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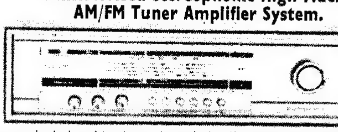

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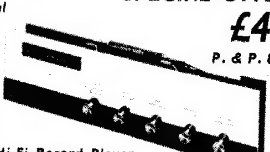

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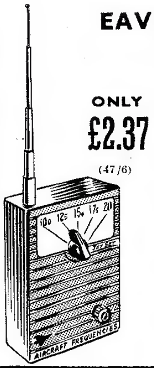

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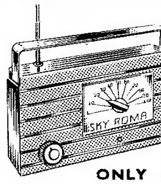

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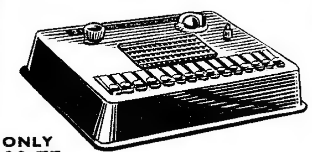

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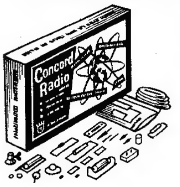

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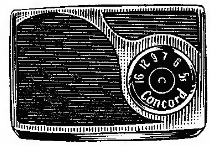

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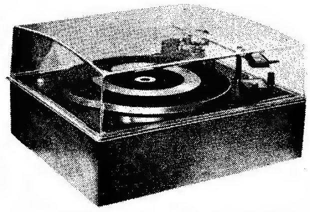

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SCOOP BUY
SMC-101 MOVING MAGNET STEREO CARTRIDGE.
PRICE: £3·25.

MCI-3 HIGH FIDELITY STEREO MOVING MAGNET CARTRIDGE.
PRICE: £6·00.

For complete specification on the above see our March issue, Page 889.

SPECIAL OFFERS SPEAKERS

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WHY PAY MORE—APOLLO 3-WAY SPEAKER SYSTEMS

The Systems are housed in handsome Slim-Line Cabinets of Modern Design, finished in Polished Teak with Padded Front Panel covered in I.C.I. Vynair Grille.

The **APOLLO 3-WAY SPEAKER SYSTEMS** are designed and built on the Infinite Baffle Principle and are completely Airtight and fully padded to damp out any Panel Resonance. Polished on all sides they can be used either vertically or horizontally and are ideal for Shelf or Wall Mounting.
Below are just a few from the **APOLLO** comprehensive range starting with:

APOLLO-15 3-WAY SPEAKER SYSTEM
Impedance 8 ohms. Power Handling 15 watts. RMS (30 watts peak). Frequency Range: 35 to 18,000Hz. Colour: Teak. Size 21 x 15 x 7½in.
PRICE £18·50 each (p. & p. £1·00).

THE APOLLO-10 3-WAY SPEAKER SYSTEM employs a specially designed 10in. Bass Unit which has a high efficiency Anisotropic Ferrite Magnet and two 4in. Treble Units and LC Crossover Network. Specification: Impedance 4-8 ohms (15-16 ohms to order). Power Handling 10 watts RMS (20 watts peak). Frequency Range 50 Hz to 18,000 Hz. Size 21 x 11½ x 9¾. Finish Polished Teak.
OUR PRICE £13.47 each (65p. p. & p.).

APOLLO-8 3-WAY SPEAKER SYSTEM
As above but 7 watts RMS (14 watts peak). F.R. 55 to 18,000 Hz. Size 20 x 12 x 8in.
£10·12 each (50p p. & p.).

APOLLO-66 3-WAY SPEAKER SYSTEM
As above but 5 watts RMS (10 watts peak). F.R. 75 to 18,000 Hz. Size 14½ x 8 x 6in.
PRICE £6.97 each (37½p p. & p.).

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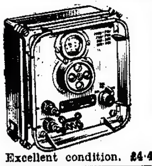
6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6×4×2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9 V battery. Coverage 88–108Mc/s. Ready built ready for use. Fantastic value for money. £6·37½. P. & P. 12½p. Stereo multiplex adaptors £4·97½.

AVO CT471A MULTIMETER

Battery operated, fully transistorised. Sensitivity 100mΩ/v.
Measures AC/DC Voltages 12mV to 1,200v.
AC/DC Current 12uA to 1.2 Amp.
Resistance 12 ohm to 120 mΩ
HF, VHF, UHF Voltage with multiplier 4v to 400v up to 50 Mc/s, 40mV to 4v up to 1,000 Mc/s.
Offered in perfect condition.
£55 each. Carr. 50p.

CRYSTAL CALIBRATORS NO. 10



Small portable crystal controlled wavemeter. Size 7 × 7½ × 4in. Frequency range 500 Kc/s–10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300V. D.C. 15mA and 12V D.C. 0.3A. Excellent condition. £4·47½. Carr. 37½p.

B.C. 221 FREQUENCY METERS

latest release 125 KHz—20 MHz. Excellent condition. Fully tested and checked and complete with calibrator charts. £27·50 each. Carr. 50p.

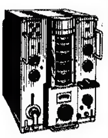
AM/FM SIGNAL GENERATORS

Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80 Mc/s. AM CW/FM. Incorporates precision dial, level meter, precision attenuator 1µV–100mV. Operation from 12 volt D.C. or 0/110/200/250 volt A.C. Size 12 × 8½ × 9in. Supplied in brand new condition complete with all connectors fully tested. £45. Carr. £1.

AVO CT.38 ELECTRONIC MULTIMETERS

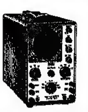
High quality 97 range instrument which measures A.C. and D.C. Voltage. Current, Resistance and Power Output Ranges D.C. volts 250mV–10,000v. (10 meg Ω –11 0meg Ω input). D.C. current 10µA–25 amps. Ohms, 0–1,000 meg Ω A.C. volt 100mV.–250V (with R.F. measuring head up to 250 Mc/s) A.C. current 10µA–25 amps. Power output 50 micro-watts–5 watts. Operation 0/110/200/250V. A.C. Supplied in perfect condition complete with circuit lead and R.F. probe. £25. Carr. 75p.

ADMIRALTY 62B RECEIVERS



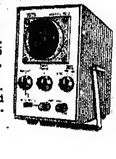
High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 150-300 Kc/s, 560 Kc's–1.5Mc/s; 3.9–30.5 Mc/s I.F. 500/Kc/s. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O. calibrator I.F. output, etc. Built-in speaker, output for phones. Operation 150/230 vol A.C. Size 19½ × 13½ × 16in. Weight 114lb. Offered in good working condition. £22·50. Carr. £1.50. With circuit diagrams. Also available B41 L.F. version of above, 15 Kc/s–700 Kc/s. £17·50. Carr. £1.50.

TO-3 PORTABLE OSCILLOSCOPE



3in. tube. Y amp. Sensitivity 0·1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps –800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300 KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £37·50. Carr. 50p.

TO-2 PORTABLE OSCILLOSCOPE



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

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

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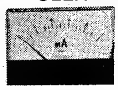


TYPE SW.100
100 x 80 mm.

50µA	£3·47½	20V. D.C. ..	£2·97½
50-0-50µA	£3·37½	50V. D.C. ..	£2·97½
100µA	£3·37½	300V. D.C.	£2·97½
100-0-100µA	£3·25	1 amp. D.C.	£2·97½
500µA	£3·12½	5 amp. D.C.	£2·97½
1mA	£2·97½	300V. A.C.	£2·97½
		VU Meter..	£3·75

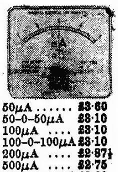
BAKELITE PANEL METERS

TYPE S-80
80 mm.
square fronts

50µA	£3·12½	50V. D.C...	£2·47½
50-0-50µA	£2·97½	300V. D.C.	£2·47½
100µA	£2·97½	1 amp. D.C.	£2·47½
100-0-100µA	£2·87½	5 amp. D.C.	£2·47½
500µA	£2·62½	300V. A.C.	£2·62½
1mA	£2·47½	VU Meter..	£3·37½
20V. D.C...	£2·47½		

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4½in. × 4½in. fronts.



		50mA	£2·60
		100mA	£2·60
		500mA	£2·60
		1 amp.	£2·60
		5 amp.	£2·60
		15 amp.....	£2·60
		30 amp.....	£2·60
		20V. D.C...	£2·60
		50V. D.C...	£2·60
50µA	£3·60	150V. D.C.	£2·60
50-0-50µA	£3·10	300V. D.C.	£2·60
100µA	£3·10	15V. A.C...	£2·60
100-0-100µA	£3·10	300V. A.C.	£2·60
200µA	£2·87½	S Meter 1mA	£2·87½
500µA	£2·75	VU Meter..	£3·60
500-0-500µA	£2·60	1 amp. A.C.*	£2·60
1mA	£2·60	5 amp. A.C.*	£2·60
1-0-1mA ..	£2·60	10 amp. A.C.*	£2·60
5mA	£2·60	20 amp. A.C.*	£2·60
10mA	£2·60	30 amp. A.C.*	£2·60

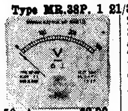
Type MR.52P. 2½in. square fronts.

50µA	£3·10	10V. D.C. ..	£2·00
50-0-50µA	£2·60	20V. D.C. ..	£2·00
100µA	£2·60	50V. D.C. ..	£2·00
100-0-100µA	£2·37½	300V. D.C.	£2·00
500µA	£2·25	15V. A.C. ..	£2·00
1mA	£2·00	300V. A.C.	£2·00
5mA	£2·00	S Meter 1mA	£2·10
10mA	£2·00	VU Meter ..	£3·10
50mA	£2·00	1 amp. A.C.*	£2·00
100mA	£2·00	5 amp. A.C.*	£2·00
500mA	£2·00	10 amp. A.C.*	£2·00
1 amp.	£2·00	20 amp. A.C.*	£2·00
5 amp.	£2·00	30 amp. A.C.*	£2·00

Type MR.65P. 3¼in. × 3¼in. fronts.

50µA	3·37½	10V. D.C. ..	£2·10
50-0-50µA	£2·75	20V. D.C. ..	£2·10
100µA	£2·75	50V. D.C. ..	£2·10
100-0-100µA	£2·60	150V.D.C...	£2·10
200µA	£2·60	300V. D.C.	£2·10
500µA	£2·37½	15V. A.C...	£2·10
500-0-500µA	£2·10	50V. A.C...	£2·10
1mA	£2·10	150V. A.C.	£2·10
5mA	£2·10	300V. A.C.	£2·10
10mA	£2·10	500V. A.C.	£2·10
50mA	£2·10	S Meter 1mA	£2·37½
100mA	£2·10	VU Meter..	£3·37½
500mA	£2·10	50mA A.C.	*£2·10
1 amp.	£2·10	100mA A.C.*	£2·10
5 amp.	£2·10	200mA A.C.*	£2·10
10 amp.....	£2·10	500mA A.C.*	£2·10
15 amp. ..	£2·10	1 amp. A.C.*	£2·10
20 amp. ..	£2·10	5 amp. A.C.*	£2·10
30 amp. ..	£2·10	10 amp. A.C.*	£2·10
50 amp. ..	£2·37½	20 amp. A.C.*	£2·10
5V. D.C. ..	£2·10	30 amp. A.C.*	£2·10

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



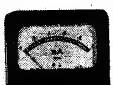
		200mA	£1·37½
		300mA	£1·37½
		500mA	£1·37½
		750mA	£1·37½
		1 amp.	£1·37½
		2 amp.	£1·37½
		5 amp.	£1·37½
		10 amp. ..	£1·37½
50µA	£2·00	3V. D.C. ..	£1·37½
50-0-50µA	£1·87½	10V. D.C...	£1·37½
100µA	£1·87½	15V. D.C...	£1·37½
100-0-100µA	£1·75	20V. D.C...	£1·37½
200µA	£1·75	100V. D.C.	£1·37½
500µA	£1·50	150V. D.C.	£1·37½
500-0-500µA	£1·37½	300V. D.C.	£1·37½
1mA	£1·37½	500V. D.C.	£1·37½
1-0-1mA ..	£1·37½	750V. D.C.	£1·37½
2mA	£1·37½	15V. A.C...	£1·37½
5mA	£1·37½	50V. A.C...	£1·37½
10mA	£1·37½	150V. A.C.	£1·37½
20mA	£1·37½	300V. A.C.	£1·37½
50mA	£1·37½	500V. A.C.	£1·37½
100mA	£1·37½	S Meter 1mA	£1·60
150mA	£1·37½	VU Meter..	£2.10

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

50µA	£2·25	5 amp.	£1·50
50-0-50µA	£2·10	10V. D.C. ..	£1·50
100µA	£2·10	20V. D.C. ..	£1·50
100-0-100µA	£1.87½	50V. D.C. ..	£1·50
200µA	£1·87½	300V. D.C.	£1·50
500µA	£1·60	15V. A.C. ..	£1·50
500-0-500µA	£1·50	300V. A.C.	£1·50
1mA	£1·50	S Meter 1mA	£1·87½
5mA	£1·50	VU Meter..	£2·25
10mA	£1·50	1 amp. A.C.*	£1·50
50mA	£1·50	5 amp. A.C.*	£1·50
100mA	£1·50	10 amp. A.C.*	£1·50
500mA	£1·50	20 amp. A.C.*	£1·50
1 amp	£1·50	30 amp. A.C.*	£1·50

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts.



		500ma	£1·75
		1 amp.	£1·75
		5 amp.	£1·75
		15 amp.....	£1·75
		30 amp.....	£1·75
		50 amp.....	£1·75
		5V. D.C. ..	£1·75
		10V. D.C. ..	£1·75
		20V. D.C. ..	£1·75
		50V. D.C. ..	£1·75
		150V. D.C.	£1·75
		300V. D.C.	£1·75
25µA	£3·50	30V. A.C.*	£1·75
50µA	£2·37½	50V. A.C.*	£1·75
50-0-50µA	£2·25	150V. A.C.*	£1·75
100µA	£2·25	300V. A.C.*	£1·75
100-0-100µA	£2·25	500mA A.C.*	£1·75
500µA	£2·10	1 amp. A.C.*	£1·75
1mA	£1·75	5 amp. A.C.*	£1·75
1-0-1mA ..	£1·75	10 amp. A.C.*	£1·75
5mA	£1·75	20 amp. A.C.*	£1·75
10mA	£1·75	30 amp. A.C.*	£1·75
50mA	£1·75	50 amp. A.C.*	£1·75
100mA	£1·75	VU Meter ..	£3·10

*MOVING IRON—ALL OTHERS MOVING COIL

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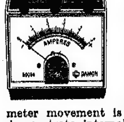
SEW EDUCATIONAL METERS



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

50µA	£4·50	50V d.c.	£3·97
100µA	£4·25	300V d.c. ...	£3·97
1mA	£3·97	Dual range	
50-0-50µA ...	£4·25	500mA/5A d.c.	£4·25
1-0-1mA.....	£3·97	5V/50V d.c...	£4·25
1A d.c.	£3·97	Triple range	
5A d.c.	£3·97	1mA/10mA/	
10V d.c.	£3·97		
20V d.c.	£3·97	100mA ...	£4·62

EDGWISE METERS

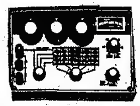
Type PE.70. 3 17/32in. × 1 15/32in. × 2½ in. deep.

50µA	£3·00	500µA	£2·60
50-0-50µA	£2·87½	1mA	£2·87½
100µA	£2·87½	300V. A.C.	£2·87½
100-0-100µA	£2·75	VU Meter..	£3·25
200µA	£2·75		

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

MARCONI TF142E DISTORTION FACTOR METERS. Excellent condition. Fully tested. £20. Carr. 75p.

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

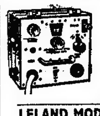


A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 meg Ω 6 Ranges ±1% L.1 µ H - 111 HENRYS 6 Ranges – 2% C. 10pF ±1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive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

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES

D.C. coupled. Band width 1Kc/s. Perfe order. £25. Carr. £1·50.

CLASS D WAVEMETERS



A crystal controlled heterodyne frequency meter covering 1·7–8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5·97½. Carr. 37½p. Or brand new £7·97½. Carr. 37½p.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0–20 Kc/s. on 2 ranges. Output 500 Ω or 5k Ω. Operation 200/250V. A.C. Supplied in perfect order. £12·50. Carr. 50p.

MARCONI TF885 VIDEO OSCILLATORS

0–5 mc/s Sine SquareWave £45. Carr. £1.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 pF-2000 mFd -2 ohms 200 meg-ohms. Also checks impedance, turns ratio, insulation, 200/250V. A.C. Brand New £17·50. Carr. 37½p.

MARCONI TF195M BEAT FREQUENCY OSCILLATORS

0–40 kc/s. £20. Carr. £1·50

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

Operative over amazingly long distances. Separate call and press to talk buttons, 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. £6·97½. P. & P. 17½p.

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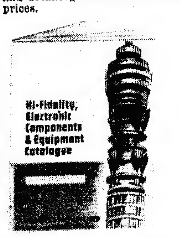

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IN4005	12p	ACY20	22p	BYZ12	30p
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IN5054	22p	ACY40	15p	MPF102	42p
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2G303	25p	AD161	37p	MPF105	40p
2G306	30p	AD162	37p	NKT213	25p
2G308	30p	AF114	25p	NKT214	15p
2G309	30p	AF115	25p	NKT216	37p
2G371	22p	AF116	25p	NKT217	40p
2G374	27p	AF117	25p	NKT224	22p
2G381	25p	AF118	62p	NKT241	27p
2N696	17p	AF119	20p	NKT261	20p
2N697	17p	AF124	25p	NKT271	25p
2N698	42p	AF126	17p	NKT272	25p
2N706	10p	AF127	17p	NKT274	20p
2N706A	12p	AF139	30p	NKT275	25p
2N708	15p	AF178	47p	NKT278	25p
2N914	22p	AF180	52p	NKT281	27p
2N916	22p	AF181	42p	NKT403	75p
2N918	37p	AF186	40p	NKT404	62p
2N929	22p	AF239	42p	NKT405	75p
2N930	25p	ASY26	25p	NKT773	25p
2N1131	30p	ASY27	32p	NKT10439	
2N1132	30p	ASY28	25p		37p
2N1302	20p	ASZ17	42p	OA5	20p
2N1303	22p	AUY10	97p	OA10	25p
2N1304	25p	BAY31	7p	OA47	10p
2N1305	25p	BC107	12p	OA70	10p
2N1306	25p	BC108	12p	OA79	10p
2N1307	25p	BC109	12p	OA81	10p
2N1308	30p	BC113	25p	OA85	12p
2N1309	25p	BC116	40p	OA90	10p
2N1613	22p	BC125	55p	OA91	7p
2N1711	25p	BC126	55p	OA95	7p
2N1889	32p	BC147	17p	OA200	7p
2N1893	50p	BC148	12p	OA202	10p
2N2147	75p	BC149	20p	OA210	17p
2N2160	65p	BC167	15p	OC19	37p
2N2193	47p	BC172	17p	OC20	97p
2N2217	40p	BC177	25p	OC22	50p
2N2218	30p	BC186	25p	OC23	60p
2N2219	32p	BC182L	10p	OC24	60p
2N2368	17p	BC184L	12p	OC25	37p
2N2369	20p	BC212L	12p	OC26	25p
2N2369A	20p	BCY30	25p	OC28	62p
2N2484	35p	BCY31	30p	OC29	62p
2N2613	35p	BCY32	50p	OC35	50p
2N2646	50p	BCY33	25p	OC36	62p
2N2904	30p	BCY34	30p	OC41	25p
2N2923	17p	BCY38	40p	OC42	30p
2N2924	17p	BCY42	15p	OC44	17p
2N2925	17p	BCY43	20p	OC45	15p
2N2926G	12p	BCY71	30p	OC46	27p
2N2926Y	12p	BCY72	15p	OC70	12p
2N29260	12p	BCZ11	40p	OC71	15p
2N3053	25p	BD121	65p	OC72	25p
2N3054	50p	BD123	80p	OC73	30p
2N3055	75p	BD124	80p	OC74	30p
2N3391A	30p	BF115	25p	OC75	25p
2N3416	37p	BF117	47p	OC76	25p
2N3570	£1·25	BF167	25p	OC77	40p
2N3702	12p	BF173	30p	OC78	20p
2N3703	12p	BF180	37p	OC81	25p
2N3704	17p	BF181	37p	OC81D	20p
2N3705	15p	BF182	32p	OC83	25p
2N3706	22p	BF184	25p	OC84	25p
2N3707	15p	BF185	25p	OC139	25p
2N3708	12p	BF194	17p	OC140	37p
2N3709	12p	BF195	15p	OC169	20p
2N3710	12p	BF200	37p	OC170	25p
2N3711	12p	BF224	30p	OC171	30p
2N3819	35p	BF225	30p	OC200	40p
2N3903	25p	BF244	47p	OC201	60p
2N3904	25p	BFX12	22p	OC202	75p
2N3905	30p	BFX13	25p	OC203	40p
2N3906	30p	BFX29	30p	OC204	40p
2N4058	17p	BFX30	32p	OC205	60p
2N4059	25p	BFX44	37p	OC207	75p
2N4061	15p	BFX85	40p	OCP71	97p
2N4062	22p	BFX86	32p	ORP12	50p
2N4286	15p	BFX87	32p	ORP60	40p
2N4287	17p	BFX88	25p	P346A	25p
2N4288	15p	BFY18	25p	PL4001	14p
2N4289	17p	BFY20	62p	PL4002	15p
2N4290	15p	BFY50	22p	PL4003	16p
2N4291	15p	BFY51	20p	PL4004	17p
2N4292	15p	BFY52	22p	PL4005	19p
2N5354	27p	BFY90	67p	PL4006	20p
2N5355	27p	BSX19	17p	PL4007	24p
2S102	25p	BSX20	17p	TI843	40p
2S103	37p	BSX21	37p	TI844	12p
2S104	37p	BSX76	15p	TI845	17p
40250	50p	BSY26	17p	TI846	17p
40361	55p	BSY27	20p	BC107/8/9	
40362	60p	BSY28	17p	25+	10p
AC107	37p	BSY38	20p	100+	9p
AC126	25p	BSY39	22p	500+	7p
AC127	25p	BSY51	32p	2N3055	
AC128	25p	BSY56	90p	25+	62p
AC154	15p	BSY95A	15p	100+	50p
AC176	25p	BY100	15p		

THYRISTORS

PIV	50	100	200	300	350	400
1A	25p	27p	37p	40p	—	47p
3A	30p	37p	40p	45p	—	50p
5A	—	55p	65p	—	—	75p
7A	—	55p	65p	70p	—	97p

VALVES

OA2	38p	25Z4	30p	EL95	35p
OB2	45p	25Z5	42p	EM80	40p
OZ4	30p	25Z6	65p	EM81	50p
IL4	20p	30C15	80p	EM84	35p
IR5	35p	30C17	85p	EM85	£1·00
IS5	25p	30C18	75p	EM87	43p
IT4	25p	30F5	85p	EY51	40p
IU4	27p	30FL1	70p	EY86	40p
IU5	50p	30FL12	92p	EY87	42p
2D21	35p	30FL14	75p	EZ40	45p
3Q4	40p	30L15	85p	EZ41	45p
3S4	35p	30L17	80p	EZ80	25p
3V4	45p	30P12	80p	EZ81	28p
5R4	60p	30P19	80p	GZ32	48p
5U4	33p	30PL1	70p	GZ34	60p
5V4	42p	30PL13	93p	KT66	£1·70
5Y3	32p	30PL14	90p	KT88	£1·75
5Z4G	40p	35L6	50p	MU14	60p
6/30L2	75p	35W4	30p	PABC80	40p
6AC7	25p	35Z4	30p	PC86	60p
6AG7	40p	35Z5	40p	PC88	60p
6AK5	30p	50B5	45p	PC97	45p
6AK6	57p	50C5	40p	PC900	48p
6AL5	20p	80	50p	PCC84	40p
6AM6	33p	85A2	45p	PCC85	40p
6AQ5	35p	807	50p	PCC88	55p
6AS6	37p	1625	50p	PCC89	50p
6AT6	30p	5763	70p	PCC189	55p
6AU6	25p	6146	£1·50	PCF80	30p
6AV6	30p	AZ31	50p	PCF82	34p
6BA6	25p	CY31	35p	PCF84	50p
6BE6	30p	DAF91	25p	PCF86	60p
6BH6	45p	DAF96	42p	PCF800	80p
6BJ6	45p	DF91	25p	PCF801	50p
6BQ7A	40p	DF96	42p	PCF802	50p
6BR7	85p	DK91	35p	PCF805	75p
6BR8	65p	DK92	50p	PCF806	70p
6BW6	85p	DK96	42p	PCF808	75p
6BW7	70p	DL92	35p	PCL82	35p
6BZ6	35p	DL94	45p	PCL83	65p
6C4	33p	DL96	42p	PCL84	45p
6CD6	£1·15	DM70	32p	PCL85	40p
6CL6	50p	DY86	33p	PCL86	45p
6CW4	63p	DY87	35p	PFL200	70p
6F1	62p	E88CC	65p	PL36	55p
6F6G	30p	E180F	95p	PL81	50p
6F13	38p	EABC80	35p	PL82	45p
6F14	65p	EAF42	35p	PL83	45p
6F15	65p	EB91	20p	PL84	40p
6F18	45p	EBC41	55p	PL500	75p
6F23	80p	EBC81	30p	PL504	80p
6H6	20p	EBF80	40p	PY32	55p
6J4	50p	EBF83	40p	PY33	63p
6J5	20p	EBF89	32p	PY80	35p
6J5GT	30p	EBL21	60p	PY81	30p
6J6	20p	EC86	60p	PY82	30p
6J7	45p	EC88	60p	PY83	38p
6K8G	35p	ECC40	60p	PY88	40p
6L6GT	45p	ECC84	30p	PY800	50p
6LD20	40p	ECC85	60p	PY801	50p
6Q7	40p	ECC88	40p	U25	75p
6SA7	40p	ECF80	35p	U26	75p
6SG7	35p	ECF82	35p	U50	32p
6SJ7	40p	ECF86	65p	U52	33p
6SK7	35p	ECH21	57p	U191	75p
6SL7	35p	ECH35	60p	U281	40p
6SN7	35p	ECH42	70p	U282	40p
6SQ7	40p	ECH81	30p	U301	40p
6U4	60p	ECH83	40p	U801	£1·00
6V6G	25p	ECL80	40p	UABC80	35p
6V6GT	32p	ECL82	35p	UAF42	55p
6X4	30p	ECL83	65p	UBC41	50p
6X5G	30p	ECL86	40p	UBC81	40p
6X5GT	27p	EF37A	60p	UBF80	40p
10C2	50p	EF39	40p	UBF89	35p
10F1	90p	EF40	50p	UCC84	49p
10P13	55p	EF41	65p	UCC85	40p
10P14	£1·10	EF42	70p	UCF80	55p
12AT6	30p	EF80	25p	UCH21	60p
12AT7	30p	EF85	35p	UCH42	70p
12AU7	30p	EF86	30p	UCH81	35p
12AX7	30p	EF89	28p	UCL82	35p
12AV6	33p	EF91	33p	UCL83	60p
12BA6	35p	EF92	40p	UF41	60p
12BE6	35p	EF183	30p	UF80	35p
12BH7	40p	EF184	35p	UF85	40p
19AQ5	35p	EH90	40p	UF89	35p
20D1	45p	EL34	50p	UL41	65p
20F2	75p	EL33	£1·25	UL84	30p
20L1	£1·10	EL41	55p	UY41	45p
20P1	50p	EL42	58p	UY85	30p
20P3	60p	EL81	55p	VR105/30	38p
20P4	£1·10	EL84	25p	VR150/30	35p
20P5	£1·20	EL85	43p		
25L6	45p	EL91	32p		

SEND SAE FOR FULL LISTS!
DISCOUNTS 10% on 12+ any one type. 15% on 25+ any one type.
Large quantity discounts on application.
Postage: Semi-Conductors 8p; Valves 15p.

ZENER DIODES

200mw. (3.3 to 33v) **15p**; 1.5watt (2.4 to 400v) **20p**; 40 watt (3.9 to 100v) **25p.**

INTEGRATED CIRCUITS

L900 **40p**; L914 **40p**; L923 **60p**; IC-10 **£2·50**; SL403 **£2·25**; MC1303 **£2·62**; MC1304 **£2·75**; PA246 **£2·45**; CA3005 **£1·17**; CA3011 **74p**; CA3052 **£1·65**; FCH131 **50p**; FCH161 **50p**; FJH141 **25p**; FJH171 **25p**; FJH181 **25p**; FJH221 **25p**; FJH231 **25p**; FJH241 **25p**; FJH251 **25p**; FJJ121 **60p**; FJJ131 **60p**; FJJ211 **£1·25**; FJY101 **25p**

HI-FI EQUIPMENT

SAVE UP TO 33⅓% OR MORE

SEND S.A.E. FOR DISCOUNT PRICE LISTS AND PACKAGE OFFERS!

GARRARD

FULL CURRENT RANGE OFFERED BRAND NEW AT FANTASTIC SAVINGS

40 Mk II stereo	£8·40	SL72B	£26·97
2025T/C stereo	£9·87	AP76	£20·97
3000 stereo	£10·50	SL75B	£30·75
SP25 Mk III	£11·75	SL95B	£40·97
		401	£29·97
SL65B	£14·97		

Carriage 37½p extra each item.

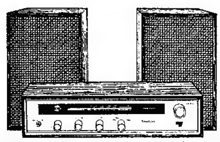
TEAK PLINTHS & PERSPEX COVERS
1. For SP25, SL65, SL55, 3000, 2025 T/C 2025, 1000. **£3·97½.**
2. For AP75, SL75, SL95. **£5·97½.**
3. For SP25 etc. to operate with lid in place **£5·97½.** Carriage 37½p extra each type. Full range of Garrard accessories available.

SPECIAL OFFERS!

Garrard SP25 MK III fitted Goldring G800 cartridge and wooden plinth and plastic cover. Ready wired. Total list price £35.
OUR PRICE **£22.50** Carr. 50p

GOLDRING GL69/2 fitted Goldring G800 cartridge complete with deluxe base and cover. Total list price £50.80.
OUR PRICE **£39** Carr. 50p

TELETON SPECIAL OFFER !



CR10T AM/FM STEREO TUNER AMPLIFIER WITH MATCHING PAIR SA1003 SPEAKER SYSTEMS. Output 4 watts per channel. Excellent reception, AFC, built-in MPX. Cer/XTAL Input. Total List **£50·25.** OUR PRICE **£29·95.** Carr. 62½p.

Also available with Garrard 2025T/C Record Changer, Plinth, cover and stereo cartridge. Ready wired **£45.** Carr. £1·00.

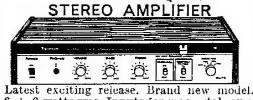
TAPE CASSETTES

Top quality in plastic library boxes.
C90 60 min **42½p**, 3 for **£1·22½.**
C60 90 min **62½p**, 3 for **£1·80.**
C120 120 min **75p**, 3 for **£2·17½.**
Cassette Head Cleaner **56p.** *Post Extra.*

HOSIDEN DH-02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable headband. 8 ohm impedance. 20-12,000 cps. Complete with lead and stereo jack plug. ONLY **£2·37½.** P. & P. 12½p.

TELETON SAQ-206 STEREO AMPLIFIER



Latest exciting release. Brand new model. 6 + 6 watts rms. Inputs for mag, xtal, aux tape. Volume, bass, treble, sliding balance, scratch filter and loudness controls. Rec. List £29. OUR PRICE **£19·97** Carr. 37p.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discount on quantities.

3in. 225ft. L.P. acetate **17½p**
3¼in. 600ft. T.P. mylar **50p**
5in. 600ft. std. plastic **42½p**
5in. 900ft. L.P. acetate **50p**
5in. 1,200ft. D.P. mylar **75p**
5¾in. 1,200ft. L.P. acetate **62½p**
5¾in. 1,200ft. L.P. mylar **80p**
5¾in. 1,800ft. D.P. mylar .... **£1·12½**
5¾in. 2,400ft. T.P. mylar .... **£1·97½**
7in. 1,200ft. std. acetate **62½p**
7in. 1,800ft. L.P. acetate **75p**
7in. 1,800ft. L.P. mylar .... **£1·00**
7in. 2,400ft. D.P. mylar .... **£1·25**
7in. 3,600ft. T.P. mylar .... **£2·25**

Postage 10p. Over £3 post paid.

B.S.R. McDONALD

MP60 **£11·95** 610 **£15·95**
510 **£12·95** 310 **£10·95**
Carriage 37½p extra each item

TEAK BASE AND PERSPEX COVER for above BSR range **£3·97½.** Carriage 37½p

TPDI SERIES with plinth and cover and ready wired.
MP60 **£19·50** 610 **£22·97**
510 **£20·97**
Carriage 50p extra each item

GOODMANS SPECIAL OFFERS!

MAXAMP 30 Stereo Amplifier 15+15 watt r.m.s. with matching STEREOMAX AM/FM Tuner. Total list price £136·52.
OUR PRICE **£89** THE PAIR Carriage £1

GOODMANS SPEAKERS !

MAXIMS
OUR PRICE **£32·60** pr. Carr. 50p.
MINISTERS
OUR PRICE **£39·97** pr. Carr. 50p.
MEZZO III,
OUR PRICE **£25.50** pr. Carr. 50p
MAGNUM K2, teak.
OUR PRICE **£33·00** pr. Carr. 50p
MAMBO, teak.
OUR PRICE **£32·50** pr. Carr. 50p
MARIMBA
OUR PRICE **£35·00** pr. Carr. 50p.
MAGISTER
OUR PRICE **£41·50** each. Carr. £1

TE-1035 STEREO HEADPHONES
Low cost high performance stereo headphones. Foam rubber ear cups. Adjustable head-band. 8 ohm impedance. 25-18,000 Hz. With lead and stereo jack plug. ONLY **£1·97½.** P. & P. 12½p

SINCLAIR EQUIPMENT

Project 60. Package offers.
2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. **£19.** Carr. 37½p. Or with PZ6 power supply **£21.** Carr. 37½p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. **£21·50.** Carr. 37½p.

Transformer for PZ8. **£2·97½** extra.
Add to any of the above **£4·87½** for active filter unit and **£16** for a pair of Q16 speakers.
Project 60 FM Tuner **£20·97½.** Carr. 37½p.
All other Sinclair products in stock.
2000 Amplifier **£22·97½** Carr. 37½p.
3000 Amplifier **£35.** Carr. 37½p.
Neoteric Amplifier **£45·97½** Carr. 37½p.

HOSIDEN DH-08S DE-LUXE STEREO HEADPHONES

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

DISCOTHEQUE EQUIPMENT PACKAGE OFFERS

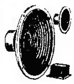
F.A.L. PHASE 50 MK.II AMPLIFIER £33.50
PR. R.S.C. L12/25 25W L/S in cabinets £19 00
Terms: Deposit £9 and 9 monthly payments of £5 (Total £54) £52.50
PACKAGE PRICE **£48** carr. £1

F.A.L. PHASE 50 MK.II AMPLIFIER £33.50
PR. FANE POP 50 L/SPEAKERS £21
Terms: Deposit £10.50 and 9 monthly payments of £5 (Total £55.50) £54.50
PACKAGE PRICE **£49.50** carr. £1

F.A.L. PHASE 100 AMPLIFIER £62.95
PR. L125 50W L/S in cabinets £59.80
Terms: Deposit £22 and 9 monthly payments of £11 (Total £121) £122.75
PACKAGE PRICE **£110** carr. £1.50

F.A.L. PHASE 100 AMPLIFIER £62.95
4 FANE POP 50 L/SPEAKERS £42
Terms: Deposit £14 and 9 monthly payments of £10 (Total £104) £104.95
PACKAGE PRICE **£94** carr. £1.50

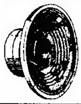
AUDIOTRINE HI-FI SPEAKER SYSTEMS



Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5.75**

OR SENIOR 15 WATT INC. HF126 15,000 LINE SPEAKER carr. 35p **£6.75** Carr. 30p

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS



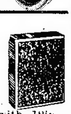
Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8–15 ohms. **Please state choice. Exceptional performance at low cost.**

HF801D	8″	8W	£2.71	HF120D	12″	15W	£4.49
HF102D	10″	10W	£3.40	HF126	12″	15W	£5.25
HF120	12″	15W	£3.99	HF126D	12″	15W	£5.75

FANE 807 HIGH FIDELITY LOUDSPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25 Hz to 15 KHz. Impedance 3 or 8-15 Ω .Gauss 10,000. Remarkable value. **£3.50**

HI-FI SPEAKER ENCLOSURES



Modern design. Teak veneer finish. Acoustically lined. All sizes approx. Carr. 25p. per enclosure
JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **£4·75**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Ported **£5·75**
SE10 For outstanding results with 10in. Hi-Fi 'spkr Size 24x15x10in. P'td. **£5.99**
SE12 For exclnt prfmnce with 12in. Hi-Fi speaker and Tweeter. Size 25 x 16 x 10½in. **£6.99**

RECORD PLAYING UNITS

Money saving units. Mounted on Plinth. Supplied with transparent plastic cover. Ready to plug into Amp. or Tape recorder.

RP1C Garrard 3000 4-speed Auto-change Unit with Sonotone 9TA/HC Ceramic Stereo Cartridge. **£19.45** Carr. 50p.

RP23C Garrard SP25 Mk III fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. **£26.09** Carr. 50p

RPC6 Garrard 5200 Auto Unit fitted Stereo Cartridge Plinth & Cover as RP2C **£15** carr. 50p.

Other types available with Magnetic cartridges and with alternative design plinths.

R.S.C. PLINTHS

Superior Solid Natural Wood Construction for Record Playing units, cut for Garrard 1025, 2025, 3000, AT60, SP25 etc. **£3.15**

WITH TRANSPARENT PLASTIC COVER **£6.30**

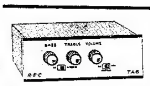
LEADING MAKES HI-FI EQUIPMENT AT CLEARANCE PRICES
Available at branches only

R.S.C. BATTERY/MAINS CONVERSION UNITS

TYPE BM1

An all-dry battery eliminator. Size 5½ x 4½ x 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram £3 or assembled ready for use £3.50

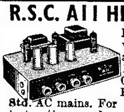
R.S.C. TA6 6 Watt HI-FI SOLID STATE AMPLIFIER



200-250v. AC mains operated. Frequency Response 30-20,000 c.p.s. —2dB. Harmonic Distortion 0.3% at 1,000 c.p.s. Separate Bass and Treble 'lift' and 'cut' controls. 3 input sockets for Mike, Gram, Radio or Tape. Input selector switch. Output for 3-15 ohm spkrs. Max. sensitivity 5mV. Output rating I.H.F.M. Fully enclosed enamelled case, 9½ × 2¾ × 5½in. Attractive brushed silver finish facia plate 10½ × 3½in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. **£7.50** Carr. 40p

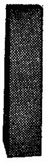
OR FACTORY BUILT WITH 12 MONTHS' GUARANTEE £9·45

R.S.C. A11 HI-FI 12-14 WATT AMPLIFIER



PUSH-PULL OUTPUT. Two input sockets with sep. vol. controls for mixing. High sensitivity, 5 valves. Bass and treble controls. Response ± 3dB 30-20,000 c/s. Hum level —60dB. Sensitivity 40 millivolts. For Crystal or Ceramic PUs. High Impedance "mikes". For Musical Instruments etc. Std. AC mains. For 3 & 15 ohm spkrs. Complete kit. Full instructions and point-to-point wiring diagrams. Carr. 60p SAE for leaflet. Twin handled metal cover **£1.75** **£10.50**
Factory built £14.75 or **Dep. £3** and 9 mthly pymnts of **£1.60** (Total **£17.40**.)

R.S.C. COLUMN SPEAKERS



IDEAL FOR VOCALISTS AND PUBLIC ADDRESS

R·S·C HI-FI CENTRES LTD.

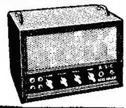
All types 15 Ohms covered in Rexine Vynair
TYPE C4100 IS ALSO SUITABLE FOR BASS GUITAR OR ELECTRONIC ORGAN

TYPE C48S 25-30 WATTS
Fitted four 8″ high flux 8 watt speakers. Overall size approx 48 x 10 x 5 in. Carr 50p
Terms: Dep £3 and 9 monthly payments £2 (Total **£21**) **£17.75**

TYPE C412S 50 WATTS
Fitted four 12″ 11,000 line 15 watt speakers: Overall size approx 56 x 14 x 9 in. Carr 75p
Terms: Dep. £4 and 9 monthly payments £3 (Total **£31**) **£27.50**

TYPE C4100 100 WATTS inc. four 12″ 50 watt speakers for conservative rating. Extra heavy construction. Size approx 58 x 16 x 10″ Acoustically filled and pressurised. Terms: Dep. £7·50 and 9 mthly. pyts. £5·45 (Total **£56·55**). Carr. £1 **£50.50**

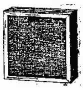
30 WATT HI-FI AMPLIFIER FOR GUITAR, VOCAL OR INSTRUMENTAL GROUP.



A 2 or 4 input, 2 vol. control Hi-Fi unit with Separate Bass and Treble controls. Current valves. Peak output rating. Strong Rexine covered cabinet with handles. Attractive black/gold P.V.C. facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet.
Terms: Deposit **£3.70** and 9 monthly payments of **£2.10** (Total **£22.60**) **£19.95** Carr. 65p

HIGH QUALITY LOUDSPEAKER UNITS

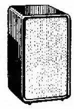
IN TEAK VENEERED CABINETS



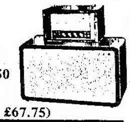
L13 13″ × 8″ 10 Watt 10,000 lines 3 or 15 ohms. State impedance required. **£5.25** carr. 40p

L12 12″ 25 WATT 10,000 lines 15 ohms. **£9.50** carr. 45p

L12/25 50 WATT
Two tone Rexine and vynair finish. Fitted pair of 12″ 50 watt high flux speakers for conservative rating. Impedance 8-15 ohms. Carr. 75p **£29.50**



R.S.C. BASS REGENT 50 WATT AMPLIFIER



A powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists. gram, radio, tape, Peak Output rating.
Loudspeaker unit optional horizontal or vertical mounting. **£60**
★ **Two extra heavy duty 12in. Loudspeakers.**
★ **Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes".** Carr. £1.50
Bass and Treble controls. Send S.A.E. for leaflet.
Credit Terms Deposit **£16** and 9 monthly payments of **£5.75** (Total **£67.75**)

FAL PHASE 50 MkII AMPLIFIER 50W

Solid state 4 Separately controlled inputs. Plus master vol. control. Ind. Bass and Treble Controls. Protective circuit to guard against damage from accidental shorts. Output for Speaker/s 3·30 ohms. Size 17″ × 7″ × 7½″ 200-250v. A.C. mains. I.H.F.M. Output rating.
Or deposit £6 & £9 monthly payments £3·50. Total £37·50. **£33.50** Carr. 65p

FAL PHASE 100 AMPLIFIER 100W

Solid State. 4 Separately controlled inputs Plus master volume control. Ind. Bass and Treble Controls. Output for speaker/s 3·30 ohms. Protective circuit to guard against damage from accidental shorts. I.H.F.M. Output rating.
Or deposit £12 & 9 monthly payments £6·25. Total £68·25. **£61.95** Carr. 75p
Send S.A.E. for leaflets.

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 years' guarantee. High flux ceramic magnets. Heavy cast chassis. All carr. free.

'POP' 100
18″ 100 Watt
14,000 gauss
8/15Ω
£22.05
Dep: **£6** and 9 monthly payments **£2·10** (Total **£24·90**)

'POP' 60
15″ 60 Watt
14,000 gauss
8/15Ω
£12.90
Dep. **£3.30** and 9 monthly payments. **£1.30** (Total **£15**).

'POP' 50
12″ 50 Watt
13,000 gauss
15Ω **£10.50**
Dep **£2** and 9 monthly payments **£1.15** (Total **£12.35**)
Pair suitable all purposes

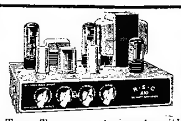
FOR BASS GUITAR, ELECT. ORGAN, ETC.

FANE LOUDSPEAKERS 'POP' 25/2

12in. 25 WATT

Dual Cone 15 Ω (for uses other than Bass Guitar or Electronic Organ).
£6.75 Carr. free
or Dep. **£1** and 9 mthly payments **75p** (Total **£7.75**).

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



Highly sensitive. Push-Pull high output, Hum level—70dB. Response ±3dB 30-20,000 c/s. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 millivolts. For High Impedance microphones. **For Clubs, Schools, Theatres. Dance Halls Outdoor Functions,** etc. For **Electronic Organ, Guitar, String Bass,** etc. Gram, Radio or Tape. Two separate inputs with vol. controls permit such as "mike" and Pick-up etc. to be used for mixing purposes, 200-250 v. 50 c/s A.C mains. For 3 and 15 ohm speakers. Complete Kit of parts with wiring diagram and instructions. Twin-handled perforated cover **£1.75** Or factory built with EL34 output valves and 12 months' guarantee for **£19.75** **£15.75** Carr. 65p
TERMS: Deposit £4 and 9 monthly payments of **£2·10** (Total **£22·90**). Send S.A.E. for leaflet.

