PRACTICAL WIRELESS

AUGUST 1969

3/0

TRANSET

3-BAND PORTABLE RADIO

also inside

VERSATILE INTERCOM SYSTEM

Train for tomorrow's world in Radio and Television at The Pembridge College of Electronics.

The next full time 16 month College Diploma Course which gives a thorough fundamental training for radio and television engineers, starts on 3rd September 1969.

The Course includes theoretical and practical instruction on Colour Television receivers and is recognised by the Radio Trades Examination Board for the Radio and Television Servicing Certificate examinations. College Diplomas are awarded to successful students.

The way to get ahead in this fast growing industry —an industry that gives you many far-reaching opportunities—is to enrol now with the world famous Pembridge College. Minimum entrance requirements: 'O' Level, Senior Cambridge or equivalent in Mathematics and English.

To: The Pembridge College of Electronics (Dept. PW9), 34a Hereford Road, London, W.2

Please send, without obligation, details of the Full-time Course in Radio and Television.

NAME ....

ADDRESS ....

....

VALVES

SAME DAY SERVICE
NEW! TESTED! GUARANTEED!

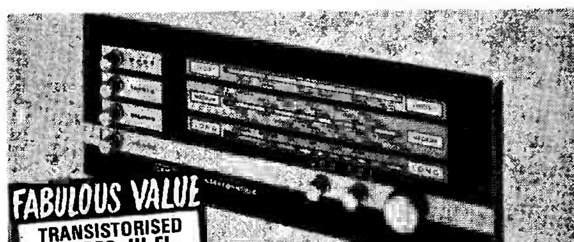
SETS 1R5, 1S5, 1T4, 3S4, 3V4, DAF91, DF91, DK91, DL92, DL94. Set of 4 for 18/6. DAF96, DF96, DK96, DL96, 4 for 26/6.

OZ4	4/6	20F2	13/6	DK96	7/-	EL34	9/6	PCL84	7/6	UBF89	6/9
1A7GT	7/6	20P3	11/9	DL35	5/-	EL41	10/6	PCL85	9/-	UC92	5/-
1H5GT	7/3	20P4	18/6	DL92	5/9	EL84	4/9	PCL86	8/-	UCC84	7/9
1N5GT	7/9	25L6GT	5/-	DL94	6/-	EL90	5/-	PENA4	12/6	UCC85	6/9
1R5	5/9	25U4GT	11/6	DL96	7/-	EL500	12/6	PEN36C	15/-	UCF80	8/3
1S5	4/3	30C1	6/6	DY86	5/9	EM80	5/9	PFL200	12/6	UCH42	9/9
1T4	2/9	30C15	13/-	DY87	5/9	EM81	6/9	PL36	9/9	UCH81	6/9
3S4	5/9	30C17	16/-	EABC80	6/6	EM84	6/6	PL81	7/3	UCL82	7/3
3V4	6/-	30C18	11/6	EAF42	8/9	EM87	7/6	PL82	7/-	UCL83	11/6
5U4G	4/6	30F5	16/-	EB91	2/3	EY51	7/3	PL83	7/-	UF41	10/6
5Y3GT	5/9	30FL1	13/9	EBC33	8/-	EY86	6/6	PL84	6/6	UF85	6/9
5Z4G	7/6	30FL12	14/6	EBC41	9/9	EZ40	7/6	PL500	13/-	UF89	6/9
6/30L2	12/-	30FL14	12/-	EBF80	6/9	EZ41	7/6	PL504	13/6	UL41	10/6
6AL5	2/3	30L1	6/6	EBF89	6/3	EZ80	4/6	PL508	23/6	UL44	20/-
6AM6	3/6	30L15	14/-	ECC81	4/9	EZ81	4/9	PL802	14/6	UL84	7/-
6AQ5	4/9	30L17	15/6	ECC82	4/9	GZ32	8/9	PM84	7/9	UM84	7/-
6AU6	4/6	30P4	12/-	ECC83	7/-	GZ34	9/9	PX25	10/6	UY41	7/6
6AT6	4/-	30P12	13/9	ECC84	5/6	KT61	8/9	PY31	5/6	UY85	5/9
6BA6	4/6	30P19	12/-	ECC85	5/9	KT66	16/-	PY32	10/-	VP4B	10/-
6BE6	4/9	30PL1	13/9	ECC804	12/-	ME1400	15/-	PY33	10/-	VP1321	21/-
6BJ6	7/-	30PL13	15/6	ECF80	7/-	N78	14/9	PY81	5/3	Z77	3/6
6BW6	13/-	30PL14	15/6	ECF82	5/9	PABC80	7/-	PY82	5/3	Transistors	
6F13	3/6	35L6GT	8/-	ECH35	6/-	PC86	10/3	PY83	5/9	AC107	3/6
6F14	9/-	35W4	4/6	ECH42	10/6	PC88	10/3	PY88	6/3	AC127	2/-
6F23	14/3	35Z4GT	5/-	ECH81	5/9	PC96	8/6	PY800	7/6	AD140	7/6
6K7G	2/6	6063	12/6	ECH84	7/6	PC97	8/6	PY801	6/9	AF115	3/-
6K8G	4/3	AC/VP2	10/-	ECL80	6/9	PC900	8/-	R19	6/6	AF116	3/-
6L18	6/-	AZ31	9/-	ECL82	6/9	PCC84	6/6	R20	12/6	AF117	3/3
6V6GT	6/6	B729	12/6	ECL83	9/-	PCC85	6/6	TH21C	9/9	AF124	7/6
6X4	4/3	CCH35	10/-	ECL86	8/3	PCC88	9/9	U25	13/-	AF125	3/6
6X5GT	5/9	CL33	18/6	EF37A	6/6	PCC89	10/6	U26	12/-	AF126	7/-
7B7	7/-	CY31	6/9	EF39	4/9	PCC189	11/6	U47	13/6	AF127	3/6
7C6	6/9	DAC32	7/3	EF41	10/9	PCF80	6/6	U49	13/6	OC26	5/9
7Y4	6/6	DAF91	4/3	EF80	4/9	PCF82	6/6	U52	4/6	OC44	2/3
10F1	14/-	DAF96	6/6	EF85	6/-	PCF86	9/6	U78	4/3	OC45	2/3
10P13	15/6	DF33	7/9	EF86	6/3	PCF200	13/6	U191	12/6	OC71	2/6
12AH8	33/-	DF91	2/9	EF89	5/3	PCF800	13/6	U801	19/6	OC72	2/6
12AT7	4/9	DF96	6/6	EF91	3/6	PCF801	6/9	UABC80	6/9	OC75	2/6
12AU6	4/9	DH77	4/-	EF94	4/6	PCF802	9/6	UAF42	9/6	OC81	2/3
12AU7	4/9	DH81	10/9	EF183	6/-	PCF805	11/6	UB41	6/6	OC81D	2/3
12AX7	4/9	DK32	7/6	EF184	5/6	PCF808	12/-	UBC41	8/6	OC82	2/3
12K8GT	7/-	DK91	5/9	EH90	6/3	PCL82	7/-	UBC81	7/-	OC82D	2/6
19BG6G	17/6	DK92	9/3	EL33	8/9	PCL83	9/-	UBF80	6/-	OC170	2/6

READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.



FABULOUS VALUE

TRANSISTORISED STEREO HI-FI RECORD PLAYER

Build your own Hi-Fi Record Player with the Serenade fully transistorised amplifier which comes complete with 2-10" x 6" speakers and the latest BSR 4 Speed Stereo/ Mono Record Changer.

Advanced solid state amplifier only 4½" deep, 14 transistors plus 4 diodes, separate Bass and Treble—10 watts total power. Frequency response 50-15,000 c/s.

EASY TO INSTALL
NO TECHNICAL KNOWLEDGE REQUIRED

Only **28** Gns. +P&P 17/6

H. P. terms available. Dep. £9.16.0 & 12 monthly payments of 36/9 (Total H.P. £31.17.0). Send £10.13.6 today. *Amplifier available separately at only* **17 Gns.**

FANTASTIC BARGAIN OFFER!

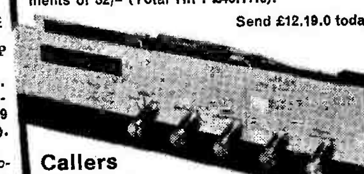
"TRANSCONTINENTAL" FULLY TRANSISTORISED STEREOPHONIC RADIOGRAM CHASSIS

Complete with 2-10" x 6" speakers and the latest BSR Mono/Stereo Record Changer—a complete radiogram at half normal price ONLY **34½** GNS. P&P 17/6

10 Watts Total output
17 Transistors & 10 diodes

EASILY FITTED NO TECHNICAL KNOWLEDGE NECESSARY
H.P. available £12.1.6 dep. plus 18 monthly payments of 32/- (Total H.P. £40.17.6).

Send £12.19.0 today



Callers Welcome

POST THIS COUPON NOW!

PLEASE SEND ME FREE DETAILS OF YOUR RANGE

Name ....

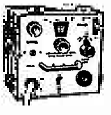
Address ....

LEWIS radio 100 CHASE SIDE, SOUTHGATE. Dep. P869 LONDON, N.14. TELEPHONE PAL 3733/9666

RACAL RA-17

First ministry release of these world famous communication receivers. Frequency range 500 kc/s–30 Mc/s. Available in excellent condition, fully tested and guaranteed. £150. Carr. 40/–.

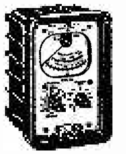
CLASS D WAVEMETERS



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. **£5.19.6.** Carr. 7/6. Or brand new with accessories. **£7.19.6.** Carr. 7/6.

CLASS D WAVEMETERS No. 2

Crystal controlled. 1·2–19 Mc/s. Mains or 12V. D.C. operation. Complete with calibration charts. Excellent condition. **£12.10.0.** Carr. 30/–.



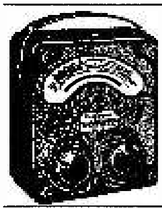
MARCONI CT/44/TF956

AF Absorption Wattmeter

1 μ/watt to 6 watts. **£20.** Carr. 10/-.

LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

Frequency 0–20 Kc/s. on 2 ranges. Output 500Ω or 5kΩ. Operation 200/250V. A.C. Supplied in perfect order. **£12.10.0.** Carr. 10/–.



AVOMETERS

Supplied in excellent condition, fully tested and checked. Complete with prods, leads and instructions. Model 47A **£9.19.6.** P. & P. 7/6.

SOLARTRON CD-1016 OSCILLOSCOPE

Double beam. D.C. To 5 Mc/s. Excellent condition. **£55** each. Carr. 20/–.

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. 20/-.

GEARED MAINS MOTORS

Paralux type SD19 230/250V. A.C. Reversible. 30 r.p.m. 40 lb./ins. Complete with capacitor. Excellent condition. **99/6.** Carr. 10/–.

SINCLAIR EQUIPMENT

Z12 12 watt amplifier, **89/6**
PZ4 Power Supply Unit **89/6**
Stereo 25 Preamp. **£9.19.6**
Q14 Speakers **£7.19.6**
Micromatic Radio Kit. 49/6. Built 59/6.
ALL POST PAID

SPECIAL OFFER

Two **Z12** Amps., **PZ4** Power Supply, **Stereo 25** Preamplifier, **£22,** or with two **Q14** speakers, **£37.**

NEW SINCLAIR 2000 SYSTEM

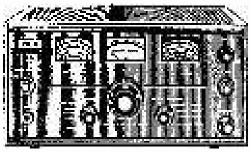
35 watt Integrated Amplifier, **£29.** Carr. 5/-. Self-powered FM Tuner, **£25.** Carr. 5/-.

ECHO HS-606 STEREO HEADPHONES

Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25-17,000 cps. 8 ohm imp. **67/6** P. & P. 2/6.

UNR-30 4-BAND COMMUNICATION RECEIVER

Covering 550 Kc/s–30 Mc/s. Incorporates BFO. Built in speaker and phone jack. Metal cabinet. Operation 220/240V. A.C. Supplied brand new, guaranteed with instructions. Carr. 7/6 **13 gns.**



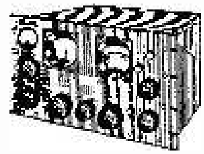
TRIO COMMUNICATION RECEIVER MODEL 9R-59DE

4 band receiver covering 550 Kc/s to 30 Mc/s. continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW ● ANL ● Variable BFO ● S meter ● Sep. bandspread dial ● IF 455 Kc/s ● Audio output 1·5 W. ● Variable RF and AF gain controls. 115/250V. A.C. Mains. Beautifully designed. Size: 7 × 15 × 10in. With instruction manual and service data. **£42.10.0,** carriage paid. **TRIO COMMUNICATION TYPE HEADPHONES.** Normally £5.19.6. OUR PRICE **£3.15.0** if purchased with above receiver.

TRIO JR-500SE 10–80 METRE AMATEUR COMMUNICATION RECEIVER IN STOCK **£69.10.0. Carr. paid.**

SPECIAL BONUS OFFER! TRIO SP5D Matching Speaker Mate and TRIO HS4 Communication Headphones Normal Value £10.7.0., FREE OF CHARGE with every JR.500SE purchased.

HAMMARLUND SP600JX COMMUNICATION RECEIVER

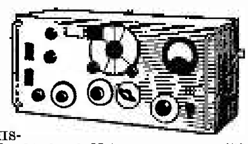


High quality professional dual conversion communication receivers available for the first time in this country at a reasonable price. Frequency range 540 Kc/s–54 Mc/s. in 6 bands variable tuning or 6 channel crystal controlled. 2·5 watt output into 600 ohms. Input 110/230V. A.C. 20 valve circuit incorporating: Xtal filter B.F.O. A.N.L. Xtal calibrator, S meter etc. Size 19 × 12 × 22in. (List £520). Offered in excellent condition, fully tested and checked. **£100** each.

