flux 10,000 gauss. **£2·75** State 3 or 8 or 15 ohm. Post 25p

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All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer. Input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. Size 3½ × 1½ × 1¼in. **£2·20** Post 20p

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Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12v. or H.T. line 200-300V. d.c. operation. Size 1½" × 1¼" × ½". Response 25 c/s. to 25 Kc/s, 26 dB gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **99p** Post 20p

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Woofer 10½ × 6½in. Ceramic Magnet, 44ozs. 13,000 lines, Tweeter 3½in. square, 10,000 lines. Crossover condenser full instructions supplied. Impedance 8 ohms. Power 12 watts. **£5·75** Post 25p.

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MINIATURE 200V 20mA, 6·3V 1A 2½ × 2½ × 2in. 75p
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HEATER TRANS. 6·3V 3A 75p
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30V £2·80
1 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £2·25
1 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £2·25
2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £3·50
5 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 £5·75
6, 8 and 12V 5 amp £1·20. 3 amp, 3, 5, 8, 10, 13 and 5-0-5V £1·30, Ditto 5 amp. £1·50; 6-0-6V 500mA 90p 9V 1 amp 95p 12V 300mA 75p 12V 500mA 85p 12V 750mA 95p. 40V 1 amp £1·75.
AUTO TRANSFORMERS, 115V to 230V or 230V to 115V 150W £2·25; 500W £6·25; 750W £10; 1000W £15
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4/350V .. 14p	250/25V .. 14p	50+50/300V .. 50p
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16/450V 22p	1000/25V .. 35p	32+32/250V .. 20p
32/450V 35p	1000/50V .. 47p	32+32/450V .. 60p
32/500V 50p	8+8/450V .. 22p	250+50/325V .. 55p
25/25V .. 10p	8+16/450V 25p	100+50+50/350V 55p
50/50V .. 10p	16+16/450V 40p	

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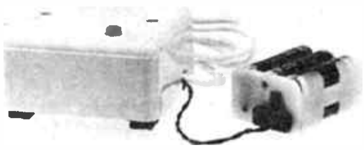

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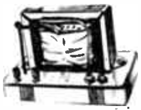
12 VOLT 1½ AMP. POWER PACK



This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mF smoothing. Price £2·20 plus 20p post & packing.

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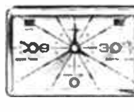

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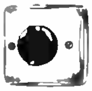

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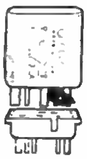

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ON THE AIR

AMATEUR BANDS

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 hamebrew 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, VE3AII/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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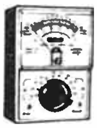
AUDIOTRONIC Model ATM1



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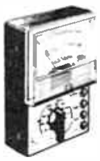
AUDIOTRONIC Model ATM5



Jewel movement, attractively moulded case with edgwise ohms adjustment. Ranges: 0-3/15/150/300/1200V AC, (2500 opv). 0-6/30/300/600V DC, (5000 opv). 0-300 uA/0-300mA DC. Resistance: x 10 & x 100. – 10 to +16dB Supplied with battery test leads and data booklet. Size: 121 x 73 x 29mm

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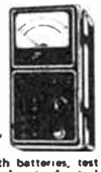

10,000opv. A first class, instrument manufactured in USSR to the highest standards. Ranges: 2.5/10/50/ 250/500/1000V DC. 2.5/10/50/250/500/1000V AC. DC current 100uA/1/10/100mA/1A. Resistence 300 ohms/3/30/300k/3 Meg. ohms. Complete with batteries, test leads, instructions and a sturdy steel carrying case.

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OUR PRICE £5.95 P&P 15p

HIOKI Model 720X VOM

A versatile, accurate measuring instrument. 20,000 opv. 0/5/25/100/500/1000V DC. 0/10/50/250/1000V AC. 0–50uA/250mA. 0–20k/2 Megohms.

OUR PRICE £5.97 P&P 20p

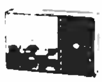
TMK MODEL TW50K

46 ranges, mirror scale. 50k/V DC 50k/V AC. DC Volts: 0.125/0.25/1.25/2.5/5/10/25/50/125/250/500/1000. AC Volts 1.5/3/5/10/25/50/125/250/500/1000. 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.

OUR PRICE £8.50 P&P 17p

ALL PRICES EXCLUDE VAT

U4323 MULTIMETER



20,000opv. Simple unit with audio/IF 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 OC. Resistence 5/50/500 ohms/5/10/100k ohms/1Meg. Battery operated. Size: 160 x 97 x 40mm. Supplied in carrying case complete with test leads.

OUR PRICE £7.00 P&P 20p

MODEL TE300

30,000opv. Mirror scale. Overload protection. 0/0.6/3/15/60/300/1200V DC. 0/6/30/120/600/1200V AC. 0/30uA/6mA/60mA/300mA/600mA. 0/8k/80k/800k/8 Meg ohms. –20 to +63dB.

OUR PRICE £7.50 P&P 15p

U4324 MULTIMETER

High sensitivity, overload protected. 20,000opv. Ranges: 0.6/1.2/3/12/30/60/120/600/1200V DC. 3/6/15/60/150/300/600/900V AC. Current: 0.06/0.6/6/60/600mA/3A DC. 0.3/3/30/300mA/3A AC. Resistence: 25/500 ohms/0.5/5/50/500k ohms/5 Mohms. Decibels: –10 to +12dB. Size 167 x 98 x 63mm. Supplied complete with test leads, spare diode and instructions.

OUR PRICE £8.00 P&P 20p

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/0.5/2.5A DC. 5/25/100mA/0.5/2.5A AC. Resistance: 0.3/3/30/300k ohms. Size: 205 x 110 x 84mm. Supplied complete with leads, crocodile clips and steel carrying case.

OUR PRICE £8.75 P&P 20p

U4312 MULTIMETER

extremely sturdy instrument for general electrical use. 667opv. 0/0.3/1.5/7.5/30/60/150/300/600/900V DC & 75mV. 0/0.3/1.5/7.5/30/60/150/300/600/900V AC. 0/300uA/1.5/6/15/150/60/600mA/1/1.5/6A OC. 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.

OUR PRICE £9.75 P&P 25p

U91 Clamp VOLT AMMETER

For measuring AC voltage and current without breaking circuit. Ranges 300/600V AC. Current: 10/25/100/250/500A. Accuracy 4%. Size 283 x 94 x 36mm. Complete with carrying case, leads and fuses.

OUR PRICE £10.50 P&P 20p

MODEL C7080EN

Giant 6" mirror scale. 20,000 opv. 0/0.25/1/2.5/10/50/250/1000/5000V OC. 0/2.5/10/50/250/1000/5000V AC. 0/50uA/1/10/100/500mA/10A DC. 0/2k/200k/20 Meg. –20 to +50dB.

OUR PRICE £13.95 P&P 35p

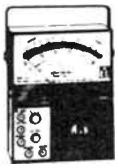
MODEL 500

30,000 opv with overload protection. Mirror scale. 0/0.5/2.5/10/25/100/250/500/1000V DC. 0/2.5/10/25/100/250/500/1000V AC. 0/50uA/5/50/500mA. 12A DC. 0/60k/6 meg/60 megohms.

OUR PRICE £10.95 Carr. paid

Leather case for above £1.75

KAMODEN 360 MULTIMETER



High sensitivity. DC 100kohm/V AC 10kohm/V 5" mirror scale, overload protected. Ranges: 0.5/2.5/10/50/250/1000V DC. 5/10/50/250/1000V AC. Current: 0.01mA/0.5/5/50/500mA/10A. Resistance: 0.1/1/10/100 ohms/1/10/100k ohms/10/100M ohms. Decibels –20 to +62dB. Battery operated. Size: 180 x 140 x 80mm. Supplied complete with test leads etc.