RSC TRANSFORMERS, L.F. CHOKES & RECTIFIERS

FULLY GUARANTEED. Impregnated and Interleaved where necessary

Primaries 200-250v. 50c/s. Screened
MIDGET CLAMPED TYPE 2⅝ × 2⅝ × 2¼in.
250v., 60mA, 6.3v. 2a **90p**
250-0-250v., 60mA 6.3v 2a **95p**
FULLY SHROUDED UPRIGHT MOUNTING
250-0-250v. 60mA, 6.3v. 2a., 0-5-6.3v. 2a. **£1.25**
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a. **£1.99**
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a. **£1.99**
300-0-300v. 130mA, 6.3v. 4a., c.t., 6.3v. 1a. For Mullard 510 Amplifier **£2.40**
350-0-350v. 100mA, 6.3v. 4a., 0.5-6.3v. 3a. **£1.99**
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a. **£2.40**
425-0-425v. 200mA, 6.3v. 4a., c.t., 5v. 3a. **£4.49**
425-0-425v. 200mA, 6.3v. 4a., 6.3v. 3a., 5v. 3a **£4.69**
450-0-450v. 250mA, 6.3v. 4a., c.t., 5v. 3a. **£4.99**
TOP SHROUDED DROP-THRO' TYPE
250-0-250v. 70mA, 6.3v. 2a., 0-5-6.3v. 2a. **£1.20**
250-0-250v. 100mA. 6.3v. 3.5a. **£1.40**
250-0-250v. 100mA, 6.3v. 2a., 6.3v. 1a. .. **£1.45**
350-0-350v. 80mA, 6.3v. 2a., 0-5-6.3v. 2a. **£1.50**
250-0-250v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a. **£1.99**
300-0-300v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a. **£1.99**
300-0-300v. 130mA, 6.3v. 4a., 0-5-6.3v. 1a. Suitable for Mullard 510 Amplifier **£2.35**
350-0-350v. 100mA, 6.3v. 4a., 0-5-6.3v. 3a. **£1.99**
350-0-350v. 150mA, 6.3v. 4a., 0-5-6.3v. 3a. **£2.35**

FILAMENT or TRANSISTOR POWER PACK Types 6.3v. 1.5a. **45p**; 6.3v. 2a. **49p**; 6.3v. 3a. **69p**; 6.3v. 6a. **£1.15**; 12v. 1a. **50p**; 12v. 3a. or 24v. 1.5a **£1.20**; 0.9-18v. 1½a. **99p**; 0-12-25-42v. 2a. **£1.60**
CHARGER TRANSFORMERS 0-9-15v. 1½a. **95p**; 2½a. **99p**; 3a. **£1.10**; 5a. **£1.30**; 6a. **£1.49**; 8a. **£1.85**
AUTO (Step UP/step DOWN) TRANSFORMERS 0-110/120v. 200-230-250v., 50-80 watts **99p**; 150 watts, **£1.70** 250 watts **£2.49**; 500 watts **£5.25.**
OUTPUT TRANSFORMERS
Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω **45p**
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω .. **75p**
Push-Pull 10 watts 6V6, ECL86 to 3, 5, 8 or 15 Ω **£1.25**
Push-Pull EL84 to 3 or 15 Ω 10-12 watts .. **£1.20**
Push-Pull Ultra Linear for Mullard 510, etc. **£1.99**
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω **£1.80**
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω **£2.99**
SMOOTHING CHOKES 150mA, 7-10H. 250 Ω **65p**; 100mA, 10H, 200 Ω **55p**; 80mA, 10H, 350 Ω **45p**; 60mA, 10H, 400 Ω **25p.**

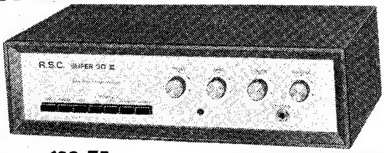
SELENIUM RECTIFIERS F. W. (Bridged)
All 6/12v. D.C. output. Max. A.C. input 18v. 1a. **25p.** 2a. **35p.** 3a. **50p.** 4a. **65p.** 6a. **80p.**

Introducing R.S.C. MkIII SUPER 30 HI-FI STEREO AMPLIFIER

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

Only high grade components by leading manufacturers.

COMPLETE KIT OF PARTS **£25**



Or **FACTORY BUILT** with 12 months guarantee **£33·75**
Dep. £5·75 and 9 monthly payments £3·50 (Total £37·25)
Or **FACTORY BUILT** in cabinet as illustrated **£36·75**
Dep. £6 and 9 monthly payments £3·86 (Total £40·74)

PRINTED CIRCUITRY, TWENTY SILICON TRANSISTORS. FOUR DIODES, FOUR RECTIFIERS.
TECHNICAL DETAILS (Applying to each channel where appropriate)
CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble, and Balance. Plus Ceramic/Mag P.U. Switch.

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

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

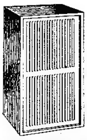
R·S·C HIGH FIDELITY STEREO 'PACKAGE' OFFERS

Four fully wired units ready to 'plug in.'
★ SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
★ GARRARD SP25 MKIII Turntable on Plinth with cover
★ GOLDRING CS90 Ceramic Pick up Cartridge with diamond stylus
★ PAIR OF STANWAY II Speaker Units
Special Total Price **£79·80** Carr. £1·50

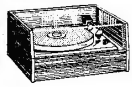
★ Super 30 Amplifier (15 + 15 watt) in veneered housing
★ Goldring GL69 II Transcription Turntable on Plinth as illustrated
★ Goldring Magnetic P.U. Cartridge.
★ Pair of Stanway II speaker units
Special Total Price **£96·75** Carr. £1.50

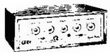
Matching as recommended for optimum performance. Send S.A.E for coloured brochure showing other money-saving offers.

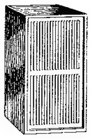
Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.



Stanway II







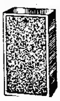
ATTRACTIVE TEAK or AFRORMOSIA VENEERED CABINETS and PLINTHS

TERMS AVAILABLE ON ALL PACKAGE OFFERS

★ TA12 AMPLIFIER 6·5+6·5 watt in veneered housing
★ GARRARD SP25 MK III Player unit on Plinth
★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
★ PAIR OF DORCHESTER Loudspeaker Units
Special Total Price **£58** Carr. £1·25
Or Deposit £7·15 and 9 monthly payments £6·35 (Total £64·30). Trans. Plastic Cover £3·15 extra.

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

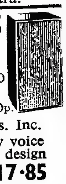
'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM



★ **Moderate size only 25×14×10in.**
★ **Response 30-20,000 c.p.s. Impedance 15 ohms**
COMPLETE KIT **£22** Carr. 63p
★ **Performance comparable with units costing considerably more.**
Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system (3) 8 × 5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material. (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4·50 and 9 monthly payments £2·25 (Total £24·75).

DEMONSTRATIONS AT ALL BRANCHES

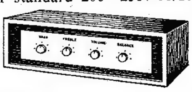
HIGH FIDELITY LOUDSPEAKER UNITS



Cabinets latest style Satin Teak veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.
DORCHESTER (Illustrated) Size 16×11×9in. appr. Range 45-15,000 c.p.s. Rating 8-10 watts. Fitted High flux 13×8in. Dual Cone speaker. Imp. 3 or 15 ohms. **£9·45** Carr. 40p.
STANWAY II Size 20 × 10¾ × 9½in. approx. Rating 10 watts. Inc. 13 × 8in. speaker with highly flexible cone surround, long throw voice coil and line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 15 ohms. Gives smooth realistic sound output. See (package offers) for illustration **£17·85**

RSC G66 6+6 WATT high quality STEREO AMPLIFIER

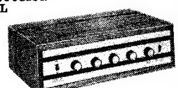
Individual Ganged controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Suitable for Crystal Pick-ups, etc., and for loudspeaker output impedances of 3 to 15 ohms. For standard 200—250v A.C. mains operation. Attractive silver finished metal facia plate & matching control knobs.



Complete KIT of PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£9·99**
Or **FACTORY BUILT IN TEAK VENEERED CABINET as illustrated** **£12·50** carr 40p, or dep £2 and 9 mthly pymnts. £1·45 (Total £15·05)

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

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION
HIGH FIDELITY OUTPUT OF 6.5 WATTS PER CHANNEL



Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. —2dB ★ Harmonic Distortion 0.3% at 1,000 c.p.s. Hum and Noise — 70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★Handsome finish Facia plate & Knobs.
COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS. **£15·50** Carr. 40p.
Factory built with 12 months guarantee £19·50 or Deposit £3 and 9 mthly pymts £2·05 (Total £21·45). Or in Teak veneer housing **£23** Dep. £3 & 9 mthly payments £2.55 (Total £25·95). Send S.A.E. for leaflet

AUDIOTRINE A55 HIGH QUALITY STEREO SYSTEM

5 + 5 WATT OUTPUT

GARRARD 5200 Changer with low mass pick-up arm and Stereo Cartridge.
CONTROLS: TREBLE, BASS, VOLUME, STEREO, BALANCE.
Operation on 200 - 250v. A.C. mains.
Output rating. I.H.F.M

Luxurious Teak Veneer Finished Cabinets. Transparent plastic (tinted) cover included for main unit. Silver finished facia plate and matching control knobs.

PAIR OF LOUDSPEAKER UNITS incorporating high flux 8 × 5 ins. speaker. Size approx. 13×7½×8¾ ins.
Price complete ONLY **£42** Carr. £1·25
Terms: Deposit £5·50 and 9 monthly payments £4·50 (Total £46.)

A REALLY SURPRISING STANDARD OF QUALITY IS OBTAINABLE FROM THIS COMPACT LOW PRICED SYSTEM

LOW DEPOSIT CREDIT TERMS

AVAILABLE ON PURCHASES OVER £8 (KITS OF PARTS EXCEPTED)

INTEREST CHARGES REFUNDED

ON CREDIT SALES SETTLED IN 3 MONTHS

PARTRIDGE "JOYSTICK" SHORT WAVE AERIALS AND TUNERS AT ALL BRANCHES (S.A.E. for full list)

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
BLACKPOOL (Agent) O. & C. Electronics, 227 Church Street
BIRMINGHAM 30/31 Gt. Western Arcade (Half-day Wed.) 021-236-1279
DERBY 26 Osmaston Rd., The Spot (Half-day Wed.) Tel. 41361
DARLINGTON 18 Priestgate (Half-day Wed.) Tel. 68043
EDINBURGH 133 Leith St. (Half-day Wed.) Tel. 556 5766
GLASGOW 326 Argyle St. (Half-day Tues.) Tel. CITy 4158
HULL 91 Paragon Street (Half-day Thursday) Tel. 20505

R·S·C HI-FI CENTRES LTD.

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Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 25p extra under £2. 30p extra over £2 or as quoted. Trade supplied. S.A.E. please with enquiries
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R+TV

RADIO & TV COMPONENTS (Acton) Ltd.

21c HIGH STREET, ACTON, LONDON, W.3. 6NG
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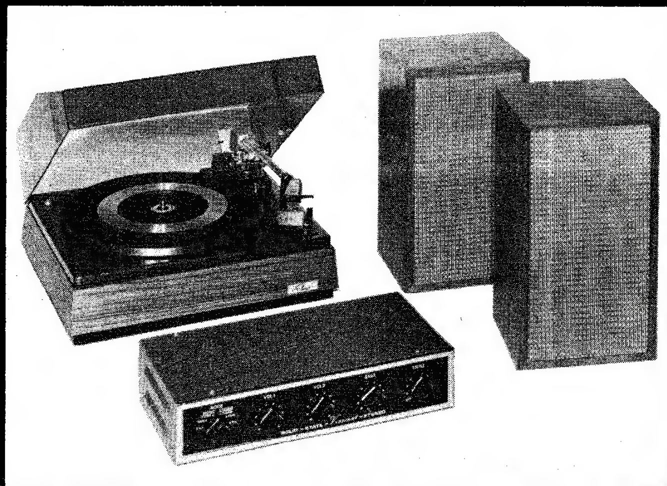
ALL MAIL ORDERS TO OUR ACTON BRANCH
Terms C.W.O. All enquires S.A.E.

Complete Stereo System £43



WITH VISCOUNT F.E.T. FIELD EFFECT TRANSISTORS AMPLIFIER

This superb stereo system is a real price break through. It comprises the **VISCOUNT F.E.T. Mk I** amplifier on which full details are given below, the famous Garrard SP 25 Mk III (including teak veneer base and transparent cover) with diamond cartridge or 2025 TC and the very successful DUO type 2 speakers. Measuring 17½in x 10¾in x 6¾in, the Duo type 2 speakers are teak finished with matching Vynair grills. They incorporate a 3 ohm. 13in x 8in drive unit and Parasitic tweeter. Max. power handling 10 watts. Price £13·50 per pair plus p. & p. £1·50.

Complete stereo system £43 plus £2·50 p. & p. or with Mk II Amplifier and Magnetic Cartridge £48 & £2·50 p. & p.

The Viscount F.E.T. MkI **£14.25** + 50p. p. & p. High fidelity transistor stereo amplifier employing field effect transistors. With this feature and accompanying guaranteed specifications below, the Viscount F.E.T. vastly surpasses amplifiers costing far more.

Specification—Output per channel 10 watts r.m.s. into 3 ohms Frequency bandwidth 20 Hz to 20 kHz + 1db at 1 watt. Total distortion at 1 kHz at 9 watts 0.5% Input sensitivities CER. P.U. 100mV into 3 meg ohms. Tuner 100mV into 100K ohms. Tape 100mV into 100K ohms. Overload Factor Better than 26db.

Signal to noise ratio—70db on all inputs (with vol. max). Controls—6 position selector switch (3 pos. stereo and 3 pos. mono). Separate volume controls for left and right channels. Bass ± 14db at 60 Hz. Treble (with D.P.S. on off) ± 12 db at 10 KHz. Tape recording output sockets on each channel. Size 12½in. 6in. 2¾in. in simulated teak case. BUILT & TESTED.

MkII (MAG P.U.) **£15.75** plus 50p. p. & p.
Specification same as Mk. 1, but with the following inputs. Mag. P.U. CER. P.U. Tuner. Spec. on Mag. P.U. 3mV at 1 kHz input impedance 47K. Fully equalised to within ±1db RIAA. Signal to noise ratio—65db (vol. max).

The £25 Stereo system

The Duetto is a good quality stereo amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.

SPECIFICATION—
R.M.S. power output 3 watts per channel into 10 ohms speakers.

INPUT SENSITIVITY. Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.

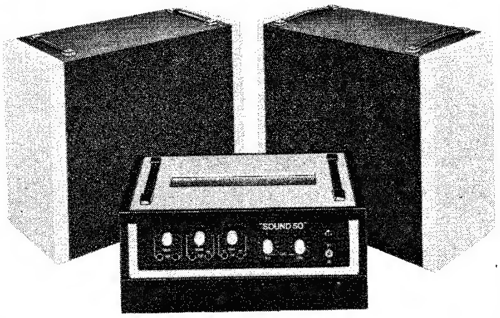
CONTROLS: 4-position selector switch (2 pos. mono and 2 pos stereo) dual ganged volume control.

TONE CONTROL Treble lift and cut Separate on off switch. A preset balance control.

Duetto integrated transistor stereo Amp.	**£9.50**	50p
Garrard Changer from	**£7.97**	50p
Cover and teak finish plinth	**£4.75**	50p
Duo Type I speakers (see opp. page)	**£4.20**	50p
The above items purchased together	**£25.00**	£2.00

SOUND 50

50 WATT AMPLIFIER & SPEAKER SYSTEM

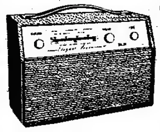


The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.

Output Power: 45 watts R.M.S. (Sine wave drive). **Frequency response:** −3dB points 30Hz at 18KHz. **Total distortion:** less than 2% at rated output. **Signal to noise ratio:** better than 60dB.
Speaker Impedance: 3, 8 or 15 ohms. **Bass Control Range:** ± 13dB at 60Hz. **Treble Control Range:** ± 12dB at 10 KHz. **Inputs:** 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.
To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.
SPEAKERS! Size 20″ × 20″ × 10″ incorporating Baker's 12″ heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM **£50** Plus £4 P. & P.
Sound 50 amp and 2 speakers

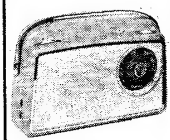
or available separately.
Amplifier **£28.50** plus £1.50 P. & P.
Speakers **£12.50** each plus £1.75 P. & P.



The ELEGANT SEVEN Mk. III
(350mW Output)

7 transistor fully-tunable M.W.—L.W. superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.
MAINS POWER PACK KIT: **47p** extra.

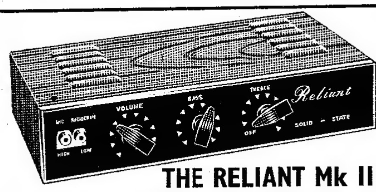
Price **£5.25** plus 50p. P. & P.
Circuit 13p FREE WITH PARTS.



The DORSET (600mW Output)

Price **£5.25** plus 50p P. & P.
Circuit 13p FREE WITH PARTS

7-transistor fully tunable M.W.—L.W. superhet portable—with baby alarm facility. Set of parts. The latest modulised and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in.
MAINS POWER PACK KIT: **47p** extra.



THE RELIANT Mk III
SOLID-STATE GENERAL PURPOSE AMPLIFIER

in simulated teak case **£7.25** plus P. & P. 50p

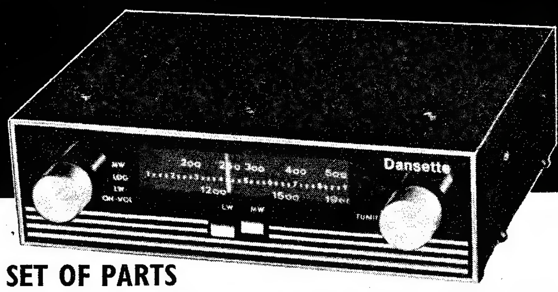
SPECIFICATIONS
Output ± 10 watts. Output impedance—3 to 4 ohms.
Inputs 1. -xtal mic 10mV Tone Controls—Treble control range ± 12dB at 10KHz. 2. -gram/radio 250mV. Bass control range ± 13dB at 100Hz.
Frequency Response—(with tone controls central) Minus 3dB points at 20Hz and 40KHz. Signal to Noise Ratio—better than −60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input—220/250V. A.C. Size of chassis—10¾in. x 4¾in. x 2¼in. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Built and tested.

THE DUO SPEAKER SYSTEM

Similar in design to those on the previous page the 2-way speaker system is beautifully finished in polished teak veneer. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:—
Impedance 8 or 10 ohms (please state requirement). It incorporates high flux 7in. x 3½in. speaker and 2¼in. speaker. Teak finish 11½in. x 6in. x 5¾in. **£4.20** each. 50p P. & P.

LIQUIDATED STOCK
DANSETTE
TOURISTE MK3
CAR RADIO



ALL TRANSISTOR

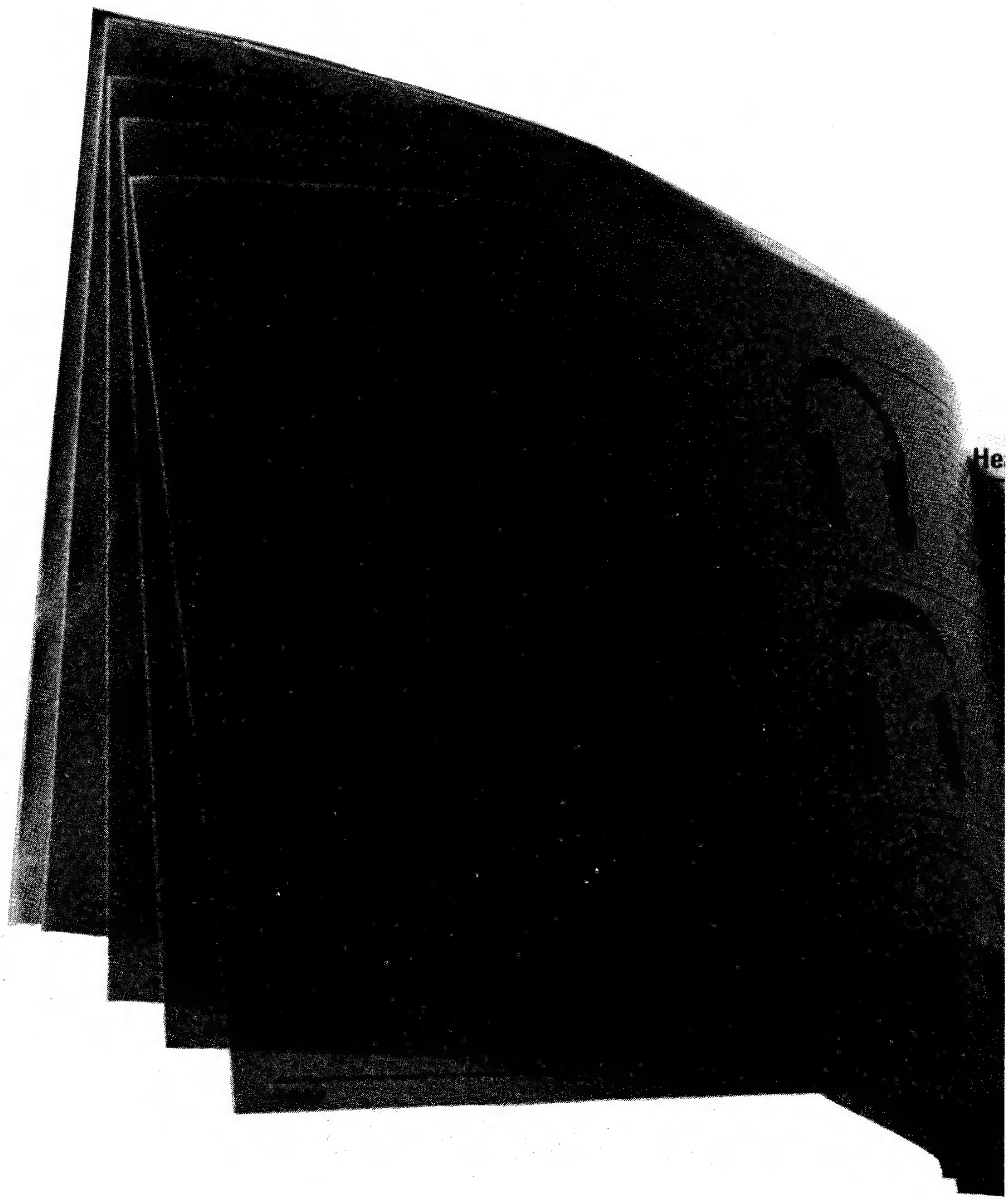
Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1 MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts.

Originally sold completely built for £15.4.6 (£15.23) Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in deep.

See top of previous page for address

SET OF PARTS
£6.30
plus P. & P. 50p.
Circuit diagram 13p. Free with parts
Speaker, baffle and fixing kit **£1.25** extra plus 25p. p. & p. Postage free when ordered with parts.

RADIO & TV COMPONENTS
R+TV
(ACTON) LIMITED



The Eagle Annual.

Sorry, no Dan Dare, Digby or P.C. 49. Because this is the new Eagle annual catalogue. And it's packed with interesting things. Like the new TSA 151 stereo amplifier: it uses a new block construction silicon output device for absolute reliability. It's got low noise silicon transistors throughout. Its output is 15 Watts per channel. That's 15 Watts RMS, not an exaggerated figure for maximum music power.

The price? A very reasonable £36.

And for people who like to listen to stereo undisturbed, we've got the new SE 100 headphones.

Dual cone transducers are used throughout, and, to keep the weight down, the independent volume controls are mounted on a separate unit with a pocket clip. £16·00.

Every item in the annual has been specified or selected by Gerry Adler. Eagle is Gerry's baby, and he's very fussy about what goes out under the Eagle banner. He gets very twitchy at the thought of a duff diode. A bit like the Mekon in fact.

But he does it for a reason.

He believes that if the first Eagle product you buy is O.K., you'll come back for more.

That's what's made Eagle a success.

Eagle International

we don't stand still.

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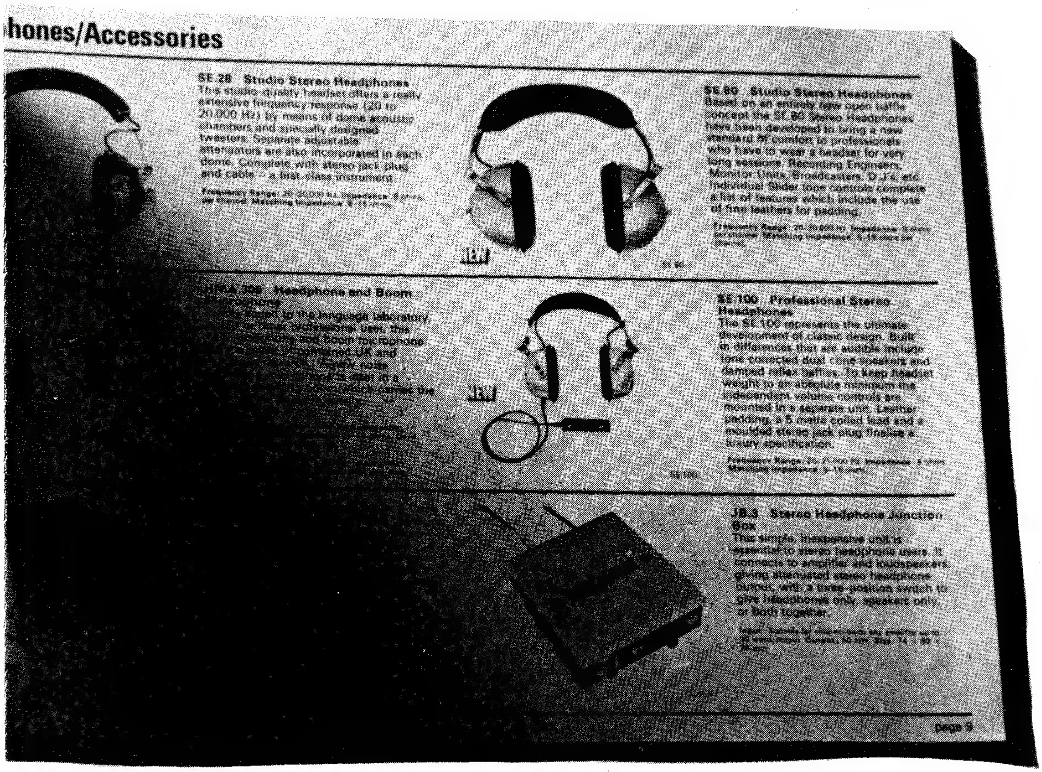
Tel: 01-636 0964

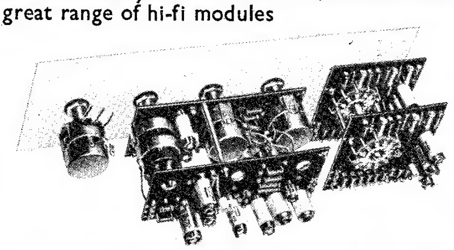


Which ever way you choose

(BUILT OR KIT)

MARTIN AUDIOKITS

For the do-it-yourself enthusiast, the return of a great range of hi-fi modules



You are going to enjoy better listening for less cost and greater reliability

ready to play

LEWIS AUDIO SYSTEMS comprise ready built equipment designed and built to advanced technical standards of efficiency and styling. Their prices make true hi-fi available to a wider public than ever. Based on the excellent **Lewis Audio SA. 55** stereo amplifier in which FETS are used in the pre-amp to ensure better quality throughout, the range offers choice of free-standing amplifier with separate playing unit in plinth with plastic hard top or the *Compact* assembly in which the amplifier is built into the base of the plinth and motor assembly. Separate matched speakers are available for either system. Illustrated above is the Lewis S.55 Mk. II Compact System.

LEWIS AUDIO SYSTEMS

SA.55 STEREO AMPLIFIER—6 watts RMS output per ch. into 15 ohm speakers Controls— Input selector/Vol/Bass/Treble/Balance/ On-Off. Tape Record and replay facilities. DIN socket connections. Modern teak finished cabinet.
R.R.P **£18·90**

SC.55 Mk. II 'Compact' with Garrard 2025TC and SA.55 amplifier built into plinth R.R.P. **£40·32**

PLINTHS WITH HARD TOPS & FITTED GARRARD UNITS

Garrard 2025TC with Sonotone 9TA/HC R.R.P. **£16·50**

Garrard 40B with Sonotone 9TA/HC R.R.P. **£20·16**

Garrard SP.25 Mk. III less cartridge R.R.P. **£20·16**

LOUDSPEAKERS

LS. 16 'Major'—13" x 8" three way system in American Walnut finished cabinet. 8 ohms R.R.P. **£11·70**

LS.17 6" three way system in teak or Am. walnut finish. 15 or 8 ohms R.R.P. **£10·80**

LS.18 8" three way system in teak or Am. walnut finish 15 or 8 ohms. R.R.P. **£12·60**

● **TRADE ENQUIRIES WELCOME**

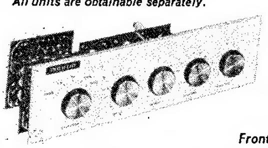
for the constructor

MARTIN AUDIOKITS were first to make modular unit construction available to the hi-fi enthusiast keen to save by building his own assembly. AUDIOKITS were first to feature "add-on-ability" by which a simple system could be expanded to high performance stereo equipment by the addition of easily added on units. Many who built with MARTIN AUDIOKITS years ago continue to enjoy unsurpassed quality and reliability from them to this day. **NOW YOU CAN BUY AUDIOKITS AGAIN** to allow you to build a high fidelity system to your personal choice and which will satisfy completely on performance, simplicity of assembly, robustness and reliability. These units are beautifully engineered and solidly built for a lifetime of trouble-free service. You can start with mono and add on units to make stereo, or build with stereo throughout.

TYPICAL MARTIN ASSEMBLIES

1478E	Five stage matched input selector unit; controls and pre-amp; power amp. (10 watts RMS into 15 ohms) power supply; front escutcheon plate (mono)	Total price **£17·50**
1478SE	Similar to above but for stereo.	Total price **£29·95**
9748SE	Stereo assembly for use with high grade ceramic and low power mag. pick-ups.	Total price **£32·95**

All units are obtainable separately. *State pick-up when ordering.*



● **EACH MARTIN AUDIOKIT MODULE IS COMPLETE IN ITSELF AND REQUIRES THE ADDITION OF NO FURTHER COMPONENTS TO IT.**

● **ALL UNITS INDIVIDUALLY TESTED AND CHECKED BEFORE LEAVING OUR FACTORY.**

Front escutcheon panel of assembly 1458SE

Coupon brings information

LOUIS & LEWIS (ELECTRONICS) LTD

154-155, HIGH STREET, BRENTFORD, MIDDLESEX
Telephone 01-560 1161

TO LOUIS & LEWIS (ELECTRONICS) LTD. 154 HIGH ST. BRENTFORD, MIDDX.

I am particularly interested in MARTIN AUDIOKITS ......
LEWIS AUDIO SYSTEMS ......

Please send details, (post free) to:

NAME ....

ADDRESS ....

.... PW.2

PRACTICAL WIRELESS

VOL 47 NO 1
Issue 771

MAY 1971

TOPIC OF THE MONTH

★ components list!

THE ready supply of components is, of course, the life-line of the radio constructor, even if in these days they are sometimes crammed together to form integrated circuits or grouped and encapsulated as modules. But despite the existence of a vast multitude of components, we still hear of people unhappy about not getting what they want from their local suppliers or via mail order.

Undoubtedly, the supply position forms a different pattern these days; stocks of some items become exhausted quicker than they used to do; new versions appear as alternatives which are not always direct replacements. Years ago, a particular component would stay in a catalogue for a decade, but today's constructors cannot rely on an item staying in stock for even a year. Very often it is a case of 'take it or leave it—while it's there!'

Why, then, should this be so? Well, at the International London Electronic Component Show, opening at Olympia on May 18th, 358 . British component manufacturers will be displaying their wares; these companies representing an industry with annual sales of more than £190 million. But despite this huge turnover, there is concern in the trade balance due to increasing imports of components. The exhibition will be a showplace for these competitors, from the USA, France, Russia, Israel, Hungary, India, Japan, Yugoslavia and other countries.

Components, then, are big business—big international business—and the competition is hot. To stay in the race demands investment, production and marketing of a very high level in the teeth of fiercely contesting rivals. Consider, then, this feverish background the next time you call in at your local dealer for a batch of 22k resistors, six 100 puffs and a couple of AF117's!

For the facts of economic life today mean that to many component makers the home constructor either does not exist or is very small fry indeed. In fact, if it were not for manufacturers' spin-offs and end-of-run oddments we would be in a very sad state. So next time you feel like complaining about components, be thankful that we are served as well as we are. Things could be far worse.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

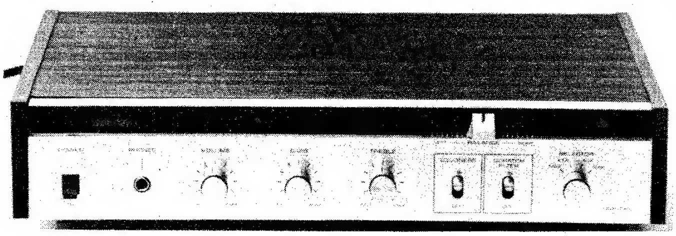
CONSTRUCTIONAL

OTHER FEATURES

JUNE ISSUE WILL BE PUBLISHED ON MAY 7th

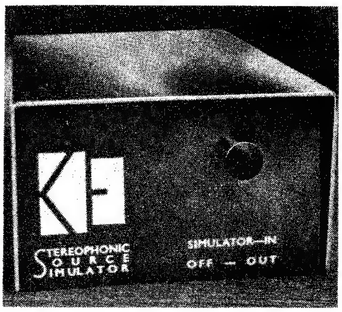
NEWS... NEWS... NEWS...

Stereo from Teleton



A new stereo amplifier with 26 semiconductors and 18 silicon transistors has been launched by Teleton Electro (UK) Ltd. The new amplifier, known as the SAQ 206, has an output power of 6 watts continuous at 1% distortion and a frequency response of 40-15,000Hz. It is equipped with inputs for magnetic and crystal pick-up plus tape playback. Output from speakers and headphones is 8Ω and the model is equipped with both scratch filter and loudness control. The amplifier has a brushed aluminium front and matt walnut cabinet. The SAQ 206 operates at 110/240 volts, 50Hz. Retail price of the SAQ 206 is £32·50.

The "S.S.S."



Briefly explained, this device consists of an electronic synthesiser which when placed between a mono programme source and a stereo amplifier will create a very realistic stereo effect from all forms of music. Whilst quality components are used throughout to give performance consistent with the most expensive high-fidelity equipment, the recommended retail price is just £10.

The most obvious uses to which the simulator might be put are: between tuner and stereo amplifier for the effect of stereo radio from mono transmissions; between a mono/stereo pickup and stereo amplifier to give simulated stereo with mono records; and between tape recorder and stereo amplifier to give the effect of stereo replay with tapes recorded on a mono machine.

Whilst normal retailer outlets, will be used, in order to enable the customer to more easily obtain this product during the early stages of production the company's fullest attentions will be concentrated upon mail order sales (p&p 20p). Their broadsheet on this product is available on receipt of a stamped addressed envelope. *Kampel Electronics Ltd., 99 Old Christchurch Road, Bournemouth BH1 1EP (Tel. Bournemouth 28998).*

Diary Dates

Apr 19-22. Physics Exhibition, Alexandra Palace, London.

Apr 20-21. Electromation Exhibition, Royal Station Hotel. Newcastle.

Apr 20-23. Technicom '71 — Conference and Exhibition, Hotel Technical Communication for Industry and the Professions, Hotel Metropole, Brighton.

Apr 22-23. Electromation Exhibition, Grand Hotel, West Hartlepool.

Apr 23. Colloquium on Railway Automation (IEE), Savoy Place, London.

Eton Computer

Boys at Eton College, the famous English public school, are learning the language and concepts of computers with the assistance of a Marconi-Elliott machine. A "903" computer is now in operation at the school and pupils are using it to learn what computers are, what they do, and how one makes them do it. By operating the 903 themselves, the boys are picking up the 'jargon' of the computer world, gaining knowledge of order and instruction codes and probing the intricacies of program writing.

The 903 is also being used more directly as a functional 'tool' by senior boys and members of the Eton staff to help them in the work that they are carrying out. For example, a teacher of Astronomy is using the processor to perform many of his more complex calculations.

Cassette Cleaner

The Bib Division of *Multicore Solders Limited, Hemel Hempstead, Hertfordshire,* announce the introduction of their new Cassette Tape Head Cleaning Tape, suitable for all compact cassette type recorders and car playing units.

The unit comprises a cassette tape container in which high quality cleaning tape has been incorporated to clean tape heads, capstan and pinch wheel. It is very simple to use, in the same manner as a tape cassette it is placed in the machine and operated in the play-back position. The whole operation takes only about a minute. A plastic container is provided in which to keep the cleaning tape cassette. This accessory retails at 10s. 7d./53p including p.t. and is available from leading Hi-Fi shops.

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

Mr. Fillmore

After a brief illness Mr. Leonard Walter Fillmore, Managing Director of Jackson Brothers (London) Limited died on the morning of Saturday, January 30th, aged 67. With his father and brother he founded Jackson Brothers in the early twenties and pioneered the development of Variable Capacitors and associated Drive Mechanisms. His inventive genius led to many patents in Components for communications equipments over a span of nearly 50 years.

During the war years he was very active on Ministry Standardisation Panels. From then right up to the time of his death he worked on Panel 'F', the Variable Capacitor Standardisation Panel of R.E.C.M.F. He was Chairman of Panel 'F' from September 1951 to January 1965. On relinquishing the Chairmanship he continued as Vice Chairman. Thus for nearly 30 years he devoted considerable time and energy to the Establishments of Standards both National and International for Variable Capacitors. His earlier work on the production of R.I.C. and R.C.S. Specifications has had great influence on the evolution of current International Specifications (I.E.C.).

In recent years he was deeply involved in the preparation of detailed Common Standards under the present Burghard System. His death is not only a great personal loss to his many friends but also to the entire Electronic Industry.

Group One

About a year ago, Home Radio (Components) Ltd., formed a buying group with about 15 other dealers in the London area, which they provisionally called "Group One". Its primary object was to buy components at the best prices in reasonable quantities. There are several secondary aims such as exchange of surplus stock and information.

In a letter to PRACTICAL WIRELESS, Mr. A. Sproxton, a Director of Home Radio, says, "To some extent this has been forced on us because we wished to buy certain items that wholesalers do not wish to handle and the manufacturers will only sell in quantities that are beyond the pocket of one dealer to buy. But I would like to stress the fact that this is not aimed at distributors or wholesalers (I for one have always believed that they do a useful job and earn their money) in fact any small wholesaler or manufacturer would be welcome to join. I feel sure that you will agree this is a desirable scheme as ultimately it means we can offer readers a greater range of goods at the lowest prices. Initially we are going to limit it to about 20 dealers (not on account of any closed shop principle, but because we thought — quite wrongly — that we could not handle the administration of a larger number). Now we would like to offer membership to any Bona Fide trader in the U.K. and I would be very grateful if you could make this generally known through your columns. At the moment there is no entrance fee or subscription, if anyone is interested please write to me. *Home Radio (Components) Ltd., 234-240 London Road, Mitcham, Surrey, CR4 3HD.*

U.K.-Finland

The United Kingdom — Finnish trade deficit of over £72m appears to be set for a £10m reduction as a result of the British Trade Drive in Finland. Britain is now the third in the list of suppliers to Finland.

Camera catch

A camera which not only photographs a traffic offence at the moment it happens, but also simultaneously records the time and the date on the same negative, may soon be used by police forces in the U.K.

It has been developed by a South African company and is already in use by the police in that country.

Known as the Trafficam, the camera can be powered by either the car battery or the built-in power pack of eight Mallory Manganese Alkaline Mn1500 penlight size batteries for fully automatic instant use.

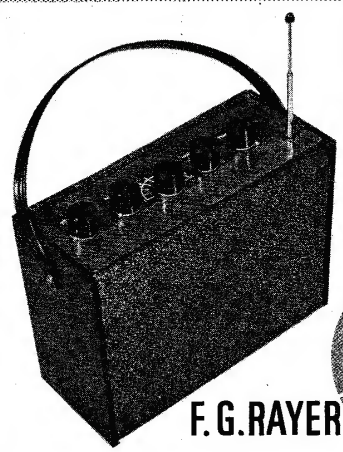
Spanish appliances

Fabrelec, one of Spain's biggest manufacturers of electrical appliances, and Westinghouse Electric Corporation, have signed patent licences, technical assistance agreements and trademark agreements for the manufacture of electrical appliances.

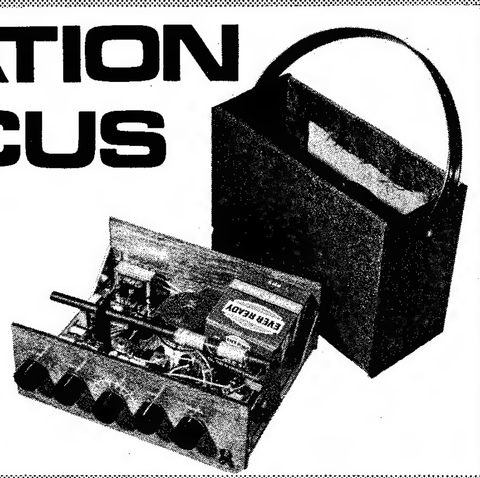
Powerful

The new range of seven zinc carbon batteries now being marketed by Mallory Batteries for general electrical and radio appliances. These are in addition to the mercury and alkaline batteries marketed under the company's Duracell brand name. *Mallory Batteries Ltd., Gatwick Rd., Crawley, Sussex.*

STATION FOCUS SIX



COVER PROJECT



F. G. RAYER

WITH many transistor portables, tuning is somewhat sharp and possibly tricky, especially at the high-frequency end of the medium wave band. The receiver described here overcomes this by using "station focus"—a control which allows oscillator tuning to be shifted slightly, for easy and exact tuning of a signal.

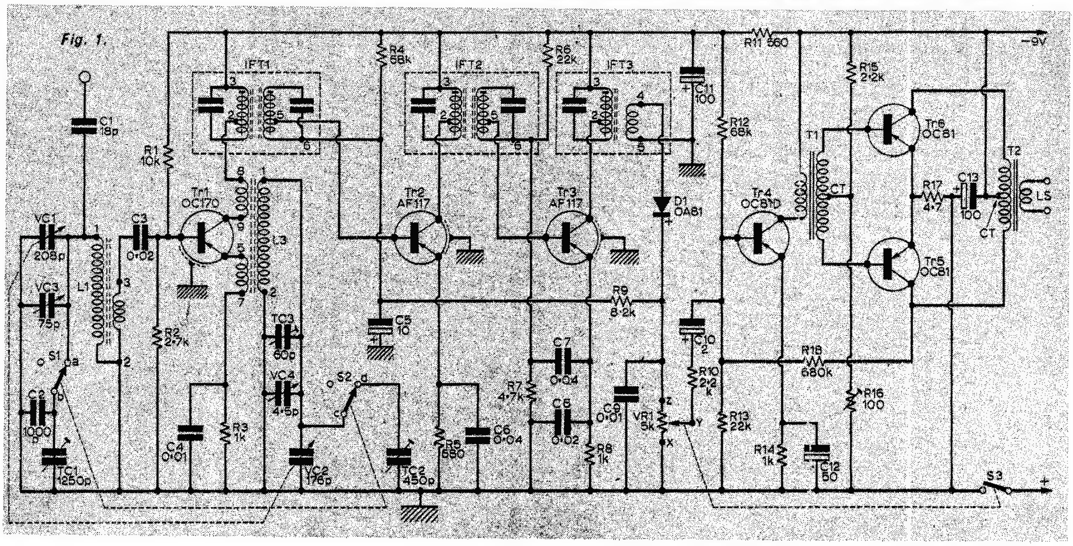
The circuit is shown in Fig. 1, and a ferrite rod aerial is used for normal reception. This gives sufficient signal strength from most transmissions likely to be required. For weaker signals, or during those times of day when reception is less good, a telescopic aerial can be extended. This is coupled to the tuned winding of the ferrite rod, L1, by the small capacitor C1. VC3 is an aerial circuit trimmer, allowing L1 to be peaked for maximum possible efficiency on all frequencies, with the aerial closed or extended.

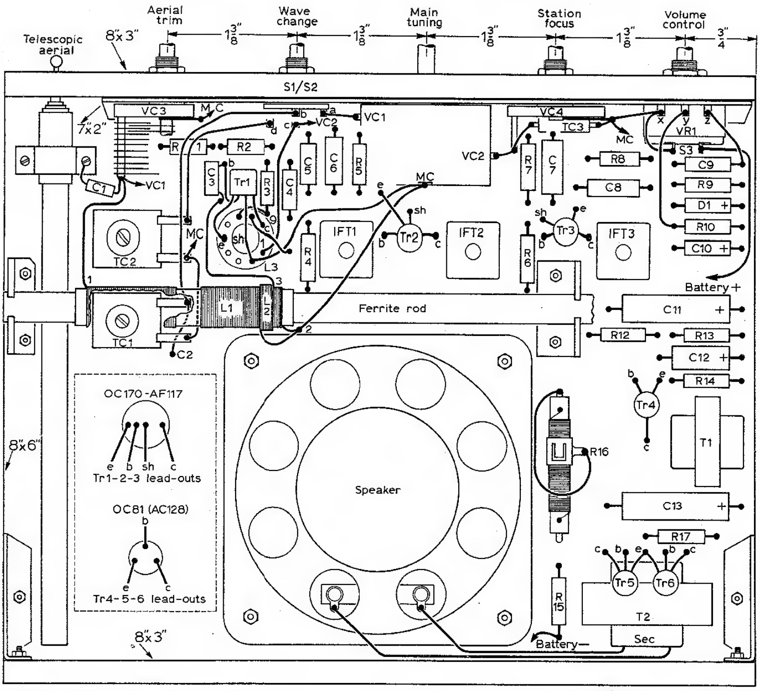
Normal medium wave coverage is about 550-1600kHz. In the interests of easy switching, full long wave frequency coverage is not provided. However, switch S1 places TC1 and C2 across L1, and S2 puts TC2 across the oscillator coil L3. This allows a narrow band around 200kHz to be tuned for BBC Radio 2 transmissions on this frequency.

Tr1 is an OC170, followed by two double-tuned i.f.t.'s with AF117 transistors, and this combination gives good sensitivity and selectivity. The OA81 diode D1 used with i.f.t.3 provides automatic gain control bias in the usual way, through R9, and VR1 is the audio volume control.