LAFAYETTE LA-224T TRANSISTOR STEREO AMPLIFIER

19 transistors, 8 diodes, IHF music power, 30W at 8Ω. Response 30–20,000 ± 2dB at 1W. Distortion 1% or less. Inputs 3mV and 250mV. Output 3–16Ω. Separate L and R. volume controls. Treble and bass control. Stereo phone jack. Brushed aluminium, gold anodised extruded front panel with complementary metal case. Size 10¾ × 3 9/16 × 7 13/16in. Operation 115/230V. A.C. **£28.** Carriage 7/6.

MARCONI TEST EQUIPMENT



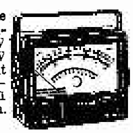
EX-MILITARY RECONDITIONED. TF.144G STANDARD SIGNAL GENERATORS, 85 Kc/s–25 Mc/s, **£25.** Carr. 30/–. TF.885 VIDEO OSCILLATOR 0–5 Mc/s **£45** Carr. 30/–. TF.195M BEAT FREQUENCY OSCILLATOR 0–40 Kc/s. 200/250V. A.C. **£20** Carr. 30/–. TF.142E Distortion Factor Meter, **£20** Carr. 20/–. All above offered in excellent condition, fully tested and checked. TF.1100 VALVE VOLTMETER, Brand New, **£50.** TF.1267 TRANSMISSION TEST SET, Brand New, **£75.** TF.1371 Wide Band Millivolt Meter, Brand New. **£50.**

MULTIMETERS *for EVERY purpose!*

LAFAYETTE DE-LUXE 100KΩ/VOLT "LAB TESTER" Giant 6½in. scale. Built-in meter protection 0/·5/2·5/10/50/250/500/1,000V D.C. 0/3/10/50/250/500/1,000V A.C. 0/10/100μA/10/100/500mA/2·5/10A. 0/1K/10K/100K/10M/10MΩ. – 10 to 49·4dB **£18.18.0.** P. & P. 5/–.

TE-900 20,000Ω/VOLT GIANT MULTIMETER mirror scale and overload protection. 6in. full view meter. 2 colour scale. 0/2·5/10/250/1,000/5,000 v. A.C. 0/25/12·5/10/50/250/1,000/5,000v. D.C.0/50μA/110/100/500 mA/10 amp. D.C. 02K/200K/20 MEG. OHM. **£15.** P. & P. 5/-.

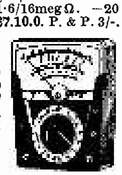
MODEL AS-100D. 100KΩ/VOLT. 5in. mirror scale. Built-in meter protection. 0/3/12/60/120/300/600/1,200v. D.C. 0/6/30/120/300/600v. A.C. 0/10μA/6/60/300mA/12 amp. 0/2K/200K/2M/200MΩ. –20 to +17dB. **£12.10.0.** P. & P. 3/6.



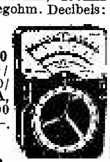
LAFAYETTE 57 Range Super 50kΩ/volt Multimeter. D.C. volts 12 mV –1000V. A.C. volts 1·5V –1000V D.C. current 25μA–10 amp Ohms 0–10megΩdB –20 to +81 dB. Overload protection. **£12.10.0.** Carr. 3/6.

MODEL TE-90 50,000 O.P.V. mirror scale overload protection 0/3/15/60/300/600/1200v. D.C. 0/6/30/120/300/1200v. D.C. ·03/6/60/600mA. D.C. 16K/160K/1·6/16megΩ. –20 to +63dB. **£7.10.0.** P. & P. 3/-.

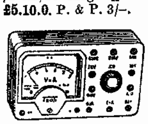
PROFESSIONAL 20,000 opv LAB. TYPE Multitester. Automatic overload protection, mirror scale. Ranges: 1/10/50/250/500/1,000 volts. D.C. and A.C. 0–500μA, 10mA, 250mA Current: 0/20K, 200K, 2 megohm. Decibels: –20 to +22dB. **£5.19.6.** P. & P. 2/6.



MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200v. D.C. 0/6/30/120/600/1,200v. A.C. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 Meg. Ω **£5.10.0.** P. & P. 3/–.



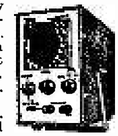
MODEL TE-80. 20,000 O.P.V. 0/10/50/100/500/1,000v A C 0/5/25/50/250/500/1,000v D C. 0–50μA, 5/50/500mA. 0/6K/60K/600 K/6meg. **£4.17.6.** P. & P. 3/–.



MODEL PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000v. A.C. and D.C. 0/1/100/500/mA. D.C 0/100KΩ. **39/6.** P. & P. 1/6.

MODEL TE-12 20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000v. D.C. 0/6/30/120/600/1,200v. A.C. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg.Ω 50pF. 0·2mFd. **£5.19.6.** P. & P. 3/6.

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 pF. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240V. a.c. Supplied brand new with handbook. **£22.10.0.** Carr. 10/–.

FIELD TELEPHONES TYPE L

Generator ringing, metal cases. Operates from two 1·5V batteries (not supplied). Excellent condition. **£4.10.0** per pair. Carr. 10/–.

TE-40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01/·003/·1/·3/1/3/10/30/100/300V. R.N.S. 4cps.-1·2 Mc/s. Decibels –40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V. A.C. **£17.10.0.** Carr. 5/-.

AUTO TRANSFORMERS

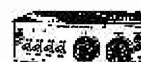
0/115/230V. Step up or step down. Fully shrouded.

150 W.	**£1.12.6.**	P. & P. 3/6.
300 W.	**£2. 7.6.**	P. & P. 3/6.
500 W.	**£3.10.0.**	P. & P. 6/6.
1,000 W.	**£5.10.0.**	P. & P. 7/6.
1,500 W.	**£6.10.0.**	P. & P. 8/6.
7,500 W.	**£15.10.0.**	P. & P. 20/–.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

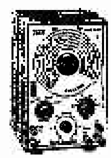
Sine: 20c/s to 200 Kc/s on 4 bands. Square: 20c/s to 30Kc/s. Output impedance 5,000 ohms. 200/250V. A.C. Supplied brand new and guaranteed with instruction manual and leads, **£16.10.0.** Carr. 7/6.

TE111. DECADE RESISTANCE ATTENUATOR



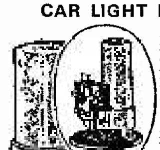
Variable range 0–111dB. Connections, Unbalanced T and Bridge T. Impedance 600Ω range (0·1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (–3dB). Accuracy: 0·05dB. +Indication dB × 0·01. Maximum input less than 4W (50V). Built in 600Ω load resistance with internal/external switch. Brand new **£27.10.0.** P. & P. 5/–.

TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 Kc/s–500 Mc/s on 6 bands. Directly calibrated. Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. **£15.** Carr. 7/6. Size 140 × 215 × 170 mm.

CAR LIGHT FLASHERS



Heavy duty light flasher employs a condenser discharge principle operating on electro mechanical relay. (As inset). Housed in strong plastic case. Flashing rate between 60-120 per minute. 12V DC operation. Maximum load 6 amps. Size 2-11/16in. dia. x 4in. Supplied brand new at a fraction of original cost. 6/6 each P. P. 2/6. (3 for 17/6 P. P. 4/6)

Full range of all components · valves semiconductors · test equipment receivers · hi-fi equipment · all at discount prices.

G. W. SMITH
& CO (RADIO) LTD.
Also see oppos. page

NEW CATALOGUE

Nearly 200 pages giving full details of a comprehensive range of COMPONENTS, TEST EQUIPMENT, COMMUNICATION EQUIPMENT AND HI-FI EQUIPMENT. Each section greatly enlarged and fully illustrated. Thousands of items many at bargain prices.

Free Discount Coupons Value 10/-

SEND NOW—ONLY 7/6 P. & P.

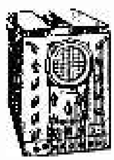
GARRARD

FULL CURRENT RANGE OFFERED BRAND NEW AND GUARANTEED AT FANTASTIC SAVINGS

SRP22 Mono	£6.10.0	*SP25 MK II	£11.19.6
SRP22 Stereo	£6.19.6	*SL55	£11.19.6
*1025 Mono	£7.10.0	A70 MK II	£12.10.0
*1025 Stereo	£7.15.0	*AT60 MK II	£13.10.0
*2025 Stereo	£7.19.6	*SL65	£14.14.0
*2025T/C		AP75	£19. 0.0
Mono/Stereo	£8.17.6	401	£28. 7.6
		SL75	£29. 0.0
*3000 Stereo	£9.19.6	SL95	£35. 0.0

Carriage/insurance 7/6 extra any model. WB4 Bases £3.19.6. Perspex covers £3.10.0. *Special offer base and cover available for these models at £4.15.0. Carr. 5/-. Full range of Garrard accessories available.

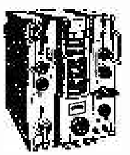
TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope. T.B. 2 cps–750 Kc/s. Bandwidth 5·5 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.

ADMIRALTY B.40 RECEIVERS

Released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s–30 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, band-pass filter, noise limiter, crystal controlled B.F.O., calibrator. O/F output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19½ × 13½ × 16in. Weight 114 lbs. Offered in good working condition. £22.10.0. Carr. 30/-. With circuit diagrams. Also available B.41 L.F. version of above. 15 Kc/s–700 Kc/s. £17.10.0. Carr. 30/-.



R209 MK II COMMUNICATION RECEIVER

11 valve high grade communication receiver suitable for tropical use. 1·20 Mc/s on 4 bands. AM/CW/FM operation. Incorporates precision vernier driver, B.F.O., aerial trimmer, internal speaker and 12v. D.C. internal power supply. Supplied in excellent condition, fully tested and checked £15.0.0. Carr. 20/-.

ADVANCE TEST EQUIPMENT

Brand new and boxed in original sealed cartons

VM. 76 VALVE VOLTMETER. R.F. measurements in excess of 100 Mc/s and D.C. measurements up to 100V with accuracy of +2% D.C. range 300 MV to 1 KV. A.C. range 300 MV to 300 V RMS. Resistance ·02–500 MΩ. Price £72.

VM.78 A.C. MILLIVOLT METER. Transistorised 1 MV–300 V. Frequency 1 c/s to 1 Mc/s. Price £55.

VM.79 UHF MILLIVOLT METER. Transistorised. A.C. range 10 MV–3 V. D.C. current range ·01µA–·3 MA. Resistance 1 ohm–10 megohms. Price £125.

H1B AUDIO SIGNAL GENERATOR. 15 c/s–50 Kc/s. sine or square wave. Price £30.

J1B AUDIO SIGNAL GENERATOR. 15 c/s–50 Kc/s. Price £30.

J2B AUDIO SIGNAL GENERATOR. As per J1B except fitted with output meter. Price £35.

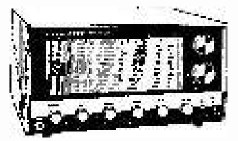
TT1S TRANSISTOR TESTER. £37.10.0.

Carriage 10/- per item.

SOLARTRON MONITOR OSCILLOSCOPE TYPE 101

An extremely high quality oscilloscope with time base of 10µ/sec to 20m/sec. Internal Y amplifier. Separate mains power supply 200/250v. Supplied in excellent condition with cables, probe, etc., as received from Ministry. £8.19.6, carriage 30/-.

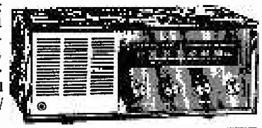
LAFAYETTE SOLID STATE HA600 RECEIVER



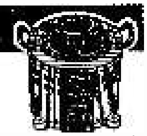
5 BAND AM/CW/SSB AMATEUR AND SHORT WAVE 150 Kc/s–400 Kc/s and 550 Kc/s–30 Mc/s F E T front end ● 2 mechanical filters ● Huge dial ● Product detector ● Crystal calibrator ● Variable BFO ● Noise limiter ● S meter ● 24in Bandspread ● 230V. A.C./12V. D.C. neg. earth operation ● RF gain control. Size 15in. × 9¾in. × 8¼in. Weight 18 lbs. EXCEPTIONAL VALUE. £45. Carr. 10/-. S.A.E. for full details.

LAFAYETTE PF-60 SOLID STATE VHF FM RECEIVER

A completely new transistorised receiver covering 152–174 Mc/s. Fully tunable or crystal controlled (not supplied) for fixed frequency operation. Incorporates 4 INTEGRATED CIRCUITS. Built in speaker and illuminated dial. Squelch and volume controls. Tape recorder output. 75 Ω aerial input. Headphone jack. Operation 230V. A.C./12V. D.C. Neg. earth. £37.10.0. Carr. 10/-.

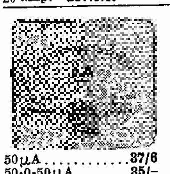


Variable Voltage TRANSFORMERS



Brand new, guaranteed and carriage paid.
High quality construction. Input 230V. 50–60 cycles.
Output full variable from 0·260 volts. Bulk quantities available.
1 amp.—£5.10.0; 2·5 amp.—£6.15.0; 5 amp.—£9.15.0;
8 amp.—£14.10.0; 10 amp.—£18.10.0; 12 amp.—£21.0.0;
20 amp.—£37.0.0.

CLEAR PLASTIC PANEL METERS

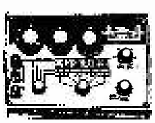


First grade quality Moving Coil panel meters available ex-stock. S.A.E. for illustrated leaflet. Discounts for quantity. Type MR 38P. 1 21/32in. square fronts.

50µA 37/6	500-0-500µA 25/-	50mA 25/-	150V. D.C. ..25/-
50-0-50µA 35/-	1mA 25/-	100mA 25/-	300V. D.C. ..25/-
100µA 35/-	1-0-1mA 25/-	150mA 25/-	500V. D.C. ..25/-
100-0-100µA 32/6	2mA 25/-	200mA 25/-	750V. D.C. ..25/-
200µA 32/6	5mA 25/-	300mA 25/-	15V. A.C. ...25/-
500µA 39/6	10mA 25/-	500mA 25/-	50V. A.C. ...25/-
	750mA 25/-	3V. D.C. 25/-	150V. A.C. ..25/-
	1 amp 25/-	10V. D.C. ...25/-	300V. A.C. ..25/-
	2 amp 25/-	20V. D.C. ...25/-	500V. A.C. ..25/-
	5 amp 25/-	100V. D.C. ..25/-	S meter 1mA 29/6
	20mA 25/-		VU meter ..38/6

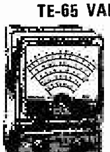
Postage Extra. Larger sizes available—send for lists.