OUR PRICE £13.95 P&P 25p

HIOKI MODEL 700X

100,000opv. Overload protection. Mirror scale 0.3/0.6/1.2/1.5/3/6/12/30/60/120/300/600/1200V DC. 1.5/3/6/12/30/60/150/300/600/1200V AC. 15/30uA/3/6/30/60/150/500mA/6/12A DC 2k/200k/2M/20MOhms –20 to +63dB.

OUR PRICE £14.95 P&P20p

KAMODEN HM720B FET VOM

Input impedence 10 Megohms. Ranges 0/.25/1/2.5/10/50/1000V 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

OUR PRICE £14.95 P&P 30p

TMK MODEL 117 FET ELECTRONIC VOLTMETER

Battery operated. 11 Meg input, 26 ranges. Large 4½" mirror scale. Size: 149 x 117 x 60mm. 0.3–1200V DC. 3–300V RMS AC. 8–800V P-P. DC current 0.12–12mA. Resistance up to 2000MOhms. Decibels. –20 to +51dB. Supplied complete with leads and instructions.

OUR PRICE £17.50 P&P 20p

KAMODEN 72200 Multitester

High sensitivity tester. 200,000 opv Overload protected Mirror scale. Ranges: –0/.06/.3/3/30/120/600/1200V DC. 0/3/12/60/300/11200 V AC. 0/6uA/1.2mA/120mA/600mA/12A DC 0/12A AC. –20 to +63dB. 0/2k/200k/2 Meg/200 Megohms

OUR PRICE £16.95 P&P 30p

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.

OUR PRICE £17.50 P&P 25p

U4317 MULTIMETER

High sensitivity instrument for field and laboratory work Knife edge pointer. 86mm. mirror scale. Ranges: 100mV/0.5/2.5/10/25/50/100/250/500/1000 V 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.

OUR PRICE £15.00 P&P 20p

TE40 HIGH SENSITIVITY AC VOLTMETER

10 Meg input. 10 ranges: 0.001/0.03/0.1/0.3/1/3/11/30/100/300V RMS. 5cps–1.2MHz. –40 to +50dB supplied brand new complete with leads and instructions.

OUR PRICE £17.50 P&P 25p

TE65 VALVE VOLTMETER

28 ranges. DC volts 1.5–1500V. AC volts 1.5–1500V. Resistance up to 1000 Megohms. 200/240V AC operation. Complete with probe and instructions.

OUR PRICE £17.50 P&P 30p

Additional probes available RF £2.12, HV £2.50

TMK LAB TESTER

100,000opv. 6½" scale. Buzzer short circuit check. Sensitivity 100,000 opv OC. 5k/V AC DC Volts: 0.5/2.5/10/50/250/1000V AC. 3/10/50/250/500/1000V DC. current 10/100uA/10/10/100/500mA/2.5/10A. Resistance: 1k/10k/100k/10 Meg/100 Meg ohms. Decibels: –10 to +49dB. Plastic case with carrying handle. Size: 190 x 172 x 99mm.

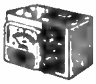
OUR PRICE £19.95 P&P 25p

MODEL U4311 Sub-standard Multi-range Volt-Ammeter

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. 0/3/7.5/15/30/75/150/300/750mA/1.5/3/7.5A AC. 0/75/150/300/750mV/1.5/3/7.5/15/30/75/150/300/750V DC. 0/750mV/1.5/3 /7.5/15/30/75/150/300/750V AC. Automatic cut out device. Supplied complete with test leads, manual and test certificates.

OUR PRICE £49.00 P&P 50p

LB3 TRANSISTOR TESTER



Tests ICO and B. PNP/NPN. Operates from 9V battery. Complete with all instructions etc.

OUR PRICE £3.95 P&P 20p

LB4 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1.5V batteries. Complete with instructions etc.

OUR PRICE £4.50 P&P 20p

U4341 MULTIMETER TRANSISTOR TEST

27 ranges. 16,700opv. Overload protected. Ranges: 0.3/1.5/6/30/60/150/300/900V DC. 1.5/7.5/30/150/300/750V AC. Current: 0.06/0.6/6/60/600mA DC. 0.3/3/30/300mA AC. Resistance: 0.06/0.6/2/6/20/60/200k ohms/2 Mohms. Battery operated. Supplied complete with probes, leads and steel carrying case. Size: 115 x 215 x 90mm.

OUR PRICE £10.50 P&P 20p

KAMODEN HM350 TRANSISTOR TESTER

High quality instrument to test reverse leak current and DC current. Amplification factor of NPN, PNP, diodes, transistors, SCR's etc. 4" square clear scale meter. Operates from internal batteries. Complete with instructions, leads carrying handle.

OUR PRICE £12.50 P&P 30p

S100TR MULTIMETER–TRANSISTOR TESTER

100,000opv. Mirror scale. Overload protection. 0/0.12/0.6/3/12/30/120/600V DC. 0/6/30/120/600V AC. 0/12/600uA/12/300mA6 12A OC. 0/10k/1 Meg/100 Meg. –20 to +50dB. 0.01–0.2 MFD. Transistor tester measures Alpha, Beta and ICO. Complete with instructions, batteries and leads.

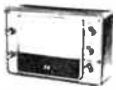
OUR PRICE £14.95 P&P 25p

Model 449A In Circuit TRANSISTOR TESTER

Checks true AC, Beta in/out. Checks ICO. Checks diodes in/out. Checks SCR etc. Beta HI 10–500 LO 2–50. ICO 0–5000uA. 220/240 V AC operation.

OUR PRICE £17.50 P&P 25p

KAMODEN HMG500 insulation resistance tester



Range 0–1,000 Megohms, 500V. Battery operated Wide range clear meter 4" x 4¾". Complete with deluxe carrying case, batteries and instructions

OUR PRICE £19.95 P&P 30p

TE16A TRANSISTORISED SIGNAL GENERATOR

5 ranges, 400kHz to 30 MHz. An inexpensive instrument for the handy-man. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. Size: 149 x 149 x 92mm Complete with instructions and leads.

OUR PRICE £8.97 P&P 25p

TE22 SINE SQUARE WAVE AUDIO GENERATOR

Sine 20cps to 200kHz on 4 bands. Square 20 cps to 30 kHz. Output impedence 5000 Ohms. 200/250V AC operation. Supplied brand new guaranteed, with instruction manual and leads.

OUR PRICE £17.50 P&P 37p

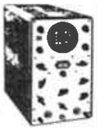
ARF 300 AF/RF SIGNAL GENERATOR

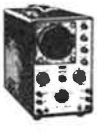
All transistorised compact fully portable. AF sine-wave 18Hz to 220 kHz. AF square wave 18Hz to 100k Hz. Output Square/Sine wave 10V. P-P RF 100kHz to 200MHz. Output 1V maximum. 220/240V AC operation. Complete with instructions and leads.