The driver stage Tr4, OC81D, and output pair Tr5/6, 2 x OC81, are straightforward and give ample volume. R18 is for negative feedback over these stages, while R16 is adjustable, so that base operating conditions for Tr5/6 can be set for best results.

Fig. 1.





General Construction

The way in which the receiver is assembled is very convenient for wiring, testing and adjusting. The loudspeaker and all small components are on an 8 x 6in. perspex panel. A 7 x 2in. flanged aluminium plate ("universal chassis" ready-formed side) is bolted to the top of this panel, and carries the variable capacitors, switch and volume control. A three-ply panel 8 x 3in. is secured with the bush nuts of these items, and projects about $^3/_8$in. over the wiring side of the 8 x 6in. panel. At the bottom of the 8 x 6in. panel, a further piece of three-ply also 8 x 3in. is fixed with brackets.

With this form of construction, the receiver will rest in any position, to insert and wire components and will stand vertically in a normal working position, without a cabinet. The bottom piece 8 x 3in. carries the battery. The controls are on the top, so the whole receiver can be lowered into the case which clears 8 x $6^1/_2$ x 3in. inside and has apertures opposite the speaker.

The 8 x 6in. panel is $^1/_8$in. perspex, so that all components and connections can be seen from either side. If this feature is not required, the receiver can be built on a paxolin panel.

Perspex is usually supplied covered on both sides with paper, which is left in place until cutting and drilling are finished. The panel is marked out to take components as in Fig. 2. A $^1/_{16}$in. drill was used for the wire ends of resistors, etc., and $^1/_8$in. for bolts which hold the speaker, brackets, etc.

Drilling positions for the i.f.t. pins can be found by pressing paper on pins, then locating the paper on the panel, and marking through with a sharply pointed tool. A central hole is necessary under i.f.t.1 and i.f.t.2, to take a trimming tool.

The speaker aperture is most readily cut with an adjustable washer or tank cutter, but can be made with a fine toothed saw.

Check the holes against Fig. 3. Drilling is much easier before any components are mounted, but if any holes are missed, they can be drilled later. Drill the 7 x 2in. flanged plate and panel, so that they can be secured together with the two bolts

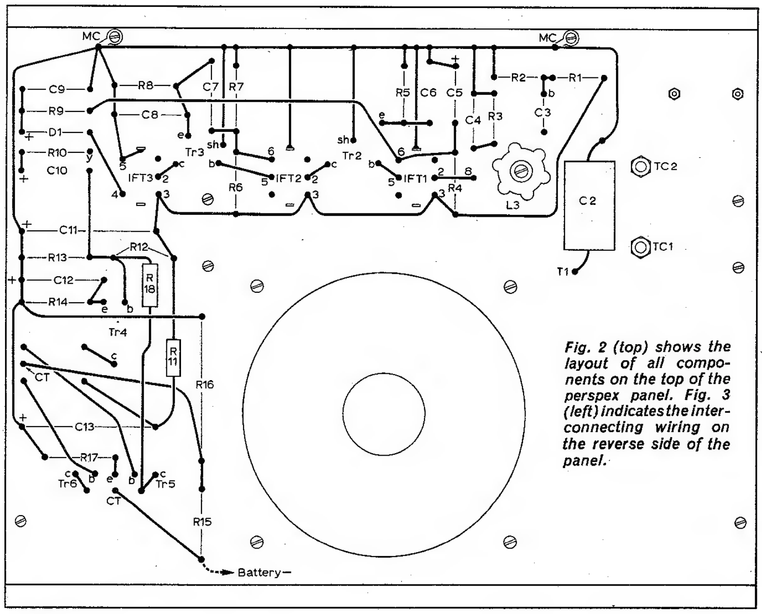


Fig. 2 (top) shows the layout of all components on the top of the perspex panel. Fig. 3 (left) indicates the interconnecting wiring on the reverse side of the panel.

marked MC in Fig. 3. This plate is to the right in Fig. 2, to clear the extending aerial.

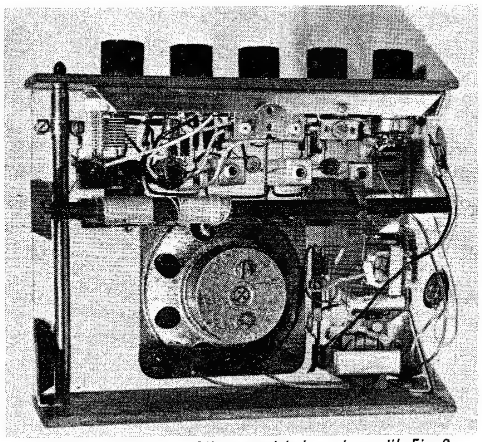
Fig. 2 also shows the spacing for the variable capacitors the holes for which are most readily made with a punch. VC1 is held with three bolts which run into tapped holes in the front plate. These bolts must be very short, or washers must be added, so that the ends do not foul the moving or fixed plates of the capacitor.

The ferrite rod and speaker are left off until last.

Wiring Tips

Place tags under the bolt heads and nuts of both bolts MC, Fig. 3. A 20 s.w.g. bare tinned copper wire is soldered from tag to tag, as shown, as a positive or "earth" return and VC1/2 is connected to this circuit through the metal plate. Connect VC3 and VC4 to the adjacent tags this side, Fig. 2, and also X on VR1, and S3.

All other wiring is carried out with 26 s.w.g. tinned copper wire, with 1mm. insulated sleeving. It is convenient to use red for all "earth" or positive circuits, black for negative circuits, and some other colour for other connections.



Compare this view of the completed receiver with Fig. 2.

I.F.T.'s 1 and 2 have slightly closer spacing between pins 1 and 2, and 5 and 6, as in Fig. 3 and must be inserted and wired this way. The cans of all i.f.t.'s are earthed.

As a check, each component can be marked with coloured pencil on the diagrams as it is inserted and each connection can be similarly marked, as it is made. If this is done systematically, it is unlikely that anything will be omitted.

Electrolytic capacitors must be inserted with the polarity as shown. Trimmers TC1 and TC2 are of a type which can be secured with nuts (Fig. 3). The small trimmer TC3 can be soldered across VC4, or supported on a small bracket from the flange.

The telescopic aerial is fixed so that it can be drawn up through a hole in the top panel. Wire VR1 to MC, C9 and R10 as shown, and run red flex from the switch on this control, S3, soldering on a positive battery clip. The battery negative lead comes from R15.

Connect a flexible lead from the slider of R16, to one end, as in Fig. 2.

Transistors

These are best added after the resistors and capacitors. Fig. 2 shows the four leads of Tr1, Tr2 and Tr3, which are for emitter, base, shield and collector.

Transistors Tr4, Tr5 and Tr6 have three leads, for emitter, base and collector, as shown in Fig. 2. If Tr4 is an OC81D and Tr5/6 are OC81's, with leads in line, then a red spot indicates the collector.

Shape the leads so that they are clear of each other, and will pass down through the correct holes. The transistors can be about ½in. clear of the panel, but leads should not be unnecessarily long in the i.f. stages. They are then soldered as in Fig. 3, and snipped off.

Form the leads of Tr1 as in Fig. 2, and put sleeving on them before soldering. With Tr5 and Tr6, both emitter wires go through a single hole, to R17. Place D1 with its polarity as shown.

Heat shunts are not generally required if the connections are soldered rapidly with a properly heated iron. The iron is removed immediately the joint is made.

★ components list

Resistors:

R1 10kΩ	R7 4·7 kΩ	R13 22kΩ
R2 2·7kΩ	R8 1kΩ	R14 1kΩ
R3 1kΩ	R9 8·2kΩ	R15 2·2kΩ
R4 68kΩ	R10 2·2kΩ	R16 100Ω*
R5 680Ω	R11 560Ω	R17 4·7Ω
R6 22kΩ	R12 68kΩ	R18 680kΩ

All ¼W 10% except R16 * Pre-set (Home Radio VR101) VR1/S3 5k Ω pot. (log) with switch.

Capacitors:

C1 18pF	C6 0·04μF	C11 100μF 12V
C2 1000pF SM5%	C7 0·04μF	C12 50μF 6V
C3 0·02μF	C8 0·02μF	C13 100μF 12V
C4 0·01μF	C9 0·01μF	
C5 10μF 6V	C10 2μF 6V	

VC1/VC2 208+176pF ganged (Jackson)
VC3 75pF air-spaced variable, miniature.
VC4 2 to 4·5 pF air-spaced variable, miniature.
TC1 1250pF pre-set (Home Radio VC29SA)
TC2 450pF pre-set (Home Radio VC29R)
TC3 60pF pre-set

Semi-conductors:

Tr1 OC170	Tr4 OC81D (or AC128)
Tr2 AF117	Tr5 OC81 (or AC128)
Tr3 AF117	Tr6 OC81 (or AC 128)
	D1 OA81

Inductors:

L1/L2 Ferrite rod aerial (M.W. only) (Denco FRA1)
IFT1 IFT18/465 (Denco) IFT2 IFT18/465 (Denco)
IFT3 IFT14/465 (Denco)
L3 Range 2T Red (Denco)

Miscellaneous:

Speaker, 3½in 3Ω. T1, Driver transformer (Home Radio TR64). T2, Output transformer (Home Radio TR65A). S1/S2, 2 pole 2 way switch. Telescopic aerial with bracket. Universal chassis member 7 x 2in. (Home Radio CU136). Knobs (5). Perspex (or paxolin) 8 x 6 x ⅛in. Plywood 8 x 3in. (2 off). "Radio Constructor" panel transfers.

TO BE CONTINUED

TAKE 20

No. 25
AUDIO AMPLIFIER

JULIAN ANDERSON

A series of simple transistor projects, each using less than twenty components and costing less than one pound to build.

IT is the aim of this page to give circuits and explain the operation of the simplest type of circuits and we are of course limited to £1·00 and twenty components and obviously this places certain restrictions on the quality of the finished articles. Nevertheless simplicity also leads to a lesser likelihood of mistakes and the circuits usually have a wide range of uses in many fields. This month's project fits into this category; it is an audio amplifier which may be used to boost the output of an earphone type radio, as a pickup amplifier or an intercom. It is extremely simple and, to my knowledge, has never been published before.

THE CIRCUIT

The secret of the simplicity of the circuit shown in Fig. 1 is the directly coupled Darlington Pair of transistors, Tr1 and Tr2. This configuration, which is also known as a super-alpha pair, acts rather like a single transistor with very high gain, the base being represented by the base of Tr1, the emitter by the emitter of Tr2 and the collector by the common collector connections. The gain of this combination is roughly equal to the products of the gains of the individual transistors. With the specified transistors the minimum gain should be no less than 8,000 using the green version of the 2N2926 (highest gain grouping) or a maximum of over 20,000!

With gains of this sort of order it's not surprising that few components are needed.

If one looks upon a transistor as a resistor whose value between the emitter and collector alters, depending on the base bias applied, it can quickly be seen how the circuit operates—and why the gain is so high. Regarding the operation in this way, Tr1 becomes a variable bias resistor for Tr2 so that the higher the input signal, the greater the bias.

The quiescent current through the transistor pair depends on the value of R1 and although the value shown—1·8MΩ—worked well with several transistors used for Tr1 and Tr2, the value does depend on the gain of the pair and may have to be selected from a range between 680kΩ and 3·9MΩ.

The quiescent current through Tr2 is fairly high—20mA or so—and it is for this reason that we are using a BFY51 rather than a transistor with a lower current handling capacity.

C1, VR1 and C2 simply act as d.c. blocking capacitors and as a volume control. The input impedance of this type of circuit is high and this allows for the use of low value blocking capacitors in conjunction with a high value volume control—here a 1MΩ type is used. It is not recommended to substitute an 8Ω or a 3Ω speaker directly into the collector circuit, though the use of a transformer with a ratio of about 5:1 would allow these to be used.

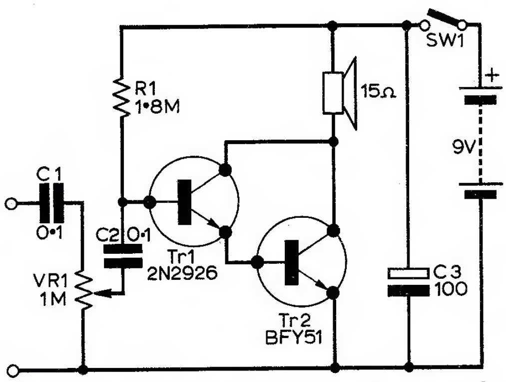


Fig. 1. The circuit of the "Take 20" Darlington pair audio amplifier

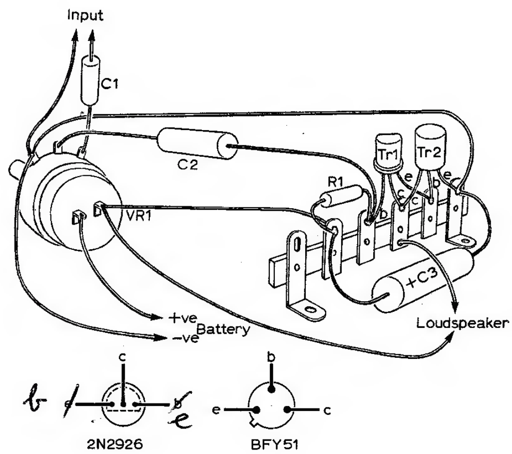


Fig. 2. A suggested layout for the amplifier using a small tag-strip; the transistor lead connections are shown below, viewed from the lead ends.

A suggested layout on a short tag-strip is shown in Fig. 2, though as the circuit is published as a general purpose type, it will normally be built as part of some other circuit.

A PP9 battery should be sufficient for this circuit; the smaller PP3 type will be unable to supply the necessary current as the power output of the amplifier will be about 200mW. This output level is quite adequate for most uses.

The final quality is surprisingly good and all-in-all the circuit will be found to be a very useful one. ■

10 WATT

AUDIO AMPLIFIER

HALVOR MOORSHEAD

IT is difficult to fit the amplifier described in this article into any normal category. By the DIN specification it is probably Hi-Fi but by current accepted standards of Hi-Fi it leaves a little to be desired.

The ten watt output is far higher than normal record player amplifiers, yet is well below the usual 25W which now seems to be the lowest power acceptable.

It is neither as cheap to build as the amplifiers featured in "Take 20" but neither does the cost approach that of commercial amplifiers. So this amplifier is in the "Mid-Fi" field. The quality is good—laboratory tests show a flat output from 40Hz to 20kHz with harmonic distortion below 1% at 1kHz at 5W output. This distortion level is high by prevalent standards but since the human ear cannot distinguish even 2% of harmonic distortion, it hardly matters.

The cost of the project is low. The amplifier by itself should be rather less than £5 and the cost of the separate power supply will probably add another £3—these prices do not, of course, include the loudspeakers.

The circuit and the construction details cover a mono version but naturally when doubled up, using dual pots for the volume and tone controls, and fitted with a balance control, it would be perfectly satisfactory for stereo.

Since the amplifier as described does have limitations in performance, it is not intended for use with expensive magnetic pickups and it is assumed that it will be used with ceramic or crystal types. If a magnetic pickup facility was to be incorporated, correction would also have to be applied.

No great originality is claimed for the circuit—it is largely based on Mullard designs though slight modifications have been incorporated. The output transistors are the common AD161-AD162 complementary pair and closely matched pairs of these are currently available for as little as 50p though they are more commonly sold for 80p.

The finished amplifier, in the monophonic version, is small, though not so small that construction is difficult and it was designed to this size so that it can fit into almost any record player cabinet. If the amplifier is to stand on its own a wooden surround would improve appearances. The power supply is built separately and this can be mounted quite a distance from the amplifier—if fitted into a record player this can be fitted at the back.

Loudspeakers are not dealt with as this is a completely different field but the impedance can be anything between 5Ω and 15Ω. The amplifier has been tested running for several hours at full output on a 3Ω speaker system but this low impedance cannot be recommended in all cases, though no harm came to the prototype.

The hum and noise level are extremely low; at full output they were only just audible with an ear inside the speaker cone and at a foot away, non-existent.

One of the problems with home built amplifiers of this type is instability, the author has often come across this and knows of others who have experienced the same problems.

The design shown should be unconditionally stable and two features are incorporated in the circuit to increase stability, even though without them the stability was good; this means that anyone building the amplifier can be sure that these problems will not arise even if the layout chosen would tend to oscillation.

THE CIRCUIT

The complete circuit, apart from the power supply, is shown in Fig. 1 and this comprises three main sections: the preamp., the tone control and filter stage and the output amplifier.

It has already been mentioned that the amplifier is designed for use with ceramic or crystal pickups. Although these have got a very high output—at the very least 80mV and often ten times that level, the inherent impedance of these types is high and unless they are coupled to a high input impedance, the frequency response will suffer. Transistors in the common emitter mode have typical input impedances of about 20kΩ, far too low to mate the pickup to, so for this reason the inputs are connected directly to a 1MΩ resistor in series with the input and this, of course, determines that the input impedance is at

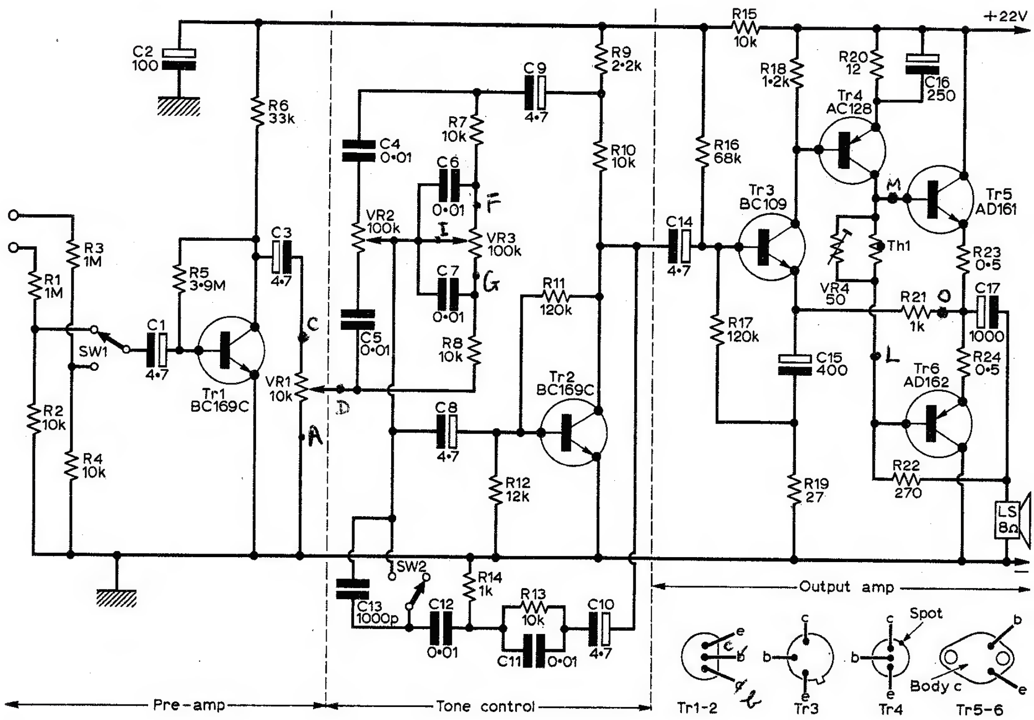


Fig. 1 : The complete circuit of the 10W amplifier. A full description of the operation and function of the components is given in the text.

★ components list

Resistors

R1	1MΩ—see text	R13	10kΩ
R2	10kΩ	R14	1kΩ
R3	1MΩ—see text	R15	10kΩ
R4	10kΩ	R16	68kΩ
R5	3·9MΩ	R17	120kΩ
R6	33kΩ	R18	1·2kΩ
R7	10kΩ	R19	27Ω
R8	10kΩ	R20	12Ω
R9	2·2kΩ	R21	1kΩ
R10	10kΩ	R22	270Ω ½W
R11	120kΩ	R23	0·47Ω (or 0·5Ω) 2W
R12	12kΩ	R24	0·47Ω (or 0·5Ω) 2W

All resistors ½W, 5% except where stated

VR1	10kΩ log.	VR3	100kΩ lin.
VR2	100kΩ lin.	VR4	50Ω skeleton preset.

Capacitors

C1	4·7μF 15V	C10	4·7μF 15V
C2	100μF 25V	C11	0·01μF
C3	4·7μF 15V	C12	0·01μF
C4	0·01μF	C13	1000pF
C5	0·01μF	C14	4·7μF 15V
C6	0·01μF	C15	400μF 15V
C7	0·01μF	C16	250μF 6V
C8	4·7μF 15V	C17	1000μF 25V
C9	4·7μF 15V	C18	2500μF 50V

Semiconductors

Tr1	BC169C	Tr6	AD162
Tr2	BC169C	TH1	VA1077 (32Ω) (Electrovalue)
Tr3	BC109	BR1	Silicon Bridge Rectifier—see text
Tr4	AC128		
Tr5	AD161		

Miscellaneous

SW1, SW2	Miniature changeover slide switches
Transformer	250V pri., 17 or 18V secondary, 1·5A
Fuse	With fuseholder, 1A
Metal Chassis	7in x 4in x 1½in, H. L. Smith Ltd.
Sockets	Input, 3-pin DIN, Output, DIN L.S. Type
Tagstrip	2-way
Veroboard	0·15in matrix, 4¾in x 2½in
Heatsink	Wrap around type for AC128

least this high.

Two inputs are provided and as shown are for similar levels and impedances. One is provided for the pickup, the other for a radio tuner. Radio tuners have outputs which vary from about 50mV to 1V and R3 (if the tuner is to be connected to this section) may well have to be varied from the given value to match the tuner used. The value shown is suitable for 500mV.

For a 1V output it should be 2MΩ while for 50mV it should be 100kΩ. Since the output impedance of tuners is rarely high it doesn't matter if the input impedance is lower for this side. In any case the value should be chosen so that the levels at the input to Tr1 are similar for both tuner and pickup.

Therefore R1 and R2, R3 and R4 act as the input attenuators and matchers. The output for the attenuators go directly to the input select switch and the output from this goes to the base of Tr1 via the blocking capacitor C1.

The function of Tr1 is to raise the level of the signal to a suitable level to feed the tone control network and overcome the necessary attenuation brought about by the input resistors. Tr1 is a BC169C, a plastic version of the low noise BC109. R5 provides the base bias and is of this high value because of the high gain of the transistor.

The output of the preamplifier connects via the blocking capacitor C3 to the volume control, a 10kΩ log. potentiometer. If a stereo version is to be built the only additional component necessary would be a balance control which fits at this point in the circuit. This should be a 25kΩ linear pot., the outer tags connecting to the sliders of the two volume controls with its own slider going to chassis.

The output from the volume control goes to one side of the tone control network comprising VR2, VR3, C4 to C7 and R7 and R8. The other side of the tone control network is connected to a negative phase signal so that the output of the network can be varied from minimum bass and treble to maximums of the same signals.

The output of the network connects to the base of Tr2 which is baised by R11 and R12. The feedback to the tone control network is taken from the potential divider R9 and R10 which between them form the load for Tr2.

Another output from the collector of Tr2 is taken via blocking capacitor C10 to the "Hi-Cut" filter which is designed to couple back to the base as little of the frequencies below 7kHz as possible and as much of the higher frequencies as possible. As the filter is connected in the negative feedback mode this has the effect of giving a very steep cut above 7kHz and acts very effectively as a scratch filter for poorly treated or old records.

In addition when used to amplify radio signals it will help to get rid of the higher frequency heterodynes present on many a.m. signals after dark.

A filter of this sort should not be confused with a tone control which is designed to gradually slope the high or low frequencies. The "Hi-Cut" filter is designed to have little effect below 7kHz and a lot above it.

The filter is switched in or out by SW2 but C13 is arranged to couple at all times. This is included so that even with the filter out there is a very steep cut at a much higher frequency—about 40kHz—and signals much above this are completely eliminated. Since this is well outside the audio range it in no way impairs the quality but it does serve two other functions.

The fantastic frequency response of the silicon transistors used in modern audio amplifiers leads to the amplification of any r.f. signals picked up in the wiring which tend to be detected at some point in the circuit. The high input impedances included in the earlier stages do nothing to help this. The filter completely eliminates these problems.

For similar reasons it is quite common for instability to become a problem, output signals of a high level being capacitively coupled to the input circuitry. The filter greatly reduces the likelihood of this.

The output of the tone control couples to the output stage and is first amplified by Tr3 whose emitter is held at half the supply volts which appear at the junction of R23-R24 and is smoothed by C15. The inclusion of R19 incorporates a degree of negative feedback and thus improves the quality and stability of the output stage.

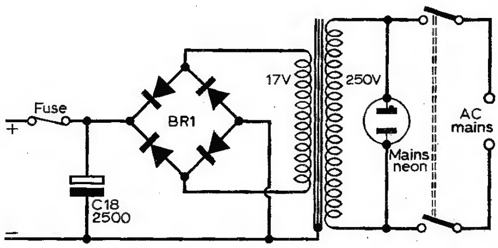


Fig. 2: The power supply circuit.

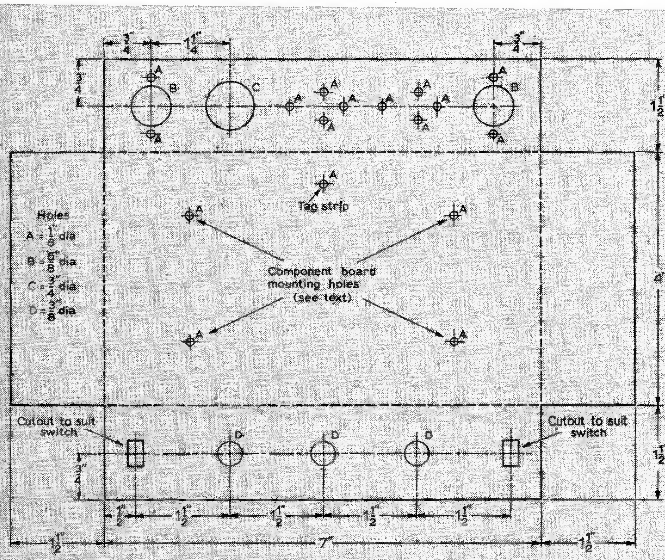


Fig. 3: The drilling of the chassis. A suitable inexpensive one, as used in the prototype is available from H. L. Smith Ltd., 287 Edgware Rd., London W.2.

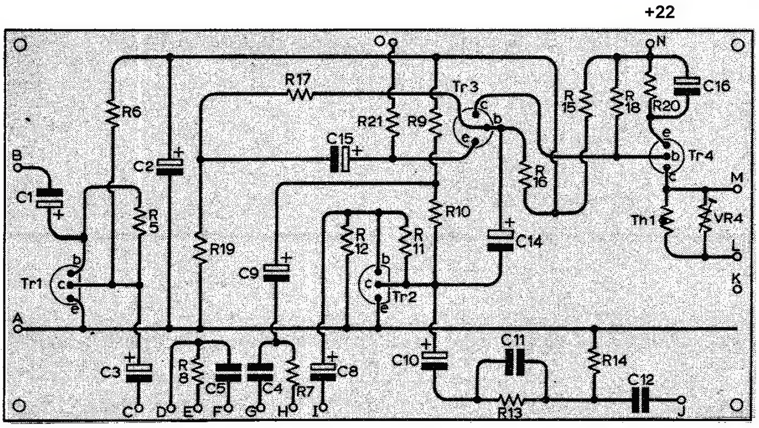
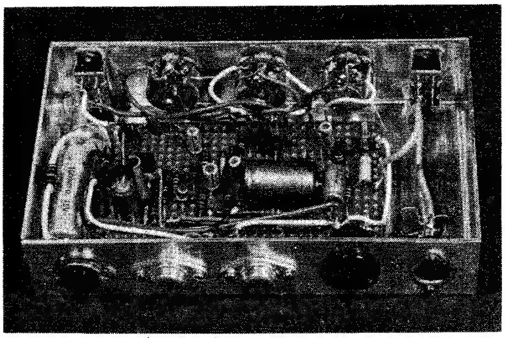
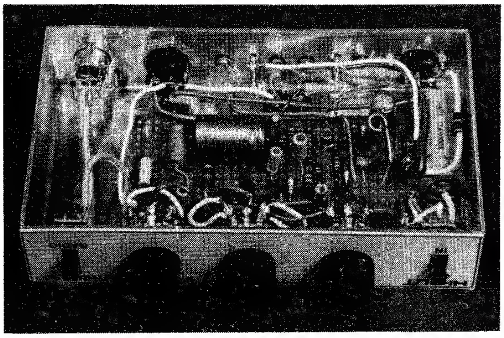


Fig. 4: The component layout on plain veroboard.

The output from Tr3 is directly coupled to the driver transistor Tr4, a p-n-p germanium type, which, because of the high currents it is passing must be protected from run-away by R20, decoupled by C16.

The output from Tr4 is coupled to the bases of the output pair Tr5 and Tr6, the slight bias necessary between them provided by the thermistor TH1 whose slope is made linear by paralleling it with a 50Ω preset whose setting also determines the quiescent current in the output stage.





Two internal views of the 10W amplifier showing the general layout. Compare these with Figs. 4 and 5.

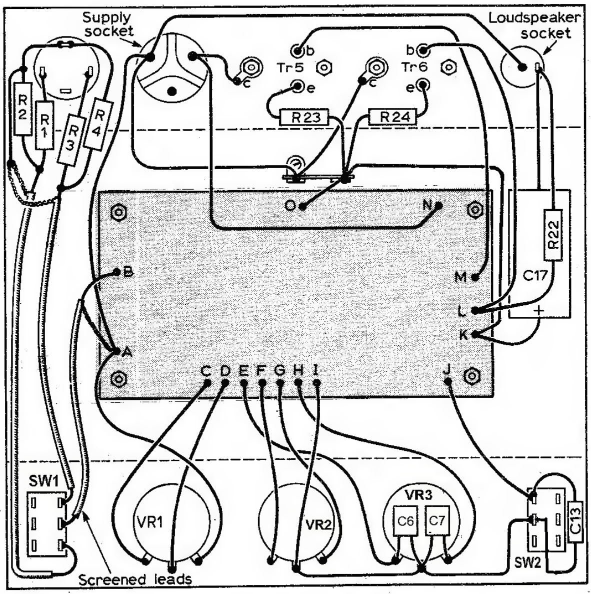


Fig. 5: The wiring between the component board and those components mounted directly on the chassis.

A degree of feedback is applied by connecting the load resistor of Tr4 (R22) through the loudspeaker.

The output of the complementary pair provides the low impedance output via C17 which has to be high in value to effectively couple the bass notes to the loudspeaker.

Amplifiers of this type require a low impedance power supply—batteries will be no good. The current drawn varies between a few milliamps and an amp. The transformer has a primary winding of 250V with a 17V, 1A secondary which connects to the Bridge Rectifier BR1. Various types are suitable and some inexpensive plastic encapsulated types such as the Mullard BY164 are highly suitable. However any type with a voltage and current rating of 30V, 1A should be satisfactory.

To keep the hum level down to an acceptable level, the reservoir capacitor has to be of a high value. Some protection to both the power supply and the amplifier is provided by the 1A fuse in the line.

Careful smoothing of the supply voltage is necessary in the earlier stages and this is catered for by C2; any value lower than this may lead to low frequency instability. If motor-boating *does* occur the value of C2 should be increased.

CONSTRUCTION

The amplifier is built inside a small aluminium chassis $7 \times 4 \times 1\frac{1}{2}$in. with one long side holding the controls with the inputs, outputs and power transistors sited on the back. The drilling of the prototype chassis is shown in Fig. 3.

Small slide switches are used for SW1 and SW2 and rectangular holes have to be cut at each end of the control panel for these. Slide switches are designed to be bolted to the chassis but a much smarter and easier job is made by gluing these on using Araldite.

The holes for the power transistor leads and mounting screws are most easily made by using the mica washers, which should be provided with the transistors, as a template.

On the prototype the supply is arranged to plug in using a Bulgin connector, but of course a simple hole fitted with a rubber grommet would be just as good to feed the two wires to the power supply.

To make the wiring short, a small tag strip should be mounted near the output transistors to hold R23 and R24.

The majority of the components are mounted on a piece of plain Veroboard, 0·15in matrix, sized $4\frac{3}{4} \times 2\frac{1}{2}$in. The siting of the components on this is shown in Fig. 4. C15 is a bulky component and has to be sited as shown in order to fit in.

Tr4 will be warm in operation and it is important that a heatsink is fitted to avoid thermal runaway. The output transistors also need a heatsink and this is provided for by bolting these to the back. Even though the body of Tr6 is at chassis potential (the body being the collector) do *not* be tempted to leave off the mica insulating washer that is also needed for Tr5. Hum may be introduced due to earth loops if it is left off.

The output capacitor is connected directly between the output socket and a mounting pin fitted on the component board, so is R22.

The wiring between the board and the components mounted on the chassis is shown in Fig. 5.

No wiring is shown for the power supply as this will depend on the transformer and bridge rectifier used, but it is so simple that it can easily be worked out.

If a switch is needed for this it should be mounted on the power supply chassis.

Only one input socket is provided—a DIN 3-pin type and both inputs should be wired to it, the attenuator resistors are also mounted on it.

If the slide switches are glued to the chassis as suggested, a sheet of white card can be fitted over the front panel, as there will be no screws to stop it from laying flat, and a very acceptable face plate can be achieved as shown.

TESTING

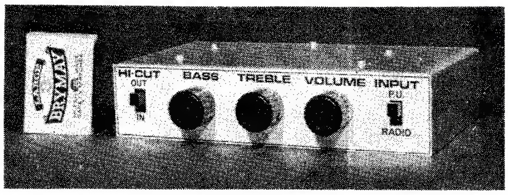
Once the wiring is completed and thoroughly checked it is worthwhile measuring with an ohmmeter the resistance between the bases of the output transistors. The resistance should be low and the preset VR4 adjusted for minimum resistance. (This means that there should be a short between them.) Also check that the collector of Tr5 is insulated from the chassis. If all is well with these tests it is unlikely that harm will befall your newly completed project.

If two PP9 batteries are available, these can be used to supply 18V for initial testing. The noise level, even on full output, should be very low, but the dabbing of a finger on the input should produce a high hum level.

If all seems well a pickup can be connected. On full output there will be severe distortion due to the use of batteries but the use of these lessens the likelihood of destroying the transistors if there are any mistakes in wiring, etc.

With all these points checked, the power supply can be connected. There may still be distortion due to the setting of VR4 and this should then be backed off until the audible distortion just disappears while ensuring that Tr4, Tr5 and Tr6 do not get hot.

The effectiveness of the tone controls and the Hi-Cut filter should be considerable and the output be more than adequate. ■



The small size of the amplifier can be judged by the matchbox on the left yet the photographs on the previous page show that layout is not crowded.

CQ!CQ!CQ!CQ!

INFORMATION WANTED

...details of the makers of the stereo amplifier marketed by Electronic Sales (Victoria) Ltd. I was led to understand that this was covered by maker's guarantee but have no idea who they were. The fault is that I switched on without speakers connected.—A. E. Webb, 25 Heather Road, Milton, Abingdon, Berkshire.

...any information on the Fi-Cord 1A tape recorder. I wish to modify this machine to one with a more modern specification.—M. A. Amstell, 37 Basing Hill, Wembley Park, Middlesex.

...borrow manual of—or acquire constructional information on Heathkit battery portable UXR1—A. Pitt, Rendcomb College, Nr. Cirencester, Gloucestershire.

...any information, or the loan of a circuit for a Selmer Type "C" Clavioline with the transistor line-up 4 x 2SB176, 2SB175B and 2SB1738.—J. M. Newby, 27 St. Johns Road, Shildon, Co. Durham.

—any information on the Standard Radio 5AH transmitter. Also, where can I get a BA114 Mullard diode and has it an equivalent?—P. Gladwin, Westfield Farm, Towersey, Thame, Oxon. OX9 3QB.

...any information on modifications to, and the handbook and circuit diagram of the R 209 Mk. 2 receiver.—P. Reeves, 2 Hunts Mead, Billericay, Essex.

ISSUES WANTED

...Practical Wireless dated October 1967 containing the Music Box article. Ten shillings paid for same.—"The Occupier", 3 Lawrence Close, White City Estate, London, W.12.

...the March 1970 issue of Practical Television.—J. Barin, 7 Eastside Road, London, N.W.11 OAY.

...January to September 1968 copies of P.E.—M. Duxbury, 2 Jefferson Drive, Ulverston, Lancashire.

ISSUES FOR DISPOSAL

...copies of Practical Wireless for 1963/4/5/6. Anyone can have them FREE.—S. J. Wells, 34 Brockman Rise, Bromley, Kent.

...Practical Electronics from the start (November 1964) to December 1968. Practical Wireless from May, 1965 to April, 1966. All are complete and in binders. Any offers considered.—N. J. Moore, Flat 5, 7 Corfton Road, Ealing, London, W.5.

EQUIPMENT WANTED

—a dual i.f.t. numbered "L8" for a Jason Argonaut f.m./a.m. tuner.—A. Kenway, 16 Hilliers Lane, Beddington, Surrey.

LITERATURE WANTED

...copy of Mullard Circuits for Audio Amplifiers, second edition (1962). The price at the time was 8s. 6d. Please state price and postage.—G. W. Saunders, 26 Rowan Crescent, Streatham, London, S.W.16.

practically wireless commentary by HENRY

No. 79

The Tero-Technologist

DESPITE the fact that there were only eight entries for last year's John Rouse Trophy (RSGB constructional entry for under-sixteens), and our disgruntled Editor found it necessary to bemoan (September 1970) that few radio amateurs now build their own main station gear, we feel encouraged by the response to Project Autumn 1970, to recommend those bright young sparks about to cast off the shackles of school to think about the radio servicing business.

Henry recently enjoyed a talk with a bunch of school-leavers. Many of them were captivated by the glittering world of electronics. Bemused by the button-pressing magic of *Dr. Who* and *Star-Trek,* bedazzled by the multi-million flash of instrumentation in the Space-age-for-real, they imagine that radio and television engineers in the entertainment industry must hold the key to perpetual interest.

Henry is amazed at the blurred occupational edges. These youngsters imagine that the lucrative and glamour-ridden world of the television 'star' is gained via the cabled chaos of the studio floor, or, at best, the hallowed hush of the control room.

Hush! Have you ever been in a control room when the producer is shouting at three cameramen at once, when the *sotto voce* of the floor director's talkback is rattling the monitor loudspeakers, when the continuity girl has dissolved into tears over a lost page four and the musical arrangements depend on the cue-consciousness of a half-drunk tape recorder operator?

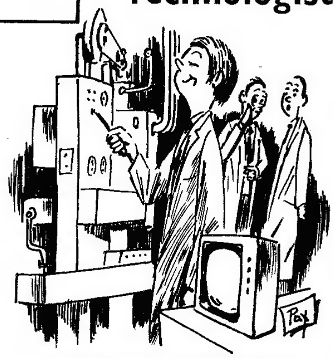
The continuity girl dissolved into tears.

Very few performers come up from these ranks. To begin with, a few weeks behind the cameras, or abaft the mikes, soon disillusion any would-be entertainer. There's Harold Williamson, of course, but he is not exactly an entertainer. And there's 'Professor' Stanley Unwin, whose prowess should convince us that a spell in the camera crew would make anyone talk gobbledygook. One or two disc jockeys know a little of what goes on beneath the platter. But those who fancy *that* job may not have any notion of the sweat and toil that can go into sorting out, helping to edit and presenting *'a favourite toon for Mrs. Pettifer of Lower Peckham Rye.'*

Sometimes, the yearning is genuine. The lure of electronics really fascinates youth. Some of the mystery has been peeled away by a keen science master, revealing even greater depths. Space-age phenomena make much that was wonderful seem mundane—when we hear a gravelly op-check from many thousands of miles away, we are now more likely to carp at its roughness than marvel we can get it at all!

But Miss Today and Master Tomorrow take miracles in their stride. Perhaps I should have told them about the openings in Tero-technology, a word the Min-Tech boys coined for Maintenance Engineers. These maligned gentlemen are fast becoming an élite. They work for large engineering companies, daily waving their magic wands over the fallible products of systems designers.

They are expected to instal, commission and maintain any-



Leaving behind a trail of modified machinery.

thing from an air-drying purifier to a fully automated oilfield. Electronics is only part of the game to them—building blocks are what we should consider factory-sized projects.

I know one of these gents. He came out of redbrick with a poor degree, entered industry as an assistant to an assistant of an assistant designer. Moved from firm to firm, absorbing knowledge like a sponge and leaving behind a trail of modified machinery. He graduated to his present job simply because nobody else dared take it. And now he picks up all the bricks that scatter-brained designers have dropped besides acting as consultant for half-a-dozen international concerns.

From whence came his qualifications? Well, despite our modern technicological age and the outmoded place for an amateur, I suggest he received his impetus and his capacity for a quirky open mind from his younger love of amateur radio, constructional hi-fi and continual dissatisfaction with marketed products. He is a gadget man' and proud of it, even if his present job of 'panel-changing' involves him in king-sized modules.

If anyone tells you, young shaver, that the day of the dabbler has gone, just point to the tero-technologist and be thankful.

SERVICING

AN INTRODUCTION TO FAULT-FINDING

PART 1

H. W. HELLYER

THIS SERIES, WRITTEN BY H. W. HELLYER AND G. J. KING, BEGINS WITH A DISCUSSION OF THE BASIC COMPONENTS OF ANY PIECE OF ELECTRONIC EQUIPMENT, THE RESISTOR, CAPACITOR AND INDUCTOR, WITH SOME NOTES ON THE VALVE AND TRANSISTOR.

BEFORE we can repair a radio receiver, audio amplifier or any other piece of electronic equipment, we must understand something about the fundamental parts of the circuit. Any circuit can eventually be broken down into its component parts or combinations of parts, just as any whole circuit will separate, for convenience, into a number of 'building bricks', as we shall see when my colleague Gordon J. King takes over the next part of this series.

My job, this month, is to lay the ground, describe the 'bones' which form the skeleton circuits and give a few hints about their testing.

Description of components and their functions must needs be brief. We haven't the space for a detailed exposition or for more than a quick look at the three main classes of circuit bones—resistors, capacitors and inductors.

RESISTORS

Sub-dividing the first class, we have fixed, variable and non-linear resistors.

Fixed types may be of carbon, of composition, metal-oxide film on a glass rod or any of several proprietary substances. Values of these components will vary between a fraction of an ohm and several million.

Tolerances are important to the designer and to the engineer who follows in his footsteps by maintaining the equipment. For resistors the tolerances fall into groups, from 1% to as much as 20%. The current a resistor can safely carry is important also for this determines the choice of wattage of the component we may need, to replace a damaged one in a circuit.

The wattage (W) is equal to the product of the current (I) through the resistor (R) and the voltage developed across it (V). By Ohm's Law, $W = I^2R$ or V^2/R or $V \times I$.

Resistors of more than about 2 or 3 watts will usually be wirewound. These are generally bulkier and often consist of a ceramic tube with resistive wire wound on it anchored to stiff wire ends.

Non-inductive wirewound resistors are very necessary for some positions in the circuit and these are made by winding the resistive element in such a way that the two legs of the 'coil' lie together and magnetic fields tend to cancel each other. Such bifilar winding, as it is called, will also be met with in coil construction, where it is used for the same purpose of cancellation of unwanted magnetic fields.

Practical points: composition resistors are easily damaged by heat. Discolouration of the coding or body paint is an indication that excess current has passed. Do not ignore the warning, look for the reason. Metal-oxide components (and some of the older composition types) had end caps clamped on, relying on physical pressure for their resistive contact.

A loose clamp, or a badly connected lead wire to a cap, is the possible cause of a 'high resistance' joint. As these types are often painted over, with the poor joint beneath the coating of paint, the end cap may not appear to be loose at all.

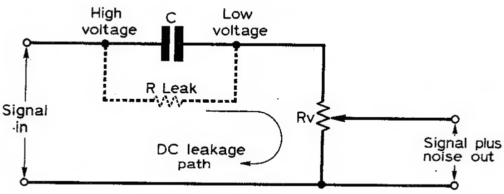
Colour coding has been standardised pretty well by now, although there are always awkward exceptions. Dirt, heat and age may discolour components and obscure or alter colours, so the rule should be: 'When in doubt—check.' A table of colour codes, including tolerances, etc., is given for resistors.

To some extent, the same code can be used for capacitors, as can the abbreviated method of indicating component values. Despite attempts at standardisation, values may be expressed in several different ways. A 4700 ohms resistor, for example, may be designated 4·7k, or 4k7, or given its full title.

Variable resistors come in a number of varieties, from the common, three-tag 'volume control' we know so well, to multi-section, tapped sliders, often ganged mechanically as well. Basically, the variable resistor can be sub-divided into carbon-track and wirewound types, and a further classification must specify whether the 'law' of the resistor is logarithmic or linear, i.e. log. or lin.

Linear types are self-evident; the resistance in circuit varies in proportion to the angular rotation of the spindle to which the wiper is attached (or the lengthwise travel of 'slider' types). Log. types have a track whose resistance increases logarithmically as the spindle moves, so that for a great proportion of travel there is little change in resistance, then as the rotation continues, the resistance increases more and more rapidly, i.e., the scale of resistance is cramped toward the upper end. As this conforms more with the physical nature of hearing, such a control is more often used for a volume control, whereas lin. types will usually be found in tone and balance control circuits.

Practical points: noisy volume controls are a frequent complaint—not always justifiable. Very often, the real trouble lies in stages prior to the control, with the fault revealed as the control 'opens up'. An example here is a leaky coupling capacitor in a valved circuit, where the coupling is from the anode of the preceding stage to the 'top end' of the volume control, the potential across the capacitor being nearly that of the h.t. line. This causes a small current to flow through the variable resistor, with resultant noise.