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 megΩ 6 Ranges ±1%. L.1 µH – 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. 5/-.

TE-65 VALVE VOLTMETER



High quality instrument with 28 ranges. D.C. volts 1·5—1,500v. A.C. volts 1·5—1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions. £17.10.0. P. & P. 6/-. Additional probes available: R.F. 35/-. H.V. 42/6.

AMERICAN TAPE

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

3in. 225ft. L.P. acetate	3/6
3¼in. 600ft. T.P. mylar	10/-
5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/-
5in. 1,200ft. D.P. mylar	15/-
5¾in. 1,200ft. L.P. acetate	12/6
5¾in. 1,200ft. L.P. mylar	16/-
5¾in. 1,800ft. D.P. mylar	32/6
5¾in. 2,400ft. T.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/-
7in. 1,800ft. L.P. mylar	20/-
7in. 2,400ft. D.P. mylar	25/-
7in. 3,600ft. T.P. mylar	45/-

Postage 2/-. Over £3 post paid.

COMPUTER TAPE. Very little used, excellent condition. 2,400ft. x ½in. 19/6 reel, P. & P. 5/-.

RECORDING HEADS

Reuter ½-track. As fitted to Collaro Mk. IV and Studio Decks. High imp. record playback, low imp. erase. Lower track only. Brand new. 19/6 pair.

COSMOCORD ½-track heads. High imp. record/playback 65/-. Low imp. erase 20/-.

MARRIOTT ½-track heads. High imp. record/playback 65/-. Low imp. erase 20/-. Post extra.

★ TRANSISTORISED FM TUNER ★

6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88–108Mc/s Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiplex adaptors 99/6.

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. £6.19.6. P. & P. 3/6.

TE-16A Transistorised Signal Generator. 5 ranges 400kHz–30mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¼ × 3½in. Complete with instructions and leads. £7.19.6. P. & P. 4/-.

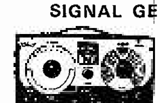
MODEL ZQM TRANSISTOR CHECKER

It has the fullest capacity for checking on A, B and Ico. Equally adaptable for checking diodes, etc. Spec.: A: 0·7–0·9967. B: 5–200. Ico: 0–50 microamps 0–5mA. Resistance for diode 200Ω–1MΩ. Supplied complete with instructions, battery and lead. £5.19.6. P. & P. 2/6

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s–260 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator. Operation 200/240v. A.C. Brand new with instructions. £15.0.0. P. & P. 7/6, S.A.E. for details.

ARF-100 COMBINED AF-RD SIGNAL GENERATOR



A.F. SINE WAVE 20–200,000 c/s. Square wave 20–30,000 c/s. O/P. **HIGH IMP. 21V.** P/P600Ω 3·8V. P/P. TF 100 Kc/s–300 Mc/s. Variable R.F. attenuation int/ext. modulation. Incorporates dual purpose meter to monitor AF output and % mod. on R.F. 220/240V. A.C £30.0.0. Carr. 7/6.

LAFAYETTE TE-46 RESISTANCE CAPACITY ANALYSER

2 pF-2000 mFd 2 ohms 200 megohms. Also checks impedance, turns ratio, insulation, 200/250V. A.C. Brand New £17.10.0 Carr. 7/6.

NOW OPEN IN EDGWARE ROAD

Our new walk around shop is now open at 311 Edgware Road fully stocked with all Hi-Fi, Communication and Test Equipment. *Call into your nearest shop—Edgware Road for all Equipment—Lisle Street for all Equipment and Components.*

G.W. SMITH & CO (RADIO) LIMITED

3 and 34, LISLE STREET, 01-437 8204
LEICESTER SQ., LONDON, W.C.2 01-437 9155
311, EDGWARE RD., LONDON, W.2 01-262 0387
(ALL MAIL ORDERS TO:— 3, LISLE STREET, LEICESTER SQUARE, LONDON, W.C.2)

OPEN 9 a.m. to 6 p.m. every day Monday to Saturday (Edgware Road ½ day Thurs.) Trade supplied.

F.A.L. Phase 32

You must hear this superb unit

15 + 15 WATT HIGH FIDELITY OUTPUT

SOLID STATE STEREO AMPLIFIER

Recommended Retail Price ONLY **35** Gns.

★ ***Excellent performance***
★ ***High grade components and transistors***
★ ***Impressive technical specification***
★ ***Attractive appearance***
★ ***Modest cost***

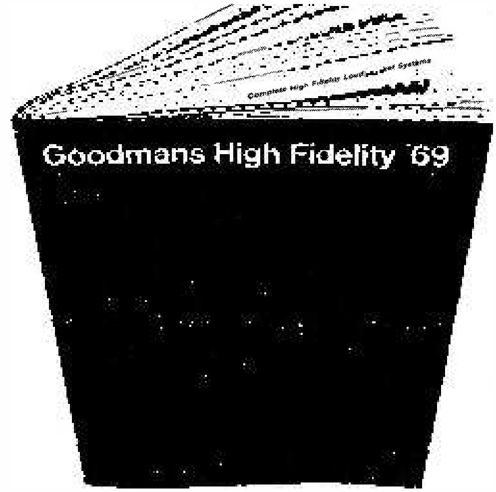
Housed in Teak veneered Cabinet, Switched selection of Mic., Magnetic P.U., Ceramic P.U., Radio Tuner, Tape Recorder.

SEND S.A.E. FOR FULLY DESCRIPTIVE LEAFLET

Available from your local Hi-Fi Dealer

Wholesale and Retail enquiries to Manufacturers

FUTURISTIC AIDS LTD, 103 Henconner Lane, Leeds 13



New Edition–Now Out

Thinking of High Fidelity—first read Goodmans 28 page High Fidelity Manual. It contains interesting articles on Stereo; an Introduction to High Fidelity; Stage-built systems; as well as full details of Goodmans High Fidelity audio products.

Send for your free copy

Please send me a free copy of Goodmans Manual

Name______________________________

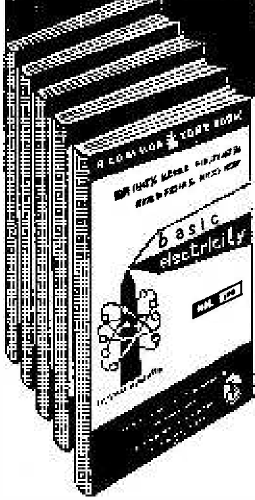
Address______________________________

PW8

Goodmans Loudspeakers Limited

Axiom Works, Wembley, Middlesex. Tel: 01-902 1200

YOURS FREE FOR 7 DAYS



The 'New Picture-Book' way of learning

BASIC ELECTRICITY (5 VOLS.) ELECTRONICS (6 VOLS.)

You'll find it easy to learn with this outstandingly successful NEW PICTORIAL METHOD—the essential facts are explained in the simplest language, one at a time, and each is illustrated by an accurate, cartoon-type drawing. The books are based on the latest research into simplified learning techniques. This has proved that the PICTORIAL APPROACH to learning is the quickest and soundest way of gaining mastery over these subjects.

TO TRY IT, IS TO PROVE IT

This carefully planned series of manuals has proved a valuable course in training technicians in Electricity, Electronics, Radio and Telecommunications.

WHAT READERS SAY

'May I take this opportunity to thank you for such enlightening works and may I add, in terms, easily understood by the novice." L. W. M., Birmingham.

"I find that the new pictorial method is so easy to understand, and I will undoubtedly enjoy reading the following five volumes: thank you for a wonderful set of books." C. B., London.

"Please accept my admiration for producing a long felt want in the field of understanding Electronics." S. B. J., London.

"The easiest set of manuals it has been my pleasure to study." J. P. P., Taunton.

A TECH-PRESS PUBLICATION

POST NOW FOR THIS OFFER!!

To The SELRAY BOOK CO., 60 HAYES HILL, HAYES, BROMLEY, KENT BR2 7HP

Please send me WITHOUT OBLIGATION TO PURCHASE, one of the above sets on 7 DAYS FREE TRIAL, I will either return set, carriage paid, in good condition within 7 days or send the following amounts. BASIC ELECTRICITY 75/- Cash Price, or Down Payment of **20/-** followed by 3 fortnightly payments of **20/-** each. BASIC ELECTRONICS **90/-** Cash Price, or Down Payment of **20/-** followed by 4 fortnightly payments of **20/-** each. This offer applies to UNITED KINGDOM ONLY. Overseas customers cash with order, prices as above.

Tick Set required *(Only one set allowed on free trial)*

BASIC ELECTRICITY ☐ **BASIC ELECTRONICS** ☐

Prices include Postage and Packing.

Signature ....

(If under 21 signature required of parent or guardian)

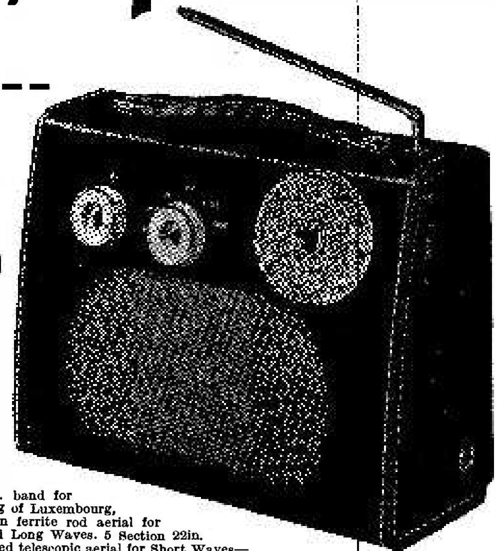
NAME ....
BLOCK LETTERS

FULL POSTAL ADDRESS ....

....

Build yourself a quality transistor radio

backed by our after sales service!



roamer seven mk IV

SEVEN WAVEBAND PORTABLE

SEVEN TUNABLE WAVEBANDS—
MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND.

Extra M.W. band for easier tuning of Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. 5 Section 22in. chrome plated telescopic aerial for Short Waves—can be angled and rotated for peak S.W. listening. Socket for Car Aerial. Powerful push pull output. 7 transistors and 2 diodes including Micro-Alloy R.F. Transistors. Famous make 7 x 4in. P.M. speaker for rich-tone volume. Air spaced ganged tuning condenser. Volume on/off control wave change switches and tuning control. Attractive case with carrying handle. Size 9 x 7 x 4in. approx. First grade components. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build.

Total building costs

£5.19.6 P. & P. 7/6

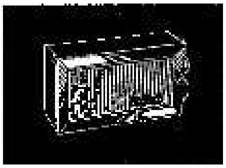
Personal Earpiece with switched socket for private listening 5/- extra.

Parts price list and easy build plans 3/- (Free with parts).

pocket five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive black and gold case. Size 5½ x 1½ x 3½in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. All first grade components—7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker, also Personal Earpiece with switched socket for private listening. Easy build plans and parts price list 1/6 (FREE with parts).



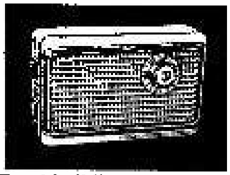
Total building costs

44/6 P. & P. 3/6

transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND (to 50 metres approx.) PORTABLE WITH SPEAKER AND EARPIECE

Attractive case with red speaker grille. Size 6½ x 4½in. x 1½in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker also Personal Earpiece with switched socket for private listening. All first grade components. Easy build plans and parts price list 1/6 (FREE with parts.)



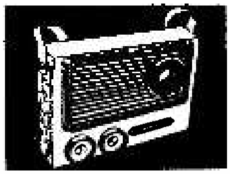
Total building costs

47/6 P. & P. 3/9

super seven

THREE WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case size 7½ x 5½ x 1½in. with gilt fittings. The ideal radio for home or outdoors. Covers Medium and Long Waves and Trawler Band. Special circuit incorporating 2 R.F. Stages, push pull output, ferrite rod aerial, 7 transistors and 2 diodes, 3in. speaker (will drive larger speaker) and all first grade components. Easy build plans and parts price list 2/- (FREE with parts). (Personal Earpiece with switched socket for private listening 5/- extra.)



Total building costs

69/6 P. & P. 4/6

roamer six

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case with gilt fittings. Size 7½ x 5½ x 1½in. Tunable on Medium and Long waves, two short waves, Trawler Band Plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short waves. All top grade components. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors etc. (Carrying strap 1/6 extra). Easy build plans and parts price list 2/-.

Total building costs

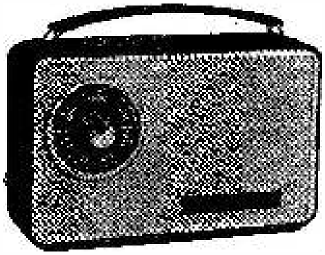
79/6 P. & P. 4/6

**** Callers side entrance Stylo Shoe Shop***

**** Open 10-1, 2.30-4.30 Mon-Fri. 9-12.30 Sat***

NEW LOOK melody six

TWO WAVEBAND PORTABLE



8 stages—6 transistors and 2 diodes. Covers Medium and Long Waves. Top quality 3½in. Loudspeaker for quality output and also with Personal Earpiece with switched socket for private listening. Two R.F. stages for extra boost. High "Q". Ferrite Rod Aerial. Push-pull output. Handsome pocket size case with gilt fittings. Size 6½ x 4 x 2in. Easy build plans and parts price list 2/- (FREE with parts).

Total building costs

69/6 P. & P. 4/3

RADIO EXCHANGE CO

61 HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £........................ please send items marked

ROAMER SEVEN	☐	ROAMER SIX	☐
TRANSONA FIVE	☐	SUPER SEVEN	☐
POCKET FIVE	☐	MELODY SIX	☐

Parts price list and plans for ....

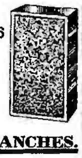
Name ....

Address ....