OUR PRICE £29.95 P&P 50p

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

CI5 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP Bandwidth: 10MHz Sensitivity at 100kHz VRMS/mm: 0.1–25 HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3–25 Preset triggered sweep 1–3000usec. Free running 20–200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115–230V AC.
OUR PRICE £39.00 Carr. paid

TO3 Portable OSCILLOSCOPE

3" tube. Y amp sensitivity 0.1Vp-p/CM. Bandwidth: 1.5Hz–1.5MHz. Input Impedance: 2 MOhms, 25pF. X amp. sensitivity: 0.9Vp-p/CM. Bandwidth 1.5Hz–800kHz. Input impedence 2 Meg Ohms, 20pF. Time base, five ranges 10Hz to 300kHz. Synchronisation. Internal or external. Illuminated scale 140 x 215 x 330mm. Weight 15½lbs. 220/240V AC. Supplied brand new with handbook.
OUR PRICE £52.50 P&P 50p

RUSSIAN CI16 Double Beam OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 5" x 4" CRT. Calibrated triggered sweep from 0.2usec to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.
OUR PRICE £87.00 Carr. paid

MCA220 Automatic Voltage Stabiliser

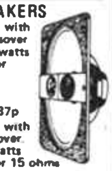
Input 88–125V AC or 176–250 V AC. Output 120V AC or 240V AC. 200V A rating.
OUR PRICE £11.97 P&P 50p

PS100B Regulated POWER SUPPLY UNIT

Solid state. Output 6, 9 or 12V DC up to 3 Amp. Meter to monitor current. Input 220/240V AC Size: 100 x 82 x 159mm.
OUR PRICE £11.97 P&P 25p

PS200 Regulated POWER SUPPLY UNIT

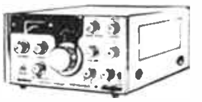
Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 190 x 136 x 98mm.
OUR PRICE £19.95 P&P 25p

EMI LOUDSPEAKERS

Model 350 13 x 8" with single tweeter/crossover 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.
OUR PRICE £7.25 each P&P 37p
Model 450 13 x 8" with twin tweeter/crossover 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms
OUR PRICE £3.62 each P&P 25p

Also see previous pages

ALL PRICES EXCLUDE VAT

SUPER VALUE TOP QUALITY TRIO communications equipment

TRIO JR599 RECEIVER

Nine wave-bands covering 1.8–29.7 MHz, 144–146MHz and 10MHz WWV SSB, CW, AM and FM. AF output is more than 1 watt. S Meter. Squelch control. BFO. Variable AF and RF controls. 4–16 ohm output and jack for phones. Power requirement 100/240V AC, 12/14V DC. Size: 270 x 140 x 310mm.
Our Price £132.50 CARR. PAID

TRIO 9R590S RECEIVER

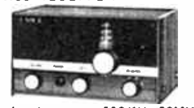
Four bands covering 550kHz to 30 MHz continuous and electrical bandspread on 10, 15, 20, 40, and 80 mtrs. 8 valve plus 7 diode circuit. 4 to 8 ohm output and phone jack. SSB–CW, ANL, variable BFO. S Meter and separate band spread dial. IF frequency 445kHz, audio output 1½ watt. Variable RF and AF gain controls. 115/250V AC, with instructions.
Our Price £42.50 CARR. PAID

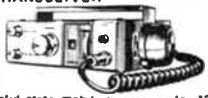
TRIO JR310 SSB RECEIVER

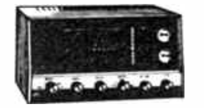
Covers 3.5, 7, 14, 21, 28, 28.5 and 29.1MHz bands and WWV 15MHz. SSB, AM and CW. AF output more than 1W. Crystal controlled BFO for SSB. S Meter, ANL etc. AC 110/120–220/240V. Size: 330 x 179 x 310mm.
OUR PRICE £75.00 Carr. paid

TRIO TR2200 RECEIVER

Fully transistorised portable VHF transceiver Will transmit and receive on six channels between 144–146MHz. 1 watt transmitter. 12V DC internal or external supply. Built-in charger for Ni-Cad cells. Power/volume switch, squelch control, channel selector, mic. socket, earphone/external speaker socket. Complete with microphone and 144.48, 144.72 & 145.32 crystals. Size: 134 x 58 x 180mm.
OUR PRICE £79.50 Carr.paid

UNR30 RECEIVER

Four bands covering 550 KHz/30MHz BFO. Built-in speaker. Operates from 220/240V AC. Brand new with instructions.
OUR PRICE £15.75 P&P 37p

BELTEK W5400 CAR TRANSCEIVER

Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squelch and channel selector. Internal 3" speaker. Complete with dynamic mic. PTT switch, three sets of crystals for 144.48, 144.6 and 145MHz, mounting bracket and instructions. Size: 150 x 70 x 220mm.
OUR PRICE £75.00 P&P 50p

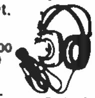
LAFAYETTE HA600 Receiver

General coverage 150–400kHz, 550 kHz–30MHz. FET front end 2 mechanical filters, product detector. Noise limiter, variable BFO, S Meter, Bandspread and RF gain. 220/240V AC or 12V DC. Brand new with instructions.
OUR PRICE £50.00 P&P 50p

SH628 STEREO HEADPHONES

Outstanding value. With soft ear pads and adjustable headband. 8–16 ohms. 20–20,000Hz. Complete with lead and stereo plug.
OUR PRICE £1.87 P&P 30p

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.
OUR PRICE £1.97 P&P 30p

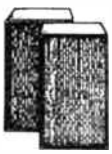
TE1018 Deluxe Mono High Impedence Headset.

Sensitive magnetic headset with soft ear pads. Impedence 2,600 ohms (600 ohms OC) Frequency response: 200–4,000Hz.
OUR PRICE £2.25 P&P 30p

DH02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head band. Impedence 8 ohms 20–12,000Hz. Complete with lead and plug.
OUR PRICE £2.25 P&P 30p

BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedence 16 ohms. Microphone impedence 200 ohms
OUR PRICE £5.95 P&P 30p

SPECIAL BARGAIN !! STEREOSOUND SPEAKERS

Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm. 8 ohms. 8 watts RMS, 16 watts peak. Complete with Din lead.
OUR PRICE £12.95 P&P 50p

JOSTY KIT — HIGH QUALITY CONSTRUCTION KITS
WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£4.80
AF30 Mono pre-amplifier	£2.61
AF310 Mono amplifier	£5.91
AT5 Auto light control	£2.58
AT30 Photo cell switch unit	£5.70
AT50 400W Light dimmer/speed control	£4.80
AT55 1,300W Light control/speed control	£5.70
AT56 2,200W Light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control	£14.55
HF61 MW transistor radio	£3.33
HF65 FM Transmitter	£2.70
HF75 FM transistor radio	£2.88
HF310 FM tuner unit	£15.81
HF325 Deluxe FM tuner unit	£24.12
HF330 FM stereo decoder	£9.96
HF395 Aerial amplifier for AM/FM bands I, II, & III	£1.77
GP310 Stereo pre-amplifier	£21.27
GU330 Tremolo unit	£7.50
NT10 PSU 100mA/9–12V	£6.15
NT300 Professional stabilised PSU, 2 x 30V, 2.2A	£12.51
NT305 Transistor converter 12/15V AC/DC to 6V, 7.5V or 9V DC	£4.50
NT310 PSU 240V AC to 2 x 18V DC at 2A	£4.80
NT315 PSU 240V AC to 4.5–15V DC at 500mA	£9.57
AE1 100mW output stage	£1.65
AE2 Pre-amplifier	£1.26
AE3 Diode receiver	£2.00
AE4 Flasher	£1.09
AE5 Astable multivibrator	£1.05
AE6 Monostable multivibrator	£1.02
AE7 RC generator	£1.06
AE8 Bass filter	99
AE9 Treble filter	99
AE10 CCIR filter	99

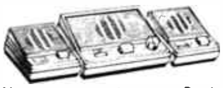
NEW FROM JOSTY-KIT 'Amateur Electronics'
The professional book for the amateur—covers the subject from basic principles to advanced electronic techniques. Complete with circuit board for making ten of the kits listed above.
OUR PRICE £3.30 (No VAT)
P & P 25p plus VAT

FRUSTRATED EXPORT ORDER !!
Philco Ford 5245 Mains Tape Recorder.