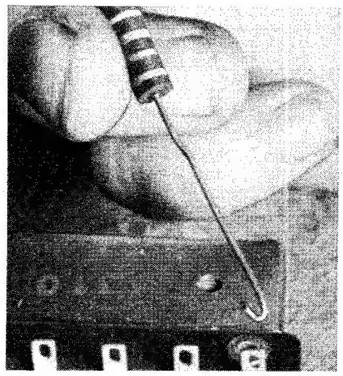


Reported "noisy" volume controls can be due to a leaky coupling capacitor.

Similar faults occur in transistorised equipment, where electrolytic capacitors are needed to maintain the time constants of the interstage circuits.

Noisy controls can be caused by poor connection between spindle and main body, or to wiper support. Where there is a divided section of the control casing, poor clamping or corrosion between surfaces can also be an unsuspected cause of noise, as can inefficient earthing.

A composition track volume control already damaged by current flow, caused by a leaking capacitor, may have a 'hot spot', a portion of the track pitted or burned. This will never succumb successfully to treatment. Replacement is the only cure. But carbon track variable resistors that have simply aged, which can be opened easily, could be treated by rubbing over the track with a soft lead pencil. If the damage is not too far gone, the crackle can sometimes be cured by injection of switch-cleaning fluid; several aerosol preparations are available.



Even in black and white the colour bands on this 1-watt composition resistor are clearly seen.

Personally, I do not favour this method. It is, at best, a temporary solution. Replacement of the offending control is always best. But though the professional in me must advocate the fitting of new parts, the practical wireless hobbyist in me says 'what about cost and availability?' If you are prepared to spend infinite pains in rejuvenating an outworn part, then good luck to you.

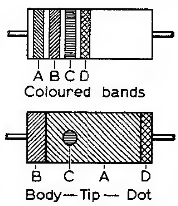
Small variable resistors, used as preset controls

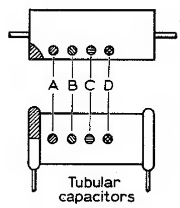
COLOUR CODE FOR CAPACITORS AND RESISTORS

	First Figure 'A'	Sec'd. Figure 'B'	Multiplier 'C'		Tolerance 'D'		
			Resistors	Caps pF	Res	Ceramic Capacitors to 10pF	Ceramic Capacitors over 10pF
Black	—	0	1	1	—	2pF	±20%
Brown	1	1	10	10	±1%	0·1pF	±1%
Red	2	2	100	100	±2%	—	±2%
Orange	3	3	1,000	1,000	—	—	±2½%
Yellow	4	4	10,000	10,000	—	—	—
Green	5	5	100,000	—	—	0·5pF	±5%
Blue	6	6	1,000,000	—	—	—	—
Violet	7	7	10,000,000	—	—	—	—
Grey	8	8	100,000,000	0·01μF	—	0·25pF	—
White	9	9	1,000,000,000	0·1μF	—	1pF	±10%
No colour	—	—	—	—	±20%	—	—
Silver	—	—	—	—	±10%	—	—
Gold	—	—	—	—	± 5%	—	—

A salmon-pink fifth ring or body colour denotes a Grade 1 high-stability composition resistor. There are variations in the code for capacitors other than ceramic tubular types.

The "preferred" series of values is as follows:—
1·0 1·2 1·5 1·8 2·2 2·7 3·3 3·9 4·7 5·6 6·8 8·2 and their decades.



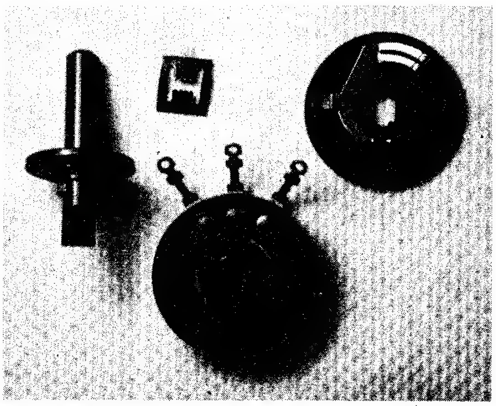


Above, left, shows two ways of indicating the value of a fixed resistor; coloured bands and the body-tip-dot method. Above, right, shows how coloured dots are used for the same purpose with tubular ceramic capacitors. However capacitor coding has not followed the same standard pattern as resistor coding there being national and even manufacturers' variations. The code shown in the table is the common one. Manufacturers often use plain marking for the value, tolerance etc. on the body of a capacitor.

in many circuits, are vulnerable to damage by a heavy hand. The usual trouble is strain of the wiper portion from its open rivet attachment to the body of the control. These controls are not intended to carry much current. They will burn out easily and the burn is sometimes invisible—the usual place being adjacent to the end contact. If the control is used as a simple variable resistor and the track is damaged, a simple solution is to reverse the end connection, thus using the other terminal of the track. It is best, when connecting simple variable resistors into circuit, to bridge the slider to the 'common' end. Similar remarks apply to the potentiometer, or the larger variable control.

A final class, the dual concentric control, is being met very often in stereo equipment, needing another special point of attention to be noted. This is the possibility of noise due to imperfect contact between the sections of the control. Sliding metal surfaces tend to generate electrical as well as mechanical noise and this can sometimes be picked up and amplified. A cleaning and greasing regime for such controls will help—but really this is a design problem, and the root cause may be that the control is 'too early' in the circuit. I feel sure my colleague will have a few remarks to offer about such circuitry in a later part.

Non-linear resistors: Final mention has to be made of the special resistors increasingly being encountered: such things as temperature and voltage-dependent resistors, thermistors, varistors, etc. The thermistor at one time performed a voltage dropping function as part of the series chain in the heater line of an ac/dc receiver. As the component warmed, its resistance decreased and from a cold value of several thousand ohms reached an eventual value of one or two ohms (in some cases up to about



A dismantled potentiometer showing, top left, the spindle; top centre, the fixing spring; bottom centre, the carbon track with rivetted tags. At top right, the wiper with split spring for flexibility.

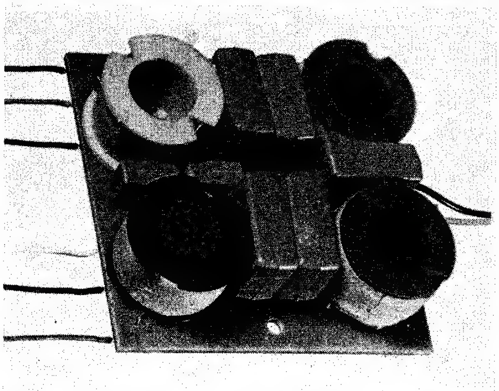
40 ohms) when at operating temperature. This regulated the current flow, preventing damage to cold valve heaters and obviating cathode stripping which can be caused by excessive emission. H.T. applied quickly, when semiconductor rectifiers are associated with valved circuits is a common cause of cathode stripping.

Practical points: such components must be allowed to dissipate their heat. They should be mounted in a ventilating flow of air, if the repairer or constructor has any choice in this matter. Care must be taken to dress wires away from the hot thermistor, and to keep other components out of its heat field.

Smaller temperature-dependent resistors will be found in power output stages, near or attached to the heat sinks of power transistors. Their purpose is to regulate the bias circuits so that an increase in heat causes a reduction in current. More will be said later about these protection devices.

Varistors are resistors which change their value according to the voltage across them. Again, they are met in many modern circuits where electronic control is needed, and some of the stabilising circuits in which they are employed will be dealt with in succeeding articles.

Light-dependent resistors have a special function, their resistance decreasing as the light falling on their target area increases. There are a number of



Inductors and polyester capacitors in a speaker crossover network.

special types with special applications and only a few of them will concern us here. A practical point arises from this: when these 'variable' or non-linear components are met, take great care that any replacement made shall be exact. There are seldom effective substitutes, and the designer may have chosen a particular component with parameters in mind which may not strike us immediately. The range of variation, the voltage rating and the current rating should be studied.

CAPACITORS

Capacitors sub-divide into three main groups: fixed, variable and electrolytic. Within these groups, there are many more divisions.

Fixed capacitors have various dielectrics and there are various methods of constructing and laying the foil or plates, giving all manner of special characteristics. It would be futile to attempt to explain these in detail, but a few salient points should be explained.

As with resistors, choice must be made according to capacitive value, tolerance, working voltage, peak voltage, temperature variation and in some special cases, frequency characteristics. For variable components, especially presets, the range of variation and its law must be taken into account.

Negative temperature coefficient components are widely used nowadays. There are many ways of

All prices in pounds and new pence

NEW VALVES

		6BA6	25	6J6	20	7C5	£1·13	12SR7	35	37	40	DAC32	42	EBL21	60	EL34	53	N78	£1·00	PL504	80	U404	40
		6BE6	30	6J7M	45	7C6	75	14H7	50	42	50	DAF91	25	EBL31	£1·38	EL38	£1·25	N108	£1·40	PL508	90	U801	£1·18
		6BH6	45	6J7G	45	7D5	55	19AQ5	40	50B5	45	DAF96	42	EC90	33	EL41	55	OA2	38	PL509	£1·45	UABC80	35
		6BJ6	45	6J7GT	38	7H7	35	20D1	50	50C5	40	DCC90	£1·00	ECC81	33	EL42	58	OC3	38	PL802	83	UAF42	55
		6BQ7A	40	6K6GT	55	7R7	70	20F2	70	50CD6G	£1·65	DF33	48	ECC82	30	EL84	25	OZ4	40	PX4	£2·00	UBC41	50
1A7	40	6BR7	85	6K7M	35	7S7	£2·25	20L1	£1·10	50L6GT	50	DF70	45	ECC83	30	EL95	35	PC86	60	PX25	£2·00	UBC81	46
1CP31	£6·13	6BR8	65	6K7G	20	7Y4	60	20P4	£1·10	75	50	DF91	25	ECC84	30	ELL80	£1·00	PC88	60	PY33	63	UBF80	40
1D5	40	6BS7	£1·30	6K7GT	35	9BW6	50	20P5	£1·20	78	45	DF92	20	ECC85	25	EM34	90	PC97	50	PY81	30	UBF89	38
1H5	42	6BW6	85	6K8M	60	10C2	63	25A6	35	80	50	DF96	42	ECC88	40	EM80	40	PCC84	40	PY82	30	UCC84	43
IN5GT	48	6BW7	70	6K8G	35	10F1	90	25L6GT	45	85A2	40	DH3-91	£6·13	ECH21	63	EM81	63	PCC89	53	PY83	38	UCC85	40
IR5	35	6C4	33	6K8GT	50	10F3	90	25Y5	60	150B2	60	DH77	30	ECH35	60	EM84	38	PCC189	55	PY500	£1·00	UCF80	55
IS4	27	6C5G	30	6K25	75	10F9	50	25Z4	45	150C4	60	DK32	40	ECH42	70	EY51	40	PCF80	33	PY800	50	UCH42	70
IS5	25	6C6	25	6L6G	45	10F18	45	25Z5	55	801	50	DK91	35	ECH81	30	EY86	40	PCF82	35	PY801	50	UCH81	35
IT4	25	6CD6G	£1·20	6L18	45	10LD11	60	25Z6	65	807	50	DK92	50	ECH83	43	EZ35	35	PCF84	50	R2	60	UCL82	38
3A4	35	6CH6	55	6Q7G	30	10P13	68	30C1	33	813USA	£3·75	DK96	42	ECL80	40	EZ40	45	PCF86	60	R19	40	UCL83	60
3Q4	40	6CW4	63	6Q7GT	43	11E3	£4·00	30C15	80	866A	75	DL66	£1·25	ECL82	35	EZ41	48	PCF801	50	S130	£1·75	UF41	60
3Q5	45	6D6	25	6SA7M	40	12AT6	30	30C17	85	954	60	DL92	35	ECL83	65	EZ80	28	PCF802	50	SP4	50	UF89	38
3S4	35	6E5	38	6SC7	70	12AT7	33	30C18	75	1625	40	DL93	35	ECL86	45	EZ81	28	PCF805	75	SP41	45	UL41	65
3V4	45	6F1	70	6SG7	35	12AU6	30	30F5	85	4022AR	£5·00	DL94	45	ECLL800		GY501	80	PCF806	70	SP61	55	UL84	35
5R4GY	60	6F5G	50	6SH7	35	12AU7	30	30FL1	75	5763	70	DL95	40		£1·50	GZ30	50	PCF808	78	STV280/80		UM80	28
5U4G	33	6F6G	30	6SJ7	30	12AX7	30	30FL12	95	7193	20	DL96	42	EF9	£1·00	GZ32	50	PCL82	38		£10·00	UU6	£1·05
5V4G	42	6F8G	35	6SK7GT	30	12BA6	35	30FL14	75	7475	40	DM70	40	EF37A	60	GZ34	60	PCL83	58	SU25	£1·00	UU7	£1·05
5Y3GT	32	6F11	38	6SL7GT	35	12BE6	35	30L15	85	A61	48	DY86	33	EF39	40	KT36	£1·00	PCL84	43	SU2150	75	UU8	£1·05
5Z4G	40	6F13	38	6SN7GT	35	12C8GT	35	30L17	85	ATP4	35	DY87	35	EF41	65	KT61	£1·25	PCL85	40	T41	£1·00	UU9	45
6/30L2	75	6F14	65	6SQ7	40	12E1	£1·35	30P4	£1·12	ATP5	60	E88CC	65	EF50	25	KT66	£1·70	PCL86	46	TDD4	50	UY21	50
6A7	75	6F23	80	6U4GT	60	12J5GT	25	30P12	80	ATP7	50	EA50	20	EF80	25	KT81	£1·75	PD500	£1·50	TH41	£1·75	UY41	45
6A8G	63	6F24	75	6U5G	40	12J7GT	35	30P19	80	AU2	£4·00	EABC80	35	EF85	35	KT81(7C5)		PENA4	£1·00	U10	60	UY85	33
6AK5	30	6F25	75	6V6M	60	12K7GT	35	30PL1	80	AU5	60	EAF42	55	EF86	33		£1·13	PENB4	£1·00	U14	60	VMP4G	85
6AM5	32	6F28	70	6V6G	30	12K8GT	50	30PL13	93	AZ1	48	EB91	20	EF89	28	KT88	£1,75	PEN45	40	U19	£2·50	VP4B	£1·25
6AM6	33	6F32	25	6V6GT	38	12Q7GT	35	30PL14	90	AZ31	55	EBC33	50	EF91	33	KTW61	£1·00	PEN46	40	U25	78	VR105/30	38
6AQ5	35	6G6	25	6X4	30	12SA7	40	35A5	75	CBL31	90	EBC41	55	EF92	40	KTZ41	45	PL36	55	U26	78	VR150/30	35
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				2N2369A	25	AC126	25	AF115	30	BFY50	23	KS100A	20	NKT713	25	OAZ207	48	OC45	15	OC82D	15	ZTX107	15
1N914	08	2N697	18	2N2646	53	AC127	25	AF117	25	BFY51	20	MJE520	88	OA70	10	OAZ210	33	OC57	60	OC84	25	ZTX108	15
1S113	25	2N706	10	2N2904	30	AC128	25	ASY26	25	BY100	18	MJE2955		OA71	10	OAZ222	40	OC58	60	OC170	25	ZTX300	13
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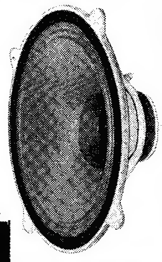

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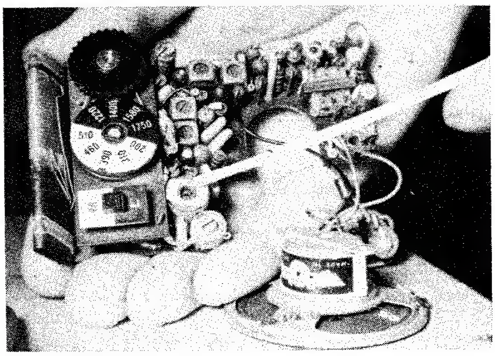
stabilising tuned circuits but undoubtedly one of the easiest is to counter the drift due to warming up of the receiver by alteration to the tuning itself. This is done by the inclusion of a capacitor whose value decreases as the temperature increases. Important practical point here is, of course, to ensure that replacement shall always be with the same type.

Standard tubular capacitors are generally ceramic but there are variations such as the high voltage varicaps, made with barrier dielectric techniques, used widely with transistorised circuitry. These are junction-diodes chosen to take advantage of the capacitance effect: they will concern us later.

Variable capacitors may be the simple compression types found atop the small sealed ganged tuning capacitors in modern transistorised radios, or larger, more precise versions with fine thread screws and several interleaved layers of dielectric. Beehive capacitors, with concentric barrels and a coarse thread, are often found in older sets.



A small pot-core inductor, used here as the tuned circuit of the frequency-changer stage.

Electrolytics have an additional factor in their leakage current. In power supply circuits, where electrolytics are used to filter alternating currents from a supply that should be essentially d.c., we often come across the device of an additional, smaller, decoupling component across the main decoupler. This is to bypass the higher frequency currents that may be present in the ripple current.

Ripple current, in power supply circuits, is an important factor. It bears a direct relationship to the direct current drawn by the equipment, the load. For full-wave rectification, ripple current is about $1\frac{1}{2}$ times the d.c., but a half wave circuit needs a reservoir capacitor in its filter circuit with a ripple current rating of three times the d.c.—a point to be watched when making replacements.

Excessive ripple current will cause overheating —application of "raw a.c." across an electrolytic can cause a spectacular but dangerous explosion. A point to be watched is the relationship of frequency and capacity. If high frequency ripple is present, the impedance of the capacitor, which may have been sufficiently low at its filter frequencies, rises dramatically and the heating effect increases.

The inductive element of electrolytic capacitors may have to be taken into account. This also will be mentioned later, when we come to practical circuitry.

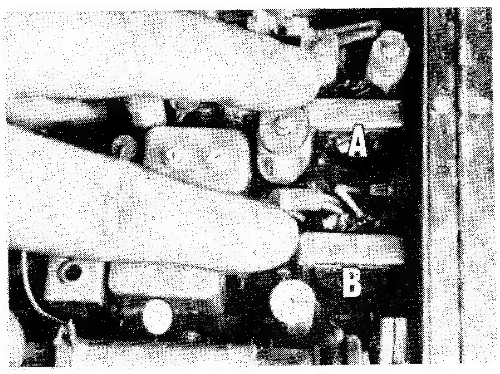
Polyester capacitors are being increasingly used in radio work because their method of construction decreases the inductive element. The tantalum capacitor, with some special virtues and few drawbacks except cost, has been used in many circuits, its advantage being a relatively large capacitance (albeit at low working voltage) for small physical size.

INDUCTORS

Inductors will be found in all sorts of applications, from the small ferrite beads with a single turn of wire around them to the multi-layer, tapped transformer of the modern stereo radio receiver. From the servicing point of view, inductance is either there or not—one seldom has to make up inductors, and we shall not waste space by talking about the factors determining inductance, permeability and so on. Instead, let's concentrate on the practical aspect of core variation, and the ways to overcome core breakage.

Iron dust cores are the usual way to change inductance of coils, these being threaded into the coil former. The individual particles of iron dust are insulated from each other, although closely packed, affording low loss and high permeability and so a miniaturisation of the whole inductor. But, for this reason, the cores themselves are more fragile.

It is not uncommon for wireless workshops to hold in stock large quantities of replacement iron dust cores. Instead of wasting time fiddling—often ineffectually—with painted, varnished, waxed or lacquered cores which crumble when torsional pressure is applied, the technique is to shatter the core, carefully remove the bits and clean the thread with a metal runner (of the same thread pitch), finally inserting a new core and aligning.



Interstage transformers A and B of a small transistor radio, with transistors between them wired directly into the circuit. Also to be seen are vertically mounted electrolytic capacitors and screened tuned circuits.

OTHER CIRCUIT ELEMENTS

A mention will have to be made of the alternative to the conventional inductor, the ceramic filter. The tuned circuit resonates at a frequency to which the crystal (usually a man-made crystal, a ceramic) is carefully cut and shaped. The actual arrangement is not straightforward as a simple crystal so used would have far too sharp a tuning response.

A pass-band of 180kHz is needed for the handling of the 15kHz audio signals at low distortion which we now require from our f.m. receivers. So two ceramic elements are used, with bandpass coupling. This gives the required bandwidth but retains the advantage of a sharp "skirt" at the extremes of the filter response curve.

Later we shall consider integrated circuits which are revolutionising receiver design in the same way as the innovation of transistors did some time ago. Also the use of various special semiconductors must be discussed. Field effect transistors (f.e.t.'s) have brought new opportunities to circuit designers, especially in the input circuits of v.h.f. receivers as well as to tape recording circuitry.

THERMIONIC VALVES

Valves are on the way out—thus runs the creed of some authorities. So they may well be, for there is little in the domestic field that is done by thermionic devices that can not be done as well or better by semiconductors. For a while, the barriers of high power meant that valves were still needed for certain applications. Now, with the improved silicon semiconductors available, even this barrier has broken down and the only remaining market for domestic valved circuitry appears to be in some television receivers, although a number of these are already fully transistorised.

But from the servicing aspect, valves are still very much with us. Not only do we need to know what they will do and how the circuits work but also what substitutes are available. Such information is not always convenient to come by—the best method of determining replacement suitability, of both valves and transistors, is a study of the relevant parameters.

Taking a simple case—nevertheless, not an uncommon case, for the triode amplifier stage is very often met with, especially in the low-signal sections of tape recorders—we have to consider first the operating conditions, i.e., heater voltage and current, circuit suitability, etc., and after that we can look at the Ia/Va curves, the Ia/Vg curves and the mutual conductance.

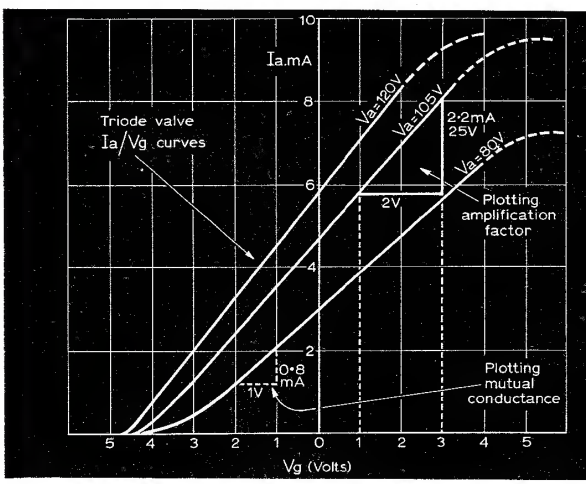
For any particular anode voltage there will be a curve which slopes up and then tails off when the anode current increases to and beyond a certain point, for a given grid voltage. There is a cut-off point where negative grid volts reduce anode current to zero and a saturation point where further positive grid volts cannot affect anode current. If we know the valve bias, cathode or grid, we can work out whether our alternative will do what we want.

If there is any further doubt, we can tackle the mutual conductance curves and the a.c. resistance. Amplification factor can be obtained from the results we already have, thus from the various factors already at our disposal we should be able to build up as good a picture about the valve we have as we are likely to need. Nine times out of ten we shall not need it: we shall be able to turn up our tables, select a replacement and go ahead. The tenth time could baffle us and this extra little bit of knowledge could save pounds.

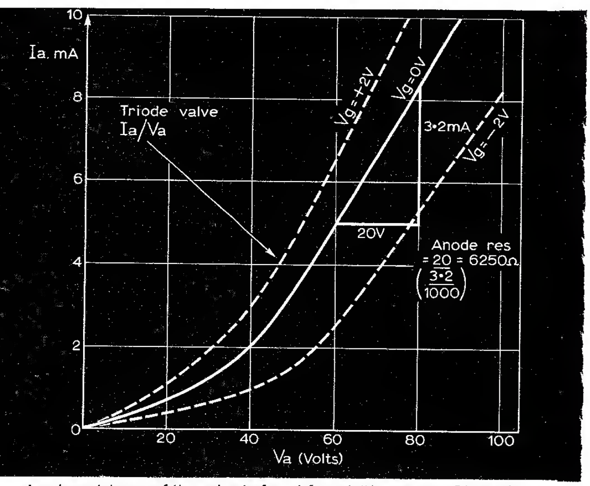
SEMICONDUCTORS

Semiconductors can nowadays be divided into three sections: diodes, bipolar devices and others (which includes f.e.t.'s etc.). We are concerned with diodes very much indeed, as we shall see; there are plain rectifiers, diodes used as blocking devices, diodes used as circuit guide lines and finally variable capacitance diodes which can play an important part in the tuning of circuits.

The bipolar transistor (so called because it has two types of current carrier) has a few fundamental parameters that will enable us more easily to identify it and choose a possible substitute. Understanding of these parameters will also help us in the solution of some teasing circuit faults.



The Ia/Vg curves of valves tell us a lot about their characteristics. Three curves shown are plotted at different anode voltages. By comparing anode current change with grid voltage change causing it, we obtain the mutual conductance, gm, in mA/volt. Comparing curves we get the amplification factor, μ.



Anode resistance of the valve is found from Ia/Va curves. Given the anode load, the stage gain $= \frac{\mu \times Ra}{Ra + ra}$
Where Ra = anode load, ra = anode resistance and μ = amplification factor.

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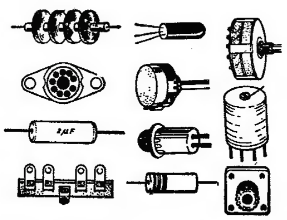

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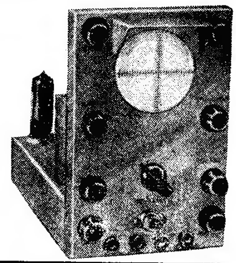

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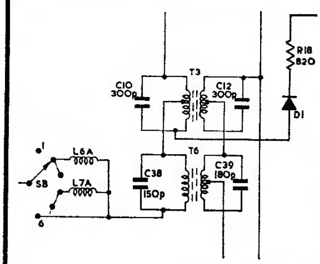

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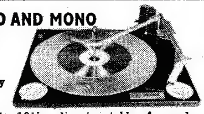

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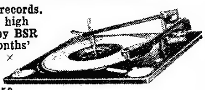

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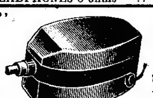

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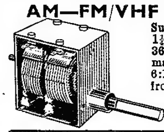

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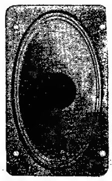

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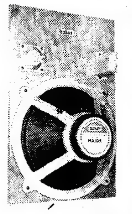

30-14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. Voice coils 3 or 8 or 15 ohms. Post Free

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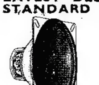

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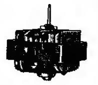
VALVE HOLDERS, 5p; CERAMIC 8p; CANS 5p.



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120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA. Spindle 0·187 × 0·75in. Size 3¼ × 2½ × 2¼in. (illustrated). Post 15p. **£1.25**

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The stated parameters will always depend on operating temperature, a typical mean figure being 25°C. If the operating conditions vary, it is important that the parameters be corrected accordingly, but this is not generally the province of the chap who is doing the repairs.

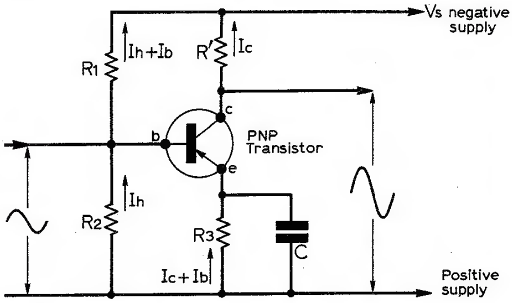


Fig. 1: Common-emitter PNP amplifier stage with arrows indicating "hole" conduction. Base voltage is stabilised by R1 and R2 with additional bias provided by R3.

It is to be assumed that the designer has done his homework. Table 1 gives the more important things we need to know about a transistor and a specimen set of figures for a general purpose n.p.n. silicon transistor has been quoted, to show the way these figures are expressed.

As an example of the use of these terms, Fig. 1 shows a p.n.p. transistor in common-emitter mode, as would be used for a simple amplifier. In this mode, we need to know the ratio of change of collector current for a change in base current, i.e., the current gain, β or α_0' (beta or alpha nought dash). The subscript nought means that the current gain applies to d.c., the dash indicates the signal input is applied to the base. A plain α (alpha), without the dash is the symbol for current transfer ratio, and we usually see this written in a statement showing increase, this $\Delta\alpha$ or $\delta\alpha$.

The relationship between alpha and alpha-dash is important, and the formula

$$\alpha' = \frac{\alpha}{(1-\alpha)}$$

will be encountered. In Fig. 1 we see the various currents and voltages outlined with the arrows denoting hole conduction.

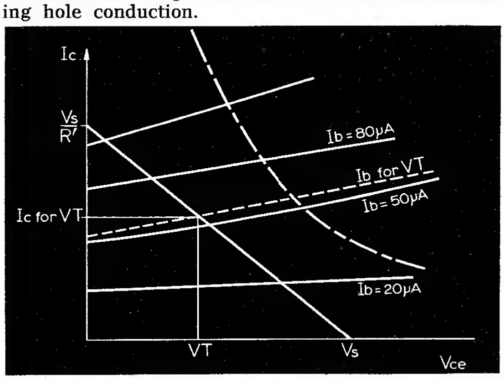


Fig. 2: A load-line drawn on the output characteristic curve of the transistor in Fig. 1. This depends on supply voltage Vs and value of R'. Chain-dotted line is power limitation and VT the working voltage.

TABLE 1

Ratings		
Max. Collector-Base Voltage	V_{CBO}	25V
Max. Collector-Emitter Voltage	V_{CEO}	25V
Max. Emitter-Base Voltage	V_{EBO}	5V
Max. Peak Collector Current	I_{CM}	500mA
Max. Dissipation (at T_{amb}=25° C.)		300mW
Max. operating temp.		−55 to 125°C
Characteristics		
Max. Collector-Base Reverse Current	I_{CBO}	0·2μA
Max. Emitter-Base Reverse current	I_{EBO}	0·2μA
Max. Collector-Emitter sustaining voltage	$V_{CEO\,(sus)}$	25V
Max. Collector-Emitter saturation voltage	$V_{CE\,(sat)}$	0·35V
Base-Emitter saturation voltage	$V_{BE\,(sat)}$	0·65-1·0V
DC current gain	h_{FE}	50-300
Min. Gain-Bandwidth Product	f_T	150
Max. output capacitance	C_{ab}	6pf
Typical Noise Figure	N	7dB

Characteristic curves. From what we already know, we can draw up a similar family of curves to those we used for valves. Fig. 2 shows just such a series of curves used to determine the static collector current for various output characteristic curves. Values in the simple diagram we saw before can be calculated from this load-line graph, thus:

At cut-off, V_{ce} = supply voltage.

At maximum current, all the voltage is dropped across R′ and maximum current is V_{supply}/R'. If we choose a suitable voltage, call it VT for the collector, the base and collector currents can be determined from the load-line.

Volts drop across R′ is $I_c \times R'$. Value of

$$R3 = V_s - \left[(I_c \times R') + VT. \right]$$

We get the static value of V_{be} from the input characteristic and know that the voltage drop across R2 = drop across R3 minus V_{be}.

Then $V_{R2} = \left[R3 \times (I_c + I_b) \right] - V_{be}$

If we now choose a suitable value of I_L we get the value of R2, thus:

$$\frac{\left[R3 \times (I_c + I_b) \right] - V_{be}}{I_L}$$

and the voltage across R1 is the difference between V_s and V_{R2}, or as calculated from the value of I_b (Ohms Law) taken from the load-line.

Dynamic considerations differ and the conditions for different kinds of transistor differ. These we shall tackle as they arise. The foregoing has been intended as an example—a way of laying the ground for Mr. King to launch into servicing techniques and circuitry without having to waste his time explaining every detail as he goes along.

END OF PART ONE

THE MW COLUMN

THE proposal to start local commercial radio on the medium waves has focused attention on two international common frequencies—1484kHz and 1594kHz. Many low power stations in Europe and parts of Africa occupy these channels, the only restriction being that there should not be interference between them. The BBC uses both frequencies for 2kW relays, so DXing on these channels will, in some parts of the country be limited to times when these locals are off the air. Manx Radio is on 1594kHz from sunset until 2015hrs while BBC3 broadcasts from Bournemouth and Dundee until 2230hrs. Look for CSB4 Emissoras Associadas de Lisboa; the US Air Force station in Athens; Marrakesh in Morocco and possibly Nova Lisboa in Angola; all on 1594kHz. The other channel—1484kHz—is more popular and is used by BBC4 in Kent, Lancashire and Norfolk; BBC2 in Scotland and BBC1 in Bournemouth. During the summer, the USAF base at Kenitra in Morocco has been heard on 1484 on several occasions while the USN 250-watter at Keflavik, Iceland, has also been logged. Radio Gibraltar is on this channel from 0655hrs to 2300hrs but has so far eluded the writer. Others to search for on 1484 are CSB90 in Funchal Maderia; Volos, a regional station in Greece; Riga in Latvia; Limassol in Cyprus; Ankara Turkey; Jeddah in Saudia Arabia.

A recent note by David Gibson referred lightheartedly to a DXer using the PW medium wave loop on the 10m amateur band. A MW loop will not, of course, function properly on 30MHz but it is quite easy to modify one to cover the Top Band. Remove one turn from the main winding; the range will now extend to 2MHz and the loop can be used for nulling-out Loran or other QRM. Useful results can be obtained in daylight with a modified MW loop to 3MHz but as frequency increases the directional properties gradually disappear.

As winter approaches in the southern hemisphere Latin Americans become prominent and can be heard in Europe from midnight until daybreak. Two high power stations in Buenos Aires Argentina are nearly always audible; LR1 1070kHz and LR3 950kHz. They are commercially owned and identify frequently between jingles. LR3 has the call Radio Belgrano and LR1 is Radio el Mundo. Others to look for include LR4 910kHz Radio Splendid Buenos Aires; LT2 1230kHz R. Splendid Rosario; LS6 1350kHz R. America Buenos Aires. From nearby Montevideo in Uruguay CX14 Radio Espectador is on 810kHz; CX28 R. Imparcial is on 1090kHz and CX16 850kHz has the unusual identification 'Radio Carve.' Venezuela is on a direct sea path across the Atlantic and can be logged on all parts of the band. Listen for YVLH 650kHz Radio Giradot in Maracay; YVKS 750kHz Radio Caracas; YVNM 1000kHz R. Mil in Moron; YVRS 1020kHz R. Margarita La Asuncion; YVQJ 1080kHz R. Barcelona; YVQT 1110kHz R. Carupano; YVOZ 1200kHz R. Tiempo Caracas; YVOH 1230kHz R. Valera.

CHARLES MOLLOY

Electronotes..

S. GINSBERG

Solid-state devices are slowly but surely advancing in areas which were previously held by the valve. But there are some applications where transistors find it hard to compete. This is highlighted in places where high power coupled with high frequency are required. To produce kilowatts at microwave frequencies is still the prerogative of the valve.

An application which illustrates this is that of cooking. Microwave ovens are becoming a reality as various types of sustenance are bronzed to culinary perfection by very high frequency energy.

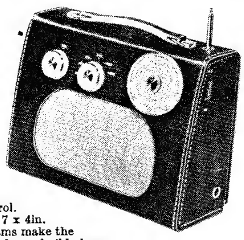
Strange things happen when one uses radar-type frequencies to cook. An egg, for example, can be "boiled" by placing it in the oven and setting the timer for some 25 seconds. Thirty-five seconds will supply the article hard-boiled. Funny thing is that at around the 45 second mark the egg goes off with a bang. This is because the microwave energy concentrates at the centre of the unfortunate egg.

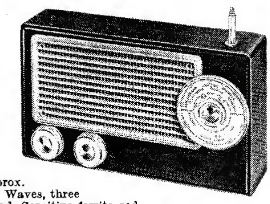
Small tea cakes, made from a proprietary brand of cake mix, take barely 35 seconds to cook and it is amusing to watch a lifeless paper cup full of gooey cake mix suddenly spring into life and fill the container. The weekend joint is reckoned to take around the eight-minute mark. No washing up of pots if you put the food on a paper container.

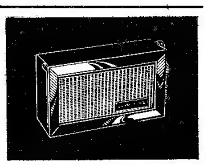
Digital techniques are still gaining popularity in electronic circles. More and more voltmeters and multimeters are boasting a digital readout. But the readouts are now commonly becoming available by themselves and there is an increasing number of modules being launched. These usually take the form of a small oblong package which houses a number of readout devices and often all the necessary logic circuitry for driving the solid-state readouts themselves. The whole package is offered as a single unit which can be fitted on to a front panel. Thus instead of fitting a meter, it is now possible to fit a solid state direct digital readout device. One of the advantages of direct readout is that parallax is avoided—the difference in absolute reading which is dependant upon whether the eye is directly over the needle of a conventional meter or slightly to one side.

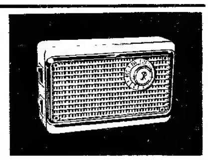
Perhaps the most advanced digital meter available is one which automatically checks its own accuracy against a standard cell between readings. The circuitry switches from the measurement at the probes to the standard cell and back again. It does this repetitively and any slight difference between the standard cell and what the meter should read is immediately corrected by a fast-acting feedback loop.

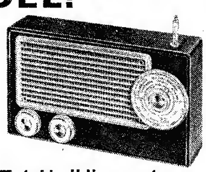
TONE
ON/OFF
VOL
SW1











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1N5GT	·38	30C15	·63	DL96	·36	EM81	·41	PCL85	·45	UBF89	·33
1R5	·28	30C17	·80	DY86	·28	EM84	·33	PCL86	·41	UCC84	·35
1S5	·21	30C18	·67	DY87	·28	EM87	·37	PCL88	·72	UCC85	·36
1T4	·16	30F5	·76	EABC80	·32	EY51	·36	PCL800	·77	UCF80	·36
3S4	·28	30FL1	·63	EAF42	·50	EY86	·32	PENA4	·42	UCH42	·62
3V4	·37	30FL12	·72	EB91	·11	EZ40	·43	PEN36C	·70	UCH81	·32
5Y3GT	·30	30FL14	·72	EBC33	·40	EZ41	·43	PFL200	·58	UCL82	·35
5Z4G	·37	30L1	·32	EBC41	·52	EZ80	·23	PL36	·48	UCL83	·55
6/30L2	·58	30L15	·62	EBC90	·22	EZ81	·24	PL81	·46	UF41	·62
6AL5	·11	30L17	·73	EBF80	·33	GZ32	·43	PL81A	·51	UF89	·33
6AM6	·13	30P4	·65	EBF89	·31	GZ34	·48	PL82	·32	UL41	·60
6AQ5	·26	30P12	·77	ECC81	·18	KT41	·77	PL83	·35	UL44	£1·00
6AT6	·22	30P19	·65	ECC82	·23	KT61	·48	PL84	·33	UL84	·35
6AU6	·22	30PL1	·63	ECC83	·35	KT66	·83	PL500	·65	UM80	·25
6BA6	·22	30PL13	·88	ECC85	·28	LN319	·63	PL504	·67	UM84	·22
6BE6	·23	30PL14	·70	ECC804	·60	LN329	·72	PL508	£1·17	UY41	·41
6BJ6	·42	30PL15	·62	ECF80	·30	LN339	·63	PM84	·37	UY85	·28
6BW7	·60	35L6GT	·43	ECF82	·30	N78	·87	PX25	£1·17	VP4B	·77
6CD6G	£1·10	35W4	·24	ECH35	·30	P61	·50	PY32	·55	W119	·35
6F14	·45	35Z4GT	·25	ECH42	·63	PABC80	·35	PY33	·55	Z77	·22
6F23	·73	807	·45	ECH81	·28	PC86	·51	PY81	·26	**Transistors**	
6F25	·62	6063	·62	ECH83	·41	PC88	·51	PY82	·26	AC107	·17
6K7G	·12	AC/VP2	·77	ECH84	·37	PC96	·42	PY83	·28	AC127	·18
6K8G	·17	AZ31	·47	ECL80	·35	PC97	·40	PY88	·34	AD140	·37
6SL7GT	·27	B349	·65	ECL82	·33	PC900	·37	PY800	·37	AF115	·20
6V6G	·17	B729	·62	ECL86	·40	PCC84	·32	PY801	·37	AF116	·20
6V6GT	·32	CCH35	·67	EF39	·23	PCC85	·30	R19	·32	AF117	·20
6X4	·23	CL33	·92	EF41	·58	PCC88	·45	R20	·65	AF118	·48
6X5GT	·28	CY31	·33	EF80	·24	PCC89	·47	U25	·68	AF125	·17
10F18	·35	DAC32	·36	EF85	·31	PCC189	·51	U26	·65	AF127	·17
10P13	·60	DAF91	·21	EF86	·31	PCC805	·65	U47	·68	OC26	·25
12AH8	£2·25	DAF96	·36	EF89	·26	PCF80	·30	U49	·65	OC44	·12
12AT7	·18	DF33	·38	EF91	·13	PCF82	·32	U78	·24	OC45	·12
12AU6	·23	DF91	·16	EF183	·28	PCF86	·47	U191	·62	OC71	·12
12AU7	·23	DF96	·36	EF184	·32	PCF800	·67	U193	·42	OC72	·12
12AX7	·23	DH77	·22	EH90	·42	PCF801	·33	U251	·72	OC75	·12
19BG6G	·87	DK32	·37	EL33	·48	PCF802	·45	U301	·52	OC81	·12
20F2	·67	DK91	·28	EL34	·47	PCF805	·67	U329	·72	OC81D	·12
20P3	·85	DK92	·42	EL41	·55	PCF806	·60	U801	·98	OC82	·12
20P4	·92	DK96	·36	EL84	·24	PCF808	·72	UABC80	·32	OC82D	·12
25L6GT	·25	DL35	·25	EL90	·26	PCL82	·36	UAF42	·51	OC170	·22

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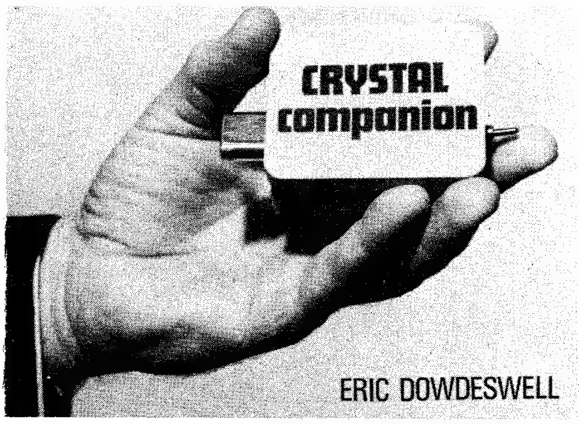


WITH the large numbers of crystals now available at low prices it is not unusual to go into a components shop and find a large box full of assorted crystals being continually churned over by eager hands in search of some peculiar frequency.

While the old 10X type of crystal can probably stand up to such rough usage the more delicate HC6U type is liable to succumb to such barbaric treatment.

The older "surplus" types can be over 25 years old and although well wrapped and apparently "as new" will often be found to have electrodes that have oxidised making the crystal useless. Having bought such a crystal and got it home it is a little annoying to discover that the wretched thing won't work!

This little crystal checker was designed to slip into the pocket so that it can be used to check almost any type of crystal before it is bought. It has worked with crystals from 100kHz to over 10MHz without any trouble.

Operation

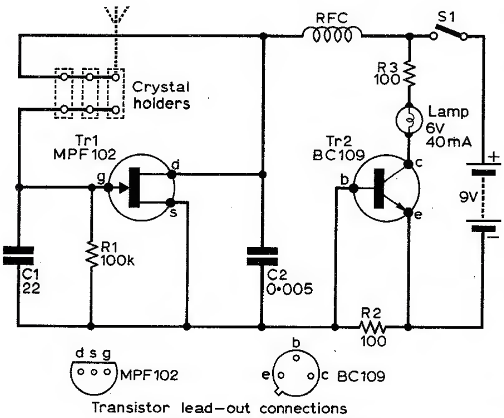
The circuit is very simple but a little different from those usually found in this particular application insofar as the operation is "fail-safe". That is, the indicator lamp is on when the crystal is not oscillating thus providing a check on the working of the lamp. If the lamp came on only when the crystal was oscillating failure of the lamp to light could be due to either a faulty crystal or dud lamp.

The oscillator circuit itself uses an MPF102 f.e.t. transistor and just four other components plus three crystal holders. The lamp control circuit has a BC109 silicon transistor which acts as a switch for the lamp circuit.

In the non-oscillating state the MPF102 draws about 10mA current through resistor R2 which switches the BC109 "on" the lamp circuit being completed through the current limiting resistor R3 to the 9V supply. In this condition the lamp will light.

With a good crystal plugged in to one of the holders the MPF102 current drops to less than 1mA, depending on the activity of the crystal used, the BC109 is switched "off" and the lamp goes out.

Since the lamp draws around 30mA the unit should not be left switched on longer than is required to check a crystal in order to prevent the early demise of the PP3 battery.



Circuit diagram of the Companion.