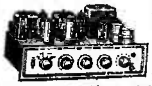
.... PW8

THE 'YORK' HIGH FIDELITY 3 SPEAKER SYSTEM

★ Moderate size, only 25 x 14 x 10in. Complete Kit **19½ Gns.**
★ Response 30-20,000 c.p.s. Impedance 15 ohms. Carr. 12/6
★ Performance comparable with units costing considerably more. Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range 'speaker. (4) High efficiency tweeter. (5) Measured weight of woollen acoustic damping material. (6) Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £5.10.6 and 9 monthly payments 39/- (Total £23.1.0). DEMONSTRATIONS AT ALL BRANCHES.



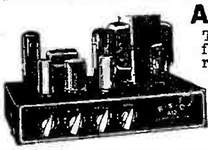
R.S.C. STEREO/20 HI-FI AMPLIFIER



PROVIDING 10/14 WATT ULTRA LINEAR PEAK PUSH-PULL OUTPUT ON EACH CHANNEL. SUITABLE FOR "MIKE", GRAM. RADIO OR TAPE. (7) valves ECC83, (2) ECL86, (4) EZ81. **Frequency Response:** ±2dB 30-20,000 c.p.s. **Hum Level:** 65dB down. **Sensitivity:** 30 millivolts max. **Harmonic Distortion:** 0·2% ★**Four-position tone compensation and Input Selector Switch.** ★**Stereo/Mono switch.** ★**Neon panel indicator.** ★**Handsome Perspex Frontplate.** ★**Separate Bass and Treble controls.** Output transformers are high quality sectionally wound. Outputs for 3 and 15 ohms speakers. Complete set of parts, point-to-point wiring diagrams and instructions. Or factory assembled with our usual 12 mths' gntee 19gns. Or Dep. £4.10.0 and 9 monthly payments £2 (Total £22.10.0). *Send S.A.E. for leaflet.*

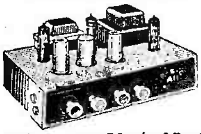
15 Gns. Carr. 12/6

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



Highly sensitive. Push-Pull high output, with Pre-amp./Tone Control Stages. Performance figures of factory built units: Hum level —70dB. Frequency response ±3dB 30-20,000c/s. Sectionally wound output transformer. All high grade components. Valves EF86, EF86, ECC83, 807, 807, GZ34. Separate Bass and Treble Controls. Sensitivity 36 mV. Suitable for high impedance microphones, Crystal or Ceramic P.U's. Designed for **Clubs, Schools, Theatres, Dance Halls** or **Outdoor Functions**, etc. For use with **Electronic Organ, Guitar, String Bass**, etc. Gram, Radio or Tape. Reserve L.T. and H.T. for **Radio Tuner.** Two inputs with associated volume controls so that two separate inputs such as Gram and "Mike" can be mixed. 200-250v. 50c/s A.C. mains. For 3 and 15 ohm speakers. Complete kit of parts with point-to-point wiring diagrams and instructions. Carr. 12/6 **14 Gns.** Twin-handled perforated cover 27/6. Supplied factory built with EL34 output valves. 12 months' guarantee for **17 gns. TERMS: Deposit £6** and 9 monthly payments of 32/- (Total £20.8.0). Send S.A.E. for leaflet.

R.S.C. A11 HIGH FIDELITY 12-14 WATT AMPLIFIER



PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP. Two input sockets with associated controls allowing mixing of "mike" and gram, etc, etc. High sensitivity. 5 valves—ECC83 (2), EL84 (2), EZ81. High quality sectionally wound output transformer. IND. BASS AND TREBLE CONTROLS. Frequency response ±3dB 30-20,000 c/s. Hum level —60dB. SENSITIVITY 40 millivolts. For Crystal or Ceramic PUs. High Impedance "mikes". For Musical Instruments such as String Bass, Electronic Guitars etc. Size approx. 12 x 9 x 7in. For AC mains 200-250v. 50 cps Output for 3 and 15 ohm spkrs. SAE for leaflet. Complete kit. **9 Gns.** Full instructions and point-to-point wiring diagrams. Carr 11/6 (or factory built 12 Gns.) Twin handled metal cover 27/6. TERMS ON ASSEMBLED UNITS. Deposit 97/6 and 9 monthly payments of 22/-. (Total £14.15.6).

RSC A11T TRANSISTORISED VERSION of above complete kit 9 Gns (Assembled 13 Gns)

R.S.C. BASS-REGENT 50 WATT AMPLIFIER

An exceptionally powerful high quality all-purpose unit for lead, rhythm, bass guitar, vocalists, gram, radio, tape. Peak O/P rating.
★ Two extra heavy duty 12in. Loudspeakers.
★ Four Jack inputs and two Volume Controls for simultaneous use of up to four pick-ups or "mikes". Bass and Treble controls.

52 Gns. Carr. 30/- or dep. £10.1.9 and 9 monthly payments of £5.11.9. (Total 57½ gns.). Send S.A.E. for leaflet.

G100 100 watt peak output with Pr. speaker columns and a Bass Unit (Six 12" and Two 15" Spkrs). 99½ gns

R.S.C. BATTERY/MAINS CONVERSION UNITS

Type BM1 An all-dry battery eliminator. Size 5½x4½x 2in. approx. Completely replaces batteries supplying 1·5v. and 90v. where A.C. mains 200/250v. 50c/s is available. Complete kit with diagram 49/11 or assembled 59/11.

SELENIUM RECTIFIERS | F.W. (Bridged)

All 6/12v. D.C. output. Max. A.C. input 18v. 1a. 4/3. 2a. 6/11. 3a. 9/9. 4a. 12/9. 6a. 15/9.

R.S.C. MAINS TRANSFORMERS

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

MIDGET CLAMPED TYPE 2½ x 2¼ x 2¼in.

250v., 60mA, 6·3v. 2a.	15/11
250-0-250v., 60mA 6·3v. 2a.	16/11

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250v. 60mA, 6·3v. 2a., 0-5-6·3v. 2a.	21/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	37/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	37/9
300-0-300v. 130mA, 6·3v. 4a., c.t., 6·3v. 1a. For Mullard 510 Amplifier	45/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	37/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	47/9
425-0-425v. 200mA, 6·3v. 4a., c.t., 5v. 3a.	69/9
425-0-425v. 200mA, 6·3v. 4a., 6·3v. 3a., 5v. 3a.	75/-
450-0-450v. 250mA, 6·3v. 4a., c.t., 5v. 3a.	87/9

TOP SHROUDED DROP-THROUGH TYPE

250-0-250v. 70mA, 6·3v. 2a., 0-5-6·3v. 2a.	21/9
250-0-250v. 100mA, 6·3v. 3·5a.	25/9
250-0-250v. 100mA, 6·3v. 2a, 6·3v. 1a.	26/9
350-0-350v. 80mA, 6·3v. 2a., 0-5-6·3v. 2a.	27/9
250-0-250v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	37/9
300-0-300v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	37/9
300-0-300v. 130mA, 6·3v. 4a., 0-5-6·3v. 1a. Suitable for Mullard 510 Amplifier	44/9
350-0-350v. 100mA, 6·3v. 4a., 0-5-6·3v. 3a.	37/9
350-0-350v. 150mA, 6·3v. 4a., 0-5-6·3v. 3a.	45/11

FILAMENT or TRANSISTOR POWER PACK Types 6·3v. 1·5a. 7/9; 6·3v. 2a. 8/9; 6·3v. 3a. 10/9; 6·3v. 6a. 21/9; 12v. 1a. 8/9; 12v. 3a. or 24v. 1·5a. 21/9; 0-9-18v. 1½a. 17/9; 0-12-25-42v. 2a. 29/9.

CHARGER TRANSFORMERS 0-9-15v. 1½a. 14/11; 2½a. 17/9; 3a. 19/11; 5a. 23/9; 6a. 27/9; 8a. 33/9.

AUTO (Step UP/step DOWN) TRANSFORMERS

0-110/120v. 200-230-250v. ......50-80 watts	15/9
150 watts, 29/11; 250 watts 49/9; 500 watts	99/9

OUTPUT TRANSFORMERS

Standard Pentode 5,000 Ω or 7,000 Ω to 3 Ω	8/9
Push-Pull 8 watts EL84 to 3 Ω or 15 Ω	12/9
Push-Pull 10 watts 6V6 ECL86 to 3, 5, 8 or 15 Ω	22/9
Push-Pull EL84 to 3 or 15 Ω 10-12 watts	21/9
Push-Pull Ultra Linear for Mullard 510, etc.	39/9
Push-Pull 15-18 watts, sectionally wound 6L6, KT66, etc., for 3 or 15 Ω	35/9
Push-Pull 20 watt high quality sectionally wound EL34, 6L6, KT66 etc. to 3 or 15 Ω	59/9

SMOOTHING CHOKES 150mA, 7-10H, 250 Ω 12/9; 100mA, 10H, 200 Ω 10/9; 80mA, 10H, 350 Ω 8/9; 60mA, 10H, 400 Ω 4/11.

BLACKPOOL

AGENT APPOINTED O. & C. ELECTRONICS 227 CHURCH ST.

R·S·C HI-FI CENTRES LTD.

R.S.C. COLUMN SPEAKERS

Covered in two-tone Rexine/Vynair, ideal for vocalists and Public Address, 15 ohm matching. **C57 15 watts** inc. five 7 x 4in. speakers £7.19.11.
TYPE C48S 30 WATTS. Fitted four 8in. high flux 8 watt speakers. Overall size approx. 42 x 10 x 5in. Or deposit 67/- and 9 mthly pmts 34/9 (Total £18.19.9) Carr. 10/-. **16 Gns.**
TYPE C412S, 50 WATTS. Fitted four 12in 11,000 line 15 watt speakers. Overall size 56 x 14 x 9in. approx. Carr. 15/-. **24 Gns.** Or Deposit £4.13.6 and 9 monthly payments of 52/6 (Total £28.5.0).

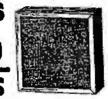
30 WATT HI-FI AMPLIFIER

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 perspex facia. Neon indicator. For 200-250v. A.C. mains. For 3 or 15 ohm speakers. Send S.A.E. for leaflet. Deposit 4 gns. and 9 mthly payments of 39/8 (Total 21 gns). **18 Gns.** Carr. 12/6

F.A.L. 'Phase Fifty' PUBLIC ADDRESS AMPLIFIER

Solid State Circuitry. 50 Watts Peak Output. 3 separately controlled inputs for mixing purposes. Separate Bass and Treble Controls. Output for loudspeakers 3—30 ohms. Suitable for Dynamic, Ribbon or Crystal Mikes. For Clubs, Theatres, Restaurants, Hotels, Schools, etc. For Vocal or Instrumental Groups. Send S.A.E. for leaflet. only **29 Gns.**

12in. HIGH QUALITY LOUDSPEAKERS



In Teak or Afrormosia veneered Cabinets
15 Watt 11,000 lines 3 or 15 ohms. Carr 7/6 **£5.15.0**
20 Watt 10,000 lines 15 ohms. Carr 8/9 **£8.19.9**

FANE ULTRA HIGH POWER LOUDSPEAKERS

All power ratings are R.M.S. continuous. 2 year guarantee. High Flux 14,000 line ceramic magnets. Heavy cast chassis.

'POP' 100	'POP' 60	'POP' 50
18" 100 Watt	15" 60 Watt	12" 50 Watt
19 GNS. Carr. 15/-	**12** GNS. Carr. free	**10** GNS. Carr. free

POWER PACK KIT

Consisting of Mains transformer, Metal Rectifier, Electrolytics, smoothing choke, chassis and circuit. 200/250v. A.C. mains. Output 250v. 60mA 6·3v. 2a. Supplied with case in lieu of chassis 29/11. Or assembled 39/11. **25/11**

CLEARANCE LINES

15" 40 WATT LOUDSPEAKERS IN CABINET 14 Gns

Heavy construction. Covering Rexine and Vynair

14 WATT HI-FI AMPLIFIERS

High sensitivity. Two separate inputs. Two vol. controls for mixing purposes. Separate Bass and Treble Controls. Valves ECC83, ECL86, ECL86, EZ80. Output for 15 ohm Loudspeaker. 200-250v 50 c.p.s. A.C. mains operation. Size approx. 8 x 8 x 6in. Factory built and fully guaranteed. Limited number to clear at **£7-19-11** Carr. 10/-

EXTENSION 'SPEAKERS 29/9

Cabinet size 12 x 8 x 5in. approx. attractive grey lizard skin finish. Fitted high flux 5 watt 3 ohm speaker.

EMI PLAYER TURNTABLES

with P.U. 4 speed. Turnover cartridge. Limited number.
Mono **59/9** Stereo **69/9**

PHONE AMPLIFIERS

Speak and listen with both hands free. Standard dry battery operated. Attractive black moulded case. **59/9**

1 WATT TRANSISTOR AMPLIFIERS

for 3-5 ohm loudspeakers. Miniature size. Brand new boxed. Post free **37/9**

PRINTED CIRCUIT KITS

for making printed circuits. **12/9**
Complete with 72 square ins. laminated board and necessary fluids. Post 2/9

J.B. VHF/FM DIAL & DRIVE ASSEMBLIES

ONLY **9/9**
Complete with escutcheon. Size 7" x 4¼". Escutcheon 7½" x 2¾". Post 2/9

TAPE RECORD/PLAYBACK AMPLIFIERS

4 watts output. Magic Eye Recording level indicator. For 3 ohm L/S. All normal facilities. Less Facia plate. For 200/250 A.C. mains. Carr 8/6. **£8.15.0**

ARMSTRONG UNITS CLEARANCE

Stereo Amplifier 222 Our Price **£25** Carr. 10/6
AM/FM Tuner Amplifier 227M Our Price **£35** Carr. 10/6

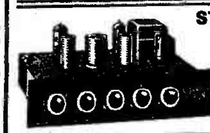
MINI-8 HI-FI LOUDSPEAKER UNITS

Teak or Afrormosia veneered cabinet, size approx. 10¾ x 6¾ x 7½in. Peak power handling 8 watts 3 ohms. Carr. 5/-. Clearance Price **59/11**

JASON VHF/FM TUNER DESIGNS

Total cost of parts FMT1 **5 Gns.** FMT2 **£6.19.11.** JTV2 **9½ Gns.** Please state channel

STEREO/TEN HIGH QUALITY AMPLIFIER



5 watts high quality peak output on each channel Sensitivity 50 millivolts. Suitable all crystal or ceramic stereo cartridges. Ganged Bass and Treble Controls. Valves ECC83 (2), EL84 (2), EZ81. For 2-3 ohm speakers. Assembled with 12 months' guarantee Carr. 7/9 **£11.19.6**

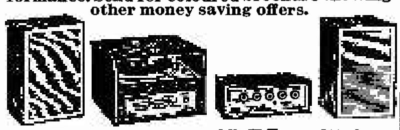
6/12V CAR BATTERY CHARGERS

Complete kit of parts with Ammeter and Circuit. Both models with variable charge rate selector.
4 amp 49/9 **6 amp 69/9**
All types 200-250v. A.C. Mains. Built 10/- extra.