2 track BSR deck with push button controls for easy operation. Tape counter and volume control Complete with hand microphone, direct recording lead, 1,200' reel of tape and spare reel. 200/250V AC. Fully guaranteed.
OUR PRICE £17.50 P&P 75p

Philco Ford 5248 Mains Tape Recorder.

Four track, two speeds. Piano key type controls, tape counter, record ing level meter, volume and tone controls etc. Complete with hand, microphone lead for direct recording 1,800' of tape and spare reel. 200/250V AC. Fully guaranteed.
OUR PRICE £27.50 P&P 75p

KE630 3 Station INTERCOM

Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries
OUR PRICE £5.25 P&P 50p

SINCLAIR CAMBRIDGE CALCULATOR

To build yourself. Complete kit of parts with step by step instructions to build a full specification pocket sized calculator.
OUR PRICE £24.95 P&P free
ALSO AVAILABLE READY BUILT
Recommended Price £29.95
OUR PRICE £27.20 P&P 25p

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SINCLAIR EXECUTIVE with MEMORY
Recommended Price £49.00
OUR PRICE £40.75 P&P 25p

SPECIAL PURCHASE!! BSR 8 Track Player Chassis

Famous BSR 8track chassis as used in model TD8S complete with silver and black escutcheon, ready to fit into cabinet. Output 125mV. 240V AC. Overall size app. 185 x 215 x 80mm.
OUR PRICE £8.95 P&P50p

MP7 MIXER-PREAMPLIFIER

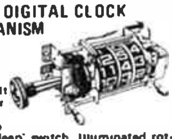
5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.
OUR PRICE £8.97 P&P 20p

FM TUNER CHASSIS

6 transistor high quality tuner. Size only 153 x 101 x 63mm 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.
OUR PRICE £5.95 P&P 20p

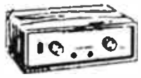
A1018 FM TUNER

Specification as above FM chassis but complete in cabinet with on/off switch. Size: 184 x 86 x 127mm.
OUR PRICE £9.65 P&P 30p
Stereo multiplex adapter £4.97

DT55B DIGITAL CLOCK MECHANISM

Features 24 hour alarm setting with built in buzzer On/off and auto alarm 'sleep' switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V. 3 Amp.
OUR PRICE £_.95 P&P 30p

BINATONE DS100 Digital Clock

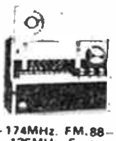
240V mains operation. Ivory case with large clear numbers for hours, minutes and seconds. Size 159 x 76 x 82mm.
OUR PRICE £4.50 P&P 30p

AUDIOTRONIC AHA101 Stereo Headphone Amplifier

All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.
OUR PRICE £7.50 P&P 20p

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

AUDIOTRONIC AMR9000
Global AM/FM Portable Radio



10 wave-bands covering AM: 535–1605kHz. LW: 150–380 kHz. MB 1.6–4MHz. SW1: 4–8MHz. SW2: 8–1.6 MHz. SW3: 16–24MHz. PSB1: 30–50 MHz. PSB2: 148–174MHz. FM.88–108MHz. Air: 108–136MHz. Feature time zone map and timing dial. Large clear scale. Telescopic aerial and built in aerial. AFC on FM. 6"x4" speaker and personal earpiece. Battery/mains operation. Size: 345 x 133 x 305mm.

OUR PRICE £36.00 P&P 50p

AUDIOTRONIC DOLBY B
Noise Reduction Units

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

PROCESS 4
For use with semi-professional tape recorders. Frequency response 30Hz –20kHz ± 2dB. S/N better than 70dB. Full source/tape monitoring. Switchable multiplex filter. Supplied with test tape.

OUR PRICE £50.00 P&P 50p

PROCESS 2
For use with cassette and tape recorders. Frequency response 30Hz–20kHz Switchable multiplex filter. 2 Dolby calibration meters. Off tape monitoring. S/N better than 70dB. Supplied complete with test tape or cassette.

OUR PRICE £34.50 P&P 50p

CT5050 Cassette Recorder

Instant recording and playing. Piano key controls. Automatic level control. Built-in speaker. Complete with remote control microphone, carrying case and shoulder strap.

OUR PRICE £8.50 P&P 50p

AUDIOTRONIC ACD660
Stereo Cassette Deck

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 line input sockets, 3.5mm microphone input sockets etc. etc. Frequency response: 40–12kHz (40–16kHz CrO2), S/N: –45dB. Crosstalk 45dB. Separation: –35dB. Noise limiter –6dB at 10kHz. Complete with connecting leads.

OUR PRICE £39.50 P&P 50p

AUDIOTRONIC LOW NOISE CASSETTES

TYPE	5	10	25
C60	£1.37	£2.61	£6.16
C90	£1.95	£3.70	£8.71
C120	£2.38	£4.50	£10.65

AUDIOTRONIC CrO2 CASSETTES

TYPE	5	10	25
CR60	£3.41	£6.72	£16.63
CR90	£4.63	£9.19	£22.80

AUDIOTRONIC 8 TRACK CARTRIDGES

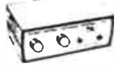
TYPE	Each	5	10
40M	75p	£3.50	£6.50
80M	99p	£4.70	£8.90

P&P Cassettes 3p, Cartridges 5p each OVER 10 of either FREE.

WALKIE TALKIES

SKYFON 100mW
OUR PRICE £24.95 per pair
P302 Two Channel 300mW
OUR PRICE £52.50 per pair
P1003 Three Channel 1 Watt
OUR PRICE £71.25 per pair
P&P 50p per pair
NB. Licence required for use in UK

1021 Stereo Listening Station



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. Two gain controls, speakers on off slide switch, stereo headphone socket.

OUR PRICE £2.25 P&P 15p

AUDIOTRONIC STEREO HEADPHONES

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LSH40 Two way speaker system Individual volume controls. 8 ohms. 20–20,000Hz
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LSH60 3" speaker units. 8 ohms. Complete with zipped carrying case. 20–20,000Hz.
OUR PRICE £8.95 P&P 30p

LSH50 Electrostatic with self powered energiser, and control unit, with headphone speaker selector. 4–32 ohms 20–24,000Hz.
OUR PRICE £16.95 P&P 30p

LQH400 4 channel dynamic headphones. Each earpiece has four drive units. 4–32 ohms 20–20,000Hz
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EA41 REVERBERATION AMPLIFIER

Self contained, transistorised, battery operated Simply plug in microphone, guitar etc. and output to your amplifier. Volume control and depth of reverberation control. Beau- walnut cabinet. 184 x 77 x 108mm.

OUR PRICE £7.50 P&P 20p

SPECIAL BARGAIN! FERGUSON 3406 HI-FI SPEAKERS

High quality 2 way speaker systems. 25 Watts. 4–8 ohms. 40Hz–18kHz. Size: 560 x 340 x 255mm. approx. Wood grain finish with black fronts.

OUR PRICE £29.95 PR. P&P £1

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C137	£7.00
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610	£11.30
610/TPD1	£15.35
710	£23.10
810	£28.25
MP60	£8.85
MP60/ADC K8	£10.90
MP60/TPD1	£14.15
HT70	£11.60
HT70/ADC K7E	£14.25
HT70/TPD1	£16.55
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GL78/G800E	£48.15
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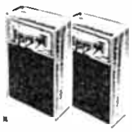
LINEAR 202 STEREO AMPLIFIER

20 Watts RMS Stereo Amplifier with controls for volume, balance, bass and treble, Mono/Stereo switch, loudness and scratch filters. Uses 20 Silicon transistors. Inputs for magnetic and crystal cartridge, Aux. and tape.