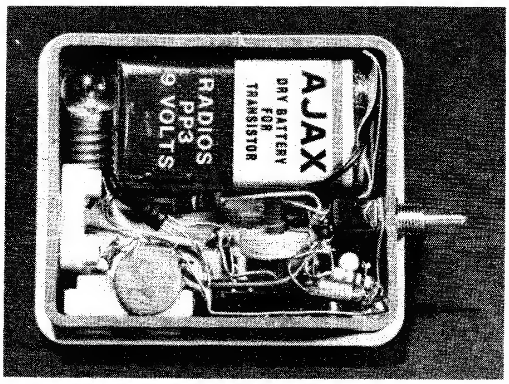
Constructing the "Companion"

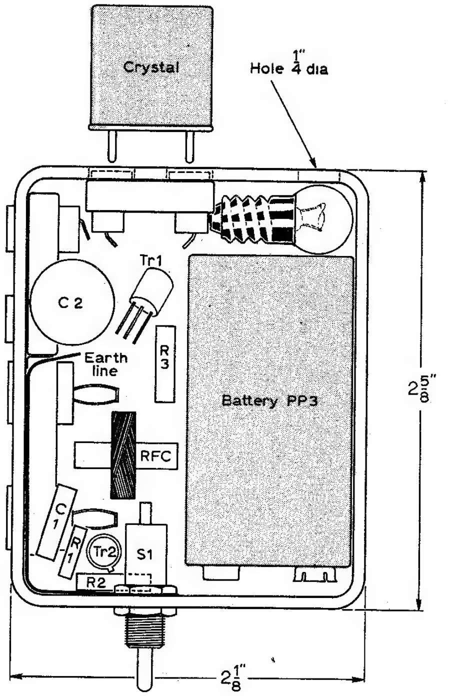
The checker can be built in any small box that will slip into the pocket and may be of metal or plastic or wood. The one used in the prototype is made up of a $\frac{3}{4}$in. long section of plastic tube, rectangular in section, $2\frac{5}{8}$ x $2\frac{1}{8}$in. similar to that used in the construction of the popular Dewbox cabinets. Two Dewbox endcaps provide a handsome finish to the case.

Holes are drilled around the centre section to accommodate the three crystal holders to take 10X, HC6U and FT241/3 crystals so as to make the checker as versatile as possible. The holders are bolted on or fixed with Araldite. A $\frac{1}{4}$in. diameter hole is drilled so that the indicator lamp is easily seen.

The simple wiring is mainly direct between components but a short busbar of thin tinned copper wire is run round one corner of the box to act as an "earth" return, one end of which is held under the locknut of the miniature on/off switch. Before doing this check that the dolly of the switch is isolated from the contacts.

After fitting the crystal holders, wire them in parallel, then fit one end cap and lay the PP3 battery



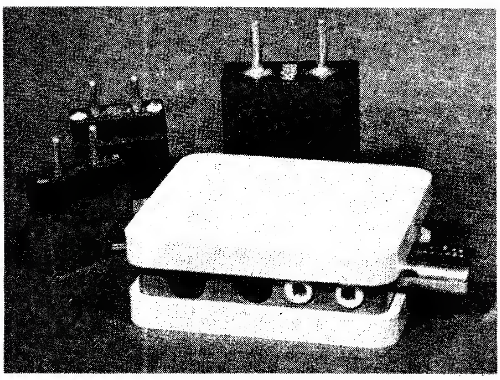


This actual size drawing of the Companion may be compared with the photograph on the previous page.

in position after which the remaining components can be soldered in place.

Because of the small size of this version of the checker a lamp holder was dispensed with and the connections soldered directly to the lamp. If a larger box is used a lampholder should be fitted.

The two transistors are wired into the circuit after everything else has been done. Especial care should be taken with the MPF102 transistor. Holding all three lead-out wires firmly in the jaws of a pair of longnosed pliers the wire ends should be tinned quickly and then soldered into the circuit without releasing the pliers. The BC109 is not so "touchy" but there is no harm in providing a heatsink when soldering it into place using the pliers as before.



★ components list

Resistors:
R1 100kΩ ⅛W R2 100Ω ⅛W R3 100Ω ⅛W

Capacitors:
C1 22pF Polystyrene C2 0·005μF disc

Semiconductors:
Tr1 MPF102 Tr2 BC109

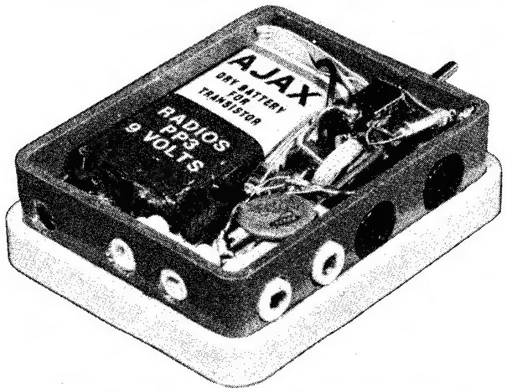
Miscellaneous:
Lamp 6V 40mA. Crystal holders (3) for HC6U, FT241/3 and 10X. S1, miniature on/off switch. Battery 9V PP3 and terminal clip. RFC, 2·5mH miniature. Dewbox ¾in. long with end caps or similar.

When the checker is completed the end caps can be pushed on leaving enough gap between them to accommodate an HC6U type crystal.

Checking Out

After double checking the wiring, paying particular attention to the transistor lead out connections, the unit can be switched on. Without a crystal plugged in the indicator lamp should light. Inserting a known good crystal should cause the lamp to go out.

The relative activity of a crystal may be estimated



This view clearly shows the hole for the indicator lamp.

by watching the lamp when the unit is switched on with a crystal in place. With an active crystal the lamp will go out immediately but if the crystal is reluctant to start the lamp will flash momentarily before going out. With a poor crystal the lamp may stay on but dimly.

With a really dud crystal the lamp will come on at full brilliance as if the crystal was not plugged in.

The "Companion" can be used on the workbench as a signal source for alignment purposes using crystals such as 470kHz or 1·6MHz for i.f. alignment or 100kHz or 1MHz for calibration work. A crystal on say 5MHz is very useful for calibration on the h.f. bands as well as for alignment.

If the checker is built into a plastic box there should be enough radiation for all the above purposes. If a metal box has been used it may be necessary to plug a short stiff piece of wire into any one of the unused crystal holder sockets to increase the radiation. A miniature telescopic aerial as supplied with some transistor radios is ideal for this purpose. ■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hi-fi SIGNAL GENERA

THE audio frequency signal generator described here was designed and built to fill the need for a high quality, wide range instrument, capable of permitting accurate and reliable distortion, gain and frequency response measurements to be carried out on a wide range of audio equipment.

For an a.f. generator to be really useful, it must be accurate in respect of frequency and voltage output calibration, and it must maintain this degree of accuracy under widely varying conditions of use.

The initial calibration accuracy will depend on the frequency and voltage standards available at the time of calibration, plus the time and care taken over the calibration process. Also accuracy will be dependent upon the quality of the components used and, to a lesser extent, upon the workmanship involved. The basic design will, of course, also influence both factors.

On the present design, much thought has been expended, plus not a little experimental work, in producing a design that fulfils most adequately all the requirements of a very high quality instrument. Good quality components, used well within their ratings, ensure that initial calibration accuracy will be maintained almost indefinitely. The mechanical design also, has been aimed at producing a robust, easily assembled unit.

CIRCUIT

The generator is based, in common with virtually all available a.f. generators, upon the well known, and proven Wein Bridge. The three transistors Tr1, Tr2 and Tr3 form a high gain amplifier with d.c. coupling throughout, with the exceptions of the frequency determining capacitors. This has the twin advantages of being sparing of coupling capacitors, which lessens expense, and relieves the designer of solving unwanted phase shift problems.

The frequency of oscillation is dependent on the setting of VR1 and the capacitors selected by SW1. For oscillation to occur there must be adequate gain and there must be positive feedback, i.e. there must be a phase shift of 360° between the input and the output of the amplifier. For the Wein Bridge to oscillate, the gain requirement is very modest, being only 10db or three times. Since the gain of the

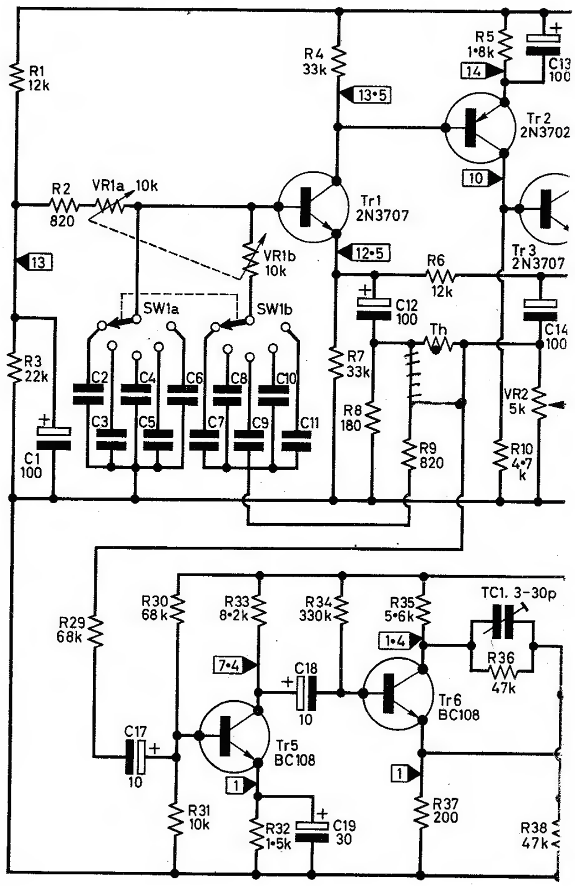
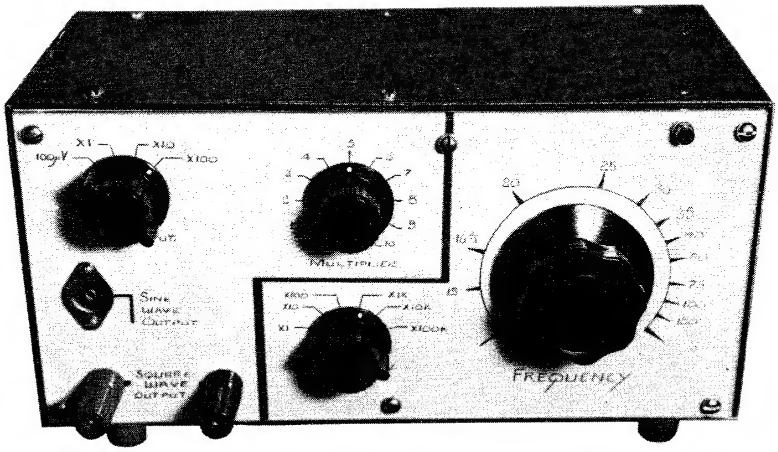
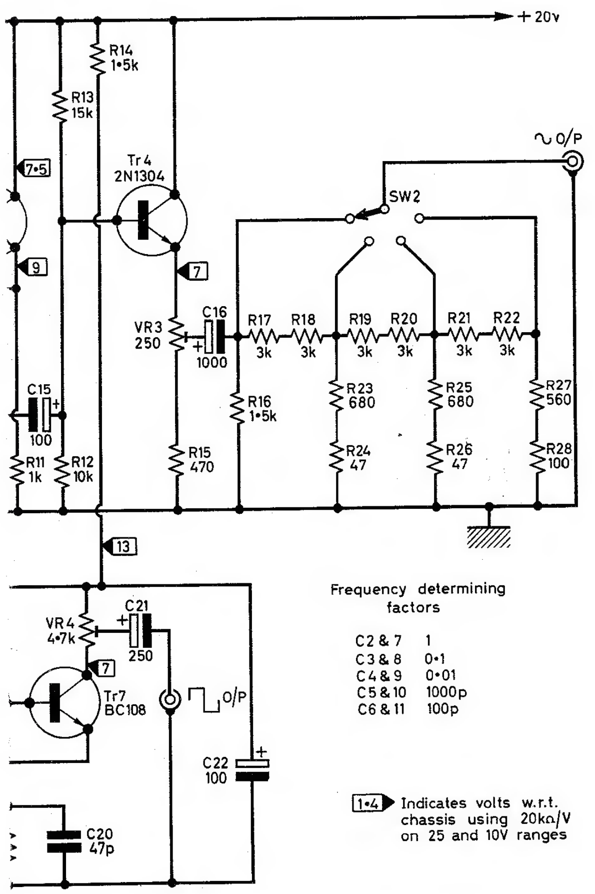


Fig. 1 : The circuit of the Hi-Fi Signal Generator, an expla

TOR

H. T. KITCHEN





...nation of the operation of the various sections is given in the text.

✶ components list

Resistors

R1	12kΩ	R15	470Ω	R29	68kΩ
R2	820Ω	R16	1·5kΩ	R30	68kΩ
R3	22kΩ	R17	3kΩ	R31	10kΩ
R4	33kΩ	R18	3kΩ	R32	1·5kΩ
R5	1·8kΩ	R19	3kΩ	R33	8·2kΩ
R6	12kΩ	R20	3kΩ	R34	330kΩ
R7	33kΩ	R21	3kΩ	R35	5·6kΩ
R8	180Ω	R22	3kΩ	R36	47kΩ
R9	820Ω	R23	680Ω	R37	200Ω
R10	4·7kΩ	R24	47Ω	R38	47kΩ
R11	1kΩ	R25	680Ω	R39	4·7kΩ
R12	10kΩ	R26	47Ω	R40	2·2kΩ
R13	15kΩ	R27	560Ω	R41	1·5kΩ
R14	1·5kΩ	R28	100Ω	All 5%	

VR1 10kΩ+10kΩ Lin. ganged
VR2 5kΩ Lin. (can be 4·7kΩ)
VR3 250Ω skeleton preset
VR4 5kΩ skeleton preset (can be 4·7kΩ)

Capacitors

C1	100μF 15V	C10	1000pF 1%†	C18	10μF 15V
C2	1μF 1%†	C11	100pF 1%†	C19	30μF 15V
C3	0·1μF 1%†	C12	100μF 15V	C20	47pF 1%
C4	0·01μF 1%†	C13	100μF 15V	C21	250μF 15V
C5	1000pF 1%†	C14	100μF 15V	C22	100μF 15V
C6	100pF 1%†	C15	100μF 15V	C23	1000μF 25V
C7	1μF 1%†	C16	1000μF 10V	C24	8μF 25V
C8	0·1μF 1%†	C17	10μF 15V	C25	100μF 50V
C9	0·01μF 1%†				

TC1 3-30pF Beehive trimmer † see text

Semiconductors

Tr1	2N3707	Tr8	BC108
Tr2	2N3702	Tr9	2N3053
Tr3	2N3707	ZD1	5·6V, 400mW Zener Diode
Tr4	2N1304	TH	S.T.C. R53 Thermistor
Tr5	BC108	BR1	Bridge Rectifier, silicon BY164 or similar
Tr6	BC108		
Tr7	BC108		

Miscellaneous

SW1 2-pole, 6-way (only 5 positions used)
SW2 2-pole, 4-way
SW3 Mains on-off
T1 Mains transformer, 240V pri., 12-0-12 sec (used as 0-24) 0·05mA, Home Radio Cat. No. TMM13.
Aluminium and perspex for case; Indicator neon; knobs etc.

transistors used is considerably higher than this, no problem exists here. The phase shift requirements are also met, since the trio introduce a phase shift of 180°, and the frequency network introduces a further 180°. Since these phase shifts are effectively in series, the requisite 360° phase shift is produced.

Stability of the output voltage is important and to this end a thermistor is used. Since it has a negative temperature coefficient, it must be connected in the negative feedback mode. In Fig 1, it is in series with C12 and C14 and controls the a.c. negative feedback from Tr3 emitter to Tr1 emitter. The correct part of its coefficient slope is selected by the value of R8, under which conditions it will hold the output constant to better than ±1dB.

Although the a.c. gain is controlled by the negative feedback via the thermistor, the d.c. gain is still high. Although the silicon transistors chosen have very stable gain and leakage characteristics, the high overall gain does mean that any change in Tr1's characteristics, and to a lesser extent in Tr2's, will disturb the operating point of Tr3 to the detriment, if not complete failure, of the complete circuit. D.C. negative feedback via R6 provides a high degree of stability against any such changes.

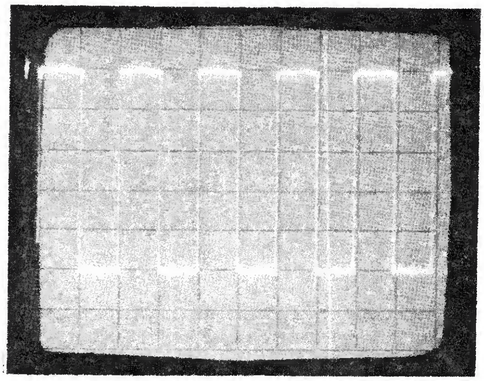
In Fig. 1 five pairs of capacitors, C2-C6 and C7-C11, provide five frequency ranges, selected by SW1, with VR1 (a and b) providing continuous coverage with some slight overlap at either end. The degree of overlap is dependent on the values of R2 and R9, increasing them decreases the overlap, the converse also applying.

The output voltage from the oscillator is taken from the wiper of VR2, which acts as an infinitely variable control, in conjunction with the decade attenuator which follows later in the circuit. This feeds into an emitter follower, Tr4, which has a high input and low output impedance and effectively isolates the oscillator from any load which may be connected across its output. Tr4 is biased at 10mA emitter current by R12 and R13, permitting resistive loads as low as 150Ω to be connected across the output without altering the output voltage by any significant amount.

The coarse attenuator comprises SW2 and range resistors R16 to R28. It is a constant impedance type, with a characteristic impedance of 600Ω, and provides four decade voltage outputs of 1V, 100mV, 10mV and 1mV. This is somewhat more complex, and requires more resistors than the simple potential divider type of attenuator. It is preferred because of the near constant resistance it offers to the load on its four ranges. The resistance values as calculated are odd but the series connection of the range resistors enables preferred value resistors to be used with very little loss of accuracy. If an accurate a.c. millivoltmeter is available, the series connections enables individual resistors, i.e. R24, R26 or R28, to be changed to enable true decade switching to be achieved. The change in value should not be great; the next preferred value should prove satisfactory.

Although sine wave testing of audio equipment can reveal a great deal of information about it, it does not always tell the full story and needs to be complimented by another wave form.

The most commonly used such waveform is a square wave, and this is produced by the two transistors Tr6 and Tr7, with the assistance of Tr5. Tr5 is an overdriven amplifying stage, fed with the sine wave via R29 and C17. The output of Tr5 is partially squared and fed via C18 to Tr6, which in conjunction with Tr7, forms the well known Schmitt Trigger configuration. The component values were chosen for a very fast rise time. TC1 is a "speed up" capacitor, and is used in conjunction with R36, to form a time constant that exactly matches the parallel RC combination of the input impedance of Tr7 base. When these are equal, the coupling from Tr6 collector to Tr7 base is truly aperiodic, and extremely rapid rise times result.



Actual photograph of the square wave at 1kHz.

The collector load of Tr7 is a preset resistor, VR4, so that the output of the square wave can be preset to any desired level, up to a maximum of approx 12V peak-to-peak. The coupling capacitor C21 must be as high in value as possible in order to maintain the tops of low frequency square waves as horizontal as possible.

POWER SUPPLIES

The question of power supplies will depend on the length of time the equipment is in use. For short, intermittent periods of use, batteries can be used. However, the current consumption of 25mA at 20v means four series connected 6V batteries of reasonably high capacity in conjunction with a 20V zener diode for stabilisation purposes. Four such batteries will be somewhat bulky, and the use of mains supplies is therefore an attraction. The circuit of the mains voltage power supply used on the prototype is shown in Fig. 2. The transformer used was rated at 50mA at 12-0-12V, used as 0-24. This is then rectified by the bridge BR1 to provide a voltage across the reservoir capacitor C25 of about 30V. This is then applied to the collector of the series regulator transistor Tr9, and to R41 which is the collector load of the error amplifier Tr8, the emitter voltage of which is held at a constant 5·6V by the zener diode ZD1. The current drawn by ZD1 is about 5mA.

COMPONENTS

For optimum performance and maximum long-term reliability, all the components used in the construction of the generator must be of good quality.

The semiconductors used were carefully selected, and should not be changed unless the individual knows what he is doing and why. Whilst comparable semiconductors do exist, their use has not been investigated, and no advice on this score is therefore offered.

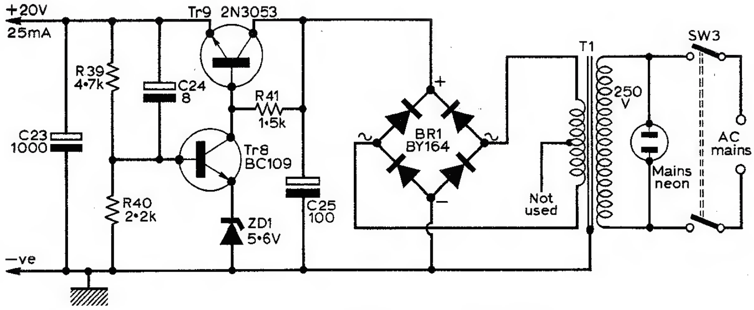


Fig. 2: The circuit of the stabilised power supply.

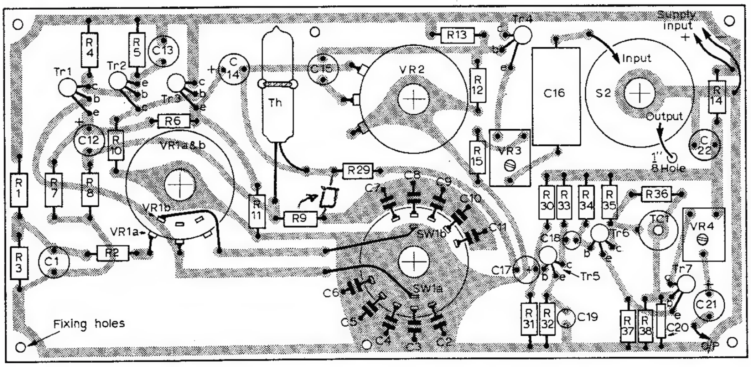


Fig. 3: The component layout and details of the printed circuit board.

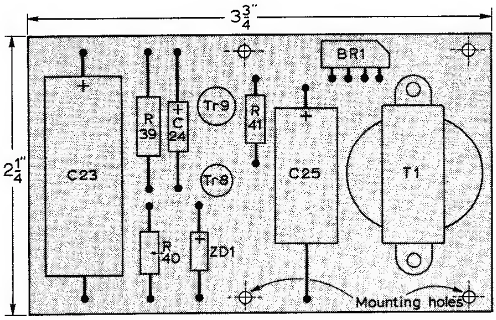
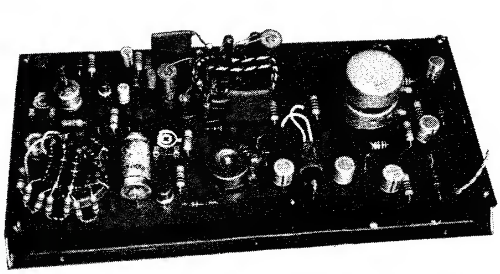


Fig. 4: The component layout of the power supply.



The neat construction using a printed circuit board can clearly be seen here.

With the availability, freely and cheaply, of high quality 5% carbon film resistors, there seems little point in using the inferior carbon composition types, unless these are to hand and cost is of paramount importance.

The majority of the electrolytic capacitors used are of the single ended, or P.C.B. type, as these assist in the conservation of space. The only radial ended electrolytics are those combining high capacity with a relatively high working voltage.

The capacitors used in the frequency determining network of the Wein Bridge should preferably be of 1% tolerance, as this means a single frequency scale can be used on the front panel. It must be admitted that 1% high value capacitors are somewhat expensive and wider tolerance capacitors can be used in the interests of economy. This then requires either the careful selection of capacitors, or the adoption of a multiple frequency dial calibration if accuracy is not to be sacrificed to cost. Readers wishing to use 1% capacitors can purchase WIMA capacitors, as used on the prototype, from WAYCOM LTD., WORKINGHAM ROAD, BRACKNELL, BERKS.

CONSTRUCTION

For this type of circuit, a circuit board of some type is almost mandatory. The prototype was built on to an etched circuit board, measuring $9\frac{1}{4}$in × $4\frac{1}{4}$in, shown in Fig. 3. The fully completed board is supported behind the front panel, and parallel to it, by means of 1in long insulated pillars drilled and tapped 4BA at either end. This allows $\frac{1}{4}$in 4BA bolts to be used for securing the circuit board, whilst the perspex and metal panel are secured by $\frac{1}{2}$in 4BA bolts.

The power supply is built upon a piece of plain Veroboard, $2\frac{1}{4}$in × $3\frac{3}{4}$in shown in Fig. 4 with the component siting.

The supply board is mounted on the rear of the cabinet. That on the prototype was backed by a piece of $\frac{1}{16}$in perspex to preclude any danger of short circuits between the component leads and the cabinet.

The front panel of the instrument was made of white card which is clamped to the front of the cabinet behind a protecting piece of $\frac{1}{16}$in perspex.

The cabinet for the prototype was made from 20s.w.g. aluminium to the sizes in Fig. 5. The easiest way of ensuring that the circuit board, cabinet front and perspex all line up accurately, essential if the control spindles are to pass without fouling through the front panels, is to make up the cabinet first. Then the circuit board and perspex are cut slightly smaller so that they drop into the recess behind the front panel, formed by the top, bottom, and sides. The required holes are then scribed through, using the metal front panel as a template, and carefully drilled out. The holes for the controls in the circuit board will need to be of $\frac{3}{8}$in diameter, the corresponding holes in the front panel can be $\frac{1}{4}$in if accuracy in alignment is achieved. The holes for the output terminals will depend on the components actually used.

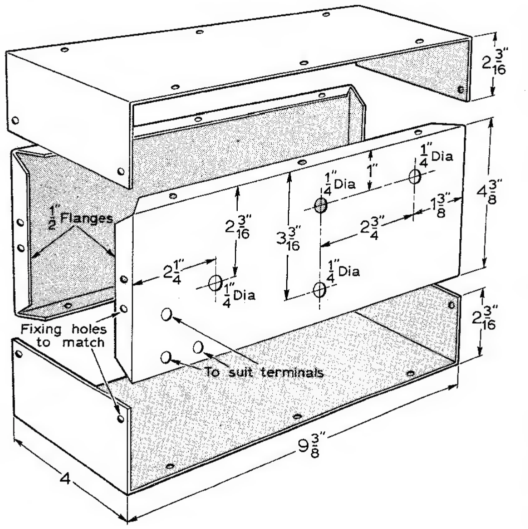


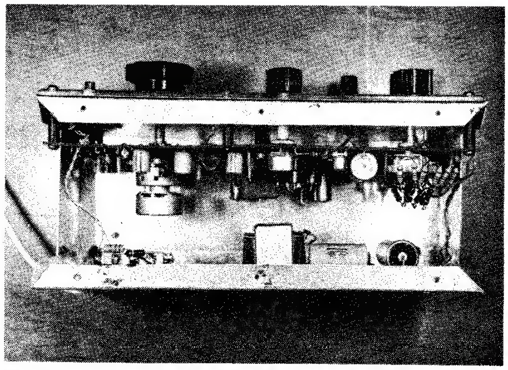
Fig. 5: The details of the case.

SETTING UP

After completing both circuit boards, they should be carefully inspected for soldering and for wiring errors. Then the power supply can be connected to the mains, its output disconnected from the generator board. The output should be monitored and either R39 or R40 altered if necessary to set the output voltage at 20V. The generator board can then be connected and further tests made. A meter capable of reading up to 25mA should be connected in series with one of the supply leads; a reading ±10% of this should be obtained. The meter can then be removed from circuit. Voltage tests using a 20KΩ/V meter should provide readings substantially in agreement with those given in Fig. 1.

In order to ensure that the generator is correctly calibrated in respect of frequency and voltage, an accurate, wide range oscilloscope and a.c. millivoltmeter are required. Another a.f. generator of known accuracy is a useful aid, but is not indispensible. It is only really necessary if wide tolerance capacitors are used in the frequency network.

The oscilloscope and meter should be connected to the sine wave output, and a check made for oscillation throughout all ranges. The sine wave should "look good"; however a visual check for distortion does not reveal it unless it is really severe. Should this prove to be the case, transistor "spreads" may be responsible, in which a change in Tr1 bias effected by changing R1 or R3 may help. If it is due to a thermistor "spread," variation in R8 may help.



Components should not be varied unless really necessary, and even then variations should be in small steps.

If all seems well, attention can be turned to frequency calibration. Here two courses are possible. If 1% capacitors are used for C2-C6 and C7-C11, one frequency scale will suffice. If wide tolerance capacitors are used, a different scale for each range will be necessary, unless some accuracy can be sacrified in the interest of simplification and one scale. Another a.f. generator will be necessary if different frequency scales are to be provided. The use of Lissajous figures for frequency calibration is well known and need not be repeated here.

Lissajous figures are used, using the mains as a frequency standard. VR1 is used on Range 1, and points plotted at 15Hz, 16·6Hz, 20Hz, 25Hz, 30Hz, 35Hz, 40Hz, 50Hz, 75Hz, 100Hz and 150Hz. Range 2 will be these frequencies x10, Range 3 will be x100 and so on.

The next step is to set the output voltage. VR2 should be at maximum, with SW2 on the 1V position. Using a frequency of 1kHz, VR3 is set to give a reading on the meter of precisely 1V. SW2 is then set at 100mV, and the output checked, similarly at 10mV and 1mV, if the meter will read as low as this R24, R26 and R28 can then be changed if necessary.

The frequency response can then be checked if required, and should be constant to ±1db from 15Hz to 150kHz, falling to −2·5db at 1·5MHz.

For setting the Schmitt trigger, the ideal 'scope would be a d.c. coupled one, with the h.f. response extending to 10MHz or higher. On an a.c. coupled 'scope, considerable sloping of the tops of the low frequency square waves can be expected.

Similarly, unless the 'scope has a first class h.f. response, rounding off the shoulders of the leading edges of the square waves can be expected at high frequencies. The measured rise time of the prototype square wave at 1kHz was 250nS (nanoseconds).

The effect of TC1 is only apparent at the higher frequencies, where it should be adjusted so that the shoulders of the leading edges of the square waves have neither "overshoot" or "sag."

VR4 can be adjusted to provide a square wave output of up to 12V peak-to-peak. Designing an attenuator that does not degrade a fast square wave is not too easy and was not attempted.

The mark-space ratio should be one-to-one, and is dependent upon Tr5 providing a symmetrical output to the trigger. Any variation of this ratio from the required 1:1 can be corrected by variation in the value of R29. ■

ON THE SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

DUE to the postal dispute no reports have reached me in time for inclusion in this issue. The following news items were obtained from Radio Sweden's DX programme: 'Sweden Calling DXers' and from my own log.

GERMANY. DRM23, *Radio Bremen* on 6190kHz has announced that it plans to increase its power from the present 10kW in the near future.

GUATEMALA. *Radio Cultural* has been reported at 1205 on 9505kHz with a strong signal.

NEW CALEDONIA. *Radio Noumea* is reported to be using the new frequency of 9510kHz. The times of the broadcasts are 0600-1100 and 2330-0200, the language used is French.

NORWAY. *Radio Norway* now broadcasts a DX programme called 'DX Radio Norway' on the first Sunday of every month. The first programme was scheduled to be broadcast on March 7th. The programmes are transmitted at 0800, 1000 and at two-hourly intervals throughout the day. Radio Norway has also reported that it hopes to have transmitters with power in the region of 500 to 1000kW in operation before the end of 1974.

PERU. *Radio Nacional*, Lima, Peru, has been heard broadcasting at 0300 on a frequency of 6082kHz. The programme consisted of Peruvian music.

Choosing a receiver

Since I started writing this column I have had many queries from readers, the most common being about the choice of equipment. In the following paragraphs I list the most important features for a DXer's receiver. Each DXer requires a slightly different receiver and the following is my own order of importance.

An adequate short-wave range. Before purchasing a receiver the listener should decide which bands he is interested in. Some listeners may require coverage of the 49m to 13m bands only, whereas others may have a special interest in the tropical bands (120 to 60 metres). Most listeners will probably settle for a general-coverage receiver (540kHz to 32MHz).

An external aerial connection. This is a very important point which can easily be overlooked. No short-wave receiver can give DX performance unless a good aerial is used.

Bandspread frequency control. With the present crowded state of the bands it is essential to have a receiver with this feature to enable adjacent stations to be separated. The receiver should also have a logging scale so that the setting can be noted and returned to at a later date.

Adequate selectivity. Selectivity is a measure of the ability of the receiver to separate two adjacent stations. Some receivers have a variable selectivity control and this can be very useful.

Adequate sensitivity. Sensitivity is a measure of the receiver's ability to pick-up and amplify weak signals. A DXer's receiver must be sensitive as he is mainly interested in weak signals.

An aerial matching device. Sometimes called an antenna trimmer this very useful control allows the aerial to be correctly matched to the receiver. A very small mis-match can cause a serious loss of signal.

A crystal calibrator. This gives signals at intervals of 100kHz and is an invaluable aid to determining the exact frequency of any station.

A signal-strength indicator. Usually in the form of a magic-eye indicator or an S-meter. These indicators enable the relative strengths of incoming signals to be determined.

An r.f. gain control. Most receivers have an audio gain control only, the addition of a separate r.f. control can greatly assist in the reception of difficult signals.

An automatic gain control switch. All receivers incorporate some form of automatic gain control which adjusts the gain of the receiver to compensate for sudden fluctuations in the input signal. The a.g.c. switch enables the circuit to be disconnected, with the circuit out of action weak signals çan be greatly amplified.

A noise limiter. Sensitive receivers are susceptible to noise interference. The noise limiter clips the tops of the noise signals and stops them from reaching the output of the receiver.

I hope that the above paragraphs have been of interest to those of you who are thinking of buying a receiver, I look forward to receiving reports from you in the near future.

All reports please to me at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex, by the 15th of the month.

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

1971 WORLD RADIO-TV HANDBOOK
Published by Billboard A.G. and available from Fountain Press, 46 Chancery Lane, London, W.C.2. 372 pages, 9 × 6in. Price £2.30

FOR those not familiar with this publication it lists virtually every radio and television station in the world and provides all the information you are ever likely to need for DXing—in fact I don't know of a short wave listener who doesn't regard it as a sort of "bible".

Every year we look forward to the new edition and we have not been disappointed with this one. The introductory articles that used to take up the first part have been dropped and published separately for the first time under the title "How to Listen 1971".

We could hardly do without it at the P.W. offices and we are sure you will be in the same position if you are interested in any form of DXing.—*H.W.M.*

ON THE SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

EACH month, letters arrive which raise various queries. Some contain the usual questions which crop up again and again, others are peculiar to a person or piece of equipment. Over the years numerous questions have been answered but it seems obvious that more and more newcomers are reading this page and are, therefore, repeating the same questions which others before them raised. So for once, let's have a session of answers to some of the problems which have arrived over a period of months.

First query is usually a "By the way" enquiry and asks what gear does G3JDG use and on what bands can emission from your scribe be detected. Gear permits 120W of a.m./c.w. from 3·5MHz to 30MHz and 10W on topband. Main interests are the h.f. DX bands and an unashamed preference for c.w. Phone is used on topband and then, usually, mobile. The receiver is a valve type with r.f., mixer, two i.f., det. and one audio plus b.f.o. and Q-multiplier. An a.t.u. is always used since aerials are a source of much experimentation. Antenna for the past six months has been a solitary slither of wire some 60ft. long at about 18ft. Current move into a "new" house should see activity on 14MHz c.w. and on topband a.m. at first. A modified Pye reporter transceiver allows 18W on 70MHz.

Two questions which occur more often than any others. Where can I get a list of callsigns and countries, and what is the "best" aerial to use? A country's list can be obtained from the R.S.G.B., 35 Doughty Street, London, WC1N 2AE, price is 6½p Incidentally, those who are not members of the R.S.G.B. might like to send for a free specimen copy of the Society's monthly publication *Radio Communication.*

The short answer to the question, "What is the best aerial to use", is simply "There is no such animal". An aerial which is excellent for a particular band will not necessarily be any good on another frequency. Again, the particular physical location can affect the performance. Aerials are often largely a matter of suck it and see.

The only aerial which might be considered an "all frequency" affair (speaking now of 1·8 to 30MHz) is simply a length of wire as long as possible, as high as possible and as far from earthed objects as possible. The wire is then fed to the receiver via an a.t.u. (aerial tuner unit). This is, in fact, the system in use at G3JDG at the moment. It is essentially a compromise system and there are other set-ups which could quite easily out-perform it. Aerials, or antennas, are a subject in themselves and there are numerous textbooks which discuss the relative merits of each type to which interested readers are respectfully referred.

A common question from newcomers is simply where to start, what receiver, etc. If the receiver is to be home-built, then much will depend upon individual skills in construction. For the absolute beginner it might be easier to purchase a simple kit, the only real alternative being to buy a ready-made unit.

Headphones are a must and aerials have already been dealt with as has a country's list. Armed with these basic essentials one is all set to start the initiation of becoming a short wave listener (s.w.l.). Amateur bands to listen on (up to 30MHz) are; 1·8—2·0MHz; 3·5—4·0MHz; 7·0—7·1MHz; 14·0—14·35MHz; 21·0—21·45MHz; 28·0—29·7MHz.

A good wall map of the world is useful and a packet of coloured drawing pins will permit stations logged to be located on the map. Incidentally, this procedure, besides adding interest, will also provide a surprisingly good working knowledge of geography over a short period of time.

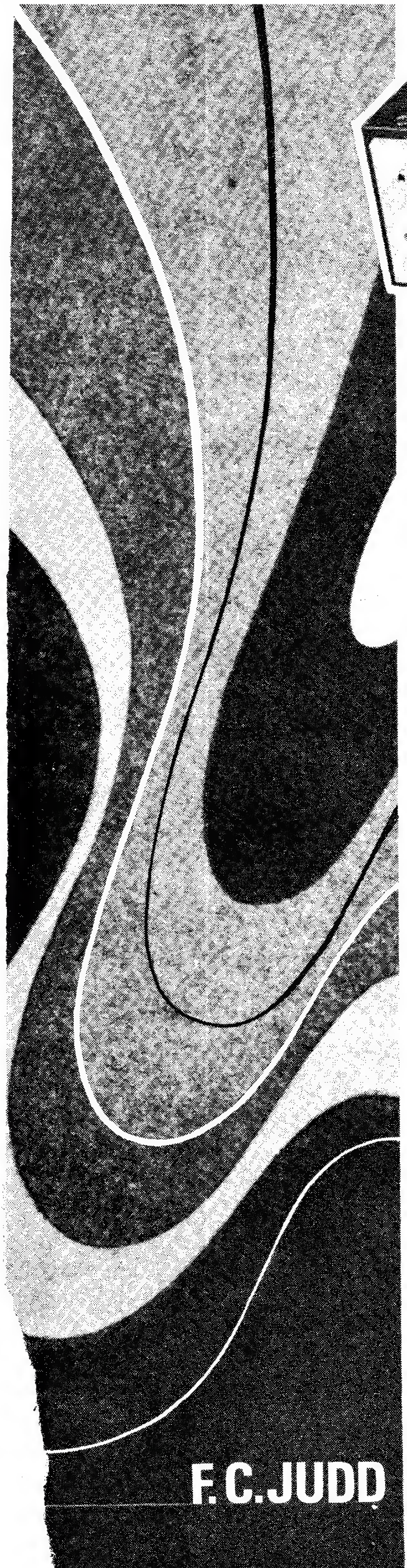
A point which often appears to baffle the beginner is the disappearance of signals from a particular band or bands. There are many causes of fluctation in communications. For example, the height of the ionised layers above the earth which reflect the radio waves back has a marked affect. Again, the activity of the sun plays an important role as does the season or time of year. As an example, at the time of writing, the 14MHz or twenty metre band is mainly active from around 0700 to 2200hrs although some signals might be heard occasionally outside these times. The 21MHz band is mainly active between 0700 and 2000hrs while up on 28MHz the signals are in evidence between 0800 and 1800hrs.

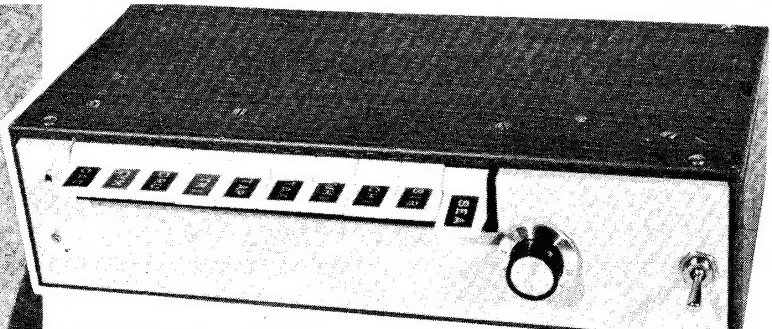
Another favourite query is how to get a transmitting licence and what is involved. The licencing body in the U.K. is the Post Office. In order to obtain a licence the Post Office need to be satisfied of a persons technical competence to operate transmitting equipment.

There are two types of licence. For a full "A" licence, which permits the holder to transmit on all amateur bands from 1·8MHz upwards, it is necessary to pass a written technical examination. The other test is that the candidate is required to send and receive Morse at the rate of 12 words per minute. A pass in the technical paper is essential for either licence.

If the Morse test is not taken it is still possible to obtain a licence but in this case transmission is restricted to the amateur frequencies from 144MHz (two meters) and higher. Thus all the h.f. DX band would be "out of bounds" as regards transmission. This licence is called a "B" licence and holders are distinguishable by a callsign which begins "G8" followed by three letters. Some holders of full licences have a G8 callsign but these are followed by only two letters. Note that in Scotland callsigns begin "GM" and in Wales with "GW". GI (Northern Ireland), GC (Channel Islands), GD (Isle of Man). Thus a G8 licence issued to a Scottish amateur would begin GM8, etc.

Logs for the Amateur Bands must arrive before the 15th of each month. The address is:
14 Manland Avenue, Harpenden, Herts





pw sound effects SYNTHESISER

PART 3

THREE more circuit boards and the power supply complete the electronic percussion and sound effects synthesiser for which general constructional details and the circuits etc. for castanets, cymbal, snare drum, triangle, woodblock, taxi horn, train whistle and bell chime were given in parts 1 and 2.

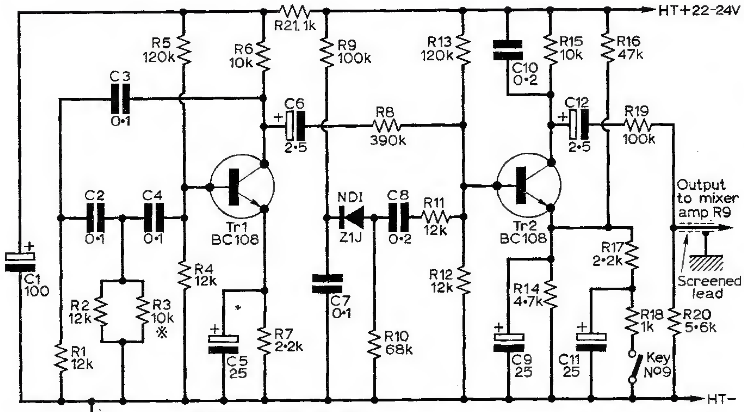
The remaining two generator circuits Nos. 9 and 10, are those for a ship's siren and the sound of the sea (surf). Details are also given in this part for the mixer amplifier and power supply etc. However, before going on to these circuits it would be as well to deal with the small modification that must be carried out on the organ key switch assembly.

There are 10 keys on this and when either one is pressed it will stay down until pressed again. This action is facilitated by small phosphor-bronze clips, one to each key and the function of each clip is to hold a small brass pin within the key guide frame. The operation of all the circuits 1 to 9 is that they must produce the sound when the key is pressed and instantly released, or pressed and held under pressure, i.e., the keys must behave like a piano key. All that is necessary is to remove the phosphor-bronze clips on keys 1 to 9 *only* and shake or pull out the small brass pins. When the keys are now pressed they will immediately return to normal when pressure is released. Key No. 10 which actuates the sea sound generator (circuit No. 10) must be left to work as intended i.e., when pressed down it must stay down until pressed again. This allows the sea sound to be run continuously without having to hold the key down.

The contact system on each key is simply a pair of single pole change-over switches and one or both can be used for the make and break of each keying circuit. The writer simply paralleled both sets of contacts but used them as a single make/break switch. This will be referred to again later.

Circuit for Ship's Siren—No. 9

This circuit is given in Fig. 22 and employs a phase shift oscillator (Tr1) operating at a frequency of about 120Hz and which can be adjusted by variation of R3. The output from Tr1 is attenuated by R8 and fed directly to Tr2 which is biased to cut-off by R16. The noise content for the sound is produced by the noise diode ND1, the output signal from this being slightly attenuated by R11. The sine-wave signal from Tr1 and the noise signal are combined in Tr2 which is keyed on by key No. 9. The output from Tr2 is attenuated to a level suitable for the mixer amplifier by R19/R20. The circuit board layout is given in Fig. 23. The circuit should require little or no adjustment except for pitch but the noise content of the sound, which should not be too predominant, can be regulated by variation of R11. Waveforms for this circuit are shown in Fig. 26 (Ship Siren circuit, A and B).



※ R3 – Pitch (See text)

Fig. 22: The circuit of the ship's siren sound synthesiser section.

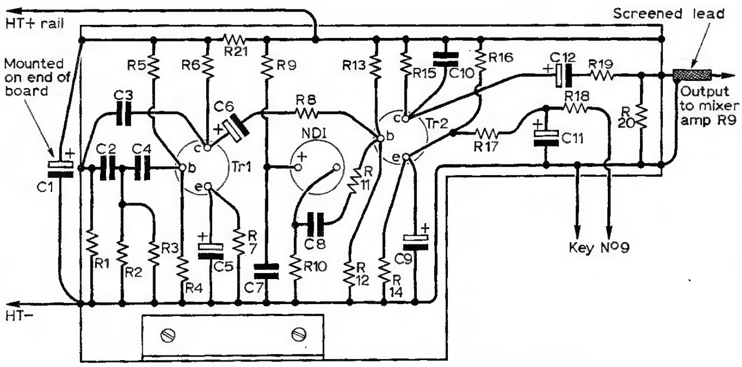
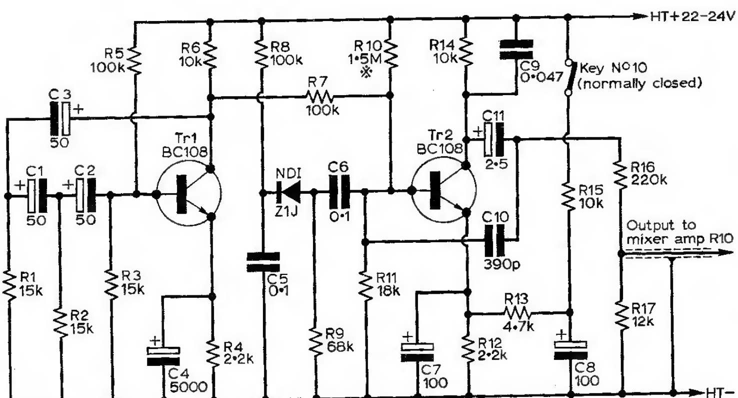


Fig. 23: The component layout for the ship's siren synthesiser.