R.S.C. SENSATIONAL HIGH FIDELITY STEREO PACKAGE OFFERS

"PACKAGE 3" 30 WATT OUTPUT
★ Goldring Transcription Turntable on Plinth
★ Shure or Goldring Magnetic Pick-up Cartridge
★ Super 30 Amplifier in veneered housing **86 Gns.**
★ Pair of Stanton Loudspeaker Units
Special total price. Four fully wired units ready to "plug-in". Carr. 25/-.
TERMS AVAILABLE ALL PACKAGE OFFERS

Matching as recommended for optimum performance. Send for coloured brochure showing other money saving offers.



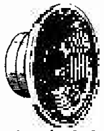
Illustrated with TFMI Mk II Tuner fitted

EXTREMELY ATTRACTIVE AND VERSATILE PLINTHS finished in Teak or Afrormosia veneer. Tinted trans. plastic "roll over" cover with satin chrome handle.

"PACKAGE 2" 30 WATT OUTPUT
★ Garrard SP25 Mk II Turntable on Plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ Super 30 Amplifier in veneered housing
★ Pair Stanton Speaker Units **76 Gns.** Carr. 25/-
Special total price. Four fully wired units ready to "plug-in"

"PACKAGE 1" 13 WATT OUTPUT
★ Garrard SP25 Mk II 4 sp player unit on plinth
★ Goldring CS90 Ceramic P.U. Cartridge
★ TA12 Amplifier in cabinet
★ Pair of Dorchester L'speaker Units. Special total price. **51 GNS.**
Or Dep. **£10** and 9 monthly payments **£5.11.0.** (Total **£59.19.0.**) Transparent plastic cover **3gns.** extra.

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS



Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround giving low fundamental resonance. "D" indicates Tweeter Cone providing extended frequency range 40–15,000 c.p.s. Impedance 3 or 15 ohms. **Please state choice.** Exceptional performance at low cost.

Prices include carriage.

HF510L	5"	10W	57/9	**HF100D**	10"	15W	£5.15.0
HF801D	8"	8W	58/9	**HF120**	12"	15W	69/9
HF811D	8"	10W	4 gns.	**HF120D**	12"	15W	79/9
HF102D	10"	8W	59/9	**HF126**	12"	15W	89/9
				HF126D	12"	15W	5 gns.

HIGH FIDELITY LOUDSPEAKER UNITS

Cabinets latest style Satin Teak or Afrormosia veneer. Acoustically lined or filled woollen damping. Ported where appropriate, credit terms available

DORCHESTER Size 16 x 11 x 9in. Appr. Range 45–15,000 c.p.s. Rating 8–10 watts. Fitted High flux 13 x 8in. Dual Cone spkr. Imp. 3 or 15 ohms **£8.19.9** Carr. 7/6

STANTON IIIS Size 18x11x10in. Rating 10 watts. Incorporating Fane 803b speaker with roll rubber cone surround and 15,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 30–20,000 c.p.s. Impedance 15 ohms. Gives smooth realistic sound output. **16 Gns.** Carr. 7/6

GLOUCESTER Size 25 x 16 x 10in. 12in. High flux 12,000 line speaker. Cross-over unit and Tweeter. Rating 10 watts. Frequency range 40–20,000 c.p.s. Impedance 15 ohms. **12½ Gns.**

E2 EQUIPMENT CABINET

Size 17" wide 14¼" deep 11¼" high. Cut for TA12, Super 15, Super 30 and other amplifiers. 'Roll over' trans. plastic cover. Satin Teak or Afrormosia veneer finish. Inc. carr. **8 Gns.**

MOTOR BOARDS cut for Garrard Turntables and many other units. Price **12/9**

RECORD PLAYING UNITS

Money saving units. Ready to plug into Amplifier or Tape Recorder. Consisting of Garrard SP25 Mk II (with heavy turntable) fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. Mounted on Plinth. Inc. trans. plastic cover. Inc. Carr. **RP2** **22Gns.**

RP3 As above but with Goldring Lenco GL68 Transcription unit and CS90 Cartridge. Supplied with trans. plastic cover. Inc. Carr. **28Gns.**

R.S.C. PLINTHS

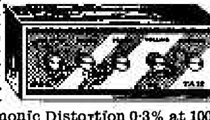
for Record Playing units. Teak finish cut for Garrard 1000. 2000. 3000, AT6, AT60, SP25 etc., etc. Available with trans. plastic cover. Inc. Carr. **59/9** **6 Gns.**
Cover sold separately at 3 Gns. Limited number of covers slightly damaged but repaired by makers. **39/9**

10 W HIGH FIDELITY AMPLIFIERS

LINEAR L10 Separate Pre-amp and Main Amp. Matched to Magnetic P.U. **To clear** **10 GNS.**

R.S.C. TA12 13 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. 'Mike' 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 30–20,000 c.p.s. —2dB ★ Harmonic Distortion 0·3% at 1000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 300mV (2) 50mV (3) 100mV (4) 2mV Output rating I.H.F.M. ★ Handsome brushed silver finish Facia and Knobs. Complete kit of parts with full wiring diagrams & instructions. Factory built with 12 mth gntee **16 GNS** or Deposit **£5.2.6** and 9 mthly pymts **31/6** (Total **£19.6.0**) Or in Teak or Afrormosia veneer housing **19½ Gns.** Dep. £5.10.6 and 9 mthly pymts 39/-. (Total £23.1.6). **12½ GNS.** Carr. 7/9

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 12,000 line 10 watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **5 Gns.** Or **Senior 15 watt inc. HF 126** 15,000 line Speaker **6 Gns.** Carr. 6/6 Carr. 5/9

HI-FI SPEAKER ENCLOSURES

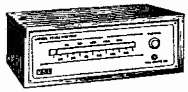
Teak or Afrormosia veneer finish. Modern design. Acoustically lined. Prices Inc. carr.
JE8 Size 16 x 11 x 9in. Pressurised. Gives pleasing results with any 8in. Hi-Fi 'speaker. **£4.10.0**
SE8 For optimum performance with any 8in. Hi-Fi 'speaker. Size 22 x 15 x 9in. Ported. **£5.10.0**
SE10 For outstanding results with 10in Hi-Fi 'spkr Size 23x15x10in. P'td. **£5.15.0**
SE12 For exclnt prfmnce with 12in Hi-Fi speaker and Tweeter. Size 25 x 16 x 10½in. **6 Gns.**

INTEREST CHARGES REFUNDED on Credit Sales settled in 3 months.

R.S.C. TA6 6 Watt HIGH FIDELITY 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. 9¾ x 2¾ x 5¼in. Attractive brushed silver finish facia plate 10½ x 3¼in. and matching knobs. Complete kit of parts with full wiring diagrams and instructions. Carr. 7/6 **£6.19.9**
Or factory built with 12 months guarantee. **£8.19.9**

R.S.C. TFM1 SOLID STATE VHF/FM RADIO TUNER

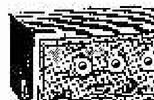


Total cost of parts with detailed wiring diagrams & instructions. Inc. Carr. **14Gns.** Or factory built **16½ gns.** Or in Teak finished cabinet as illustrated **19½ gns.** Terms: Deposit **£5** and 9 monthly payments **£2.** Total **£23.**

★ **High-sensitivity** ★ **200–250v. A.C. Mains operation.** ★ **Sharp A.M. Rejection.** ★ **Drift-free reception.** ★ **Output ample for any amplifier (approx. 500 m.v.).** ★ **Simple alignment instructions.** ★ **Output available for feeding tuning meter.** ★ **Output for feeding Stereo Multiplexer.** ★ **Tuner head using silicon Planar Transistors.** ★ **Designed for standard 80 ohm co-axial input.** Visually matching our Super 15 and 30 amplifiers and of the same high standard of performance and reliability. The pre-wired tuning head facilitates speed and simplicity of construction. Printed circuitry. Only high grade transistors and components used. A quality product at considerably less than the cost of comparable units. Stereo version, all parts **20 gns.** Inc. carr. Assembled **23½ gns.** inc. carr.

R.S.C. SUPER 15 HI-FI AMPLIFIER

SOLID STATE CONSTRUCTION
SPECIFICATIONS COMPARABLE WITH UNITS COSTING CONSIDERABLY MORE



FULLY TRANSISTORISED 200/250v. A.C. Mains.
OUTPUT 10 WATTS R.M.S. cont. into 15 ohms.
15 WATTS R.M.S. cont. into 3–4 ohms.
TRANSISTORS. 9 current types of high quality by leading manufacturers.
5 POSITION INPUT SELECTOR SWITCH
EQUALISATION to Standard R.I.A.A. and C.C.I.R. Characteristics for Gram and Tape Heads.
FULL TAPE MONITORING FACILITIES.
SENSITIVITIES: Magnetic P.U. 4 mV. Crystal or Ceramic P.U. 400 mV. Microphone 4.5 mV. Tape Head 2·5 mV. Radio/Aux or Ceramic P.U. 110 mV.
FREQUENCY RESPONSE: ±2dB 20–20,000 c.p.s.
TREBLE CONTROL: +15dB to —14dB at 10 Kc/s. **NEG FEEDBACK:** 52dB.
BASS CONTROL: +17dB to —15dB at 50 c/s. **HUM LEVEL:** —75dB.
HARMONIC DISTORTION at 10 Watts 1,000 c.p.s. 0·2%.
Complete Kit of parts with full constructional details and point to point wiring diagrams. Carr. 12/6 **12½Gns.**
Supplied factory built **15½ Gns.** Carr. 12/6. Terms: Deposit **4 Gns.** and 9 monthly payments **31/1** (Total **£18.3.9**). Or in Teak or Afrormosia veneer housing as illustrated. **19 Gns.**
ALL COMPONENTS ETC. ARE OF A HIGH STANDARD AND SUPPLIED BY LEADING MANUFACTURERS.

R.S.C. SUPER 30 STEREO AMPLIFIER

A DUAL CHANNEL VERSION OF THE SUPER 15. Employing Twin Printed Circuits. High quality Ganged Pots. Matched Components. **CROSS TALK:** —52dB at 1,000 c.p.s.
CONTROL: 5 position Input Selector. Bass Control. Treble Control. Volume Control. Balance Control. Stereo/Mono Switch. Tape Monitor Switch. Mains Switch. **INPUT SOCKETS** (Matched Pairs). (1) Magnetic P.U. (2) Ceramic or Crystal P.U. (3) Radio/Aux. (4) Tape Head/Microphone. Operation of the Input Selector Switch assures appropriate equalisation. Rigid 18 s.w.g. Chassis. Size approx. 12in. wide, 3in. high and 8in. deep. Neon Panel indicator. Attractive Facia Plate and Spun Silver Matching Knobs. Above facilities, etc., except for Ganging and Balance Control, apply also to Super 15.
THESE UNITS ARE EMINENTLY SUITABLE FOR USE WITH ANY MAKE OF PICK-UP OR MICROPHONE (Crystal, Ceramic, Magnetic, Moving Coil, Ribbon). CURRENTLY AVAILABLE SUPERB SOUND OUTPUT QUALITY CAN BE OBTAINED BY USING WITH FIRST RATE ANCILLARY EQUIPMENT. All required parts, point to point wiring diagrams and detailed instructions. Carr. 15/- **21 Gns.**
Unit factory built **28 Gns.** or deposit **£7.5.0** and 9 monthly payments **56/3.** (Total **£32.13.3**). Or in veneered housing **31 Gns.** Carr. 15/- or Deposit **£7.3.6** and 9 monthly paymts **64/-** (Total **£35.19.6**). *Send S.A.E. for leaflet.*

BRADFORD 10 North Parade. (Half-day Wed.) Tel. 25349
BLACKPOOL (Agent) O. & C. Electronics, 227 Church Street
BIRMINGHAM 30/31 Gt. Western Arcade opp. Snow Hill Station 021-236-1279 (Half-day Wed.)
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. Waverley 5766
GLASGOW 326 Argyle St. (Half-day Tues.) Tel. CITy 4158 403 Sauchiehall St. (Opp. Locarno) (Half-day Tues.) Tel. 332-1572
HULL 91 Paragon Street. (Half-day Thursday) Tel. 20505

R·S·C HI-FI CENTRES LTD.

MAIL ORDERS TO: 102 Henconner Lane, Bramley, Leeds 13. No C.O.D. under £1. Terms C.W.O. or C.O.D. Postage 4/6 extra under £2. 5/9 extra under £5. Trade supplied. S.A.E. with enquiries please. **Open all day Sats.**

Mail Orders must not be sent to shops

32 High Street. (Half-day Thurs.) Tel. 56420 **LEICESTER**
5-7 County (Mecca) Arcade, Briggate (Half-day Wed) Tel 28252 **LEEDS**
73 Dale St. (Half-day Wed.) Tel. CENtral 3573 **LIVERPOOL**
238 Edgware Road. W2 (Half-day Thurs.) Tel. PAD 1629 **LONDON**
60A Oldham Street (Half-day Wed.) Tel. CENtral 2778 **MANCHESTER**
106 Newport Rd (Half-day Wed) Tel. 47096 **MIDDLESBROUGH**
41 Blackett Street (Opp. Fenwicks Store) (Half-day Wed.) Tel. 21469 **NEWCASTLE UPON TYNE**
13 Exchange Street (Castle Market Bldgs.) (Half day Thursday) Tel. 20716 **SHEFFIELD**

COMET Hi-Fi DISCOUNT WAREHOUSE

- ALL ITEMS OFFERED ARE FULLY GUARANTEED AND BACKED BY COMET.
- OPENING HOURS: OPEN DAILY UNTIL 5.30 p.m. (8.0 p.m. THURS. AND FRI. EVENINGS) AND 5.0 p.m. SATURDAY.
- COMPLETE FREE PRICE LIST CONTAINING OVER 500 ITEMS ON REQUEST.