OUR PRICE £22.50 P&P 50p

SPECIAL BARGAIN!! PHONIC 10 Two Way Speakers



Matched pair of compact book-shelf speakers of unique design Incorporating a 2" high frequency unit & 6" woofer. 8 ohms impedance. Size: 348 x 228 x 110mm.

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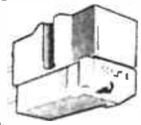
Incorporating low speed synchronous hysteresis motor giving constant turntable speed. 33 and 45 rpm. Cast Alluminium turntable. Fitted Goldring L75 arm and G800 cartridge, complete in plinth with perspex cover. Size 321 x 400 x 191mm inc. cover. AC100-130 and 200-250V.

OUR PRICE £35.95 P&P 75p

AUDIOTRONIC AMC50E STEREO Magnetic CARTRIDGE



Made by SHURE the AMC50E offers professional performance at a budget price. Frequency response: 20Hz–20kHz. Output voltage. 6.6mV. Compliance. 5 x 10–6 cm/dyne. Tracking force ¾ to 2 grammes. Stylus: Eliptical diamond .0007" x .0002".

OUR PRICE £4.50 P&P 12p

AD-76K STEREO MAGNETIC CARTRIDGE

Frequency response 20Hz–20kHz. Output: 5mV (1kHz 5 cm/sec). 0.7 mil conical diamond stylus. Channel separation 20dB. Tracking weight 1½–2½ gms. Original price £3.50

OUR PRICE £1.95 P&P 12p

TELETON F2100 STEREO RECEIVER SYSTEM

6 watts per channel AM/FM Stereo tuner amplifier, Garrard 2025TC record deck with plinth, cover and stereo cartridge, and a pair of Keletron LS50 speakers. SUPER VALUE!

OUR PRICE £48.50 Carr. & Ins. £1.25

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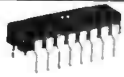

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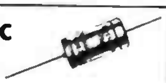

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33μF	6½p
68μF	6½p
150μF	6½p
470μF	11p
680μF	13p
1500μF	18p
2200μF	18p
3300μF	26p

10 VOLT

22μF	6½p
47μF	6½p
100μF	6½p
220μF	8p
330μF	10p
470μF	10p
1000μF	11p
1500μF	20p
2200μF	24p

16 VOLT

15μF	6½p
33μF	6½p
150μF	6½p
150μF	8p
220μF	9p
680μF	17p
1000μF	17p
1500μF	25p
2000μF	43p

25 VOLT

10μF	6½p
22μF	6½p
47μF	6½p
100μF	8p
150μF	8p
220μF	10p
470μF	13p
680μF	20p
1000μF	22p
2200μF	39p
5000μF	68p

40 VOLT

6·8μF	6½p
15μF	6½p
33μF	6½p

40 VOLT

47μF	6½p
100μF	9p
68μF	10p
220μF	11p
470μF	19p
680μF	25p
1000μF	25p
2200μF	44p

63 VOLT

1μF	6½p
2·2μF	6½p
4·7μF	6½p
6·8μF	6½p
10μF	6½p
22μF	6½p
68μF	10p
100μF	11p
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160V: 0·01μF, 0·015, 0·022, 0·033, 0·047, 0·068 3½p. 0·1 4p. 0·15 4p. 0·1 4½p. 0·15, 0·22 5½p. 0·33 7p. 0·47 9½p. 0·68 12p. 1μF 14½p. 1·5μF 22p. 2·2μF 24p

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UK110 Stereo Amp 5+5w	£11·07
UK115 Hi-Fi Amp 8w	£4·31
UK220 Signal Injector	£2·57
UK300 Four Channel Radio Control transmitter	£6·55
UK310 Radio Control Receiver	£3·28
UK325 'GXC2' Channel Splitting Unit. 1000 & 2000 Hz	£7·85
UK330 'GXC2' Channel Splitting Unit. 1500 & 2500 Hz	£7·86
UK415 Resistor Box	£8·69
UK425 Capacitor Box	£8·39
UK515 MW Radio Receiver	£7·86
UK790 Capacitive Burglar Alarm	£7·57

Many other kits available. Send for the free Amtron Catalogue.

★ These Kit Prices include VAT ★

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Friday late opening 6 o'clock

VEROBOARD

	0·1	0·15
2½ × 3¾	24p	19p
2½ × 5	27p	28p
3¾ × 3¾	27p	28p
3¾ × 5	31p	31p
17 × 2½	82p	63p
17 × 3¾	£1·10	87p
17 × 5 (Plain)		90p
Pin insertion tool	57p	57p
Spot face cutter	46p	46p
Pk 36 Pins	20p	20p

Resistors

¼ watt 5% carbon	1p
½ watt 5% carbon	1p
1 watt 10% carbon	2½p
range 10 ohms to 4·7 megohms.	
½ watt m/o 2 %	4p
range 10 ohms to 1 megohms.	

MINITRON DIGITAL INDICATOR TYPE 3015F

Read 0-9 and decimals. ONLY £1·65

400mW ZENER DIODES

BZY88 Series 3·3 volt to 33 volt.

1–99	100 plus
7p	6p

£1 BARGAIN PACKS

- £1 10 Silicon NPN Power transistors (2N3055) tested/unmarked.
- £1 30 Plastic FET's unmarked/untested, similar to 2N3819.
- £1 20 TO5 Transistors NPN 2 to 5 amp untested/unmarked.
- £1 20 TO18 transistors PNP like BC178, BC179 etc. untested/unmarked.
- £1 30 Plastic 2N3055 unmarked/untested TO220 case.
- £1 10 General Purpose, fully tested FET's.
- £1 500 carbon resistors ¼, ½, 1, 2 watt.
- £1 100 Electrolytic condensers.
- £1 250 Ceramic Polystyrene, Silver Mica etc. Condensers.
- £1 250 Polyester, Polycarbonate, Paper, etc. condensers.
- £1 25 Potentiometers assorted.
- £1 250 High Stab 1%, 2%, 5% resistors.
- £1 1lb Assorted nuts, bolts, washers, spacers, etc.
- £1 25 Assorted Switches, rotary, lever, micro, toggle, etc.
- £1 50 Preset Potentiometers

★ any 5 packs £4 ★

P/P 10p for each Pack.

Transformers

Primary 200–220–240 volt.

				P/P
MT111	12 volt	·5 amps	£1·11	16p
MT111/B	24 volt	·25 amp	£1·35	20p
MT71	12 volt	2 amp	£1·76	22p
MT71/B	24 volt	1 amp	£1·76	22p
MT18	12 volt	4 amp	£2·47	36p
MT18/B	24 volt	2 amp	£2·47	36p

30 volt transformers

Prim 200–220–240v. Secondary voltage. 12 15, 20, 24, 30v or 12–0–12v or 15–0–15v.

MT112	·5 amps	£1·32	22p
MT79	1	£1·80	36p
MT 3	2	£2·96	36p
MT20	3	£3·30	42p
MT51	5	£4·84	49p

50 volt transformers

Prim 200–220–240v. Secondary volt. 19, 25,33, 40, 50v or 25–0–25 volt.