※ R10 - To be adjusted as described in text
(Note. Tr1 oscillates at approx 1 cycle in 10 seconds)

Fig. 24: The circuit for the 'surf on the beach' sound.

Surf on the Beach—No. 10

Surf rolling up on the beach and receding is a fairly slow movement and the sound itself, which is mainly random noise, rises and falls in amplitude at the same rate as the movement of the water. Here we need a slow but sinusoidal rate of change in signal level. The noise diode ND1 provides the white noise but to be effective a slight change of pitch in the noise is needed as well as the amplitude variation.

The noise signal is fed directly to Tr2 which is rendered almost non-conducting because of the large value resistor (1·5MΩ) between the base and positive rail. The base is however, directly coupled (via R7) to the collector of the slow running phase shift oscillator Tr1. As the potential at Tr1 collector rises and falls Tr2 will become fully conductive and/or quiescent at the same rate. The noise output signal from Tr2 will rise and fall accordingly. The phase-shift oscillator runs at approximately 1 complete cycle in 10 seconds. The change in pitch of the noise output is produced by feedback via C10. In operation, key No. 10 is pressed down and stays down (see above) so that the sound continues until the key is again pressed and released. The sound must not cut off completely as the amplitude falls but simply fall to a low level. Adjustment to the value of R10 (1·5MΩ) may therefore, be necessary, i.e., the value may have to be reduced to 1·2MΩ or increased to 1·8MΩ. The sound produced by the circuit is quite realistic but should not be too loud when used as a background effect for desert island type tunes. Note that the key for this circuit (No. 10) is wired so that the key contacts are "on" whilst the circuit is non-operational. When key No. 10 is closed as shown in the circuit, Tr2 is biased to cut off. The circuit board layout is shown in Fig. 25 and relevant waveforms in Fig. 26 (Surf on Beach Circuit A and B).

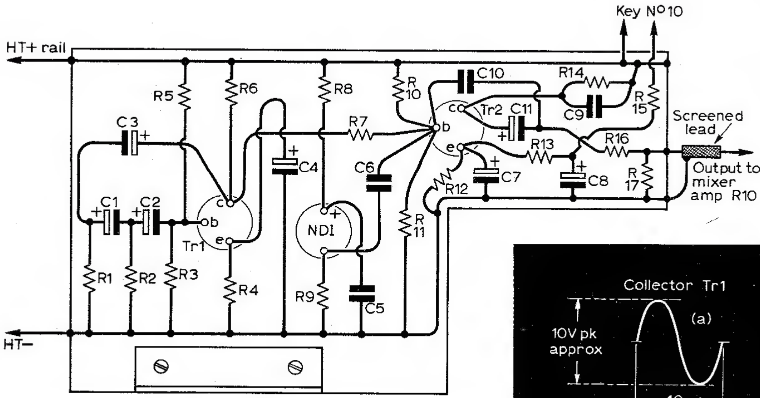


Fig. 25: The component layout for the surf sound synthesiser.

The Power Supply

The circuit for the power supply is given in Fig. 27. The supply on load, with all circuits connected but not keyed, should be not less than 22V and not greater than 24V. The smoothing resistor R, which should be about 1kΩ, may therefore require adjustment to value. The total current drawn by the generator circuits (not keyed) and the mixer amplifier should be approximately 20mA. The layout for the power supply as used on the dividing chassis of the Contil Mod 2 case employed for the prototype unit, is shown in Fig. 28.

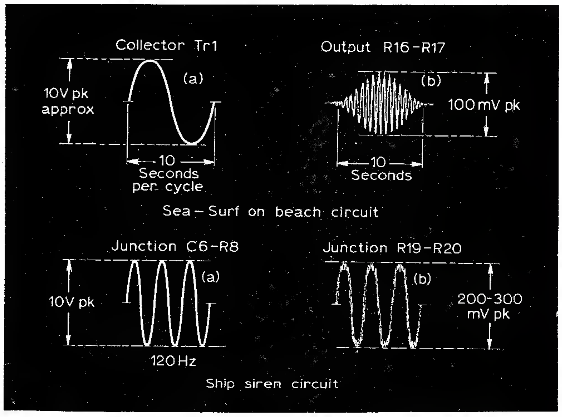


Fig. 26: The waveforms of the surf and ship's siren circuits.

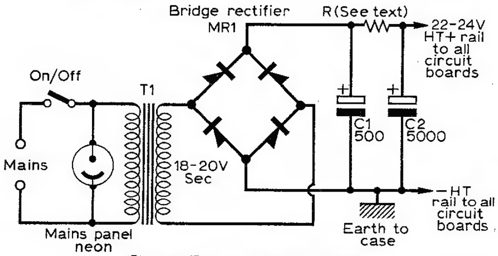


Fig. 27: The power supply circuit.

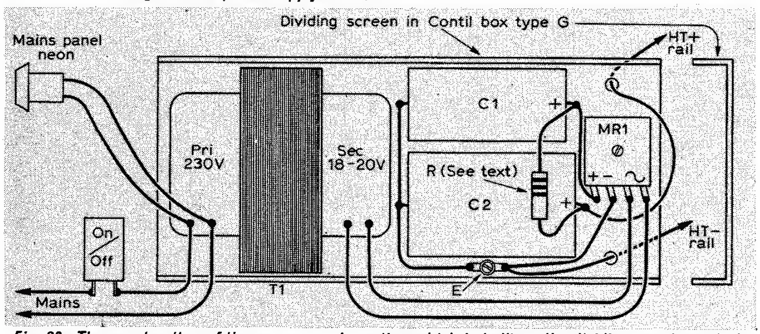


Fig. 28: The construction of the power supply section which is built on the dividing panel supplied with the case.

Mixer Amplifier

This is a single stage signal amplifier with input attenuation to reduce the signals from each of the generator circuits to a level appropriate to each of the sounds. The input attenuation resistors R1 to R10 also serve to prevent impedance loading by each circuit and also signal overloading of the amplifier itself. The values chosen for R1 to R10 may require slight adjustment one way or the other in value so that the levels of the various sounds are relative for any setting of the volume control. The volume control has been provided simply to control the overall output from the unit.

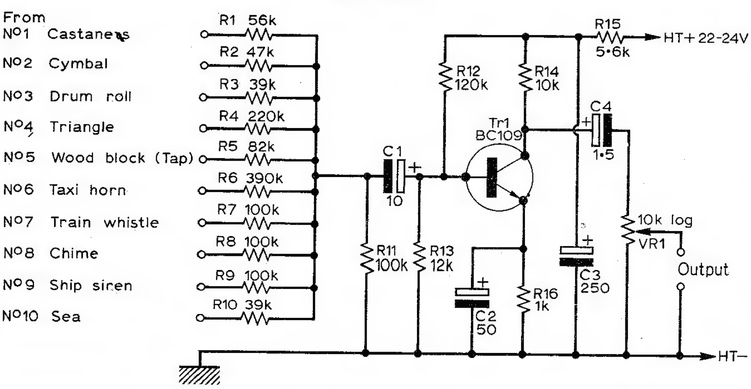


Fig. 29: The circuit of the mixer amplifier. The values of R1–R10 may have to be varied as mentioned in the text.

★ components list — part three

Ship Siren Circuit No. 9

Transistors
Tr1, Tr2 — BC108 Mullard

Noise Diode
ND1 — Z1J (see part 1) Semitron

Resistors

R1	12kΩ	R8	390kΩ	R15	10kΩ
R2	12kΩ	R9	100kΩ	R16	47kΩ
R3	10kΩ	R10	68kΩ	R17	2·2kΩ
R4	12kΩ	R11	12kΩ	R18	1kΩ
R5	120kΩ	R12	12kΩ	R19	100kΩ
R6	10kΩ	R13	120kΩ	R20	5·6kΩ
R7	2·2kΩ	R14	4·7kΩ	R21	1kΩ

All ¼W, 10% types

Capacitors

C1	100μF	C7	0·1μF
C2	0·1μF	C8	0·2μF
C3	0·1μF	C9	25μF
C4	0·1μF	C10	0·2μF
C5	25μF	C11	25μF
C6	2·5μF	C12	2·5μF

Sea (Surf on Beach) Circuit No. 10

Transistors
Tr1, Tr2 — BC108 Mullard

Noise Diode
ND1 — Z1J (see part 1) Semitron

Resistors

R1	15kΩ	R7	100kΩ	R13	4·7kΩ
R2	15kΩ	R8	100kΩ	R14	10kΩ
R3	15kΩ	R9	68kΩ	R15	10kΩ
R4	2·2kΩ	R10	1·5MΩ	R16	220kΩ
R5	100kΩ	R11	18kΩ	R17	12kΩ
R6	10kΩ	R12	2·2kΩ		

All ¼W, 10% types.

Capacitors

C1	50μF	C6	0·1μF
C2	50μF	C7	100μF
C3	50μF	C8	100μF
C4	5000μF	C9	0·047μF
C5	0·1μF	C10	390pF

Mixer Amplifier

Transistors
Tr1, BC109 Mullard

Resistors

R1	56kΩ	R7	100kΩ	R13	12kΩ
R2	47kΩ	R8	100kΩ	R14	10kΩ
R3	39kΩ	R9	100kΩ	R15	5·6kΩ
R4	220kΩ	R10	39kΩ	R16	1kΩ
R5	82kΩ	R11	100kΩ		
R6	390kΩ	R12	120kΩ		

All ¼W, 10% types

Capacitors

C1	10μF	C3	250μF
C2	50μF	C4	1·5μF

Power Supply

Transformer TI	Pri. 230V., Sec 18-20V (TS/18/2, Henry's Radio)
Resistor R	1 Watt (see text)
Capacitors	C1 500μF 30v wkg.
	C2 5000μF 25-30v wkg.
Rectifier MR1	Bridge type LT120 or LT119 (Henry's Radio)

Miscellaneous

Volume Control VR1	10kΩ log.
Output socket	Jack or Phono type.
Mains on/off switch	Toggle type
Panel Neon	230V mains type

The layout for the mixer-amplifier circuit is given in Fig. 30.

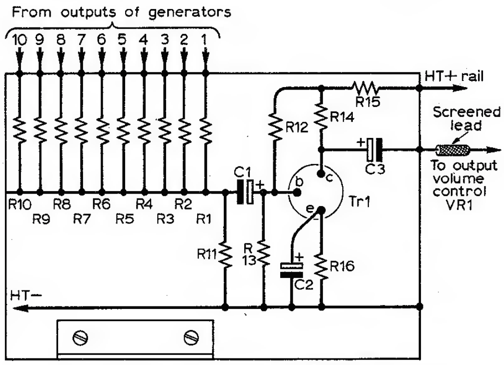


Fig. 30: The component layout of the mixer amplifier.

The Keying Contacts

The modification required to allow the keys to be pressed and instantly released, i.e., the removal of the phosphor bronze clips, was dealt with earlier. The switches attached to these keys are a pair for single pole changeover. Both sets can be used for keys 1 to 9 as shown in Fig. 31, i.e., both pairs are wired to provide a paralleled pair of on-off contacts. The same applies to key No. 10 (sea circuit) except that the rear pair as in Fig. 31b are used as the contacts are normally closed.

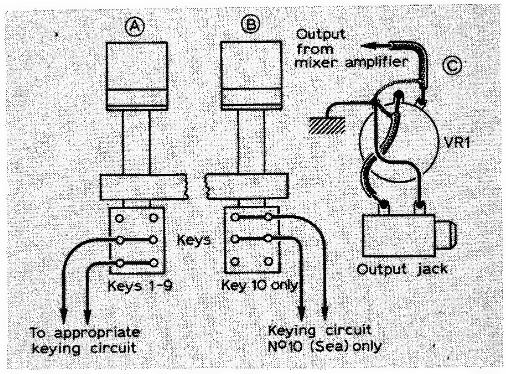


Fig. 31: The wiring of the keying contacts and the level control.

Final Assembly

If the specified case has been used, the final assembly should appear as shown in the photograph which shows the unit as seen from beneath, i.e., with the base panel removed. As explained in part 1 the circuit boards are assembled on what is really the top of the case so that when it is turned over the keys are all at the top as shown. Whatever type of case is used the assembly should follow this pattern, particularly if the unit is to be used with an electronic organ.

Operation

It was mentioned previously that each circuit

—continued on page 70

PREMIER STEREO SYSTEM "ONE" Consists of an all transistor stereo amplifier. Garrard 2025 T/C auto manual record player unit fitted stereo mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on off, stereo mono switch. Brushed aluminium front panel Black metal case with teakwood ends: Size 12 × 5½ × 3½in. high (Amplifier available separately if required £14.95 Carr. 40p.) *NOW AVAILABLE – MATCHING FM TUNER £22.05*

PREMIER STEREO SYSTEM "TWO"
As system 'ONE' above but with Garrard SP25.
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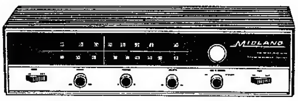
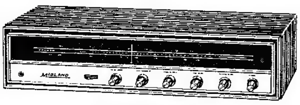


MODEL 19-520



MODEL 19-542

Specifications	MODEL 19-520	MODEL 19-542
Semi conductors	19 transistors, 12 diodes, 2 varistors	22 transistors, 12 diodes
Tuning range	FM 88–108 MHz FM Stereo Multiplex AM 535–1635 kHz	FM 88–108 mHz FM Stereo Multiplex AM 535–1605 kHz
Aerial	Internal AM and external FM	Internal AM and external FM
Frequency response	50–17,000 Hz	35–20,000 Hz
Power output	2½ watts rms per channel (8 watts music power)	4 watts rms per channel (18 watts music power)
Inputs	Ceramic phono	Magnetic/Ceramic phono and aux.
Speaker impedance	4–8 ohm	8 ohm
Controls	Power on/off, Volume, tone, balance, tuning, AFC. Stereo indicator	On/off, Volume, bass, treble, balance, tuning, AFC. Stereo indicator
Function selector	AM, FM, FM Stereo, Phono (Stereo indicator light)	AM, FM, FM Stereo, Ceramic, Magnetic. Aux.
Size	15" x 8 3/16" x 3½"	16½" x 9⅛" x 3⅛"
PRICE	**£30.45** Carr. & Ins. 50p	**£44** Carr. & Ins. 50p

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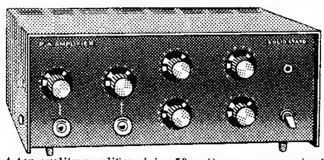
50 WATT PUBLIC ADDRESS AMPLIFIER MODEL PA-5000



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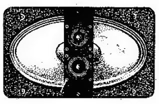

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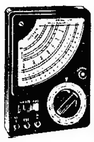

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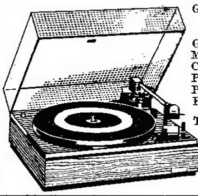

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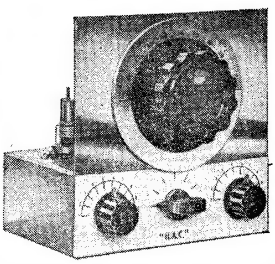

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A. LESTER-RANDS

PW WORKSHOP Oscilloscope

PART 2

THE circuit and other technical details of the P.W. oscilloscope were given in part 1. The prototype, as shown in the photographs, was constructed in a Mod-Contil case type Q which has overall dimensions of 13×9×7in. Any case of similar size could be used but the layout of the components should follow that given as closely as possible. Details for the front panel drilling are given in Fig. 2 and these apply of course to the panel of the Mod-Contil type Q case. The general assembly of the two end panels and the chassis and the positions of the c.r.t., the component tagboards and mains transformer are shown in Fig. 3. This layout is important even if a different case is used. *The transformer T1 must be situated below and to the rear of the c.r.t. and as close to the end of the chassis as possible as shown in Fig. 4.*

SUB-ASSEMBLIES

These include the main tagboard mounting screen, the panel for the c.r.t. base and the panels for the focus and brilliance controls and the X amplifier gain control. Details for the main tagboard mounting screen are given in Fig. 5 and on this are fitted the miniature tagboards as shown in Fig. 3 with insulating material beneath them to prevent short circuits. The panel and clamp material for the c.r.t. base are shown in Fig. 6 but note the slotted holes in the panel to allow the height of the c.r.t. to be adjusted relative to the front panel. The c.r.t. holder is not mounted on this panel but simply pushed on to the c.r.t. connecting pins.

Details for the focus (VR9) and brilliance (VR8) controls panel are given in Fig. 7b. The panel may be made from perspex or paxolin, $\frac{1}{8}$in. thick. Both controls are at high potential with respect to chassis and for this reason must not only be mounted on a panel of insulating material but must also be coupled to the front panel control knobs via insulating spindle couplers as shown in the photo. The remaining panel is that for the X amplifier gain control VR1 as shown in Fig. 7c and which is secured to the side of the chassis as in Fig. 7a. The spindle of this control must be cut very short (to about $\frac{1}{8}$in.) and slotted as shown as adjustment is made, when required, by screwdriver. To facilitate this a hole is cut in the side panel exactly in line with the control i.e., on the right when facing the front panel.

The three small tagboards E, F and G are located

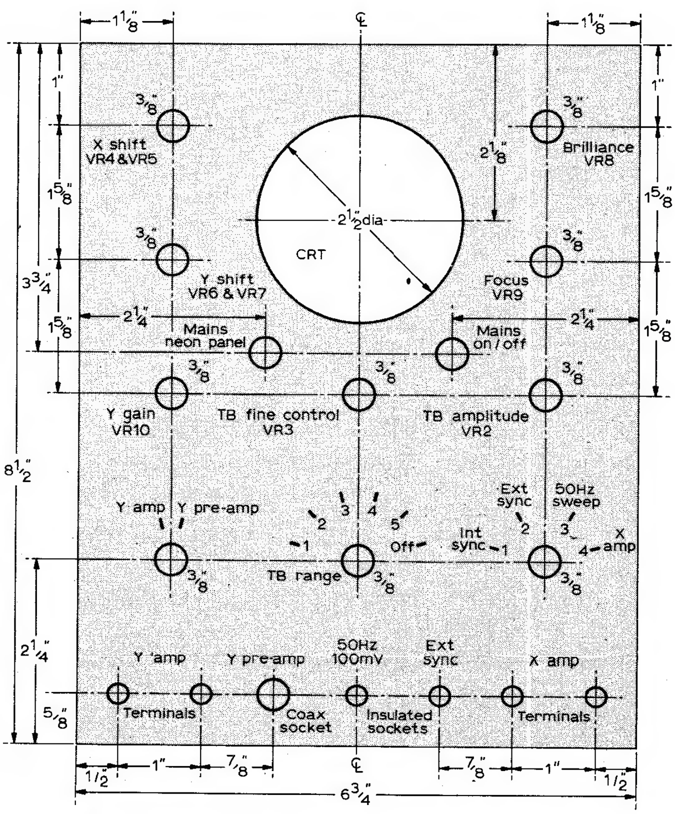
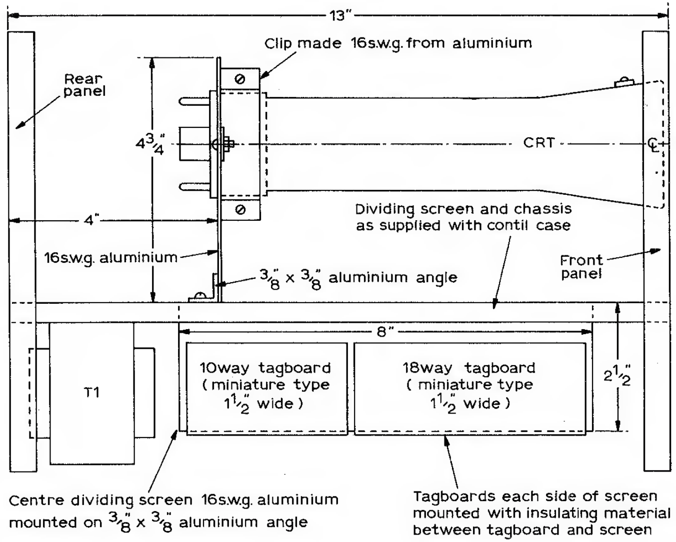


Fig. 2: The drilling of the front panel and location of the controls.



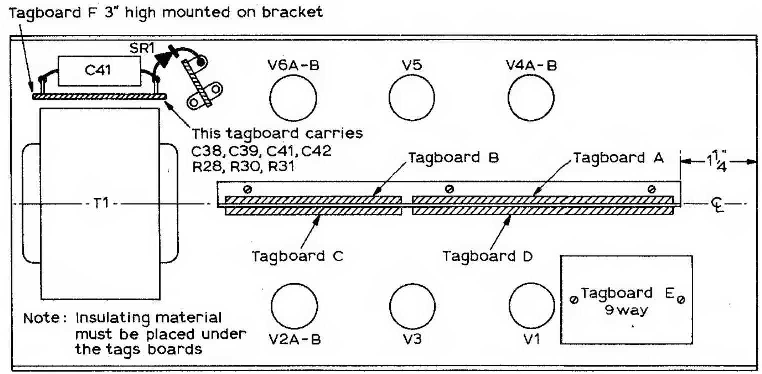
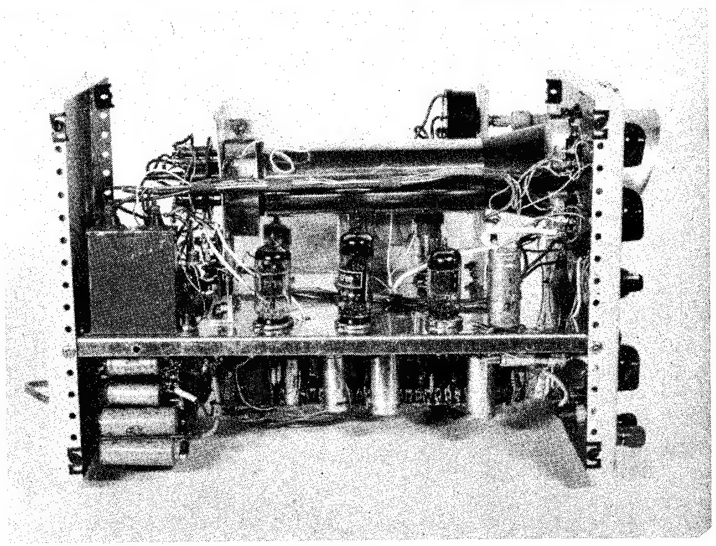
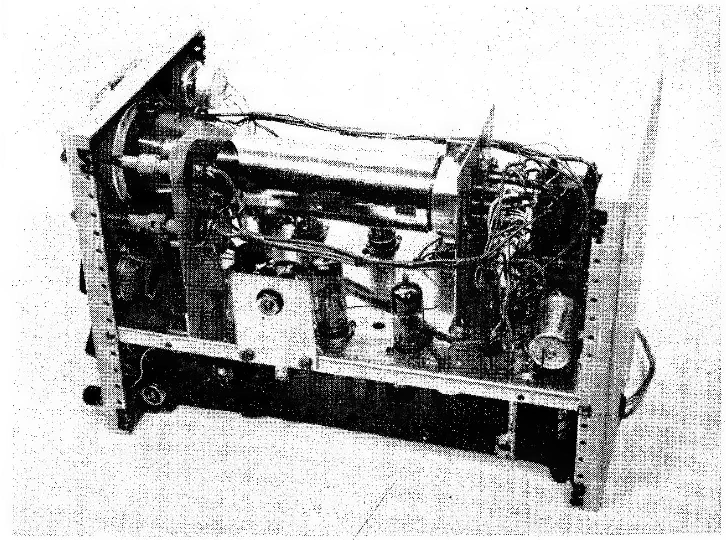


Fig. 3 (left): General assembly and layout using the specified case.

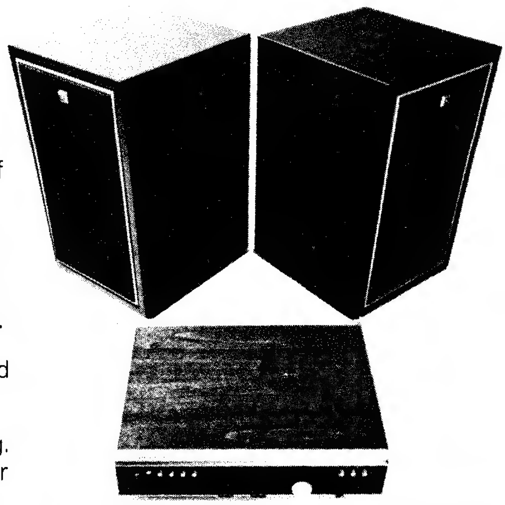
Fig. 4 (above): Location of the mains transformer, the centre screen and the tagboards.

General views of the P.W. Workshop Oscilloscope are shown below and these should be used in conjunction with the various drawings to site the main components.





HOW TO TELL A STEREO SYSTEM THAT LOOKS GOOD FROM A STEREO SYSTEM THAT SOUNDS GOOD–BEFORE YOU PART WITH YOUR MONEY.



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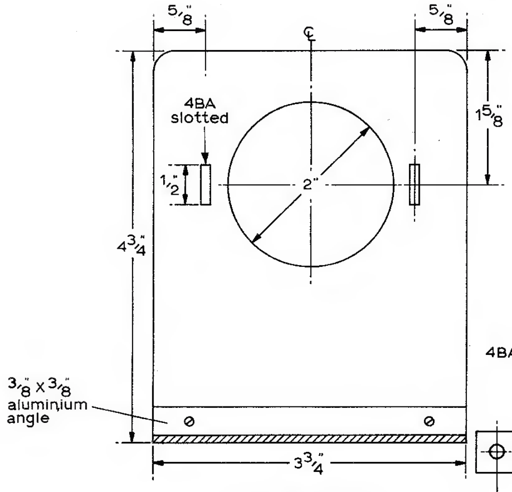
System II.	8 Watts	10 Watts	As system I.	£49·90
System III.	15 Watts	As System II	IIIA Garrard 2025TC	£59·90
			IIIB Garrard SP.25 MK III	£69·90
System IV.	20 Watts	20 Watts	Garrard SP.25 MKIII	£79·90
System V	18 Watts	20 Watts	As System IV	£115·00
System VI.	30 Watts	30 Watts	Thorens TD150AB	£182·00



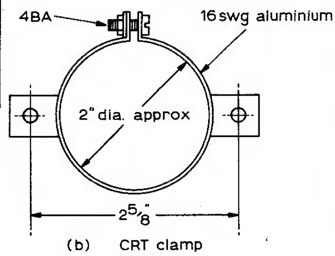


Fig. 6: The c.r.t. mounting panel and base clamp.

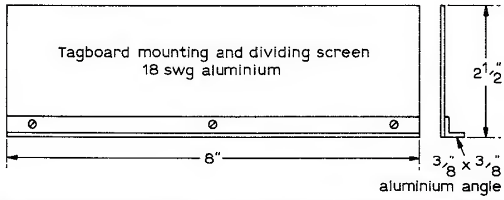


Fig. 5: The chassis dividing screen which is also used for mounting tagboards A, B, C and D.

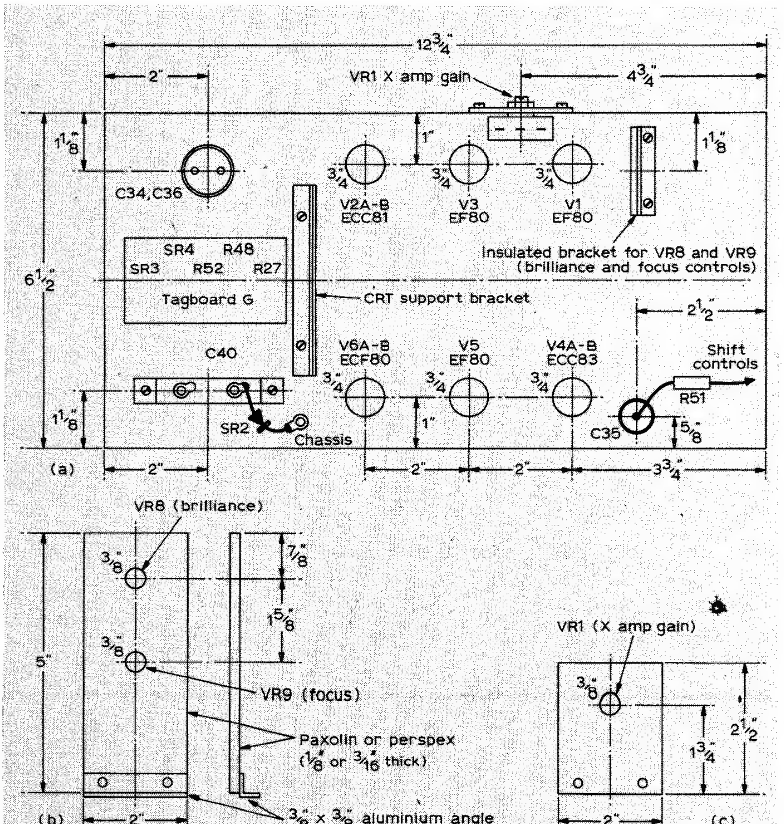


Fig. 7: Layout of the valve holders and other chassis mounted components and details for the brilliance and focus panel and the X amp gain control bracket.

as shown in Figs. 4 and 7 respectively. Tagboard F is mounted on a piece of $^3/_8$in. aluminium angle and located at the side of the mains transformer T1 (see Fig. 4). This tagboard carries the capacitors C38, C39, C41 and C42 which are fairly large so the board should be 2in. wide and have at least 6 pairs of tags. Tagboards E and G are mounted on the chassis with spacers or insulating material underneath so that the tag eyelets do not touch the chassis. These boards may be miniature ($1^1/_2$in. wide), each with 10 pairs of tags. The location of the valveholders and other chassis mounted components such as C34, C35, C36 and C40, etc., are shown in Fig. 7.

CONSTRUCTION AND WIRING

These photos show the construction and layout as seen from both sides and above and below the chassis (see also photos in Part 1). The c.r.t. is mounted so that the final anode cap is uppermost as shown in Fig. 8. This will bring the 'key' on the c.r.t. base to the vertical position and ensure that the trace is horizontal when displayed. Fig. 8 also shows the c.r.t. connections. The lead to the final anode cap can be directly soldered to the projecting pin.

The layout for the Y amplifier, the timebase and the X amplifier tagboards is shown in Figs. 9 and 10 respectively. The tagboard pairs A and B, and C and D should each be regarded as one long

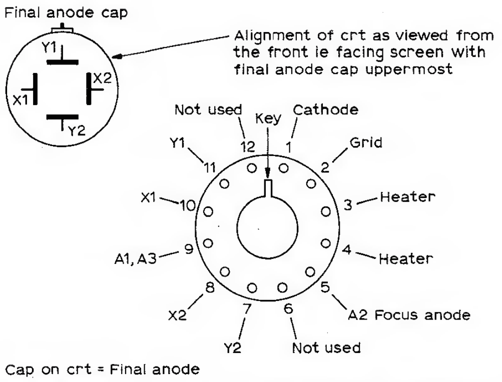


Fig. 8: C.R.T. base connections. Inset shows X and Y plate alignment in relationship to the final anode cap.

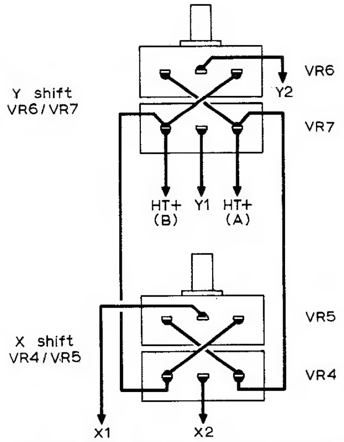


Fig. 11: Wiring of the X and Y shift controls.

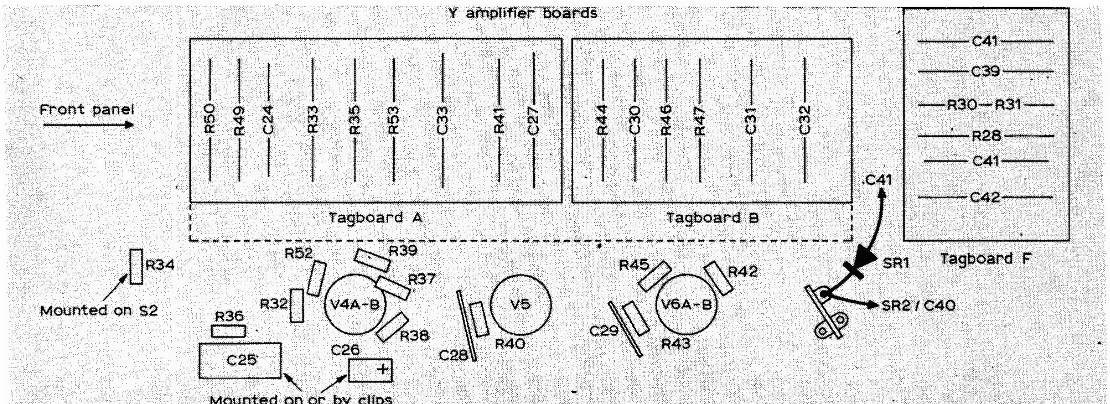


Fig. 9: Component layout for Y amplifiers and e.h.t. supply capacitors

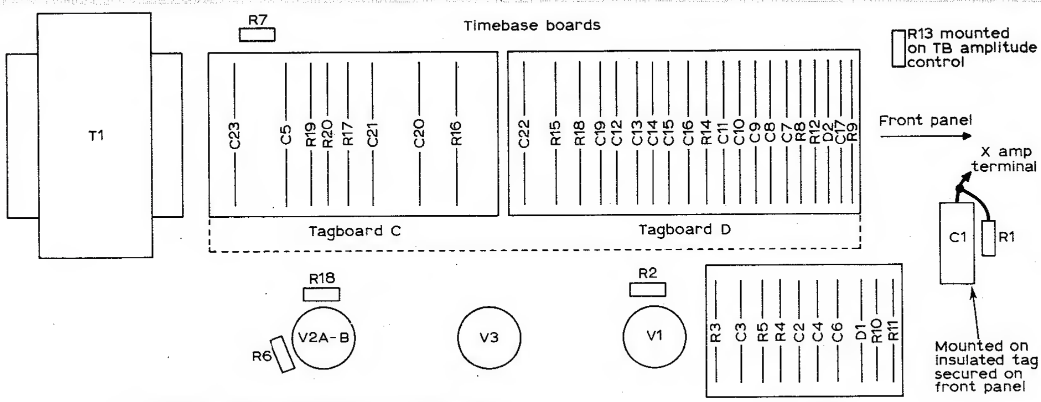


Fig. 10: Component layout for timebase and X amplifier.

board and the components spread out, each accordingly to the space required. For this reason some pairs of tags will not be used but there will be more than enough for all the components. Much the same applies to tagboards E and G. The wiring for the X and Y shift controls is given in Fig. 11. Clockwise movement of the X shift control moves the c.r.t. trace upwards, and clockwise movement of the Y shift control moves the trace to the right and vice versa in both cases.

The only rule as far as wiring is concerned is to keep all wires short as possible and do not take wires

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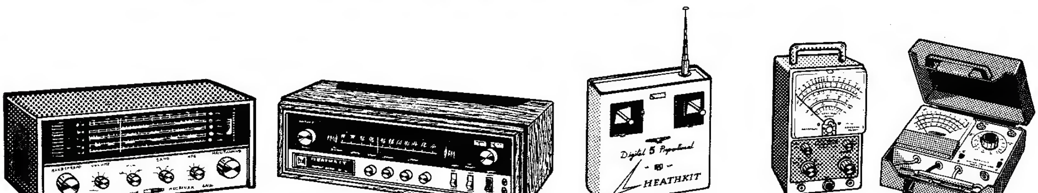

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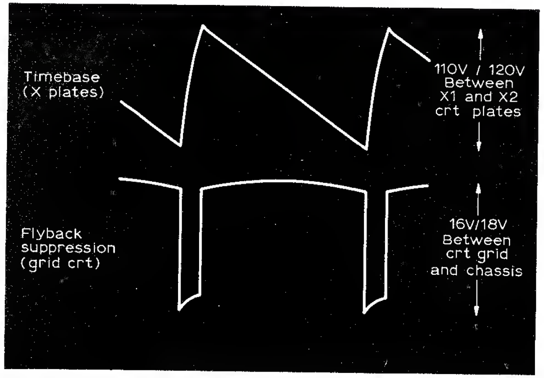
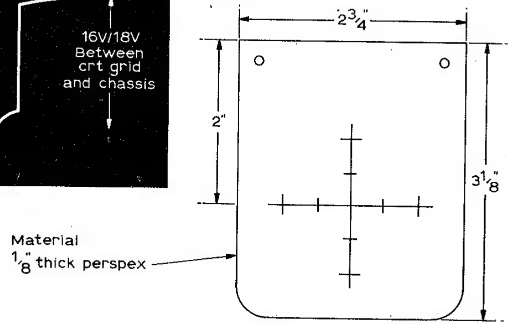


Fig. 12: Timebase and flyback suppression wave-forms.

Fig. 13: The perspex graticule for the c.r.t. screen.



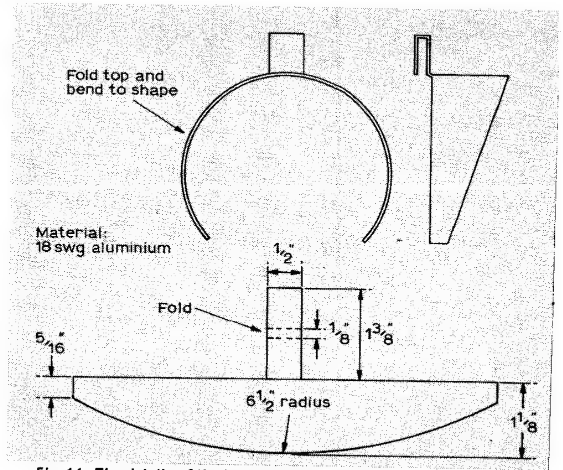
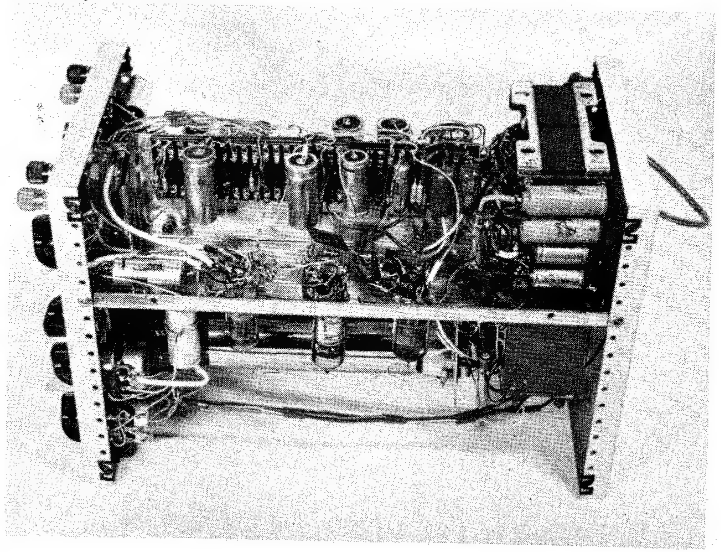
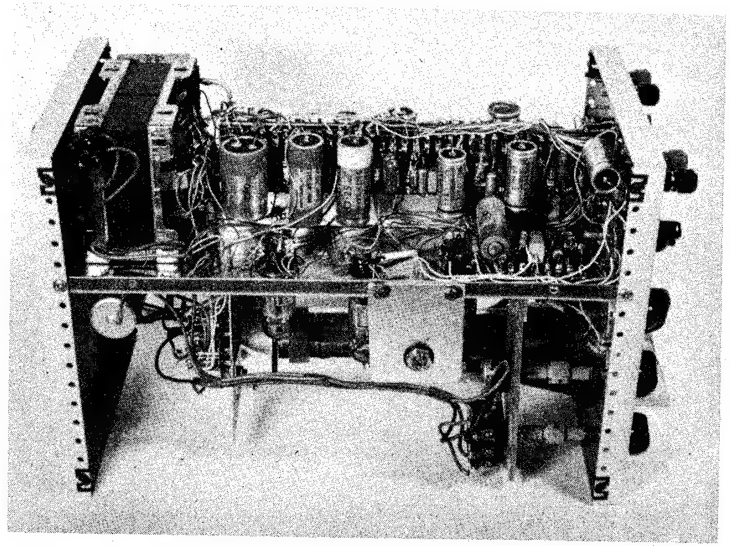


Fig. 14: The details of the hood for the c.r.t.

Two views of the underside of the completed Oscilloscope are shown below.





associated with the timebase and its controls too close to the Y amplifier wiring, that is try to keep the timebase and Y amplifier wiring to the respective sides of the centre screen.

TESTING AND PERFORMANCE

It is most important that the various potentials as shown on the circuit are obtained but note that the voltmeter used must be at least 20,000 ohms per volt, otherwise the readings obtained will be inaccurate. The measured potentials should be within 3% of those listed. (Example—for a reading of 600V the measured potential should be not less than 580V and not more than 620V.)

If another oscilloscope is available the timebase waveforms and flyback suppression pulse can be checked quite easily and should appear as in Fig. 12. Failing this, set the timebase range switch to position 1 and the fine control to about midway travel. Set the timebase amplitude control to about one third travel and the X and Y shift controls to midway. Set the Y amplitude control to zero. Adjust brilliance and focus to obtain a bright but sharp trace which should be extended fully across the screen. Check that it remains fully extended on all timebase switch positions. Now turn the timebase switch to the 'off' position in which case only the c.r.t. spot should be displayed and this should be completely round and about 1mm. in diameter. Reduce brilliance a little for this test. Check that the spot can be centred on the c.r.t. screen by means of the X and Y shift controls the setting for these being almost exactly mid-range.

With either control it should be possible to move the spot up or down, or from left to right, completely off the screen. With the timebase range switch still at the 'off' position turn the sync switch (S1 AB) to position 3, 50Hz sweep. The trace displayed should be about 1·5cm. long.

The Y amplifiers can be checked next by first setting the timebase range to position 1 and the fine control to approximately half-way. Connect the 100mV 50Hz calibration signal to the 'live' Y amplifier terminal and make sure the Y amplifier switch is to 'Y amp' and not 'Y pre-amp'. With the Y gain control at almost maximum the 50Hz sine-wave displayed should be about 2cm. peak-to-peak and there should be at least 3 or 4 complete cycles. Now switch to 'Y pre-amp' and connect the 50Hz calibration signal to the co-axial Y input and set the Y gain to $\frac{1}{10}$th of its travel. The 50Hz sine-wave displayed should again be about 2cm. peak-to-peak. Turn the Y gain a little higher so that the peaks of the test signal extend to the top and bottom of the screen. At this point the sine-wave should show no sign of clipping.

Further tests which include timebase synchronization, and the X amplifier gain etc., require the use of an audio signal generator. For the X amplifier test set the sync switch (S1 AB) to 'X amp' and turn the X amp pre-set gain control fully clockwise. Set the timebase range switch to 'off'. With a sine-wave signal of 1·5V r.m.s. to the X amp input the trace should deflect vertically to approximately 4cm. long.

Return the timebase range switch to position 2 or 3 and then set the sync switch to 'internal sync'. Inject a 1000Hz sine-wave of approximately 500mV to the 'Y amp' input and adjust the Y gain for a 4cm. display. Adjust the timebase fine control until the trace locks. Now run through the rest of the timebase ranges using input signals of appropriate frequency to ensure that each range is functioning and that synchronization can be obtained on each.

The screen graticule on the prototype was made from $\frac{1}{8}$in. thick perspex to the size shown in Fig. 13. The calibration marks were as shown, in centimetres and were produced by scoring the perspex on the side facing the c.r.t. screen. The scored lines and marks were filled with Chinagraph (soft wax pencil). The graticule can be fixed over the screen by two screws at the top which go into the front panel but with spacers on them to keep the graticule just off the tube face.

The c.r.t. hood can be made from 18s.w.g. aluminium as shown in Fig. 14. The tab at the top is folded as shown and this holds the hood on to the top of the graticule. The hood can be pained matt black inside if desired. ■

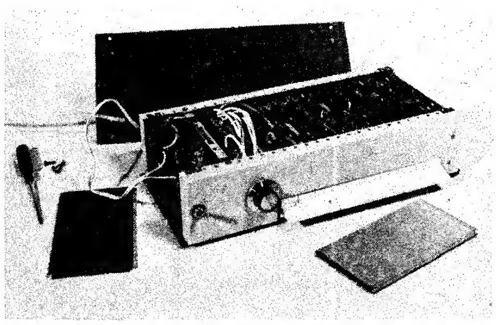
In the main circuit of the oscilloscope on page 1009 of the April issue the secondary of the mains transformer was marked 250-0-250V. This should have read 350-0-350V and is as the components list which gave it correctly.

P.W. SOUND EFFECTS SYNTHESISER

continued from page 58

could be tested separately with a 24V battery supply and the output coupled to an amplifier for aural checks. The output signal level from each generator is over 100mV. This is the best way of ensuring that each circuit is operating properly and producing the right sound and may well save time and trouble when the final assembly stage is reached.