AMPLIFIERS	Rec. Retail Price	Comet Price
DULCI 207 Stereo Amplifier	£23 2 0	£18 0 0
DULCI 207M Stereo Amplifier takes magnetic P/U ..	£27 6 0	£21 19 0
DULCI 220 Princess	£44 2 0	£34 19 6
GOODMANS Maxamp ..	£54 0 0	£45 18 0
New LEAK Stereo 30 Plus..	£52 0 0	£44 0 0
New LEAK Stereo 30 Plus In teak case	£58 10 0	£48 14 0
New LEAK Stereo 70 ..	£63 0 0	£55 0 0
LINEAR LT.66 Stereo Amplifier	£15 15 0	£13 10 0
QUAD 33 Preamplifier ..	£43 0 0	£38 11 9
QUAD 303 Stereo Main Amplifier	£55 0 0	£49 15 0
ROGERS Ravensbourne 50 watt Stereo	£59 10 0	£50 12 0
ROGERS Ravensbourne In teak case	£64 0 0	£54 8 0
ROGERS Ravensbrook ..	£41 0 0	£35 19 6
TRUVOX TSA.200	£51 9 0	£42 9 0
WHARFEDALE GP 50 Mark II P.A. Amplifier..	Special Price	£50 0 0

TUNERS	Rec. Retail Price	Comet Price
ARENA 211 Stereo with decoder	£39 18 0	£34 18 0
DULCI FMT.7 FM Tuner ..	£22 1 0	£19 0 0
DULCI FMT.7S FM Stereo Tuner	£29 8 0	£23 0 0
GOODMANS Stereomax AM/FM Stereo Tuner ..	£80 19 0	£70 19 0
LEAK FM Troughline ..	£35 15 4	£30 10 4
LEAK Troughline Tuner with multiplex	£50 11 4	£42 19 6
QUAD Stereo FM Tuner ..	£50 0 0	£45 15 0
ROGERS Cadet Mark III Tuner	£20 12 6	£17 13 0
ROGERS Ravensbourne Tuner with Decoder ..	£60 15 3	£52 2 0
TRUVOX FM 200/IC Tuner	£52 0 0	£42 0 0

TUNER-AMPLIFIERS	Rec. Retail Price	Comet Price
ARENA 2400 with Decoder	£90 6 0	£75 0 0
ARENA 2500 complete with Decoder	£97 0 0	£79 0 0
TELETON MX.990 Stereo Tuner/Amplifier with AM/FM Multiplex Stereo Radio c/w two Speakers each speaker containing 8in. bass, 2in. tweeter ..	£64 132	£54 16 0
TELETON 502X AM/FM Stereo Tuner/Amplifier 40 Watts RMS	£107 8 3	£64 0 0
TELETON F.2000 AM/FM Stereo Tuner/Amplifier 2 x 5 watts RMS with silicon transistors ..	£43 0 0	£37 0 0
TELETON R.8000 AM/FM Stereo Tuner/Amplifier 2 x 6 watts RMS, complete with 2 speaker boxes	£60 19 6	£49 19 6
TELETON CMS.400 AM/FM Multiplex Tuner/Amplifier with 2 speaker boxes and turntable	£126 0 0	£99 0 0

BUDGET HI-FI STEREO SYSTEMS

GARRARD 3500 Turntable. Amplifier 8 watts per channel. VHF Tuner and pair of matched speakers beautifully finished in teak, at a low price of only

£65 0 0

Also available without radio **£54 0 0**

VAN DER MOLEN stereo system with Garrard SP25 mounted in teak case and perspex cover. Fitted with Sonotone cartridge and integrated stereo amplifier (12 watts RMS). Complete with 2 speakers in teak cabinets.

Special price £52 0 0

LL NOVA with VHF Radio. Garrard 2025TC Autochanger with cueing device. 10 watts RMS amplifier and 2 matched bookshelf speakers.
Rec. price £72 9 6. *Comet price* **£59 19 6**

WINDSOR 1500S Solid Teak plinth with Garrard 2025TC unit, solid state amplifier, 10 watts RMS and 2 speaker units with 9 x 5 ellipticals, complete with tweeter domes housed in solid teak cabinets of pleasing design.
Rec. price £57 15 0. *Comet price* **£49 19 6**
Also available with Garrard SP25 turntable.
Rec. price £61 19 0. *Comet price* **£52 0 0**

PHILIPS STELLA ST 8008 with Philips Autochange turntable. Integrated transistorised stereo amplifier and 2 separate speakers. All in attractive teak cabinets.
Rec. price £51 19 0. *Comet price* **£44 0 0**

CARTRIDGES ALL MAKES STOCKED AT DISCOUNT PRICES

SPEAKERS	Rec. Retail Price	Comet Price
CELESTION Ditton 10 ..	£20 15 6	£17 16 0
CELESTION Ditton 15 ..	£30 12 4	£26 5 0
DULCI AS3 Speaker ..	£8 8 0	£6 19 6
GOODMANS Maxim ..	£20 0 5	£16 19 6
GOODMANS Mezzo II ..	£30 18 0	£25 13 0
GOODMANS Magnum-K..	£40 2 0	£32 19 6
GOODMANS Mirimba ..	£26 0 0	£21 0 0
GOODMANS Mambo ..	£19 19 0	£15 0 0
LEAK Sandwich ..	£43 10 0	£35 19 6
LEAK Mini-Sandwich ..	£29 15 0	£24 10 0
WHARFEDALE New "Airedale" ..	£69 10 0	£57 14 0
WHARFEDALE Denton ..	£16 6 0	£13 18 0
WHARFEDALE Super Linton	£20 13 0	£17 10 0
WHARFEDALE Melton ..	£29 10 0	£25 0 0
WHARFEDALE New Dovedale 3	£39 10 0	£32 19 6

Bowers and Wilkins Speakers also available at discount prices

TURNTABLES	Rec. Retail Price	Comet Price
GARRARD SP.25, Mark II	£15 6 4	£11 10 0
GARRARD AP.75	£23 8 1	£18 19 6
GARRARD SL.55	£13 10 11	£11 12 6
GARRARD SL.65	£17 19 4	£15 5 0
GARRARD SL.75	£34 4 11	£29 10 0
GARRARD 3000	£11 4 1	£9 10 0
GARRARD 3500	£11 18 10	£10 1 10
GOLDRING Lenco GL.68..	£22 7 2	£17 19 11
GOLDRING Lenco GL.75..	£35 15 5	£28 15 5
GOLDRING 75P	£46 18 8	£38 0 0
THORENS TD.125	£63 4 9	£55 0 0
THORENS TD.150	£28 16 11	£25 7 0
THORENS TD.150B ..	£32 17 6	£28 18 0
THORENS TD.150AB ..	£39 1 7	£33 19 6
THORENS TD.124/11 ..	£45 18 1	£40 7 0

Bases, plinths and covers stocked to suit all the above turntables.

HI-FI STEREO TAPE DECKS AND TAPE RECORDERS	Rec. Retail Price	Comet Price
AKAI X-150D deck 4 track	£130 2 4	£109 0 0
AKAI X-300 2 track.. ..	£263 0 0	£220 0 0
AKAI X-300 4 track.. ..	£263 0 0	£220 0 0
AKAI X-360 4 track.. ..	£339 0 0	£284 0 0
AKAI X-360D deck 4 track	£290 0 0	£243 0 0
AKAI 1710 4 track w/o acc.	£109 0 0	£91 0 0
AKAI 1800 4 track	£158 0 0	£133 0 0
AKAI 1800SD 4 track ..	£199 0 0	£167 0 0
AKAI 3000D deck 4 track ..	£99 10 0	£83 8 0
AKAI X-V 4 track	£180 0 0	£151 0 0
AKAI M-9 4 track w/o acc.	£195 0 0	£158 0 0
FIDELITY HF Playmaster 2 track	£26 15 6	£19 19 6
FIDELITY Braemar 2 track	£30 9 0	£24 17 5
FIDELITY Braemar 4 track	£33 12 0	£27 8 11
MARCONI 4214 twin-track Tape Recorder	£35 16 0	£31 0 0
MARCONI 4216 4-track Tape Recorder	£41 5 0	£35 19 6
MARCONI 4218 Stereo Tape Recorder	£88 0 0	£77 19 6
MARCONI 4238 4 track Tape Recorder	£58 11 0	£49 19 6
PHILIPS battery operated tape recorder Model 4200	£35 6 0	£21 19 6
SHARP 504 battery/mains tape recorder, complete with all accessories guaranteed 5 years ..	£35 5 3	£24 19 6
SHARP RD.707 Stereo Tape Recorder	£96 12 0	£81 0 0
TELETON 7D 70 Stereo Tape Deck	£85 10 3	£62 0 0
TELETON FXB501D Stereo Tape Deck and pre-amplifier	£65 0 8	£49 0 0
TELETON 401X FM Multiplex Stereo tuner amplifier 20 watts RMS	£67 2 6	£49 0 0
TELETON 7AT1 AM/FM automatic multiplex stereo tuner/amplifier 50 watts RMS with F.E.T. ..	£133 1 9	£99 0 0
TRUVOX R54 3 speed 4-track	£72 2 0	£52 2 0
TRUVOX R52 3 speed 2-track	£72 2 0	£52 2 0

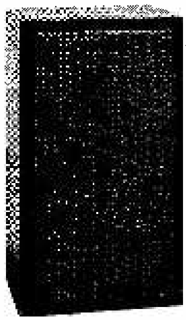
PICKUP ARMS	Rec. Retail Price	Comet Price
GOLDRING Lenco L75 ..	£12 6 6	£10 10 0
GOLDRING Lenco G65 ..	£7 13 6	£6 10 0
SME 3009 with S2 shell ..	£27 19 2	£23 17 6
SME 3012 with S2 shell ..	£29 0 0	£25 17 6

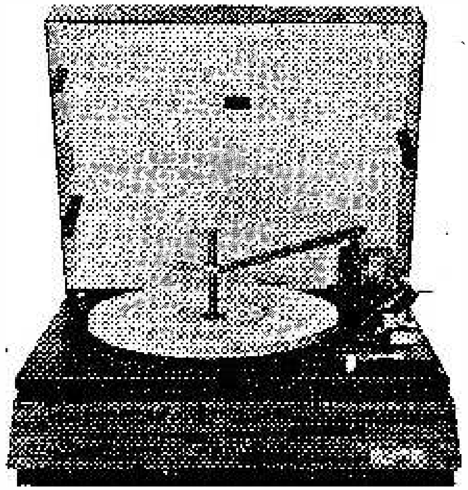
Comet Discount Warehouse

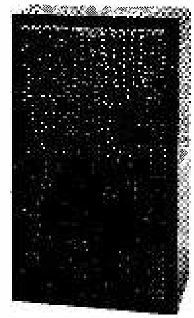
Reservoir Road, Clough Road, Hull. Tel. 42363

DELIVERY. Comet guarantee that all prices quoted are genuine. All items offered available at these prices at the time this issue closed for press. Add 9/- for post and packing on all orders.

a complete stereo system for only 28 gns!







The Duetto — 9 GNS. + 7/6 p & p

Integrated Transistor Stereo Amplifier

The Duetto is a good quality 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. Crosstalk better than 30dB at 1 Kc/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.

The Duo — 4 Gns. + 7/6 p & p

The new Duo general purpose 2-way speaker system is beautifully finished in polished teak veneer, with matching vynair grille. It is ideal for wall or shelf mounting either upright or horizontally.

Specification: Impedance 10 ohms. It incorporates Goodmans high flux 6″ x 4″ speaker and 2½″ tweeter. Teak finish. 12″ x 6¾″ x 5¾″, 4 gns each, p & p 7/6

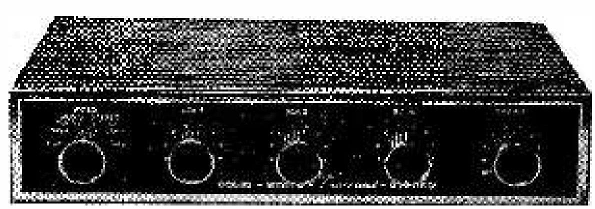
Garrard Changers from £7.19.6 p & p 7/6

Cover and Teak finish Plinth £4.15.0 p & p 7/6

The Classic — 8½ Gns. + 7/6 p & p

Controls: Selector switch Tape speed equalisation switch (3¾ and 7½ i.p.s.). Volume. Treble. Bass. 2 position scratch filter and 2 position rumble filter.

Specification: Sensitivities for 10 watt output at 1KHz. *Tape head:* 3mV (at 3¾ i.p.s.). *Mag. P.U.:* 2mV. *Cer. P.U.:* 80mV. *Radio:* 100mV. *Aux.:* 100mV. *Tape/Rec. output:* 100mV. Equalisation for each input is correct to within ± 2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone control range:* Bass ± 13dB at 60 Hz. Treble ± 14dB at 15KHz. *Total distortion:* (for 10 watt output) <1·5%. *Signal noise:* < −60dB. A.C. mains 200–250v. Built and Tested. Size 12½in. long, 4¼in. deep, 2¾in high. Teak finished case.