MT102	·5 amps	£1·76	30p
MT103	1	£2·58	38p
MT105	3	£4·84	52p
MT106	4	£6·02	52p

60 volt transformer

Prim 200–220–240 Secondary 24, 30, 40, 48, 60v or 24–0–24v or 30–0–30v

MT124AT	·5 amp	£1·76	38p
MT126AT	1	£2·47	34p
MT127	2	£3·90	44p

Miniature transformers

Prim 220 volt

BT606	100mA	6–0–6v	98p	15p
BT909	100mA	9–0–9v	98p	15p
BT12012	100mA	12–0–12v	£1·08	15p
BT24024	100mA	24–0–24v	£1·95	15p

Transistors/ Diodes

AC107	16p
AC126	14p
AC127	13p
AC128	13p
AC142K	22p
AC141K	20p
AC176	15p
AC187	18p
AC187K	20p
AC188	18p
AC188K	20p
ACY17	24p
ACY18	21p
ACY19	25p
ACY20	22p
ACY21	23p
ACY22	18p
ACY39	68p
AD140	40p
AD142	44p
AD143	39p
AD149	38p
AD150	60p
AD161	38p
AD162	38p
AF114	18p
AF115	18p
AF116	18p
AF117	18p
AF118	82p
AF124	27p
AF139	39p
AF239	41p
AL100	77p
AL102	66p
AL103	55p
BC107	11p
BC108	11p

BC109	11p
BC113	15½p
BC116	16p
BC125	16p
BC126	25p
BC132	16p
BC134	16p
BC135	16p
BC137	16p
BC138	36p
BC142	33p
BC143	33p
BC144	30p
BC145	26p
BC147	9p
BC148	9p
BC149	9p
BC153	16p
BC154	17p
BC157	13p
BC158	12p
BC159	14p
BC167	13p
BC168	11p
BC169	11p
BC177	15p
BC179	15p
BC182L	10p
BC183L	11p
BC184L	11p
BC186	33p
BC212L	11p
BC213L	11p
BC214L	11p
BC258	9p
BC259	9p
BC267	14p
BC268	15p
BC300	40p
BC301	32p
BC302	30p

BC303	50p
BC304	40p
BCY70	17p
BCY71	37p
BCY72	17p
BD131	68p
BD132	90p
BD135	42p
BD136	50p
BD141	£1·87
BD142	50p
BF159	33p
BF173	29p
BF177	28p
BF178	29p
BF179	35p
BF194	15p
BF195	17p
BF244	27p
BF260	29p
BF329	18p
BF330	18p
BF390	37p
BFX84	28p
BFX85	35p
BFX86	22p
BFX87	28p
BFX88	26p
BFY50	21p
BFY51	17p
BFY52	17p
BFY64	39p
BFY90	72p
BSX20	19p
C407	22p
C426	33p
C428	31p
C450	17p
MP8111	35p
MP8112	42p
MP8113	35p

MP8121	33p
MP8122	44p
MP8123	50p
NKT211	28p
NKT212	28p
NKT214	25p
NKT217	55p
NKT261	23p
NKT271	20p
NKT274	20p
NKT275	25p
NKT403	71p
NKT405	83p
NKY603F	66p
NKT613G	33p
NKT674	26p
NKT677G	24p
NKT713	32p
NKT773	27p
OC19	55p
OC20	55p
OC23	49p
OC25	45p
OC28	50p
OC29	50p
OC35	50p
OC36	50p
OC44	14p
OC45	14p
OC70	23p
OC71	14p
OC72	14p
OC81	14p
OC83	22p
OC84	28p
TIP29A	53p
TIP30A	64p
TIP31A	64p

TIP32A	73p
TIP33	£1·05
TIP34A	£1·54
TIP35A	£2·53
TIP36A	£3·19
TIP41A	79p
TIP42A	91p
2N706	13p
2N930	23p
2N1131	22p
2N1132	28p
2N1613	22p
2N1711	26p
2N2904	40p
2N2904A	44p
2N2905	46p
2N2924	18p
2N2926	10p
2N3053	26p
2N3054	55p
2N3055	52p
2N3702	11p
2N3703	11p
2N3704	11p
2N3705	11p
2N3706	11p
2N3707	11p
2N3708	11p
2N3709	11p
2N3710	11p
2N3711	9p
2N3794	17p
2N3819	28p
40361	50p
40362	50p
40636	50p

Diodes & Rectifiers

1N914	8p
1N916	8p
1N4148	8p
1844	10p
1N4007	22p
18113	17p
BA100	16p
BA102	25p
BA115	8p
BA144	14p
BA145	22p
BA154	14p
BAX13	14p
BAX16	14p
BAY18	19p
BAY31	9p
BY100	19p
BY126	16p
BY127	19p
BYX10	24p
OA5	19p
OA10	24p
OA47	9p
OA70	8p
OA73	11p
OA79	8p
OA81	9p
OA85	11p
OA90	8p
OA91	8p
OA95	8p
OA200	11p

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

½W Iskra high stability carbon film—very low noise—capless construction.
⅓W Mullard CR25 carbon film—very small body size 7·5 x 2·5 mm.
¼W 2% ELECTROSIL TR5.

Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
½	5%	4·7Ω–2·2MΩ	E24	1p	0·8p
⅓	10%	3·3MΩ–10MΩ	E12	1p	0·8p
¼	2%	10Ω–1MΩ	E24	3·5p	3p
1	10%	1Ω–3·9Ω	E12	1p	0·8p
½	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 ¼W, lin ½W).
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	AF126	20p	BF115	25p	OC42	12p	2N3707	12p
AC126	12p	AF139	32p	BF173	20p	OC44	12p	2N3708	10p
AC127	15p	AF178	32p	BF177	28p	OC45	12p	2N3709	11p
AC128	15p	AF180	40p	BF178	32p	OC70	12p	2N3710	11p
AC131	12p	AF181	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	40360	35p
AD149	45p	BC149	12p	BF200	32p	2N2926	10p	40361	35p
AD161	33p	BC157	14p	BFY50	20p	2N3054	58p	40362	40p
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	50p	2N3705	12p	ZTX500	15p
AF118	38p	BD133	75p	OC35	50p	2N3706	11p	ZXT503	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
1N4001	50V	1A	7p
1N4002	100V	1A	8p
1N4004	400V	1A	8p
1N4006	800V	1A	10p
1N4007	1000V	1A	10p

SIGNAL

OA85	7p
OA90	5p
OA91	5p
OA202	7p
1N4148	5p
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 complete with fixings for 4 pots.

BRUSHED ALUMINIUM PANELS

12in x 6in, 25p
12 in x 2½in, 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	2¾" x 5¼" x 1½"	50p	AB14	7" x 5" x 2½"	84p
AB8	4" x 4" x 1½"	50p	AB15	8" x 6" x 3"	108p
AB9	4" x 2¾" x 1½"	50p	AB16	10" x 7" x 3"	122p
AB10	4" x 5¼" x 1½"	50p	AB17	10" x 4½" x 3"	108p
AB11	4" x 2½" x 2"	60p	AB18	12" x 5" 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
MT50/½	0–19–25–33–40–50V	½A	£1·90
MT50/1	0–19–25–33–40–50V	1A	£2·55
MT50/2	0–19–25–33–40–50V	2A	£3·50
MT60/½	0–24–30–40–48–60V	½A	£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, 2½p. 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, 3p. 0·047μF, 0·068μF, 0·1μF, 4p. 0·15μF, 6p. 0·22μF, 7½p. 0·33μF, 11p. 0·47μF, 13p.
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, 3p. 0·1μF, 3½p. 0·15μF, 4½p. 0·22μF, 5p. 0·33μF, 6p. 0·47μF, 7½p. 0·68μF, 11p. 1·0μF, 13p.

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, 3p. 0·033μF, 0·047μF, 0·068μF, 3½p. 0·1μF, 4p. 0·15μF, 0·22μF, 5p. 0·33μF, 6½p. 0·47μF, 8½p. 0·68μF, 11p. 1·0μF, 13p. 1·5μF, 20p. 2·2μF, 24p.

MYLAR FILM CAPACITORS 100V

0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, 2½p. 0·04μF, 0·05μF, 0·068μF, 0·1μF, 3½p.