The amplifier and loudspeaker used with the completed synthesiser should be capable of good quality reproduction and have a fairly wide frequency range. The power output will depend on how loud the sounds are to be produced but should be comparable with the power output of the organ. A minimum of 10W might be suitable for the majority of domestic electronic organs. It may be possible, of course, to couple the unit directly to the organ main amplifier but care should be taken with regard to required signal level and impedance matching. ■



The completed synthesiser with the bottom and side panels removed. The power supply can be seen on the left.

A little gremlin seems to have been at work regarding the castanets circuit on page 914 of the March issue. C1 and C2 should be 0·2μF and *not* 0·02μF as given. In the text of the same the section near the middle should read "The waveform from Tr1 and Tr2 is applied to the *base* circuit of Tr3 . . ." and *not* "emitter circuit."

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2N404	22½p	2N3605	27½p	40329	30p	BCY39	52½p	BSY11	27½p	NKT451	62½p
2N696	20p	2N3606	27½p	40344	27½p	BCY40	37½p	BSY24	15p	NKT452	62½p
2N697	20p	2N3607	22½p	40347	57½p	BCY42	15p	BSY25	15p	NKT453	47½p
2N698	25p	2N3702	12½p	40348	52½p	BCY43	15p	BSY26	17½p	NKT603F	32½p
2N706	12½p	2N3703	12½p	40360	42½p	BCY54	32½p	BSY27	17½p	NKT613F	32½p
2N705A	12½p	2N3704	17½p	40361	47½p	BCY58	22½p	BSY28	17½p	NKT674F	30p
2N708	15p	2N3705	15p	40362	57½p	BCY59	22½p	BSY29	17½p	NKT677F	30p
2N709	62½p	2N3706	12½p	40370	32½p	BCY60	97½p	BSY32	25p	NKT713	20p
2N718	25p	2N3707	15p	40406	57½p	BCY70	20p	BSY36	25p	NKT781	30p
2N726	30p	2N3708	09p	40407	40p	BCY71	42½p	BSY37	25p	NKT10419	30p
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2N916	17½p	2N3711	12p	40467A	57½p	BCZ11	42½p	BSY40	32½p	NKT10519	
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2N929	22½p	2N3716	£2.90	40600	57½p	BD121	65p	BSY52	32½p	NKT20329	
2N930	27½p	2N3791	£2.75	AC 107	30p	BD123	82½p	BSY53	37½p		47½p
2N1090	22½p	2N3819	35p	AC126	20p	BD124	60p	BSY54	40p	NKT20339	
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2N1131	25p	2N3854	27½p	AC128	20p	BD132	97½p	BSY78	47½p	NKT80111	
2N1132	25p	2N3854A	27½p	AC154	22½p	BDY10	£1·37½	BSY79	45p		77½p
2N1302	17½p	2N3855	27½p	AC176	25p	BDY11	£1·62½	BSY82	52½p	NKT80112	
2N1303	17½p	2N3855A	30p	AC187	62½p	BDY17	£1·50	BSY90	57½p		97½p
2N1304	22½p	2N3856	30p	AC188	37½p	BDY18	£1·75	BSY95A	12½p	NKT80113	
2N1305	22½p	2N3856A	35p	ACY17	27½p	BDY19	£1·97½	BSW41	42½p		£1.12
2N1306	25p	2N3858	25p	ACY18	25p	BDY20	£1·12½	BSW70	27½p	NKT80211	
2N1307	25p	2N3858A	30p	ACY19	25p	BDY38	97½p	C111	75p		92½p
2N1308	30p	2N3859	27½p	ACY20	25p	BDY60	£1·25	C424	27½p	NKT80212	
2N1309	30p	2N3859A	32½p	ACY21	25p	BDY61	£1·25	C425	55p		92½p
2N1507	17½p	2N3860	30p	ACY22	20p	BDY62	£1·00	C426	40p	NKT80213	
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2N1889	32½p	2N3904	35p	AD161	37½p	BF179	72½p	GET113	20p	OC20	75p
2N1893	37½p	2N3905	37½p	AD162	37½p	BF180	35p	GET114	20p	OC22	50p
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2N2160	57½p	2N4059	10p	AF115	30p	BF185	42½p	GET120	52½p	OC25	42½p
2N2193	40p	2N4060	12½p	AF116	25p	BF194	17½p	GET873	12½p	OC26	27½p
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2N2221	25p	2N4288	17½p	AF127	17½p	BF225	20p	GET898	22½p	OC44	20p
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2N2906A	27½p	2N5354	27½p	BC116A	37½p	BFY25	25p	NKT211	30p	ORP61	50p
2N2907	30p	2N5355	27½p	BC118	32½p	BFY26	20p	NKT212	30p	P346A	22½p
2N2923	15p	2N5356	32½p	BC121	20p	BFY29	50p	NKT213	30p	TIS34	62½p
2N2924	15p	2N5365	47½p	BC122	20p	BFY30	50p	NKT214	22½p	TIS43	40p
2N2925	15p	2N5366	32½p	BC125	55p	BFY41	50p	NKT215	22½p	TIS44	12½p
2N2926		2N5367	57½p	BC126	55p	BFY43	62½p	NKT216	37½p	TIS45	12½p
Green	14p	2N5457	37½p	BC140	37½p	BFY50	22½p	NKT217	42½p	TIS46	12½p
Yellow	12½p	2S005	75p	BC147	17½p	BFY51	22½p	NKT219	30p	TIS47	12½p
Orange	12½p	2S020	£2·00	BC148	12½p	BFY52	22½p	NKT223	27½p	TIS48	12½p
2N3011	30p	2S102	50p	BC149	17½p	BFY53	17½p	NKT224	25p	TIS49	12½p
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2N3134	30p	3N83	40p	BC167	15p	BFW58	27½p	NKT241	27½p	TIS61	25p
2N3135	25p	3N128	70p	BC168B	14p	BFW59	25p	NKT242	20p	TIS62	27½p
2N3136	25p	3N140	77½p	BC168C	15p	BFW60	25p	NKT243	62½p	TIP29A	50p
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SN7420 ..	25p	20p	18p	SN7496 ..	£1·00	90p	80p
SN7430 ..	25p	20p	18p	SN74107	45p	40p	35p
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PIV	50	100	200	400	600	800	1000	1200
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6A	—	—	25p	30p	32½p	35p	50p	—
10A	—	52½p	57½p	65p	77½p	86½p	97½p	£1·25
17A	—	57½p	62½p	77½p	90p	97½p	£1·20	£1·57½

1 amp and 3 amp are plastic encapsulation.

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IS120	15p	BA141	32½p	BY127	17½p	OA81	07½p
IS121	17½p	BA142	32½p	BY164	57½p	OA85	07½p
IS130	12½p	BA144	12½p	BYX10	22½p	OA90	07½p
IS131	12½p	BA145	20p	BYZ10	35p	OA91	07½p
IS132	15p	BA154	12½p	BYZ11	32½p	OA95	07½p
IS940	07½p	BAX13	12½p	BYZ12	30p	OA200	10p
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AA129	10p	BAY18	17½p	FST3/4	22½p		
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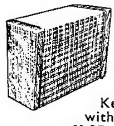

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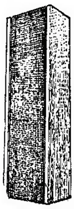

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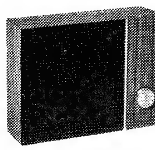

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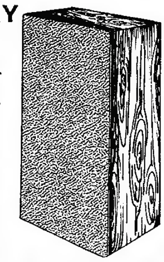

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I.C. OF THE MONTH

L.A.J. IRELAND

Number 19 — G.E. PA494 Precision Voltage Detector

BEFORE going on to consider the technical details of this month's circuit, it would be well to indicate some of the answers to the obvious question as to why the electronics enthusiast should be interested in a new high performance precision voltage detector such as the G.E. type PA 494. It was designed principally for applications requiring the logic function of a Schmitt trigger. In other words, the output of the i.c. would switch states very rapidly once the input threshold voltage had been exceeded. Applications for such a unit are obvious in circuits requiring pulse control, in that a trigger which has lost its shape can produce an accurate square wave output. In radio control of models for instance, this is a valuable feature permitting correction for signal degradation in propagation from the control transmitter to the model receiver. Of more general interest, however, are its uses in such systems as time delays, square wave generators, over-voltage and over-current protection systems, photo-electric controls, etc., some of these applications of the unit being considered in greater detail later on.

Operation

The PA494 itself comes as a four pin device mounted in a TO-5 package. The complete circuit diagram is shown in Fig. 1. Provided the input voltage at pin 1 does not exceed the reference voltage set by the resistor pair R1, R2 then Tr2 and Tr4 will be biased on causing Tr7 to saturate and an output current of up to 250 mA may be drawn from pin 3. On the other hand once the reference voltage is exceeded at the input, Tr1 and Tr3 will conduct in addition to Tr5 resulting in positive feedback to the base of Tr2. This reduces the reference voltage and at the same time turns Tr2 off. Consequently the differential amplifier will have changed states and no output current will be available at pin 3 as Tr7 will have been biased off.

Due to the Darlington input configuration of the unit an exceptionally high input impedance is achieved with a mere 100 nanoamps needed to saturate Tr1. This makes the PA494 ideally suited for high impedance sources as a result of the low input current drawn. It combines many of the features of a f.e.t. in a bi-polar device; yet it does not suffer from failure due to static discharge as is sometimes the case with the f.e.t.

Practical Uses

Now let us consider some uses to which we can put the device. Fig. 2 shows a simple bridge configuration using a photoelectric cell or a thermistor

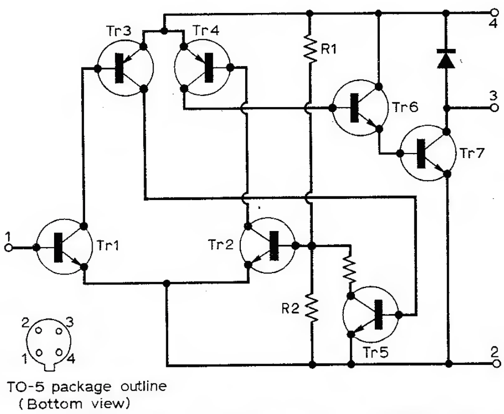


Fig. 1: Circuit of the PA494 with transistors circled for clarity.

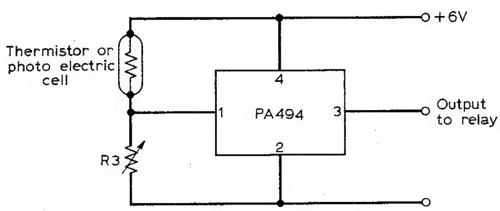
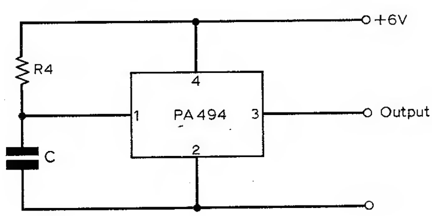


Fig. 2: (above) the PA494 in an alarm or warning system; and Fig. 3 (below), in a timing circuit.



in one arm. The coil of a relay can act as the load for Tr7 thereby providing simple photoelectric control systems or on the other hand if preferred a discrete p.n.p. power transistor may be inserted for direct control of currents up to several amperes.

The PA494 also lends itself to very neat timing circuits of intervals of up to 1 minute, by a simple r.c. network. As can be seen from Fig. 3 a d.c. output is obtained when the threshold voltage is reached in contrast to the unijunction which generates a pulse.

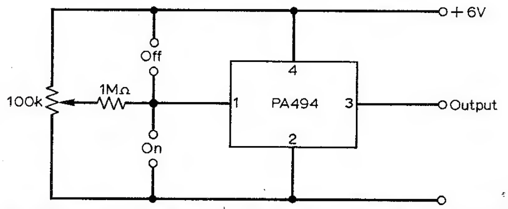


Fig. 4: Another application of the PA494. A switching or shaping circuit.

By biasing Tr1 midway between saturation and cut-off a number of interesting uses may be obtained. The same circuit as shown in Fig. 4 may be utilised as either an on-off touch switch, sine to square wave converter or pulse shaper.

No doubt further uses for the PA494 will spring to mind; a few designs have been given here in the hope that further innovations will be realised on the part of the individual constructor.

U.K. distributors for the PA494 are:— Jermyn Industries Ltd., Vestry Estate, Sevenoaks, Kent.

P.W. DESIGNER'S TROPHY

Presented at Film Show

Caleb Bradley receiving the P.W. Designer's Trophy from Norman Stevens.

Although the postal strike prevented the despatch of the usual invitation cards, a reasonable number of readers turned out to see the filmshow at the Caxton Hall, Westminster, London, on 5th. March, run as usual by Practical Wireless and Television magazines in conjunction with Mullard Ltd.

The first part of the evening was devoted to the showing of two films, "Now and Then" featuring John Pertwee and "The Electrons Tale", a light-hearted look at the story of the electron.

Following the films, the Editor, Norman Stevens, presented the Practical Wireless "Designer's Trophy 1970" awarded for the most meritorious article submitted for the Project Autumn Competition. The reader was Caleb Bradley and his article "A High Impedance Voltmeter" was featured in the April issue of PW.

Following refreshments the rest of the evening was given over to a talk by Philip Hunt of Mullards. Entitled "I.C. Story-Continued" it was a continuation of the "Introduction to the I.C." lecture given at last year's Filmshow. This time the theme was the application and servicing problems of I.C.'s.

This year's show was the last to be run in conjunction with Mullard. The company have decided to make cuts in the film and lecture department but Mr. Stevens assured those present that every effort would be made to continue the Filmshows in the years to come.

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U15	25 NPN Silicon Planar Transistors TO-5 sim. 2N697	50p
U16	10 3-amp Silicon Rectifiers Stud Type up to 1,000 PIV	50p
U17	30 Germanium PNP AF Transistors TO-5 like ACY17-22	50p
U18	8 6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	50p
U19	25 Silicon NPN Transistors like BC108	50p
U20	12 1·5 amp Silicon Rectifiers Top-Hat up to 1,000 PIV	50p
U21	30 AF Germanium alloy Transistors 2G300 Ser. & OC71	50p
U23	30 Madt's like MAT Series PNP Transistors	50p
U24	20 Germanium 1-amp Rectifiers GJM up to 300 PIV	50p
U25	25 300Mc/s NPN Silicon Transistors 2N708, BSY27	50p
U26	30 Fast Switching Silicon Diodes like 1N914 Micro-min.	50p
U28	Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc. 8 Assorted Pieces	£1
U29	10 1-amp SCR's TO85 can up to 600 PIV CRS1/25-600	£1
U31	20 Sil. Planar NPN trans. low noise Amp 2N3707	50p
U32	25 Zener diodes 400mW D07 case mixed Volts, 3-18	50p
U33	15 Plastic case 1 amp Silicon Rectifiers 1N4000 series	50p
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 28302/4	50p
U35	25 Sil. Planar trans. PNP TO-18 2N2906	50p
U36	25 Sil. Planar NPN trans. TO-5 BFY50/51/52	50p
U37	30 Sil. alloy trans. SO-2 PNP, OC200 28322	50p
U38	20 Fast Switching Sil. trans. NPN 400 Mc/s 2N3011	50p
U39	30 RF Germ. PNP trans. 2N1303/5 TO-5	50p
U40	10 Dual trans. 6 lead TO-5 2N2060	50p
U41	25 RF Germ. trans. TO-1 OC45 NKT72	50p
U42	10 VHF Germ. PNP trans. TO-1 NKT667 AF117	50p

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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UT46. Eqvt. 2N2646 Eqvt. TIS43. BEN3000 **27p** each 25-99 **25p**, 100 UP **20p**

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BI-PAK Order No.		Description	Price and Qty. Prices 1–24	25–99	100 up
BP00	7400N	Quad 2-Input NAND GATE	23p	20p	15p
BP01	7401N	Quad 2-Input NAND GATE—OPEN COLLECTOR	23p	20p	15p
BP04	7404N	HEX INVERTER	23p	20p	15p
BP10	7410N	Triple 3-Input NAND GATE	23p	20p	15p
BP20	7420N	Dual 4-Input NAND GATE	23p	20p	15p
BP30	7430N	Single 8-Input NAND GATE	23p	20p	15p
BP40	7440N	Dual 4-Input BUFFER GATE	23p	20p	15p
BP41	7441N	BCD to decimal decoder and N.I.T. Driver	87p	77p	67p
BP42	7442N	BCD to decimal decode (TTL O/P)	87p	77p	67p
BP50	7450N	Dual 2-Input AND/OR/NOT GATE—expandable	23p	20p	15p
BP53	7453N	Single 8-Input AND/OR/NOT GATE—expandable	23p	20p	15p
BP60	7460N	Dual 4-Input—expandable	23p	20p	15p
BP70	7470N	Single JK Flip-Flop—edge triggered	35p	32p	29p
BP72	7472N	Single Master Slave JK Flip-Flop	35p	32p	29p
BP73	7473N	Dual Master Slave JK Flip-Flop	43p	40p	37p
BP74	7474N	Dual D Flip-Flop	43p	40p	37p
BP75	7475N	Quad Bistable Latch	47p	45p	43p
BP76	7476N	Dual Master Slave Flip-Flop with preset and clear	47p	45p	43p
BP83	7483N	Four Bit Binary Adder	87p	77p	67p
BP90	7490N	BCD Decade Counter	87p	77p	67p
BP92	7492N	Divide by 12 4 Bit binary counter	87p	77p	67p
BP93	7493N	Divide by 16 4 Bit binary counter	87p	77p	67p
BP94	7494N	Dual Entry 4 Bit Shift Register	87p	77p	67p
BP95	7495N	4 Bit Up-Down Shift Register	87p	77p	67p
BP96	7496N	5 Bit Shift Register	£1·10	£1 00	90p

Data is available for the above Series of I.C's in booklet form price 12½p each.

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D13D1 Silicon Unilateral switch 50p each.
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AF117 transistors. Large can 4 lead type. Leads cut short but still usable, real value at 15 for **50p.**

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10-Amp 3-K.V. (3000 P.I.V.) Stud Type with Flying Leads, **80p** each.

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Manufacturers' "Fall outs"—out of spec. devices including functional units and part functional but classed as out of spec. from the manufacturers very rigid specifications. Ideal for learning about I.C's and experimental work.

PAK No.			PAK No.		
UIC00	= 12 × 7400N	50p	UIC73	= 8 × 7473N	50p
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UIC03	= 12 × 7403N	50p	UIC76	= 8 × 7476N	50p
UIC04	= 12 × 7404N	50p	UIC80	= 5 × 7480N	50p
UIC05	= 12 × 7405N	50p	UIC82	= 5 × 7482N	50p
UIC10	= 12 × 7410N	50p	UIC83	= 5 × 7483N	50p
UIC20	= 12 × 7420N	50p	UIC86	= 5 × 7486N	50p
UIC40	= 12 × 7440N	50p	UIC90	= 5 × 7490N	50p
UIC41	= 5 × 7441AN	50p	UIC92	= 5 × 7492N	50p
UIC42	= 5 × 7442N	50p	UIC93	= 5 × 7493N	50p
UIC50	= 12 × 7450N	50p	UIC94	= 5 × 7494N	50p
UIC51	= 12 × 7451N	50p	UIC95	= 5 × 7495N	50p
UIC60	= 12 × 7460N	50p	UIC96	= 5 × 7496N	50p
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RTL Micrologic Circuits	Qty. prices each 1–11	12–24	25–99	100+
Epoxy case To-5 temp. range 15°C to 55°C				
μL 900 Buffer	40p	35p	33p	27p
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μL 923 J-K Flip-flop	53p	50p	47p	45p

Full data and circuits for IC's in Booklet form price 7p each.

LINEAR I.C's

Type No.	Case	Leads	Description	Price 1–24	25–99	10^0
BP201C—SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP701C—SL701C	TO-5	8	OP Amp	63p	53p	45p
BP702C—SL702C	TO-5	8	OP Amp Direct O/P	63p	53p	45p
BP702—72702	D.I.L.	14	G.P. OP. Amp (Wide Band)	53p	45p	40p
BP709—72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP709P—μA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP741—72741	D.I.L.	14	High Gain OP. Amp (Protected)	75p	60p	50p
μA703C—μA703C	TO-5	6	R.F.—IF Amp	43p	35p	27p
TAA263	TO-72	4	A.F. Amp	70p	60p	55p
TAA293	TO-74	10	G.P. Amp	90p	75p	70p

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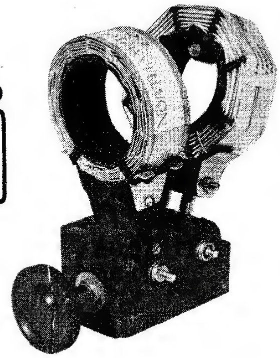


COLIN RICHES
ARTHUR DOW

ONE reads nowadays of the extremely high power stations that are being used on the very low frequencies for maintaining communication with nuclear submarines even when they are submerged. Megawatts on frequencies at the top end of the audio range are not unusual.

It was a similar combination of power and long wavelengths that opened up radio communication in the first decade of this century, but it would be invidious to compare the efficiency of those old transmitters and their aerial systems with those in use today.

We recently came across an article, written in 1912, that endeavoured to correlate power, distance and wavelength. At that time it was known that received signal strengths in the daytime were roughly inversely proportional to distance but the rule only seemed to work up to about 150 to 200 miles after which signal strength dropped off quite rapidly. This was reception by ground wave, as we know it today.

Attempts to formulate some kind of law for signals travelling over a night path came to grief as it was observed that such signals were very irregular in strength and generally stronger than the signals received over the day path. The attenuation of signals was thought to be due to their "absorption" in the upper layers of the atmosphere but assuming no absorption at all the signals over the night path were still stronger than the calculated values.

Apparent changes in the degree of absorption between summer and winter had also been noted and it was thought that the conductivity of the upper atmosphere was increased by the action of the sun's rays.

Table 1 shows the calculated relationship between the aerial current at the transmitter and two ranges, 'working range' and 'extreme distance of audibility'. The first range produced 40μA in the 'receiver resistance' of 25 ohms and the second range 10μA, corresponding to 1000μV and 250μV.

These ranges were between two ships each having aerials at 130 feet so presumably the transmitter aerial current was measured in what was the base of a top loaded vertical over an almost perfect ground plane. The wavelength in use for these experiments was 1000 metres (300kHz).

TABLE 1

Aerial Current	Working Distance		Extreme Distance	
	Day	Night (zero absorption)	Day	Night (zero absorption)
amps.	miles	miles	miles	miles
1	75	90	200	360
2	135	180	300	720
3	180	270	375	1,080
5	235	450	475	1,800
7	280	630	550	2,520
10	345	900	630	3,600
15	420	1,350	725	5,400
20	475	1,800	790	7,200
25	525	2,250	840	9,000
30	565	2,700	900	10,800
40	630	3,600	970	14,400
50	685	4,500	1,025	18,000
60	725	5,400	1,150	21,600

TABLE 2

Nautical Miles	λ= 1,000 m.	λ= 2,500 m.	λ= 3,750 m.	λ= 6,000 m.
	amps.	amps.	amps.	amps.
1,000	15	13·5	15	17
1,250	38	27	27	30
1,500	91	49	44	46
1,750	200	95	77	74
2,000	490	155	122	105
2,250	—	245	314	160
2,500	—	470	414	235
2,750	—	—	500	335
3,000	—	—	775	500

However our mathematician seems to have gone astray by overlooking the impracticability of a 21000-mile night path; perhaps he was already thinking of going into orbit!

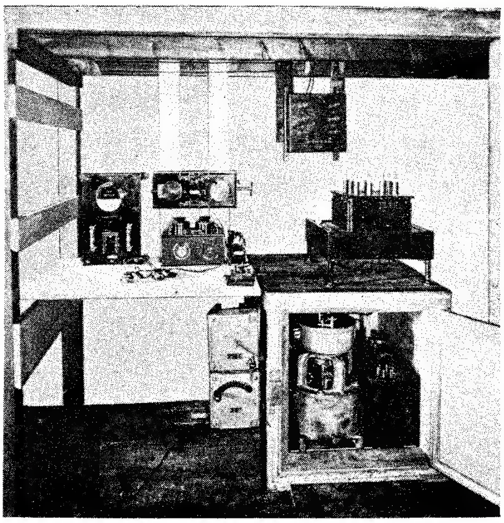
At this time, 1912, no one doubted the great advantages of long waves for communicating with distant stations and Table 2 was published to prove the point. This was based on two stations with aerials 450 high and again the distance quoted is working range.

It seems strange, in this scientific age, that brute force and long waves are still needed to establish solid communication at a distance regardless of conditions. One would think that an entirely new method of communication would have been dreamed up by now.

Ship Shack 1912

It is somewhat difficult for us, even the old-timers, to realise that in 1912 only the largest passenger ships were fitted with wireless telegraphy apparatus of a sort, that smaller ships, particularly cargo ships, were virtually lost to the rest of the world for weeks or even months on end once they had left our shores.

They did of course make visual signals to other ships and to coast stations en route so that owners had some idea of what was going on. Nevertheless ships, passengers and crews were lost at sea in circumstances where a brief radio call, had it been possible, would have brought other ships hurrying to their aid.



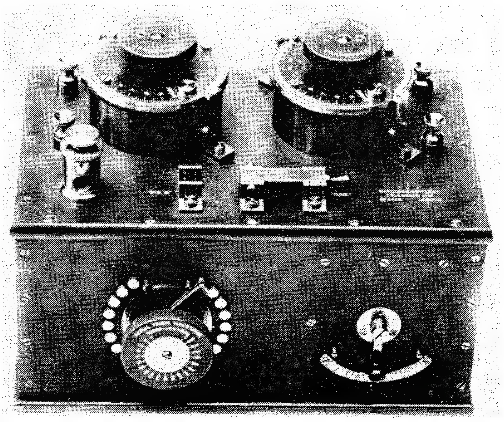
A typical ship's wireless cabin of 1912 fitted with the Marconi "½kW cargo set". The cabinet contains the vertical rotary converter with the disc discharger on top.

A dock labour dispute in 1911 did a lot to accelerate the equipping of the smaller ships with wireless telegraphy especially as owners realised that this would enable them to re-direct ships at a moment's notice which was particlularly important with perishable cargoes. It was left to the Marconi company to produce a wireless installation that was small enough and cheap enough to be suitable for the smaller ships.

Called the "½kW cargo set" it could transmit spark signals between 200 and 600 metres wavelength and receive signals between 200 and 1600 metres. The ship's d.c. mains supply energised a rotary converter which gave a ½kW of a.c. at "a spark frequency of 300 per second." A disc discharger on top of the converter was adjustable so that the discharge took place at the peak voltage output of the converter.

Tapped inductors were wound with copper strip on ebonite formers and these in conjunction with capacitors made from glass and zinc plates formed the "oscillation transformer".

It is interesting to note that the receiver, a "magnetic detector", was permanently connected to the aerial but was shorted out by an auxiliary pair of contacts on the key, "thus enabling the receiving operator to 'break-in' on the transmission in the event of erroneous reception and thus avoid waste of time". Even today very few amateur c.w. stations



A close-up of the "magnetic detector" receiver that can also be seen in the general view of the equipment

have proper "break-in" facilities, although they may have a fast changeover system, but that is not the same thing at all. Those that have true break-in do not use it to its best advantage but it must be admitted that the licence regulations governing the use of call signs does nothing to encourage the use of break-in!

Sinclair Project 60

the world's most advanced high fidelity modules

Sinclair Project 60 presents high fidelity in such a way that it meets every requirement of performance, design, quality and value and now that the remarkable phase lock loop stereo FM tuner is available, it becomes the most versatile of high fidelity systems. With Project 60, it is possible to start with a modest mono record reproducer and expand it to a sophisticated stereophonic radio and record reproducing system of fantastically good quality to hold its own with any other equipment, no matter how expensive. Project 60 is a unique high fidelity module system where compactness and ease of assembly are combined with circuitry that is far in advance of any other manufacturer in the world. Thus it is extraordinarily easy to assemble any combination of modules using nothing more complicated than the simplest of tools, and you certainly do not have to be experienced to build with complete confidence. The 48 page manual free with Project 60 equipment makes everything easy and you can house your assembly in an existing cabinet, motor plinth, free standing cabinet or virtually any arrangement you wish. Once you have completed your assembly you will have superlatively good equipment to give you years of service and enjoyment. You will have obtained superb value for money because Project 60 is the best selling modular system in Europe and can therefore be produced at extremely competitive prices and with excellent quality control.

	System	The Units to use	together with	Cost of Units
A	Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control	**£4.48**
B	Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control etc.	**£9.45**
C	20+20 W. R.M.S. stereo amplifier for most needs	**2 x Z.30s, Stereo 60, PZ.5**	Crystal, ceramic or mag. P.U., most dynamic speakers, F.M. tuner etc.	**£23.90**
D	20+20 W. R.M.S. stereo amplifier with high performance spkrs.	**2 x Z.30s, Stereo 60, PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	**£26.90**
E	40+40W. R.M.S. de-luxe stereo amplifier	**2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr**	As for D	**£34.88**
F	Outdoor P.A. system	**Z.50**	Mic., up to 4 P.A. speakers controls, etc.	**£5.48**
G	Indoor P.A.	**Z.50, PZ.8, mains transformer**	Mic., guitar, speakers, etc., controls	**£19.43**
H	High pass and low pass filters	**A.F.U.**	C, D or E	**£5.98**
J	Radio	**Stereo F.M. Tuner**	C, D or E	**£25.00**

Sinclair Radionics Ltd., London Road, St. Ives, Huntingdonshire PE17 4HJ.
Tel: St. Ives (048 06) 4311

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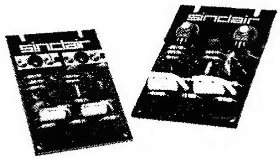
Sinclair Project 60

Z.30 & Z.50 power amplifiers



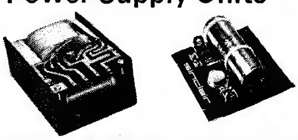
The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve unsurpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS ***(Z50 units are interchangeable with Z.30s in all applications).***
Power Outputs
Z.30 15 watts R.M.S. into 8 ohms using 35 volts: 20 watts R.M S. into 3 ohms using 30 volts.
Z.50 40 watts R.M S. into 3 ohms using 40 volts: 30 watts R.M.S. into 8 ohms, using 50 volts.
Frequency response: 30 to 300 000 Hz ±1dB.
Distortion: 0.02% into 8 ohms.
Signal to noise ratio: better than 70dB unweighted.
Input sensitivity: 250mV into 100 Kohms.
For speakers from 3 to 15 ohms impedance.
Size $3\frac{1}{2}$ x $2\frac{1}{4}$ x $\frac{1}{2}$ in.

Z.30
Built tested and guaranteed with circuits and instructions manual **£4.48**

Z.50
Built, tested and guaranteed with circuits and instructions manual. **£5.48**

Power Supply Units



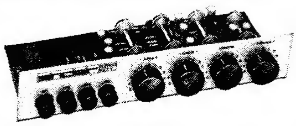
Designed specially for use with the Project 60 system of your choice.
Illustration shows PZ.5 to left and PZ.8 (for use with Z.50s) to the right. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stablised supply is essential.

PZ-5 *30 volts unstabilised* **£4.98**
PZ-6 *35 volts stabilised* **£7.98**
PZ-8 *45 volts stabilised (less mains transformer)* **£7.98**
PZ-8 *mains transformer* **£5.98**

Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work pe fectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

Stereo 60 pre-amp/control unit



Designed for the Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS
Input sensitivities: Radio–up to 3mV. Mag. p.u. 3mV: correct to R.I.A.A. curve ± 1dB: 20 to 25,000 Hz. Ceramic p.u.–up to 3mV: Aux–up to 3mV.
Output: 250mV
Signal-to-noise ratio: better than 70dB.
Channel matching: within 1dB.
Tone controls: TREBLE + 15 to —15dB at 10KHz: BASS + 15 to—15dB at 100Hz.
Front panel: brushed aluminium with black knobs and controls.
Size: $8\frac{1}{4}$ x $1\frac{1}{2}$ x 4 ins.

Built, tested and guaranteed. **£9.98**

Active Filter Unit

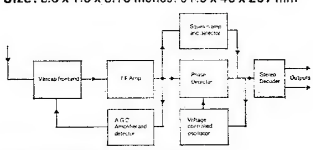
For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two stages of filtering are incorporated – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (–3dB) variable from 28kHz to 5kHz. L.F cut-off (–3dB) variable from 25Hz to 100Hz. Distortion at 1kHz (35V. supply) 0.02% at rated output.

Built, tested and guaranteed **£5.98**

Stereo FM Tuner

first in the world to use the phase lock loop principle
Before production of this tuner, the phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio over other systems. Now, for the first time, the principle has been applied to an FM tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Sensitivity is such that good reception becomes possible in difficult areas. Foreign stations can be tuned in suitable conditions and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

SPECIFICATIONS:
Number of transistors: 16 plus 20 in I.C.
Tuning range: 87.5 to 108 MHz
Capture ratio: 1.5dB
Sensitivity: 2μV for 30dB quieting: 7μV for full limiting.
Squelch level: 20μV.
A.F.C. range: ±200 KHz
Signal to noise ratio: >65dB
Audio frequency response: 10Hz—15KHz (±1dB)
Total harmonic distortion: 0.15% for 30% modulation
Stereo decoder operating level: 2μV
Pilot tone suppression: 30dB
Cross talk: 40dB
I.F. frequency: 10.7 MHz
Output voltage: 2 x 150mV R.M.S.
Aerial Impedance: 75 Ohms
Indicators: Mains on: Stereo on; tuning indicator
Operating voltage: 25-30 VDC
Size: 3.6 x 1.6 x 8.15 inches: 91.5 x 40 x 207 mm



Price: £25 built and tested. Post free

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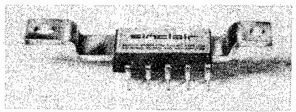
Sinclair IC10/Q16/Micromatic

IC10



The world's most advanced high fidelity amplifier

This is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself is a chip of silicon only a twentieth of an inch square by one hundredth of an inch thick, having 5 watts RMS output (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 zener diode and 18 resistors, and is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is more rugged and has considerable performance advantages, including complete freedom from thermal runaway and a very low level of distortion. The IC10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of such components as tone and volume controls and a battery or mains power supply. It may also be used in other applications including car radios, electronic organs, servo amplifiers (it is dc coupled throughout) etc.

Circuit Description

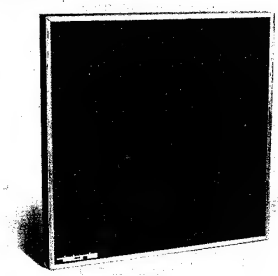
The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. There is generous negative feedback round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

Each IC10 is sold with a comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include oscillators, etc. The pre-amp section can be used as an RF or IF, amplifier without any additional transistors.

Specifications:
Output: 10 watts peak, 5 watts RMS continuous.
Frequency response: 5Hz to 100kHz 1 ± dB.
Total harmonic distortion: Less than 1% at full output.
Load impedance: 3 to 15 ohms.
Power gain: 110 dB (100,000,000,000 times) total.
Supply voltage: 8 to 18 volts. (A Sinclair power unit, PZ.7 is available for mains operation).
Size: 1 x 0.4 x 0.2 in. plus heat sink and tags.
Sensitivity 5 mV.
Input impedance: Adjustable externally up to 2.5 Mohms.

Price (with manual): £2·98 post free.

Q16



High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:
Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts TMS.
Input impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz, confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and a special cone suspension for excellent transient response.
Size and styling: 9¾ in square on face x 4¾ in. deep with neat pedestal base. Black all-over cellular foam front with natural solid teak surround.
Price £8·98.

Micromatic

Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. Powerful AGC counteracts fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute and attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver ready built and tested, you will find it as easy to take with you as your wrist watch, and dependable under the severest listening conditions.

Specifications:
Size: 36 x 33 x 13 mm ($1\frac{4}{5} \times 1\frac{3}{10} \times \frac{1}{2}$ in.)
Weight: including batteries, 28.4 gm (1 oz.).
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies, (550 to 1,600 Hz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and **solder £2·48.**
Ready built, tested and guaranteed, with earpiece **£2·98**
Two Mallory Mercury batteries type RM675 required. From radio shops, chemists, etc.

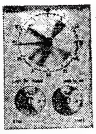
To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send ______________________	Name ______________________
______________________	Address ______________________
for which I enclose cash/cheque/money order.	PW571

Sinclair Radionics Ltd., London Road,
St. Ives, Huntingdonshire PE17 4HJ.
Tel: St. Ives (048 06) 4311

sinclair

ELECTRIC CLOCK WITH 25 AMP SWITCH

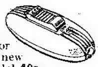


Made by Smith's, these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **£2**, less than the value of the clock alone—post and insurance 14p.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled Kit A—15-20 w. **£1** Kit B—30-40 w. **£1** Kit C—80 w. **£1·20**. Kit E—65 w. **£1·20**. Kit F for 8ft. 125 w. tube **£1·75**. Kit MF1 is for 6in., 9in. and 12in. miniature tubes **£1**. Kit MF2 for 21in. 13 w. miniature tube **£1**. Postage on Kits A and B 23p for one or two kits then 23p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p then 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

BLANKET SWITCH

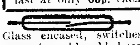


Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element, new plastic case **30p** each. 3 heat model **40p**.

BLANKET SIMMERSTAT

Although looking like, and fitted as an ordinary blanket switch, this is in fact a device for switching on for varying time periods, thus giving a complete control from off to full heat. Although suitable for controlling the temperature of any other appliances using up to 1 amp. Listed at **£1·40** each we offer these while our stocks last at only **65p**. each.

REED SWITCHES



Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:

Miniature. 1in. long × approximately 1/8in. diameter. Will make and break up to ½A up to 300 volts. Price **13p** each. **£1·20** dozen.

Standard. 2in long × 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price **10p** each. **90p** per dozen.

Flat. Flat type, 2in. long, just over 1/16in. thick, approximately ½in. wide. The Standard Type flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price **30p** each. **£3** per dozen.

Small ceramic magnets to operate these reed switches **9p** each. **90p** per dozen.

HIGH CAPACITY ELECTROLYTICS

Brand new, not ex-equipment.

100 mf.d 25v., **6p** each. **60p** doz.
250 mfd. 50v., **16p** each. **£1·65** doz.
400 mfd. 40v., **22p** each. **£2·30** doz.
500 mfd. 12v., **10p** each. **£1·05** doz.
500 mfd. 25v., **18p** each. **£1·80** doz.
500 mfd. 50v., **23p** each. **£2·40** doz.
500 mfd. 350v., **43p** each. **£4·50** doz.
1000 mfd. 12v., **15p** each. **£1·50** doz.
1000 mfd. 18v., **17p** each. **£1·70** doz.
1000 mfd. 64v., **37p** each. **£4** doz.
2000 mfd. 25v., **34p** each. **£3·95** doz.
5000 mfd. 12v., **24p** each. **£2·40** doz.
10,000 mfd. 6v., **29p** each. **£3** doz.
10,000 mfd. 15v., **43p** each. **£4·50** doz.
15,000 mfd. 10v., **53p** each. **£5** doz.
60,000 mfd. 8v., **£1·10** each. **£10** doz.
70,000 mfd. 18v., **£2** each. **£20** doz.

3 amp 12v Battery Charger Kit—comprising 230/40 mains transformer with 3 amp secondary and 3 amp rectifier **£1·15** plus 23p post.

12 volt 1½v amp Power Pack. This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mf/d/smoothing. Price **£1·40**.

Sonotone Stereo Cartidge. Turnover type, ref. No. 19 T1. This fits most British pick-ups and is a really excellent reproducer. Limited quantity, **£1**.

5 amp 3 pin Sockets. These are always good stock, you never know when you will need some. Famous make, brown bakelite, standard size, 12 for **65p** plus 23p post.

Ditto but with switch. 12 for **£1** plus 23p post.

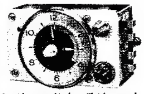
13 amp sockets, flush mounting. Bakelite, cream, less switch. 6 for **£1.**

Bakelite Panels, many thicknesses. We have just taken delivery of approximately 10 tons of bakelite in varying thicknesses from 2in. to a few thou. If you have a need for any of this then we would be glad to supply. The thickest is very heavy and could be used, for instance, as a bed for a motorised unit. Medium thickness is useful for front panels of instrument, etc., etc. Cut to your size price is **30p** per lb. plus **30p** cutting charge plus carriage.

2 amp 3 pin Switched sockets for surface mounting, brown bakelite. Made by famous maker. **13p** each or **£1·20** dozen.

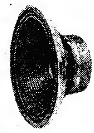
100 Assorted Silicon Rectifiers G.P. and switching diodes. Small and very small sizes. A real snip for experimenters, **65p** per 100.

20 AMP ELECTRICAL, PROGRAMMER



Learn in your sleep: Have Radio playing and kettle boiling as you awake—switch-on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an Electrical Programmer. Made by the famous Smiths Instrument Company. This is essentially a 230/240 volt mains operated Clock and a 20 amp Switch, the switch-off time of which can be delayed up to 12 hours (continuously variable not stepped). Similarly the switch-on time can be delayed. This is a beautiful unit, size 5¾ × 3¾ × 2¼in. deep. Metal encased, glass fronted with chrome surround. Offered at **£2.40** plus 23p postage and insurance.

HI-FI SPEAKERS (15, 30, 40 & 100W)

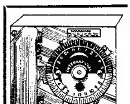


FULL FI12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—Specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12⅜in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—¼in. diam. on pitch circle 11⅛in. diam.—Overall height 5¼in. A £6 speaker offered for only **£4** plus 37p p. & p. 12in. 40 watt **£7** carr. 43p. 15in. 25 watt **£8** carr. 53p. 18in. 100 watt **£19·50** carr. £1·50.

INTEGRATED CIRCUIT BARGAIN

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

THIS MONTH'S SNIP
24-HOUR ELECTRIC TIME SWITCH



Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. **£2·50** post and ins. 23p. Additional time contacts **50p** pair

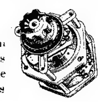
DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2** less plug **£2·25** with fitted 13 amp plug; **£2·40** with fitted 15 amp plug, plus **23p** P. & I.

BARGAIN OF THE YEAR
MICROSONIC KEYCHAIN RADIO

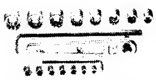
7 transistor Keychain Radio in very pretty case, size 2¾ x 2¼ x 1¼in.—complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465 Kc/s or 455 Kc/s. Power output: 40mW. Antenna: ferrite rod. Loudspeaker: Permanent magnet type.
In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new. Price only **£1·25** less batteries plus **13p**. post 6 for **£7** post free. Pair of rechargeable batteries and charger **85p**.

4 AMP VARIAC CONTROLLERS



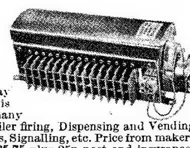
With this you can vary the voltage applied to your circuit from zero to full mains without generating undue heat. One obvious application therefore is to dim lighting. Ex equipment but little used—as good as new offered at approx. half price. **£5** plus 75p. post and ins.

19 PIECE SOCKET SETS



Complete with wall or bench rack. Most useful sizes from ¼" to 9/16" **80p** plus 23p post and insurance.

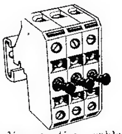
HONEYWELL PROGRAMMER



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

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

Mains Connector



A quick way to connect equipment to the mains safely and firmly—L, N. and E. coded to new colour scheme; disconnection by plugs prevents accidental switching on: has sockets which allow insertion of meter without disconnection cable inlets firmly hold one hair wire on up to four 7.029 cables. **65p** each.

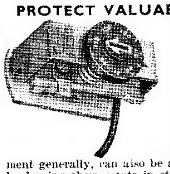
DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·50** plus 13p post and insurance. Made up model also available. **£1·90** plus 13p post & p.

BALANCED ARMATURE UNIT

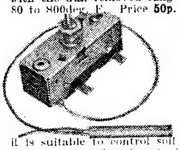
500 ohm. operates speaker or microphone, so useful in intercom or similar circuits. **33p** ea. **£3.50** doz.

PROTECT VALUABLE DEVICES



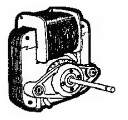
FROM THERMAL RUNAWAY OR OVER - HEATING: Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90deg. to 190 deg. F. or with the dial removed range setting is between 80 to 800deg. F. Price **50p.**

THERMOSTAT WITH PROBE



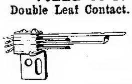
This has a sensor attached to a 15A switch by a 14in. length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at 63p each. Postage and insurance 14p.

MAINS MOTOR



Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **50p.** Postage 15p for first one then 5p for each one ordered.

NEED A SPECIAL SWITCH?



Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic push-rod suitable for operating. **5p** each, **45p** doz.

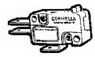
MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **13p** each, **£1·80** dozen, your assortment.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. **50p** post free.