The Viscount — 13½ Gns. + 7/6 p & p

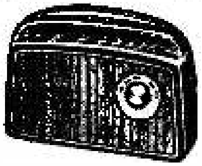
Integrated High Fidelity Transistor Stereo Amplifier

Specification—Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts monaural). Input: 6 position rotary selector switch (3 pos. mono and 3 pos. stereo), P.U., Tuner, Tape and Tape Rec. Out. Sensitivities: All inputs 100mV into 1·8M ohm. Frequency Response: 40Hz–20KHz ± 2dB. Tone Controls: Separate bass and treble controls; treble, 13dB lift and cut (at 15KHz); Bass, 15dB lift and 25dB cut (at 60Hz). Volume Controls: Separate for each channel. AC Mains Input: 200–240v. 50–60Hz. Size, 12½″ x 6″ x 2¾″ in teak finished case. Built and tested

RADIO & TV COMPONENTS (ACTON) LIMITED

All orders by post to our Acton address

21c High Street, Acton, London, W.3. and also at 323 Edgware Road, London, W.2.



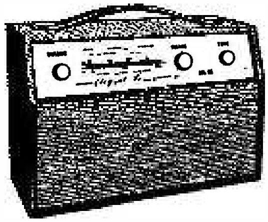
THE DORSET (600mW Output)

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: 9/6 EXTRA.

PRICE 5 GNS. + 7/6 p. & p. CIRCUIT 2/6 FREE WITH PARTS.

THE ELEGANT SEVEN MK III (350mW Output)



7-transistor fully tunable M.W.-L.W. 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: 9/6 extra.

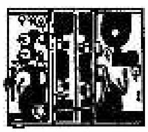
Price £4.9.6 plus 7/6 p. & p.

Circuit 2/6 FREE WITH PARTS.

2½ watt ALL TRANSISTOR AMPLIFIER

AC mains 240V. Size 7″ x 4½″ x 1¾″. Frequency response 100 c/s—10 Kc/s Semi conductors, two OC 75's two AC 128's and two stabilizers AA129. Tone and volume controls on flying leads. **£2.10.0** plus P. & P. 3/6. Suitable 8″ x 5″ 10,000 line high flux speaker, **18/6** plus 2/- P. & P.

X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP



Specifications: *Power Output* (into 3 ohms speaker) 10 watts. *Sensitivity* (for rated output): 1mV into 3K ohms (0·33 microamp). *Total Distortion at* 1KHz. at 5 watts 0·35%, at rated output 1·5%. *Frequency Response:* Minus 3dB points 20Hz and 40KHz. *Speaker:* 3–4 ohms (3–15 ohms may be used). *Supply voltage:* 24V d.c. at 800mA (6–24V may be used).

Control assembly: including resistors and capacitors.

1. Volume: PRICE **5/-**.
2. Treble: PRICE **5/-**.
3. Comprehensive bass and treble: PRICE **10/-**.

The above 3 items can be purchased for use with the X101.

Price 69/6 plus 2/6 p. & p.

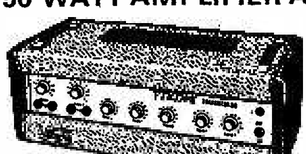
Power Supplies for the X101:

P101 M (for mono) **35/-** plus 4/6 p. & p. P101 S (for stereo) **42/6** plus 4/6 p. & p.

CAR TRANSISTOR IGNITION SYSTEM (by famous manufacturer)

For 6 volt or 12 volt positive earth systems. Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardwear (screws, washers etc.). PRICE **£4.19.6.** (post and packing 5/- extra).

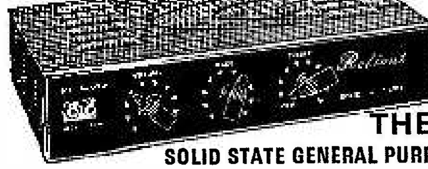
50 WATT AMPLIFIER A.C. MAINS 200-250V



Price 27 gns.
Plus 20/– p. & p.

An extremely reliable general purpose valve amplifier. Its rugged construction yet space age styling and design makes it by far the best value for money.

TECHNICAL SPECIFICATIONS
4 electronically mixed channels, with 2 inputs per channel, enables the use of 8 separate instruments at the same time. The volume controls for each channel are located directly above the corresponding input sockets. **SENSITIVITIES AND INPUT IMPEDANCES.** Channels 1 & 2 4mV at 470K. These 2 channels (4 inputs) are suitable for microphone or guitars. Channels 3 & 4 200 mV at 1m. Suitable for most high output instruments (gram, tuner, organ etc.). Input sensitivity relative to 10w output. **TONE CONTROLS ARE COMMON TO ALL INPUTS. Bass Boost** +12dB at 60 Hz/s. **Bass Cut** −13dB at 60 Hz/s. **Treble Boost** +11dB at 15 KHz/s. **Treble Cut** −12dB at 15 KHz/s. With bass and treble controls central −3dB points are 30 Hz/s and 20 KHz/s. **POWER OUTPUT.** For speech and music 50 watts rms. 100 watts peak. For sustained music 45 watts rms. 90 watts peak. For sinc wave 38·5 watts rms. Nearly 80 watts peak. Total distortion at rated output 3·2% at 1KHz/s. Total distortion at 20 watts 0·15% at 1KHz/s. Output to match into 8 or 15 ohms speaker system. **NEGATIVE FEED BACK** 20dB at 1KHz/s. **SIGNAL TO NOISE RATIO** 60dB. **MAINS VOLTAGES.** Adjustable from 200–250v. A.C. 50–60 Hz/s. A protective fuse is located at the rear of unit. Output impedance 3, 8 and 15 ohms.



THE RELIANT
SOLID STATE GENERAL PURPOSE AMPLIFIER

SPECIFICATIONS
Output—10 watts
Inputs—1. xtal mic 10mV
2. gram/radio 250mV
Output Impedance—3 to 4 ohms
Tone Controls—Treble control range ± 12dB at 10KH2
Bass control range ± 13dB at 100H2
Frequency Response—(with tone controls central) Minus 3dB points are 20H2 and 40KH2. 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—10¼″ × 4¾″ × 2½″. A.C. Mains, 200-250V. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Separate bass and treble lift control. Two inputs with control for gram. and mike. Built and tested. 8″ × 5″ speaker to suit price **14/6** plus 1/6 P. & P. Crystal mike to suit **12/6** plus 1/6 P. & P.

Reliant Mk. I. 5½ gns. plus 7/6 p. & p.
As above less teak case.

Reliant Mark II. 6½ gns. plus 7/6 p. & p.
In teak finished case.

CYLDON 2 TRANSISTOR U.H.F. TUNER

Brand new. Complete with circuit diagram.

£2.10.0 plus 1/- p. & p.

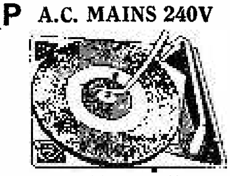
THREE-IN-ONE HI-FI 10 WATT SPEAKER

A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40–60 c/s. Frequency range 50c/s to 20kc/s. Size 13½ x 8$^{1}/_{16}$ x 4½ inches. By famous manufacturer. List Price £7. Our price **74/6** plus 5/- P. & P.
Similar speaker to the above without tweeters in 3 and 15 ohm **44/6** plus 5/- P. & P.

B.S.R. TD-2 TAPE DECK

This tape deck takes 5¾in. spools complete with two-track heads. Size 13¼in. long by 8¾in. wide. **£8.19.6** plus 7/6 p. & p.

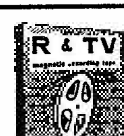
RECORD PLAYER SNIP A.C. MAINS 240V



The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7″ to 10″ or 12″. Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and insurance 7/6 extra.

POCKET MULTI-METER

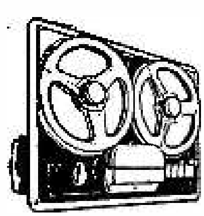
Size 3¾ x 2½ x 1¾in. Meter size 2¼ x 1¾in. Sensitivity 1000 O.P.V. on both A.C. and D.C. volts. 0–15, 0–150, 0–1000 D.C. current 0–150mA. Resistance 0–100kΩ. Complete with test prods, battery and full instructions, **42/6.** P. & P. 3/6. **FREE GIFT** for limited period only. 30 watt Electric Soldering Iron value **15/-** to every purchaser of the Pocket Multi-Meter.



FIRST QUALITY P.V.C. TAPE

5¾″	Std.	850ft.....**11/6**	5″	L.P.	850ft.....**12/–**
7″	Std.	1200ft.....**13/–**	3″	T.P.	600ft.....**12/–**
3″	L.P.	240ft..... **5/6**	5″	T.P.	1800ft.....**27/–**
5¾″	L.P.	1200ft.....**13/–**	5¾″	T.P.	2400ft.....**34/–**
7″	L.P.	1800ft.....**20/–**	7″	T.P.	3600ft.....**44/–**
5¾″	D.P.	1800ft.....**20/–**	4″	T.P.	900ft.....**16/6**

P. & P. on each 1/6.



MOTEK

3 Speed 2 track Tape Deck complete with heads, takes 7in. spool.

Incorporating 3 motors.

A.C. mains, 240 volts, listed at £21.0.0.

Our Price £9.19.6, plus 10/– P. & P.

RADIO & TV COMPONENTS (ACTON) LIMITED

All orders by post to our Acton address

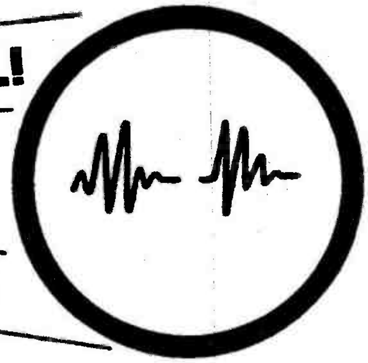
21c High Street, Acton, London, W.3. and also at 323 Edgware Road, London, W.2.

LOOK!

PRACTICAL!

VISUAL!

EXCITING!



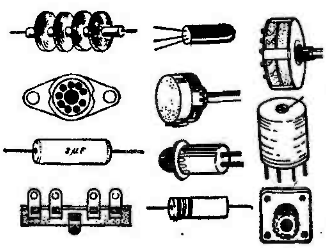
a new 4-way method of mastering

ELECTRONICS

by doing — and — seeing . . .

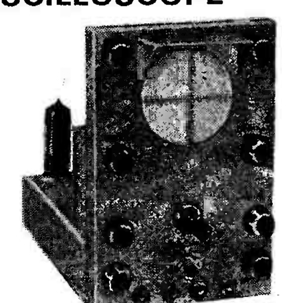
1 OWN and HANDLE a

complete range of present-day **ELECTRONIC PARTS** and **COMPONENTS**



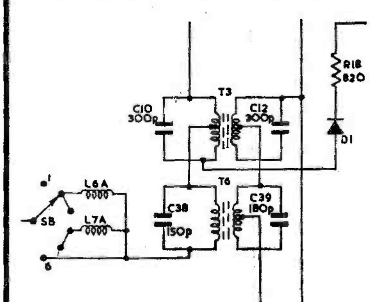
2 BUILD and USE

a modern and professional **CATHODE RAY OSCILLOSCOPE**



3 READ and DRAW and

UNDERSTAND CIRCUIT DIAGRAMS



4 CARRY OUT OVER **40** EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS AND SEE HOW THEY WORK . . . INCLUDING . . .

- VALVE EXPERIMENTS
- TRANSISTOR EXPERIMENTS
- AMPLIFIERS
- OSCILLATORS
- SIGNAL TRACER
- PHOTO ELECTRIC CIRCUIT
- COMPUTER CIRCUIT
- BASIC RADIO RECEIVER
- ELECTRONIC SWITCH
- SIMPLE TRANSMITTER
- A.C. EXPERIMENTS
- D.C. EXPERIMENTS
- SIMPLE COUNTER
- TIME DELAY CIRCUIT
- SERVICING PROCEDURES

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

FREE POST NOW for BROCHURE

or write if you prefer not to cut page

To: BRITISH NATIONAL RADIO SCHOOL, READING, BERKS. Please send your free Brochure, without obligation, to: *we do not employ representatives*

NAME..BLOCK CAPS

ADDRESS..PLEASE PW 8

PRACTICAL WIRELESS

VOL 45 No 4

Issue 750

AUGUST 1969

TOPIC OF THE MONTH

First things first

THERE is currently a good deal of talk about the shape of broadcasting, and the general concensus of opinion is that radio broadcasting in the UK finds itself in some need of reorganisation. Most of the discussion, however, seems to be centred around the constitutional basis of broadcasting and what services are required. This is rather putting the cart before the horse.

The most important aspects—which must be sorted out before considering the question of programmes—revolve around engineering problems. In a recent speech, the BBC Director-General, Mr. Charles Curran, elaborated on this theme. *En passant,* he said " . . . the long term future for radio in this country—and by long term I mean the next ten years—lies principally with v.h.f." Medium wave broadcasting will continue, he went on, but only in face of growing interference, until there is a new frequency allocation conference. But, as he pointed out, at such a conference we will do well to hold on to what we have and consequently there must be a greater exploitation of v.h.f.

Mr. Curran made three major points. First, local broadcasting on medium wave is unlikely to be a viable proposition ten years hence. Secondly, it would not be right to use the present international common frequencies for a very limited number of local stations in some areas and rely on v.h.f. in all other areas. Thirdly, it would not be right to redistribute some of the present national and regional channels for local station use; this would inevitably lead to the invasion of these frequencies by continental broadcasters

Some sources have suggested invoking Article 8 of the Copenhagen agreement (which allows the use of a frequency allocated to another country provided there is no serious interference with that country's service). This, however, would be tacit admission that the Copenhagen allocations were inadequate (whereas they are generally favourable to the UK), provoking a new frequency allocation conference from which we would certainly emerge worse off.

Obviously, v.h.f. must play a key role in any revised broadcasting shake-up and it has been suggested that v.h.f. coverage be made obligatory on all receivers made. In the USA, u.h.f. TV only got off the ground after legislation to ensure that all receivers had u.h.f. coverage.