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, 33/6·3, 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 12p

0·1μF	35V	2·2μF	35V	22μF	16V
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
2½ x 3¾	22p	16p
2½ x 5	24p	24p
3¾ x 3¾	24p	24p
3¾ x 5	27p	27p
17 x 2½	75p	57½p
17 x 3¾	100p	78p
17 x 5 (plain)	—	82p
17 x 3¾ (plain)	—	60p
17 x 2½ (plain)	—	42p
2½ x 5 (plain)	—	12p
2½ x 3¾ (plain)	—	11p
Pin insertion tool	52p	52p
Spot face cutter	42p	42p
Pkt. 50 pins	20p	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, 15p/metre.
6 way screened cable, 22p/metre.

BATTERY ELIMINATOR £1.50

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

LARGE (CAN) ELECTROLYTICS

1600μF	64V	74p	2500μF	64V	80p	4500μF	16V	50p
2500μF	40V	74p	2800μF	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 2½%

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

1½" Scale-500uA, 1mA, 10mA, 100mA £1·90

BULGIN MAINS CONNECTORS

3 Pin	1½A	Chassis Plug	10p
		Line Socket	13p
3 Pin	3A	Chassis Plug	10p
		Line Socket	14p
3 Pin	5A	Chassis Plug	16p
		Line Socket	15p
3 Pin	1½A	Chassis Socket	18p
		Line Plug	13p
3 Pin	3A	Chassis Socket	21p
		Line Plug	23p
2 Pin	5A	Line Plug	20p

THERMISTORS

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

WAVECHANGE SWITCH 23p

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

ROTARY MAINS SWITCH

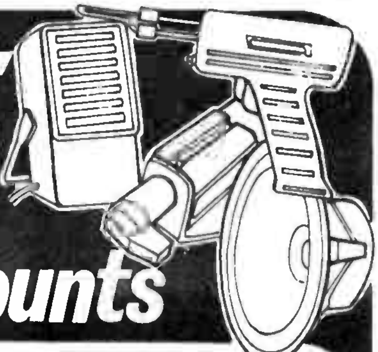
D.P. 2A 32p

LINEAR IC's

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

DIL Sockets 14 pin and 16 pin 16p

'BIG' Discounts



ALL PRICES INCLUDE V.A.T.

SPEAKER BARGAINS £

EMI 13" x 8" 3, 8 or 15 ohm
- Plain .. .. 2·05
- With Co-Axial Tweeter .. 2·20
- Twin Tweeter .. .. 3·55

Type 350 8 ohm, 20 watt 8·00
- 5½" 8 ohm, 10 watt 2·70
- 8" 8 ohm, 10 watt 3·75
- 12" 8 ohm, 20 watt 5·50
- 8" x 5" C/Mag. 5 watt 1·20
- 8" x 5" Dualcone 8 ohm, 10 watt 2·45

GOODMANS 5½" 8 ohm Dualcone .. .. .. 1·60

ELAC 8" 8ohm Dualcone .. 2·10
FANE 7" x 4" 3 or 8 ohm .. 1·00
- 8" Dualcone 8 ohm.. 2·40

CELESTION 8" 15 ohm .. 1·55
ADASTRA 10" 8 or 15 ohm, 10 watt .. .. .. 2·75
BAKER GROUP 25 12" 8 or 15 ohm, 25 watt .. .. 6·45
P. & P. .. ·25
5" 8 ohm, 5 watt C/Mag. .. ·85
2½" 8 ohm or 64 ohm .. ·50
P. & P. .. ·10

TWEETER & CROSSOVER

EMI 3½" 3 or 8 ohm C/Mag .. 1·00
Cone Tweeter 8 or 15 ohm, 10 watt .. .. .. 1·90
Cone Tweeter 8 ohm, 3 watt 1·00
Horn Tweeter 8 ohm, 20 watt 3·50
Dome Tweeter 8 ohm, 30 watt 4·00
Crossovers CN23 (3 ohm), CN28 (8 ohm), CN215 (15 ohm) .. .. 1·00
P. & P. .. ·10

KIT FORM CABINETS TEAK VENEER

12 x 12 x 5 with 8" 8" x 5" or 5½" and 3½" cut out.. .. 2·45
17 x 10 x 9 with 8" or 13" x 8" cutout .. .. .. 3·50
18 x 11 x 9 with 13" x 8" cutout for EMI 350 .. .. .. 4·25
P. & P. ea. ·35

MICROPHONES

CM20 Crystal Hand .. .. ·50
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DM160 Dynamic uni-dir, ball metal .. .. 3·95
UD130 50K/600 ohm, uni-dir ball metal .. .. .. 4·50
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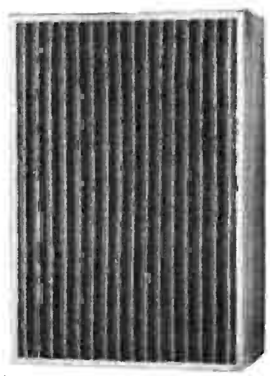

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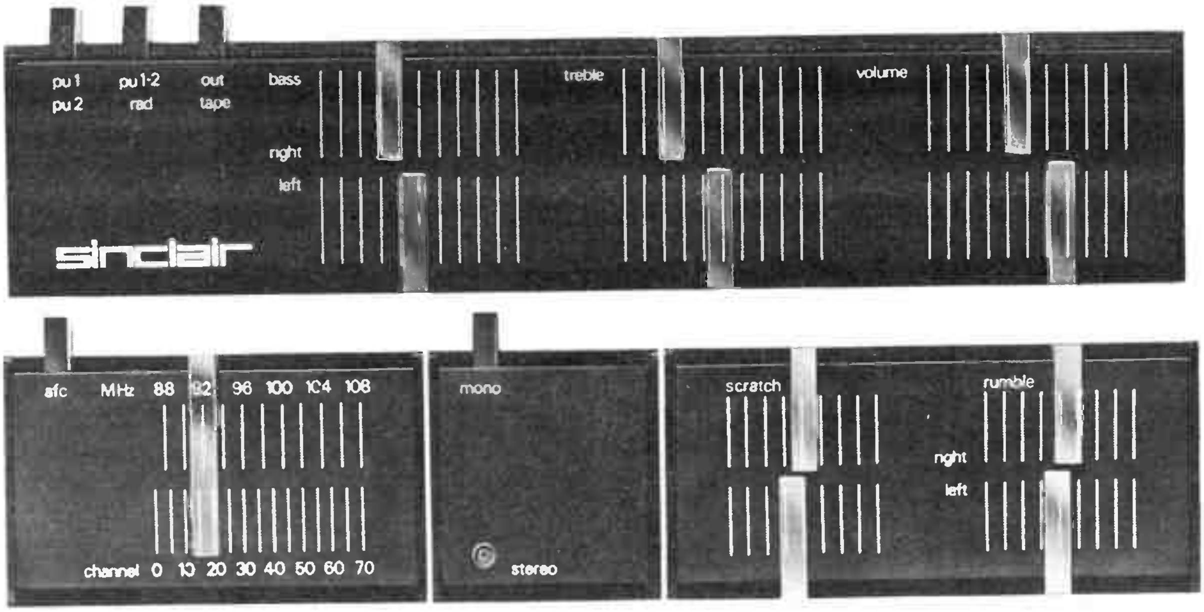
Sinclair Project 80

exciting



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

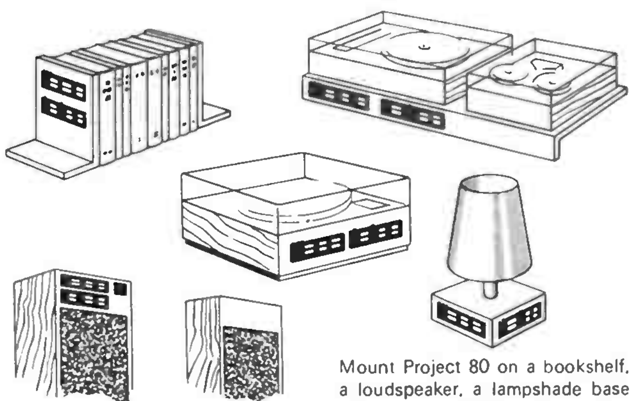
Living with hi-fi takes on new meaning with Sinclair Project 80. The electronics of these revolutionary new modules are all contained within elegantly designed matching cases no more than three-quarters of an inch deep. They are designed for mounting on any appropriate flat surface by means of 6BA bolts 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 × 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 × 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.