MICRO SWITCH



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

ELECTRONICS (CROYDON) LTD

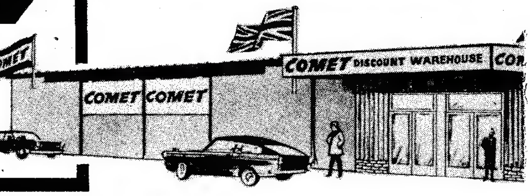
Dept. PW, 266 London Rd., Croydon CRO 2TH

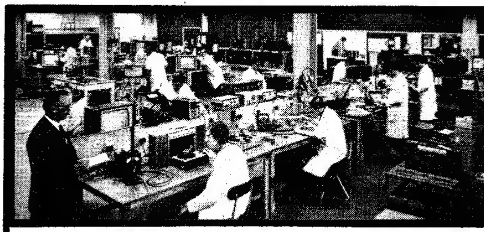
Also 102/3 Tamworth Road, Croydon

COMET

HI-FI DISCOUNT WAREHOUSES

DRIVE-IN CAR PARK





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

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

STEREO AMPLIFIERS

	Rec. Retail Price	Comet Price
ARMSTRONG 521	56·00	44·50
*DULCI 207	26·00	17·50
DULCI 207M	32·00	22·25
FERROGRAPH F307	59·00	48·00
GOODMANS Maxamp	54·00	38·00
LEAK Stereo 30 Plus	56·50	44·75
LEAK Stereo 30 Plus, in teak case	62·50	49·50
LEAK Stereo 70	69·00	55·00
LEAK Stereo 70, in teak case	75·00	59·50
*LINEAR LT 66	21·00	17·00
METROSOUND ST20	36·00	28·00
PHILIPS RH 591	79·00	61·50
PHILIPS RH 590	52·00	39·50
PHILIPS RH 580	29·00	23·00
PIONEER SA500	62·10	43·00
PIONEER SA700	98·00	70·00
PIONEER SA900	134·10	97·00
PIONEER Reverberation	45·50	33·00
ROGERS Ravensbourne	59·50	47·00
ROGERS Ravensbourne (cased)	64·00	50·00
ROGERS Ravensbrook Mk. II	47·50	38·00
ROGERS Ravensbrook (cased) Mk. II	52·50	42·00
SINCLAIR 2000	35·00	26·00
SINCLAIR PROJECT 60/2 X Z30/PZ5	23·90	17·00
SINCLAIR PROJECT 60/2 X Z50/PZ8/trans	34·86	25·50
SINCLAIR Neoteric	61·95	46·00
SINCLAIR 3000	45·00	36·00
TELETON 203E	28·75	20·00
TELETON SAQ 206 (new release)	29·00	20·00
VOLTEX 100w. Stereo Discotheque, 8 electronically mixed inputs	185·00	139·00

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

TUNERS

	Rec. Retail Price	Comet Price
*ARMSTRONG 523 AM/FM	53·76	45·00
*ARMSTRONG 524 FM	41·89	35·00
ARMSTRONG M8 Decoder	9·50	8·00
*DULCI FMT.7 FM	26·00	22·00
DULCI FMT.7S Stereo	35·00	29·95
GOODMANS Stereomax	82·52	49·95
LEAK Stereofetic Chassis	66·50	52·00
LEAK Stereofetic in teak case	72·50	59·00
PHILIPS RH 690	47·00	38·00
PHILIPS RH 691	89·00	75·50
PIONEER TX500 AM/FM	77·94	64·00
PIONEER TX900 AM/FM	153·69	125·00
ROGERS Ravensbourne	61·89	50·00
ROGERS Ravensbrook	45·01	40·00
ROGERS Ravensbrook (cased)	51·26	43·00
*SINCLAIR 2000	26·73	19·25
SINCLAIR Project 60	25·00	21·00
TELETON GT 101	45·50	34·00
TELETON 201X FM	36·00	30·00

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

TUNER/AMPLIFIERS

	Rec. Retail Price	Comet Price
AKAI AA 8500	229·00	181·00
AKAI 6600	142·53	112·00
ARENA R500	82·00	67·00
ARENA 2400	90·30	72·00
ARENA 2600 Stereo AM/FM	111·30	94·00
ARENA 2700	105·00	85·00
ARENA T1500F	72·45	60·00
ARENA T9000	303·45	258·00
ARMSTRONG M8 Decoder	9·50	8·00
ARMSTRONG 525	91·89	77·00
ARMSTRONG 526	104·71	87·00
GOODMANS Module 80S 35w. R.M.S.	95·00	75·00
GOODMANS 3000	77·73	53·00
PHILIPS RH 790	139·00	112·00
PIONEER SX770 AM/FM	160·43	126·00
PIONEER SX990 AM/FM	194·74	150·00
PIONEER 440	111·10	89·00
*TELETON F2000	51·50	32·00
TELETON 7 AT 20	105·00	80·00
TELETON 10AT1 150w. RMS	160·00	109·00
TELETON TFS50	75·50	56·00
*TELETON R.8000 with Speakers	63·25	50·00
TELETON CR55	120·00	95·00
WHARFEDALE 100.1	149·00	119·00

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

All the above Tuners and Tuner/Amplifiers include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

PICKUP ARMS

	Rec. Retail Price	Comet Price
GOLDRING Lenco L75	12·33	10·50
GOLDRING Lenco L69	9·29	7·00
SME 3009 with S2 Shell	34·47	28·00
SME 3012 with S2 Shell	36·71	31·50

CARTRIDGES

	Rec. Retail Price	Comet Price
GOLDRING 800	13·00	7·50
GOLDRING 800H	10·69	8·00
GOLDRING 800E	18·86	12·25
GOLDRING 800 Super E	26·01	20·00
*GOLDRING CS90 Stereo	5·20	4·25
*GOLDRING CS91/E	7·81	6·25
GOLDRING G850	6·50	5·25
EMPIRE 100ZE/X	63·00	52·50
EMPIRE 999VE/X	44·50	36·00
EMPIRE 999TE/X	27·60	22·50
EMPIRE 999SE/X	21·00	17·50
EMPIRE 999E/X	16·50	13·00
EMPIRE 999/X	11·50	9·25
EMPIRE 909E/X	12·85	10·25
EMPIRE 909X	9·00	7·50
EMPIRE 90EE/X	9·75	8·00
ORBIT Magnetic NM 22	Special Price	2·90
PICKERING V15 AC2	8·40	7·00
ORTOFON SL15E	29·65	23·75
ORTOFON 2X15K Transformer	7·00	5·25
SHURE M3DM	7·41	5·25
SHURE M31E	12·05	9·50
SHURE M32E	11·10	8·75
SHURE M32-3	10·20	8·00
SHURE M44-5	11·10	8·50
SHURE M44-7	10·20	8·00
SHURE M-44C	10·20	8·00
SHURE M44E	12·05	9·50
SHURE M55E	12·95	10·25
SHURE M75G	17·60	14·00
SHURE M75-6	16·70	13·00
SHURE M75EJ	19·45	16·00
SHURE M75E-95G	23·15	18·00
SHURE M75E	21·30	16·00
SHURE M75E/D19	23·15	19·00
SHURE V15-11	40·76	30·00
SHURE V15-11-7	38·90	29·00

Starred cartridges above are ceramic. All others are magnetic.

TURNTABLES

GARRARD SP25, Mk III fully wired with Goldring G800 Magnetic Cartridge. Complete with base, plinth and cover— Special Price 21·98

GARRARD 2025 fully wired with Sonotone 9TA HC Cartridge complete with base and cover Special Price **15·50**

GOLDRING 705/P turntable, complete with Goldring G850 cartridge, base and cover .... 25·00 **15·95**

	Rec. Retail Price	Comet Price
DUAL 1219 transcription	60·40	50·00
DUAL 1209 transcription	42·62	35·00
GARRARD SP25 Mk III	16·45	11·90
GARRARD SL65 B	21·25	15·90
GARRARD SL75 B	38·95	28·50
GARRARD SL95 B	53·27	38·50
GARRARD 401	38·07	29·50
GARRARD SL72 B	32·77	26·90
GARRARD 3500, with GKS Cartridge	17·23	12·90
Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500	Special Price	4·00
GARRARD 40B	13·84	10·97
GARRARD AP 76	28·88	21·50
GOLDRING 705/P with 850 Cartridge and Cover	26·00	23·90
GOLDRING GL69 Mk. II	26·63	22·50
GOLDRING GL69 P Mk. II	35·14	29·50
GOLDRING GL75	36·41	33·90
GOLDRING GL75 P	46·94	41·90
GOLDRING Covers for 69P and 75P	4·21	3·50
GOLDRING C99—plinth and cover for G99	11·45	9·90
GOLDRING G99	26·00	23·90
GOODMANS 3025	37·74	26·90
McDONALD MP 60	15·75	12·25
McDONALD 610	20·00	15·90
Base and Cover for McDONALD MP 60 and 610	Special Price	4·50
PHILIPS 228	20·00	17·00
PHILIPS GA 146	31·50	25·00
PHILIPS 217	33·00	28·00
PHILIPS 202 Electronic	69·00	57·50
PIONEER PL 12A with base & cover	49.93	37·95
PIONEER PL11	57·90	39·00
THORENS TX 25 cover	8·85	7·00
THORENS TD125	79·04	64·95
THORENS TD150A Mk. II	46·16	35·95
THORENS TD125AB	120·20	100·00
THORENS TD150AB Mk. II	49·96	42·95
THORENS TX11 Cover	4·43	3·95

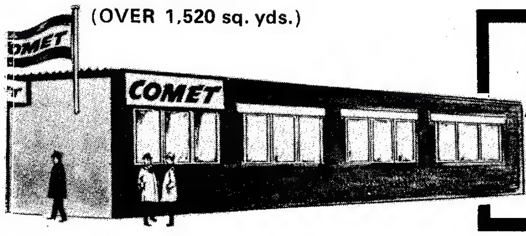
SPEAKERS

	Rec. Retail Price	Comet Price
ARENA HT 16	13·00	10·95
B & W Model 70	139·50	115·00
B & W DM3	63·00	53·00
B & W DM1	32·00	25·50
CELESTION Ditton 120	24·00	18·00
CELESTION Ditton 15	32·00	25·50
CELESTION Ditton 25	65·00	52·00
GOODMANS Minister	25·00	21·20
GOODMANS Magister	62·50	49·50
GOODMANS Maxim	20·39	16·75
GOODMANS Mezzo 3	34·00	26·50
GOODMANS Magnum K2	44·00	33·00
KEF Concord	43·50	33·00
KEF Concerto	53·50	42·00
KEF Cresta	22·17	18·00
KELETRON KN 500 4 speaker system (pair)	23·00	17·95
KELETRON KN 700 4 speaker system (pair)	27·50	21·95
KELETRON KN 1000 4 speaker system	19·25	14·95
KELETRON KN 1500 4 speaker system	24·75	19·95
KELETRON KN 2000 4 speaker system	28·75	21·95
LEAK 200	24·95	18·90
LEAK 300	32·50	23·95
LEAK 600	49·50	36·90
LOWTHER Acousta (with PM6)	45·50	38·50
LOWTHER Acousta (with PM7)	53·00	46·00
LOWTHER Ideal Baffle	35·50	30·00
METROSOUND HFS 20	18·50	13·50
METROSOUND HFS 10 (pair)	27·44	22·95
PHILIPS RH481	11·00	9·25
PHILIPS RH482	18·00	15·00
SINCLAIR Q16	8·98	8·00
STE-MA 275 3 speaker system	23·10	15·00
WHARFEDALE Speakers		
Airedale	69·50	56·00
Denton	19·95	15·90
Super Linton	24·95	20·50
Melton	32·50	25·50
Dovedale 3	42·50	32·50
Rosedale	65·00	52·50
Triton (pair)	59·90	46·90
Unit 3 Speaker Kit	13·00	10·50
Unit 4 Speaker Kit	18·00	14·25
Unit 5 Speaker Kit	26·00	20·50

CHASSIS SPEAKERS

	Rec. Retail Price	Comet Price
GOODMANS Axiette 8	8·10	6·50
GOODMANS Twinaxiette 8	9·17	7·50
GOODMANS Axiom 10	9·16	7·75

(OVER 1,520 sq. yds.)



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GOODMANS Axiom 80	28·31	23·75
GOODMANS Axiom 201	14·45	10·95
GOODMANS Axiom 301	20·70	15·75
GOODMANS Audiom 8P	5·50	4·25
GOODMANS Audiom 10P	6·00	3·58
GOODMANS Audiom 51	13·05	9·75
GOODMANS Audiom 61	18·95	14·00
GOODMANS 12P	12·87	10·00
GOODMANS 15P	20·00	16·97
GOODMANS Audiom 18P	34·00	26·97
GOODMANS Twin Axiom 10	10·23	8·25
GOODMANS ARU 172	4·50	3·50
GOODMANS Trebax 100	8·60	6·00
GOODMANS Trebax 5K/20XL	8·40	6·50
GOODMANS Midax	12·95	9·00
GOODMANS Attenuator	3·55	2·50
GOODMANS Crossover Networks XO/950/5000	9·75	7·25
GOODMANS Crossover Networks XO/950	7·40	5·75
GOODMANS Crossover Networks XO/5000	2·65	2·00
WHARFEDALE 8 in. Bronze/RS/DD	5·00	4·00
WHARFEDALE Super 8/RS/DD	8·50	7·00
WHARFEDALE Super 10/RS/DD	14·00	11·50
WHARFEDALE WMT 1 Matching Transformer	0·84	0·75

HI-FI STEREO SYSTEMS (complete)

ARENA MR15	145·00	115·95
ALBA UA552	47·50	35·95
ALBA UA662	62·99	47·95
BUSH System 749/746/764	102·65	82·65
DECCA Sound 603	72·50	59·95
DECCA Sound 604	72·50	60·95
DECCA Sound 1203	97·50	79·95
DECCALIAN 5, complete with stand.	65·50	52·95
EKCO SRG 609	88·50	69·95
EKCO ZU5	165·00	135·00
FERGUSON 3422	84·70	68·95
FERGUSON 3424	123·15	106·00
FERGUSON 3245	138·2	112·95
FIDELITY Music Master UA2	43·00	35·95
FIDELITY Music Master UA1	98·00	82·95
GOODMANS 3000 Suite	140·45	92·95
H.M.V. 2416	129·70	104·95
H.M.V. 204/5/6	202·85	169·95
K.B. KA1250, complete with two 3-way speakers	72·00	56·00
K.B. KA1250, complete with two 651 speakers	83·00	63·95
LEAK 30/GOLDRING/WHARFEDALE	182·65	142·95
LEAK 70/THORENS/WHARFEDALE	218·72	169·95
MARCONI Unit 4	77·45	66·95
MARCONI Unit 3	86·00	69·95
METROSOUND Stereo 1010	77·32	65·95
PHILIPS GF823	51·50	41·95
PHILIPS GF824	69·50	56·95
PHILIPS GF833	67·50	55·95
PHILIPS GF834	88·00	73·95
PHILIPS GF417	99·50	82·95
QUAD/THORENS/GOODMANS	372·76	312·75
TELETON 8-track Stereo	52·25	45·95
TELETON 2S60F, with Stereo Radio	75·00	55·95
TELETON CMS400, with Stereo Radio	102·50	69·95
TELETON CRIOT 2025/1003, with Stereo Radio	62·10	45·95
TOSHIBA SP8507	248·00	175·00
ULTRA 6405	79·75	66·95
TELETON Stereo 8-track Tape Audio System complete	52·25	46·00

TAPE RECORDERS AND TAPE DECKS

	Rec. Retail Price	*Comet Price*
AKAI M10L	245·05	189·00
AKAI X200D	190·00	159·95
AKAI X5000 W L	177·98	140·00
AKAI X330	342·57	269·00
AKAI X-330D	312·56	245 00
AKAI X-360	380·08	284 00
AKAI X-360 D-deck	318·92	243·00
AKAI 1800SD	199·42	167·00
AKAI 1710L	89·85	65·95
AKAI CR80 8-track stereo recorder	115·03	99·95
AKAI CR80D 8-track stereo tape deck	95·00	79·95
AKAI 4000 4-track Stereo	124·90	99·95
AKAI 4000 D 4-track Stereo deck	89·95	69·95
BUSH TP 60 Cassette Tape Recorder	29·40	24·95
BUSH TP 70 Cassette Battery/Mains Tape Recorder	29·95	23·75
BUSH Discassette DC70	21·95	16·95
FERGUSON 3252	101·80	82·95
FERGUSON 3245 Twin track	37·05	29·95
FERGUSON 3246 4-track	43·00	33·95
FERGUSON 3247 4-track	48·45	38·95
FERGUSON 3248 4-track	54·30	41·95
FERROGRAPH 722	242·54	202·00
FERROGRAPH 724	242·54	202·00
FERROGRAPH 702/W 2 track tape deck	207·35	168·00
FERROGRAPH 704/W 4 track tape deck	207·35	168·00
GRUNDIG C200L Cassette	39·90	29·95
GRUNDIG TK 141 (4-track)	61·85	49·95
GRUNDIG TK 121 (Twin-track)	56·85	43·95
GRUNDIG TK 146 (4-track Auto)	68·14	53·95
GRUNDIG TK 149 4-track	57·63	47·95
PHILIPS 2202	29·90	23·95
PHILIPS 2205 Cassette Tape Recorder	43·15	34·95
PHILIPS 4404 4-track stereo recorder	95·00	73·95
PHILIPS 4407 4-track stereo recorder	110·00	89·95
PHILIPS 4302 Twin Track Auto	39·00	32·00
PHILIPS 4307 4-track	49·50	38·95
PHILIPS 4500 4-Track Stereo Tape Deck	126·00	98·95
PHILIPS 4408 4-Track Stereo	139·00	109·00
PHILIPS N4308	60·50	47·50
PYE Cassette Recorder/Radio (Batt./Mains)	45·50	36·95
TELETON FXB 510 D 4-track Stereo	62·50	47·95
TELETON TRC 130 cassette, with VHF/AM radio. Battery/mains twin motors	39·50	29·95
TELETON TC110 cassette, battery/mains	27·50	19·95
TOSHIBA GT 840 S	110·00	59·95
TOSHIBA GT 601v Twin Track	45·15	25·95
TOSHIBA 850 SA	94·00	59·95

BASES AND COVERS

GARRARD WB1 Base	3·86	3·25
GARRARD WB4 Base	5·69	4·75
GARRARD SPC 1 Cover	3·74	3·00
GARRARD SPC 4 Cover	4·44	3·75

SPECIAL OFFER OF BASE AND COVER TO FIT

GARRARD SP25, SL55, SL65B and 3500	Special Price	4·00
GOLDRING Plinth 75	8·52	7·00
GOLDRING Plinth 69	8·52	7·00
GOLDRING Covers for 69P and 75P	4·21	3·50
THORENS TX25 (for TD125AB)	8·22	6·50
THORENS TX11 Cover	4·11	3·75
Base and Cover for TD 125	15·18	12·50
SME Plinth System 2000	39·20	31·25
MOTORBOARDS only	4·95	3·00

TEAK CASES

Leak 70/30 Amp. case	7·50	6·50
Leak Tuner case	7·50	6·50
Leak Double case for amp. & tuner	10·50	8·95

COMPLETE HI-FI SYSTEMS

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	Rec. Retail Price	*Comet Price*
TELETON Stereo 8 track tape Audio system complete with speakers	52·25	46·00
GARRARD SP 25, Mk. III mounted in base, plinth and cover with GOLDRING G800 Cartridge. Teleton 203 or 206 Stereo Amplifier 12 watts RMS, and 2 KELETRON KN500 Speakers, each speaker is a 4 speaker system	88·33	58·95
PIONEER PL 12 turntable, Goodmans Maxamp, Shure M55E Cartridge, 2 Keletron KN 700 speakers (each speaker cabinet contains 4 speakers)	144.38	105·00
GOLDRING GL 69P Mk.11 mounted in base with hinged lid, GOLDRING G800 Cartridge, Rogers Ravensbrook Amplifier in Teak case. Two Wharfedale Super Linton Speakers	151·25	115·95
GOLDRING GL 75P mounted in teak base with hinged perspex cover complete with GOLDRING G800E Cartridge. Leak Stereo 30 Plus Amplifier in Teak case. 2 GOODMANS Mezzo 3 Speakers	200·50	154·20
THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Stereo 70 Amplifier in Teak case. 2 Wharfedale Dovedale 3 Speakers	226·87	175·00
THORENS TD 125AB Electronic Turntable complete with cover. SHURE V15-11 Cartridge, GOODMANS Maxamp, GOODMANS Stereomax AM/FM Tuner. 2 GOODMANS Magister Speakers	422·48	309·00

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BRAND NEW E.M.I. LIGHTWEIGHT PICK-UP ARM WITH ARM REST, Fitted mono t/o stylus and cartridge for LP/78. ONLY **£1,** P. & P. 13p.

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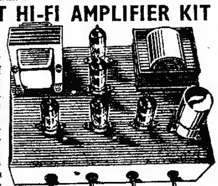
A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. wide × 3in. deep × 6in. high. Ready built and tested. PRICE **£3·75** P. & P. 30p
ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE **£4·88** P. & P. 38p.
DELUXE QUALITY PORTABLE R/P CABINET MK II. Uncut motor board size 14½ × 12in. clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 15 × 8in. PRICE **£3·98.** P. & P. 48p.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3–15 Ω speaker and 2 independent volume controls, and separate base and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 13p (Free with parts). **All parts sold separately.** ONLY **£7·97** P. & P. 43p. Also available ready built and tested complete with std. input sockets, **£9·97.** P. & P. 43p.

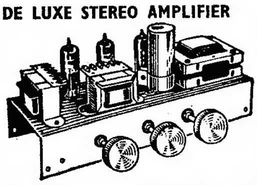
BRAND NEW TRANSISTOR BARGAINS. GET 15 (Matched pair) **75p;** V15/10p **50p;** OC71 **25p;** OC76 **30p;** AF117 **18p;** 2G339 (NPN) **15p.**
Set of Mullard 6 transistors OC44, 2—OC45, AC128D matched pair AC128 **£1·25;** ORP12 Cadmium Sulphide Cells **53p.** All post free.

VERY POWERFUL COMPACT MOTOR

For 12v. D.C. operation. Off load consumption approx. 100mA. Totally enclosed. Quiet in operation with high starting torque. Overall size approx. 1⅞"L × 1¼" dia. Free shaft 1/16" dia. × ⅜"L. Ideal for Model Makers, etc. ONLY **38p.** each P. & P. 5p.
3 or more post free (A few 6v. versions also available)

HIGH GRADE COPPER LAMINATE BOARDS. 8 × 6 × 1/16in. FIVE for **50p.** P. & P. 10p.

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 v. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as full wave rectifier. Two dual potentionmeters are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11"w × 4"d. Overall height including valves 5". Ready built and tested to a high standard. **PRICE £8·92** P. & P. 40p.

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Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6·97** Carr. 33p. With stereo cartridge **£7·97** Carr. 33p.
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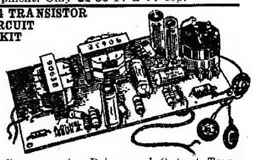
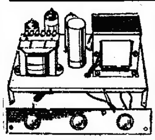
LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only **£1·50** P. & P. 10p.

HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TA1



Peak output in excess of 1½ watts. All standard British components. Built on printed circuit panel size 6 x 3in. Generous size Driver and Output Transformers. Output transformer tapped for 3 ohm and 15 ohm speakers. Transistors (GET114 or 81 Mullard AC128D and matched pair of AC128 o/p). 9 volt operation. Everything supplied, wire, battery clips, solder, etc. Comprehensive easy to follow instructions and circuit diagram **13p** (Free with Kit). All parts sold separately. **SPECIAL PRICE £2·48** P. & P. 15p.
Also ready built and tested, **£2·75.** P. & P. 15p.

3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½" w. × 4" d. × 4½" h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4·75.** P. & P. 30p.
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A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3.5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240v. Supplied absolutely Brand New completely wired and tested with good quality output transformer.
FEW ONLY. BARGAIN PRICE **£2.75** P. & P. 30p

Open 9–5.30 Monday to Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station.

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Please call in No. 11 for demonstrations.

£18.50 P. & P. 88p

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LONDON N22 6TL
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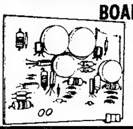

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5 BOARDS FOR **120p.** Post Free.

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E.M.I.

450 3,8,15 OHM 10 watts **£3.50** p. & p. 38p.	150 3,8,15 OHM 10 watts 13" × 8" dual cone **£2.50** p. & p. 38p.

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28 × 8½ × 16in. high. This modern design TV Stand would make an ideal base for a coffee table and is a bargain at **163p.** Post 25p

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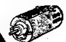
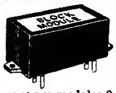


Rated up to 11·5 volt 400mA. Size 1⅜" long, ⅞" dia. Shaft 5/16" long 1/16" dia.

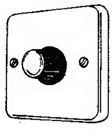
23p Post 3p

SOLID STATE BLOCK MODULES



Phono pre-amp E1311 input 100k: gain 28dB max out 3 volt: max input 50mV. Tape pre-amp as above E1313. Power amp E1314 input 1,000 ohms gain 20dB 300mW. Organ tone osc E1315 tone freq. 200-1k, Hz output 80mW. All above modules 9 volt. Dual flasher E1318 flash time 1-4 secs power 6 volt. Lamp 6v 150mA. All at **£1.25** P. & P. 10p

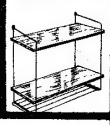
LIGHT DIMMER



The unit comes complete with MK Ivory Front Plate and Control Knob, when used in place of Light Switch it will control your room lighting from, off to full brightness. Power— up to 300 watts inteference suppressed

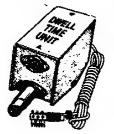
£2.75 +P. & P. 8p.

SHELF UNIT



Two teak finish shelves on a black frame (overall size 28" × 25" × 12" deep). This unit is wall mounting. **250p.** Postage Free

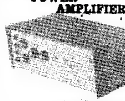
DWELL TIME UNIT



These small units contain the following components: 700 ohm DPDT relay with base, 1μF 250v. paper, 0·01μF 400v. paper, 50μF 35v. electrolytic, 3 diodes OC200 transistor, a 2N2926 type transistor unmarked, a skeleton pre-set pot, 4 pin din plug & skt., 4 foot of 4 core screen. All housed in a small neat metal box. Can be made into many timing devices.

43p +P. & P. 8p

TUAC HIGH-POWER AMPLIFIER



- True 100 watts output
- Studio switch, for lower power work, but with same tone.
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- Full power — four ohms
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- Negligible distortion right up to full output

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FULL 12 MONTH GUARANTEE

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BY100 type rectifier 800 piv 750mA	16p	each
4-pin transistor holders	3p	each
2¼" 80 ohm loudspeaker	30p	each
2¼" 8 ohm loudspeaker	33p	each
2½" 25 ohm loudspeaker	28p	each
U2 battery holders (blue plastic) ..	5p	each
10 ohm w/w pots	13p	each
OC81 double heat clips	3p	each
Tape recorder rev. counters ..	25p	each

Please include P. & P.

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IT4	·16	CCH35	·65	EBF89	·30	EL84	·24	PCL82	·33	U26	·63
3S4	·28	DAC32	·33	ECC81	·17	EY51	·35	PCL84	·35	U191	·60
3V4	·37	DAF91	·21	ECC82	·20	EY86	·31	PCL85	·42	U251	·70
6/30L2	·57	DAF96	·35	ECC83	·23	EZ80	·22	PCL86	·40	U329	·70
6AQ5	·25	DF33	·37	ECF80	·28	EZ81	·23	PFL200	·54	UABC80	·30
6BW7	·57	DF91	·16	ECF82	·28	KT61	·46	PL36	·49	UBF89	·31
6F23	·71	DF96	·35	ECH35	·27	KT66	·82	PL81	·46	UCC85	·36
6F25	·60	DK32	·33	ECH81	·28	N78	·85	PL82	·30	UCH81	·32
25L6GT	·22	DK91	·27	ECL80	·33	PC86	·49	PL83	·34	UCL82	·34
30C15	·62	DK92	·41	ECL82	·31	PC88	·49	PL84	·31	UCL83	·49
30C18	·63	DK96	·36	ECL86	·37	PC97	·39	PL500	·64	UF89	·30
30F5	·72	DL35	·23	EF39	·22	PC900	·35	PL504	·65	UL84	·32
30FL1	·62	DL92	·28	EF80	·24	PCC84	·31	PY32	·54	UY85	·27
30L15	·60	DL94	·37	EF85	·28	PCC89	·46	PY33	·54	Z77	·18
30L17	·71	DL96	·36	EF86	·31	PCC189	·50	PY81	·25		
30P4	·60	DY86	·26	EF89	·23	PCF80	·29	PY82	·25		
30P19	·60	DY87	·26	EF91	·12	PCF86	·45	PY800	·35		
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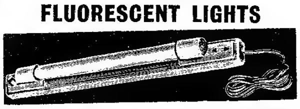

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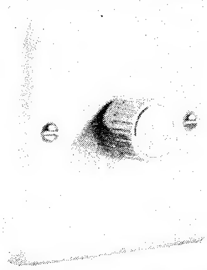

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Z & I AERO SERVICES LTD.

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Open all day Saturday

Please send all correspondence and Mail-Orders to the Head Office

When sending cash with order, please include 12½np in £ for postage and handling

MINIMUM CHARGE 12½np. No C.O.D. orders accepted

PLEASE NOTE THAT THE VALVES OFFERED BELOW ARE NOT NECESSARILY OF U.K. ORIGIN

PLEASE NOTE THAT ALL PRICES ARE IN DECIMAL PARTS OF £, I.E. IN NEW PENCE

OA2	0.38	6AQ6	0.55	6EW6	0.65	10C2	0.50
OA3	0.45	6AR5	0.35	6F1	0.70	10D1	0.50
OB2	0.35	6AR6	0.40	6F5	0.50	10D2	0.40
OB3	0.60	6AS5	0.35	6F6G	0.30	10F1	0.90
OC3	0.38	6AS7G	0.80	6F11	0.38	10F9	0.50
OD3	0.35	6AT6	0.30	6F13	0.38	10F18	0.45
IB3GT	0.38	6AU6	0.25	6F14	0.65	10L1	0.45
ICP31	6.00	6AV6	0.30	6F15	0.65	10LD11	0.60
1L4	0.20	6AW8A	0.55	6F18	0.45	10P13	0.55
1R4	0.35	6BA6	0.25	6F23	0.80	10P14	1.10
1R5	0.35	6BE6	0.30	6F24	0.75	12AB5	0.60
1S4	0.27	6BF5	0.80	6F25	0.75	12AC6	0.40
1S5	0.25	6BF6	0.50	6F26	0.35	12AL5	0.45
1T4	0.25	6BH6	0.45	6F28	0.60	12AQ5	0.43
1U4	0.27	6BJ6	0.45	6J4	0.50	12AT6	0.30
1U5	0.50	6BK7A	0.55	6J5GT	0.30	12AT7	0.33
1V2	0.45	6BN5	0.43	6J7	0.45	12AU6	0.30
1X2B	0.40	6BN6	0.40	6K6GT	0.55	12AU7	0.30
2D21	0.35	6BQ5	0.25	6K7	0.35	12AV6	0.33
3A4	0.35	6BR8	0.65	6K8G	0.35	12AV7	0.50
3B28	2.15	6BS7	1.30	6K25	0.75	12AX7	0.30
3BP1	2.75	6BW6	0.85	6L6GT	0.45	12AY7	0.70
3Q4	0.40	6BW7	0.70	6L7	0.40	12B44 A	0.55
3S4	0.35	6BX6	0.25	6L18	0.45	12BA6	0.35
3V4	0.45	6BZ6	0.35	6LD20	0.40	12BA7	0.35
5R4GY	0.60	6C4	0.33	6N7GT	0.40	12BE6	0.35
5U4G	0.33	6C5GT	0.40	6P1	0.60	12BH7	0.40
5U4GB	0.42	6CA4	0.28	6P28	0.65	12BY7	0.55
5V4G	0.42	6CA7	0.50	6Q7	0.40	12K5	0.55
5Y3GT	0.32	6CB6	0.30	6SA7	0.40	12K7GT	0.35
5Z3	0.50	6CD6GA	1.15	6SG7	0.35	12Q7G	0.30
5Z4G	0.40	6CG7	0.50	6SK7	0.35	12SR7	0.35
6/30L2	0.75	6CH6	0.55	6SL7GT	0.35	14S7	0.80
6AB4	0.35	6CL6	0.50	6SN7GT	0.35	20D1	0.45
6AF4A	0.50	6CW4	0.63	6SQ7	0.40	20L1	1.10
6AG7	0.40	6CY5	0.43	6SR7	0.40	20P1	0.50
6AH6	0.50	6CY7	0.65	6T8	0.35	20P4	1.10
6AJ8	0.30	6D3	0.45	6U4GT	0.60	20P5	1.20
6AK5	0.30	6DC6	0.75	6U8A	0.40	25C5	0.50
6AK6	0.57	6DK6	0.48	6X4	0.30	25L6GT	0.45
6AL3	0.43	6DQ6B	0.63	6X5GT	0.35	25Z4G	0.30
6AL5	0.20	6DS4	0.75	6X8	0.55	25Z6GT	0.65
6AM5	0.32	6EA8	0.58	6Y6G	0.65	30A5	0.45
6AM6	0.33	6EH7	0.30	7Y4	0.60	30AE3	0.40
6AQ5	0.35	6EJ7	0.35	9BW6	0.50	30C1	0.30

First Quality Fully Guaranteed

BRAND

ELECTRONIC VALVES

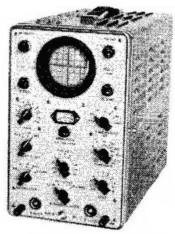
30C15	0.80	85A2	0.40	DK96	0.42	ECC84	0.30
30C17	0.85	90AG	2.40	DL96	0.42	ECC85	0.40
30C18	0.75	90AV	2.50	DM160	0.65	ECC88	0.40
30F5	0.85	90C1	0.60	DY86	0.33	ECC89	0.50
30FL1	0.70	90CV	1.25	DY87	0.35	ECC91	0.20
30FL12	0.93	807	0.50	DY802	0.50	ECC189	0.60
30FL14	0.75	812A	3.50	E88CC	0.65	ECF80	0.35
30L1	0.40	813	3.75	E130L	5.00	ECF82	0.35
30L15	0.85	866A	0.75	E180F	0.95	ECF86	0.65
30L17	0.80	5642	0.65	EABC80	0.35	ECF804	1.50
30P12	0.80	6080	1.50	EAF42	0.55	ECH42	0.70
30P19	0.80	6146	1.50	EBC33	0.50	ECH81	0.30
30PL1	0.70	6146B	2.50	EBC41	0.55	ECH83	0.40
30PL13	0.93	6360	1.25	EBC81	0.30	ECH84	0.45
30PL14	0.90	6939	2.15	EBF80	0.40	ECL80	0.40
35A3	0.55	7199	0.75	EBF83	0.40	ECL81	0.45
35A5	0.75	7360	1.80	EBF89	0.30	ECL82	0.35
35B5	0.65	7586	1.25	EC53	0.50	ECL83	0.65
35C5	0.40	7895	1.25	EC86	0.60	ECL84	0.55
35D5	0.70	9002	0.35	EC88	0.60	ECL85	0.55
35L6GT	0.50	9003	0.50	EC90	0.33	ECL86	0.40
35W4	0.30	AZ1	0.48	EC91	0.50	ECLL800	1.50
35Z3	0.60	AZ31	0.55	EC92	0.35	EF37A	0.60
35Z4G	0.30	CBL1	0.80	EC93	0.50	EF39	0.40
35Z5GT	0.40	CBL31	0.90	EC8010	2.25	EF40	0.50
50A5	0.70	CY31	0.35	ECC40	0.60	EF41	0.65
50B5	0.45	DAF96	0.42	ECC81	0.33	EF42	0.70
50C5	0.40	DF96	0.42	ECC82	0.30	EF80	0.25
50CD6G	1.65	DK40	0.55	ECC83	0.30	EF83	0.55
50L6GT	0.50	DK92	0.50				

EF85	0.35	EY88	0.43	PCL88	0.90	U78	0.30
EF86	0.30	EZ40	0.45	PCL800	0.93	U191	0.75
EF89	0.28	EZ41	0.45	PCL801	0.70	U201	0.35
EF91	0.33	EZ80	0.25	PD500	1.50	U281	0.40
EF92	0.40	EZ81	0.28	PF86	0.60	U282	0.40
EF95	0.30	GY501	0.80	PF818	0.85	U301	0.40
EF97	0.65	GZ30	0.40	PFL200	0.70	U403	0.50
EP98	0.65	GZ31	0.33	PL33	0.35	U404	0.40
EF183	0.30	GZ32	0.48	PL36	0.55	U801	1.00
EF184	0.35	GZ33	0.70	PL81	0.50	UABC80	0.35
EF800	1.00	GZ34	0.60	PL82	0.45	UAF41	0.50
EF804	1.25	HABC80	0.45	PL83	0.45	UAF42	0.55
EK90	0.30	HK90	0.35	PL84	0.40	UBC41	0.50
EL33	1.25	KT66	2.05	PL302	0.80	UBC81	0.40
EL34	0.50	KT88	2.00	PL504	0.80	UBF80	0.40
EL36	0.50	N78	1.45	PL508	0.90	UBF89	0.35
EL37	1.25	PABC80	0.40	PL509	1.30	UBL1	0.50
EL41	0.55	PC86	0.60	PL509	1·30	UBL21	0.60
EL42	0.58	PC88	0.60	PL801	0.80	UC92	0.35
EL81	0.55	PC97	0.50	PM84	0.50	UCC85	0.40
EL83	0.42	PC900	0.48	PY31	0.30	UCF80	0.55
EL84	0.25	PCC84	0.40	PY33	0.63	UCH21	0.60
EL85	0.43	PCC85	0.40	PY80	0.35	UCH42	0.70
EL86	0.40	PCC88	0.55	PY81	0.30	UCH43	0.75
EL90	0.35	PCC89	0.50	PY82	0.30	UCH81	0.35
EL95	0.35	PCC189	0.55	PY83	0.38	UCL81	0.60
EL360	1.15	PCC805	0.85	PY88	0.40	UCL82	0.35
EL803	1.00	PCC806	0.80	PY500	1.00	UCL83	0.60
EL821	0.55	PCF80	0.30	PY800	0.50	UF41	0.60
EL822	0.90	PCF82	0.35	PY801	0.50	UF42	0.60
ELL80	0.75	PCF84	0.50	PZ30	0.35	UF43	0.60
EM34	0.90	PCF86	0.60	QQV2-6	2.15	UF80	0.35
EM71	0.75	PCF87	0.85	QQVO3-10	1.25	UF85	0.40
EM80	0.40	PCF801	0.50	QQV03-20A	5.25	UF89	0.35
EM81	0.60	PCF802	0.50	TT21	2.65	UL41	0.65
EM84	0.35	PCF805	0.75	TT22	2.80	UL84	0.30
EM85	1.00	PCF806	0.70	U18/20	0.75	UM84	0.20
EM87	0.55	PCF808	0.75	U25	0.75	UY1N	0.50
EN91	0.35	PCH200	0.70	U26	0.75	UY11	0.65
EY51	0.40	PCL81	0.50	U31	0.45	UY41	0.45
EY80	0.45	PCL82	0.35	U37	1.50	UY82	0.50
EY81	0.40	PCL83	0.65	U52	0.33	UY85	0.30
EY83	0.55	PCL84	0.45	U76	0.30	W729	0.60
EY86	0.40	PCL85	0.40			Z803U	0.90
EY87	0.43	PCL86	0.45				

TRANSISTORS

2N404	0.17	2S034	1.00	BC152	0.15
2N444A	0.25	2S102	0.40	BC175	0.25
2N696	0.20	2S104	0.50	BCY30	0.35
2N697	0.23	2S701	0.50	BCY33	0.25
2N698	0.40	2S702	0.50	BCY34	0.30
2N705	0.70	2S746	0.30	BCY72	0.20
2N706	0.15	AC113	0.15	BCZ11	0.40
2N708	0.20	AC125	0.30	BD121	0.80
2N753	0.25	AC126	0.25	BD123	0.95
2N929	0.30	AC127	0.20	BF115	0.20
2N930	0.35	AC132	0.35	BF167	0.25
2N987	0.35	AC153	0.25	BF173	0.30
2N1131	0.40	AC154	0.15	BF181	0.25
2N1132	0.45	AC156	0.23	BF184	0.25
2N1184	1.25	AC157	0.20	BF185	0.20
2N1301	0.40	AC169	0.10	BF194	0.20
2N1302	0.25	AC176	0.25	BF195	0.15
2N1304	0.25	AC187	0.30	BF196	0.20
2N1305	0.25	AC188	0.30	BF197	0.20
2N1306	0.25	ACY17	0.30	BFW87	0.30
2N1307	0.30	ACY18	0.20	BFW88	0.25
2N1308	0.40	ACY19	0.25	BFW89	0.23
2N1309	0.35	ACY20	0.20	BFW91	0.20
2N1613	0.25	ACY21	0.20	BFX88	0.25
2N1711	0.30	ACY22	0.15	BFY17	0.40
2N1756	0.75	AD140	0.80	BFY19	0.60
2N2147	0.75	AD149	0.50	BFY50	0.25
2N2160	1.25	AD161	0.35	BFY51	0.20
2N2217	0.30	AD162	0.35	BFY52	0.25
2N2218	0.40	AF114	0.25	BSY26	0.25
2N2219	0.45	AF115	0.30	BSY27	0.30
2N2369A	0.25	AF116	0.25	BSY28	0.30
2N2477	0.65	AF117	0.20	BSY65	0.20
2N2646	0.60	AF118	0.45	BSY95A	0.20
2N2905	0.50	AF125	0.25	OC16	0.75
2N2923	0.15	AF127	0.25	OC22	0.65
2N2924	0.15	AF178	0.40	OC23	0.60
2N2926	0.15	AF180	0.35	OC24	0.60
2N3053	0.30	AF181	0.35	OC25	0.40
2N3055	0.75	AF186	0.50	OC26	0.30
2N3133	0.35	AF239	0.40	OC28	0.60
2N3134	0.50	AFZ11	0.45	OC29	0.65
2N3391	0.20	ASY26	0.25	OC30	0.75
2N3392	0.15	ASY27	0.30	OC35	0.50
2N3393	0.15	ASY28	0.30	OC36	0.60
2N3394	0.15	ASY29	0.30	OC42	0.30
2N3395	0.20	ASY54	0.25	OC44	0.20
2N3402	0.15	ASY74	0.50	OC45	0.20
2N3403	0.15	ASY77	0.35	OC70	0.20
2N3404	0.35	ASY82	0.20	OC71	0.15
2N3414	0.20	ASY86	0.20	OC72	0.25
2N3415	0.15	ASZ16	0.70	OC73	0.40
2N3416	0.25	ASZ17	0.75	OC75	0.25
2N3417	0.25	ASZ18	0.75	OC76	0.25
2N3702	0.15	ASZ21	0.50	OC78	0.25
2N3703	0.15	BC107	0.15	OC78D	0.20
2N3704	0.20	BC108	0.15	OC81	0.25
2N3707	0.20	BC109	0.20	OC81D	0.15
2N3709	0.15	BC113	0.40	OC83	0.20
2N3710	0.15	BC118	0.30	OC139	0.35
2N3819	0.35	BC134	0.30	OC140	0.40
2N3906	0.30	BC147	0.20	OC141	0.60
2S002	1.00	BC148	0.15	OC170	0.25
2S004	1.00	BC149	0.15	OC171	0.25

SYNCHROSCOPE TYPE C1-5



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

PRICE **£39.00.** Packing and carriage 1.50

MINIATURE 1-IN CATHODE RAY TUBE TYPE DH3-91—1CP1—1CP31

63v heater. Anode voltage 500v. Sensitivity Y plates 45v/cm; X plates 52v/cm (typical) Y plates suitable for assymmetrical deflection. Green face, medium persistence.

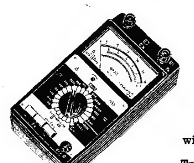
PRICE **£6.0.0** p.p. 0.25

SOLID STATE LIGHT EMITTING DIODES MV10B

T018 outline. Brightness 500 FT-L at 50mA. Forward voltage 1·65 to 2V. Diode gives bright red pinpoint of light when supplied from a 2V source. Lens diameter 0·170in. PRICE **£1.05**

OUR NEW 1970/1971 CATALOGUE IS NOW READY AND AVAILABLE FREE OF CHARGE. PLEASE SEND QUARTO STAMPED AND ADDRESSED ENVELOPE FOR THIS VALUABLE SOURCE OF REFERENCE LISTING MANY THOUSAND TYPES OF VALVES, SEMICONDUCTORS, TUBES ETC.

TWO NEW MULTIMETERS FROM RUSSIA



Type U4312 U4313

with AC current ranges

Type U4312—Low sensitivity instrument (667 o.p.v.) 1% accuracy on DC and 1·5% on AC. 9 current ranges on DC (300μA to 6A) and 8 current ranges on AC (1·5mA to 6A). 9 voltage ranges 0·3 to 900V AC/DC. Resistance 0·2 to 30k Ω. Mirror scale.

PRICE, complete with leads and steel carrying case **£9.75**

Type U4313—20,000 o.p.v. DC and 2,000 o.p.v. on AC. 8 DC current ranges 60μA to 1·5A. 6 AC current ranges 0·6 to 1·5A. 9 DC and AC voltage ranges 1·5–500V. Resistance ranges 0·5–500k Ω. Accuracy 1·5% DC and 2·5% AC. Mirror scale.
PRICE, complete with test leads and steel carrying case **£10.50**

MINIATURE CERAMIC CAPACITORS 25V WORKING

5% tolerance 22–27–33–39–47–56–68–82–100–120–150–180–220–270–330–390–470–560–680–820–1000pF
All at **20np** per twenty.
+50%–20% tolerance 1500–2200–3300–4700–6800–10,000–15,000 pF—All at **22np** per twenty.
+80%–20% tolerance 0.022–0.033–0.047 μF.
All at **28np** per twenty.
Minimum orders 20 of one size.

HALF WAVE SILICON WIRE ENDED RECTIFIERS

BY101	50 p.i.v.	1 Amp	**10np**
IN4002	100 p.i.v.	1 Amp	**10np**
BY125	200 p.i.v.	425mA	**13np**
IN4004	400 p.i.v.	1 Amp	**12np**
BY130	450 p.i.v.	800 mA	**10np**
BY127	600 p.i.v.	1 Amp	**15np**
IN4006	800 p.i.v.	1 Amp	**15np**
BY105	800 p.i.v.	1·1 Amp	**20np**

INTEGRATED MONOLITHIC DUAL OPERATIONAL AMPLIFIER MC1435P

Two identical amplifiers in 14-pin dual-in-line epoxy package. 400mW dissipation. Typical open loop voltage gain 7000. Max. differential input ± 5V. Power supplies 6 to 9V. Max. frequency 1 mc/s. **£2.00.**

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