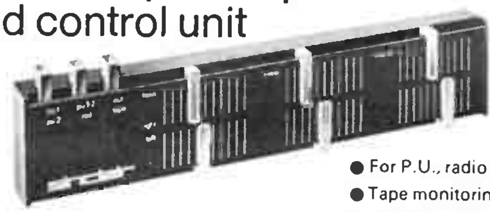
Project 80 FM tuner, decoder, and A.F.U. may be added as required



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

new thinking in modular hi·fi

Stereo 80 pre-amplifier and control unit



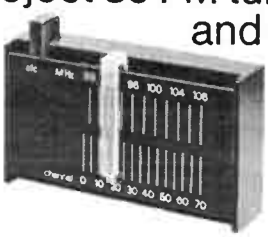
- For P.U., radio and tape
- Tape monitoring switch
- Simplest ever fixing

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 × 50 × 20mm (10¼ × 2 × ¾ins)
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 × 50 × 20mm (3½ × 2 × ¾ins)
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

R.R.P. £11.95 +£1·19 V.A.T.

DECODER
Size – 47 × 50 × 20mm (1⅞ × 2 × ¾ins)
One 19 transistor I.C.

R.R.P. £7.45 +0·74 V.A.T.

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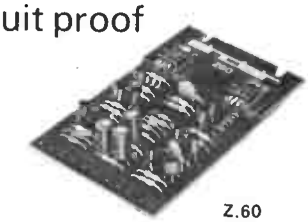
Z.40



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 × 80 × 20mm (2¼ × 3¼ × ¾ins) 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 × 98 × 15mm (2¼ × 3⅞ × ¾ins) 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 × 50 × 20mm (4¼ × 2 × ¾ins)
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

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Power supply units

PZ.8

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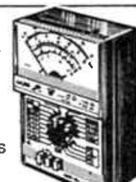

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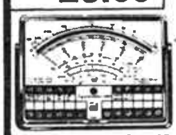

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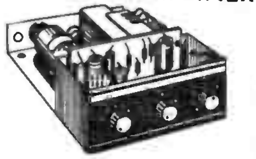

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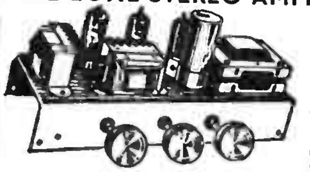

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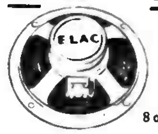

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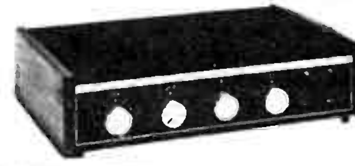

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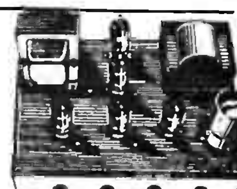

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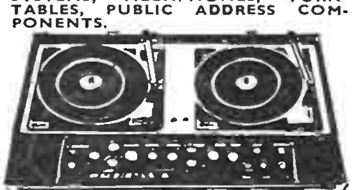

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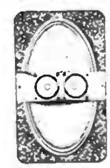

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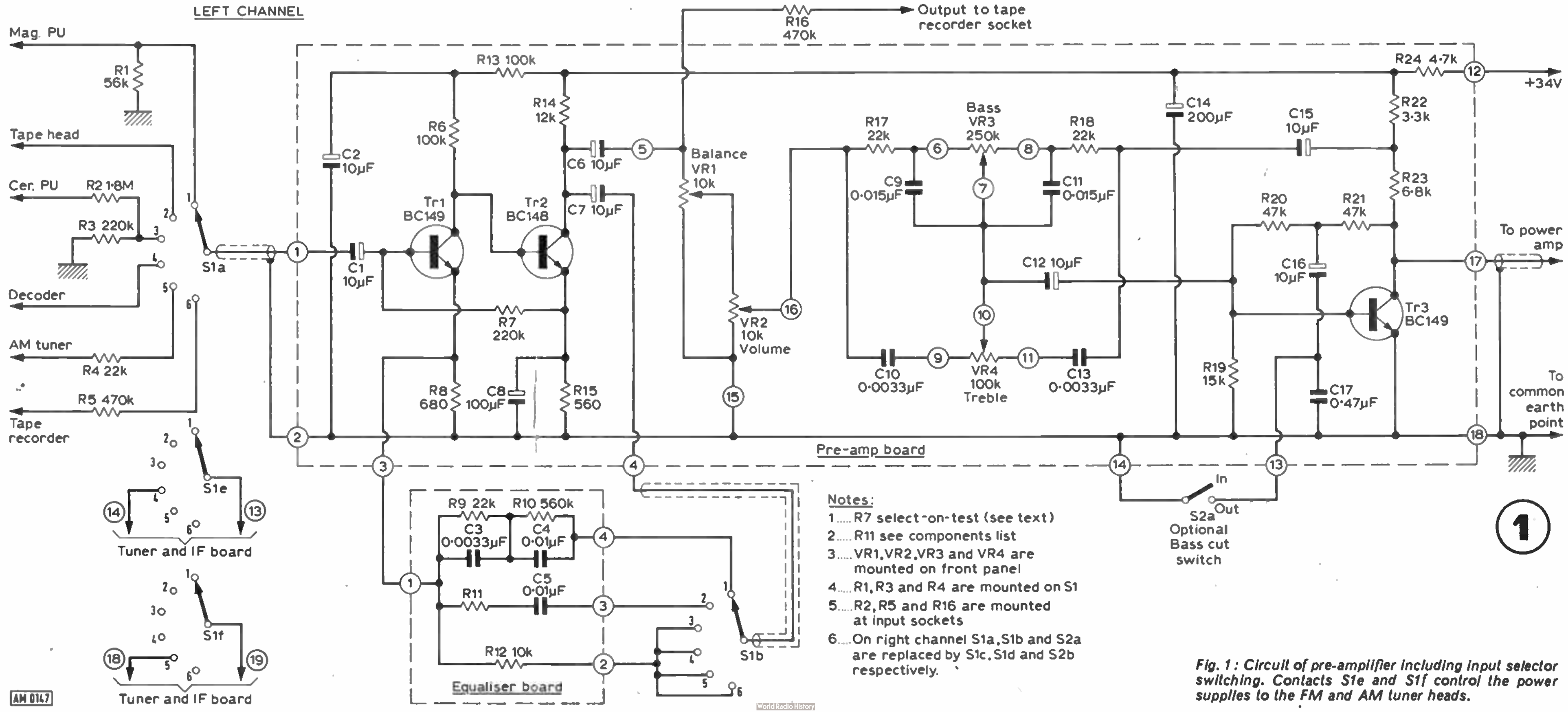

Fig. 1: Circuit of pre-amplifier including input selector switching. Contacts S1e and S1f control the power supplies to the FM and AM tuner heads.