W. N. STEVENS—*Editor*

NEWS AND COMMENT

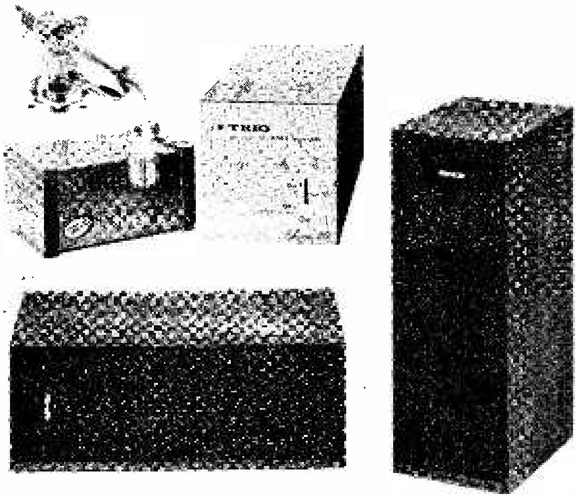
CONSTRUCTIONAL

OTHER FEATURES

SEPTEMBER ISSUE WILL BE PUBLISHED ON AUGUST 8th

NEWS AND COMMENT...

NEW AUDIO RANGE



B. H. Morris & Co. (Radio) Ltd., the sole UK distributors for "Trio", "Teac", "Sonics", and "Audio Development" announce some new items of equipment in their range. Amongst the range are the items illustrated above. The speakers are type AS-57 bookshelf models. Power handling capacity is 10W music power. Voice coil impedance is 8Ω. Frequency response is 70–18,000Hz. Enclosure dimensions are $5\frac{7}{8}$ x $15\frac{3}{4}$ x $8\frac{1}{4}$in. deep. Speaker compliment is a 5 x 7in. elliptical. Price is £15 per pair.

The pickup cartridge illustrated at the top left is the "Trio" Supreme 20 photoelectric model. It uses a lamp and screen attached to the cantilever to which is fitted the stylus and photoelectric diodes and a preamp. The movement of the screen controls the amount of light passing through it to the diodes. Therefore stylus movement on the record varies the amount of light through the screen to the diodes thus modulating the current from the cartridge. Retail price is £64 4s. 1d. plus £13 15s. 11d. p.t.

An inexpensive magnetic cartridge in the B. H. Morris range is the AD 76K with a sensitivity of 5mV at 1kHz and frequency response of 20–20,000Hz priced at 90s.

Full information of the complete range of equipment may be obtained by contacting B. H. Morris & Co. (Radio) Ltd., 84–88 Nelson Street, London, E.1. Tel.: 01-790 4824.

RADIO AND TELEVISION COURSES

The London Borough of Brent Stonebridge Evening Institute, Brentfield Road, London, N.W.10 announce their 1969/70 Radio and TV Course. It commences on 22nd and 24th September, Mondays and Wednesdays 7.0–9.0 p.m. The fees are 50s. for one or two evenings weekly for session which ends 22nd May, 1970. The course covers some theory and practical work and is mainly intended for amateurs. Cheques and P.O.s should be made payable to "The Brent Borough Treasurer" and students may enrol now by post to: 44 Worcester Crescent, Mill Hill, London, N.W.7.

RADIO CONTROL FANS

The London Radio Controlled Models Society is holding a meeting on 10th July at 7.30 p.m. Venue is "The Two Chairmen", Dartmouth Street, London, S.W.1. Further details may be obtained from the Secretary, H. C. Farley, 24 Dacre Crescent, Kimpton, Hitchin, Herts.

VERY CONVENTIONAL

Every year the Radio Society of Great Britain sponsors a convention for v.h.f.-minded radio amateurs and enthusiasts. It is usually held at the "Winning Post Hotel" near Twickenham in Middlesex, which is an ideal venue with a large car park that was completely filled at the latest convention on 26th April. Things started at 11 a.m. with an exhibition of home-constructed and commercial equipment; there was very little on show, but the quality of workmanship of the private exhibits was superb, especially a little s.s.b. transceiver for 144MHz which won D. Dall, G5AHK, the V.H.F. Committee Cup. In the afternoon, two lecture sessions ran in parallel; one was started off by Jack Hum, G5UM, who talked on how to start on v.h.f. with the minimum of trouble and expense and this was followed up with lectures on the technique of listening on v.h.f., the design and construction of 70 and 144MHz converters and general principles of the design of v.h.f. transistor transmitters. Slightly longer lectures in the other room were led by Arnold Mynett, G3HBW, who talked on v.h.f. s.s.b. phasing transceivers, followed up by G3MED discussing a spurious-free v.h.f. receiver, and in a very similar vein how to measure spurious radiation down to —90dB by G3FZL. Among the guests who sat down to an excellent dinner in the evening were Colonel I. St. Q. Severin of the cabinet office, and Dr. J. A. Saxton, director of the Radio and Space Research Station.

NEWS FROM THE CLUBS

GB3SUA will be operational 11th–13th July on 80, 20, 15, and 10m bands using s.s.b./a.m./c.w. modes. Run by Stratford upon Avon ARC to celebrate the 700th anniversary of the Guild of the Holy Cross which was the first recorded form of local government in the town. A special QSL card will be issued via the RSGB Bureau. Further details from M. J. W. Webb, G3OOQ, 14 Townsend Road, Tiddington, Stratford upon Avon.

Pudsey and District Radio Club will be running their first Mobile Rally—the White Rose Mobile Rally—on 27th July. The QTH is Allerton Girls High School, Leeds, Yorkshire. Talk-in stations will be on 160 and 2m. There will also be a.m. and s.s.b. demonstration stations. Other attractions are: raffle prizes, easy car parking, refreshments, amusements for wives and kids and the whole rally is under cover. Further details: R. Short, G3YEE, 10 Tyersal Grove, Bradford 4, Yorks.

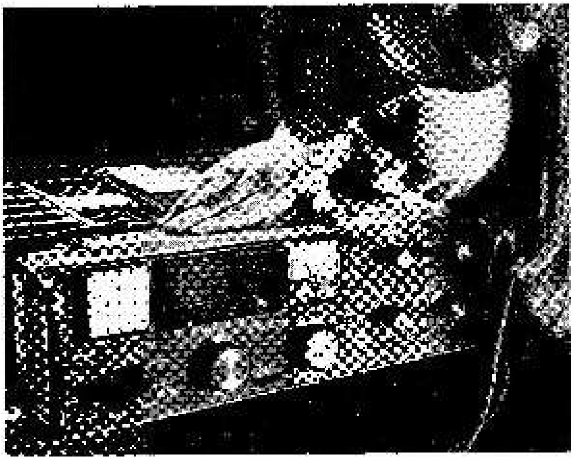
NORTHERN RADIO SOCIETIES' ASSOCIATION CONVENTION & EXHIBITION

This event was held at Belle Vue, Manchester on 27th. April, several hundred visitors attending. Mr. John Graham, G3TR, Immediate Past President of the RSGB presented the G8AYD Trophy for the best stand put on by a radio club belonging to the Association. The award was made jointly to the Manchester and District Amateur Radio Society and the South Manchester Radio Club. These two clubs put on show stands that gave a complete picture of the hobby from the very beginning.

Another stand of particular interest was that of the Wirral ARS on which were shown their group constructional projects, their latest being a 160m s.s.b. Rx/Tx

NEWS AND COMMENT...

EDDYSTONE'S NEW 10-BAND BABY



A new solid state receiver—the EC958—covering a range of 30MHz to 10kHz has been announced by Eddystone Radio—a member of GEC–Marconi Electronics. For best possible accuracy in frequency setting an optical projection method of displaying the frequency scale is used. This gives an effective length of 50in. for each display scale. Silicon transistors are used throughout and microcircuits and f.e.t.s have been employed where advantageous.

Reception facilities are c.w., m.c.w., a.m., (d.s.b.) and s.s.b. in A3A, A3H and A3J modes—upper or lower sideband. F.S.K. (F1) facilities are available when optional module (type LP. 3058) is fitted. Keying speeds up to 200 bauds with shifts of 85–850Hz can be accommodated.

Further details may be obtained from Eddystone Radio Ltd., Eddystone Works, Alvechurch Road, Birmingham 31.

COMARK MULTIMETER

The Comark Multimeter 1231 is the latest addition to the new 1000 Series. The overall accuracy is $\pm 2\%$ of f.s.d. for d.c. measurements and $\pm 3\%$ of f.s.d. for a.c. measurements over a bandwidth from 10Hz to 100kHz (3Hz to 250kHz for —3dB). Voltage sensitivity is from 1mV f.s.d. to 300V in 12 ranges with an input resistance of 1MΩ/V at d.c. the maximum current sensitivity is 1μA f.s.d. with a meter volt drop of less than 12mV. Resistance is measured to an accuracy of $\pm 5\%$ of reading from 1Ω to 100MΩ. The UK list price is £50.

NEW PREMISES FOR HOME RADIO

Home Radio have moved from their original shop in London Road, Mitcham, to the top floor of an office block 400 yards away at 240 London Road. They now have 2,400 square feet of extra space, from which to run their mail order business.

A.S.E.E. CHANGE

"The Association of Supervisory and Executive Engineers" —that is the new name for the Association of Supervision Electrical Engineers. Membership is now no longer restricted to electrical engineers.

ON 'PHONE?

Amateurs in the United States, because of changes in the Bell System telephone regulations can now legitimately operate "phone patches" connecting overseas stations to telephone subscribers.

THE MULLARD MEETINGS

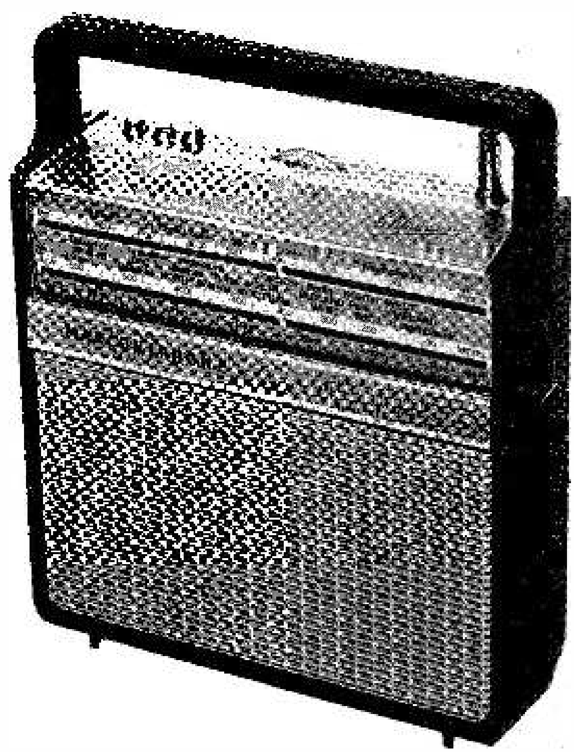
At Southampton on 5th May, the 1969/70 season of Mullard meetings for the radio and television trade opened. This year's talk is devoted almost entirely to integrated circuitry and between now and 1970 it will be given at 76 centres in the UK.

The talk deals in a general way with the development of integrated circuits, analyses their advantages and emphasises the radical changes in thinking of design. It then studies the applications of integrated circuits to colour TV receivers. I.C. manufacture is then covered and the talk finishes with a glimpse into the future and what it is likely to hold so far as I.C. applications are concerned.

The programme for July is: 9th: Dolphin Hotel, Swansea; 10th: Park Hotel, Cardiff.

All meetings start at 7.45 p.m. and any readers wishing to attend should apply for tickets to Ian Nicholson, Films and Lectures Organisation, Mullard Ltd., Torrington Place, London, W.C.1.

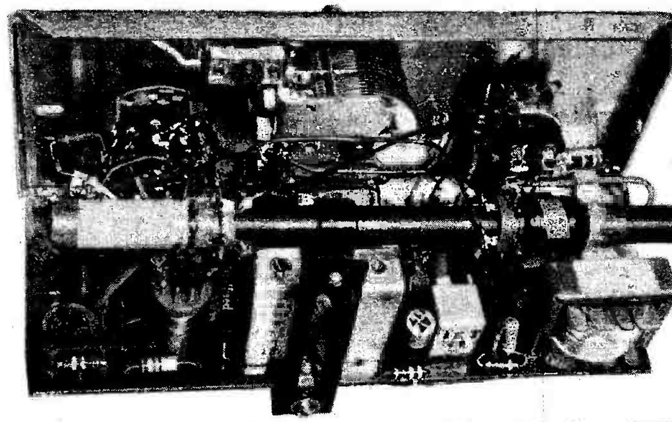
NEW FROM MARCONIPHONE



Five new models from Marconiphone include two small portable receivers, two radiograms and a record player. The two portables are similar—the 4166 having v.h.f./m.w./l.w. coverage and the 4169 covering l.w./m.w./s.w. Both have push-button waveband selection and an output of 300mW. Prices are: 4166 (£14 15s.) and 4169 (£11 10s.). The photograph shows model 4169.

TRANSET

BY F.G. RAYER G3OGR



THREE-BAND PORTABLE

WITH a receiver covering long, medium and short waves, it is of advantage to use an internal ferrite rod aerial for long and medium wave reception, and a telescopic or other external aerial for short waves. The circuit used here is of this type, and gives reception of hundreds of short wave transmissions, in addition to medium and long wave coverage. Bands actually tuned are approximately 14-6MHz s.w. (21-50m), 1,500-575kHz m.w. (200-530m) and 260-160kHz l.w. (1,150-1,900m).

Some simplification is possible by using a common oscillator coil for m.w. and l.w., and the way in which bandswitching operates can be checked with the aid of Fig. 1.

For s.w. reception, S1 earths C, tag 1 of L1, L3 and L4 being shorted out. L1 is tuned by VC1. S4 shorts A, tag 7, to earth, so that only the base winding of L1 is in use. S3 places VC2 across L2, for oscillator tuning, and S2 switches Tr1 collector to the collector winding of L2.

For m.w. reception, S1 leaves L3 in circuit, S4 introducing the base coupling winding. S3 provides oscillator tuning of L5, with the series m.w. padder C4 while S2 brings into use the collector winding of L5.

L5 is also used for l.w. reception, with the extra capacitor C5 to obtain suitable frequency coverage. The l.w. section of the ferrite rod, L4, is also in use.

L1 and L2 are individual s.w. aerial and oscillator coils. L3 and L4 are m.w. and l.w. sections of a dual-wave ferrite rod aerial. By using a series circuit as shown, no switching of Tr1 emitter is required.

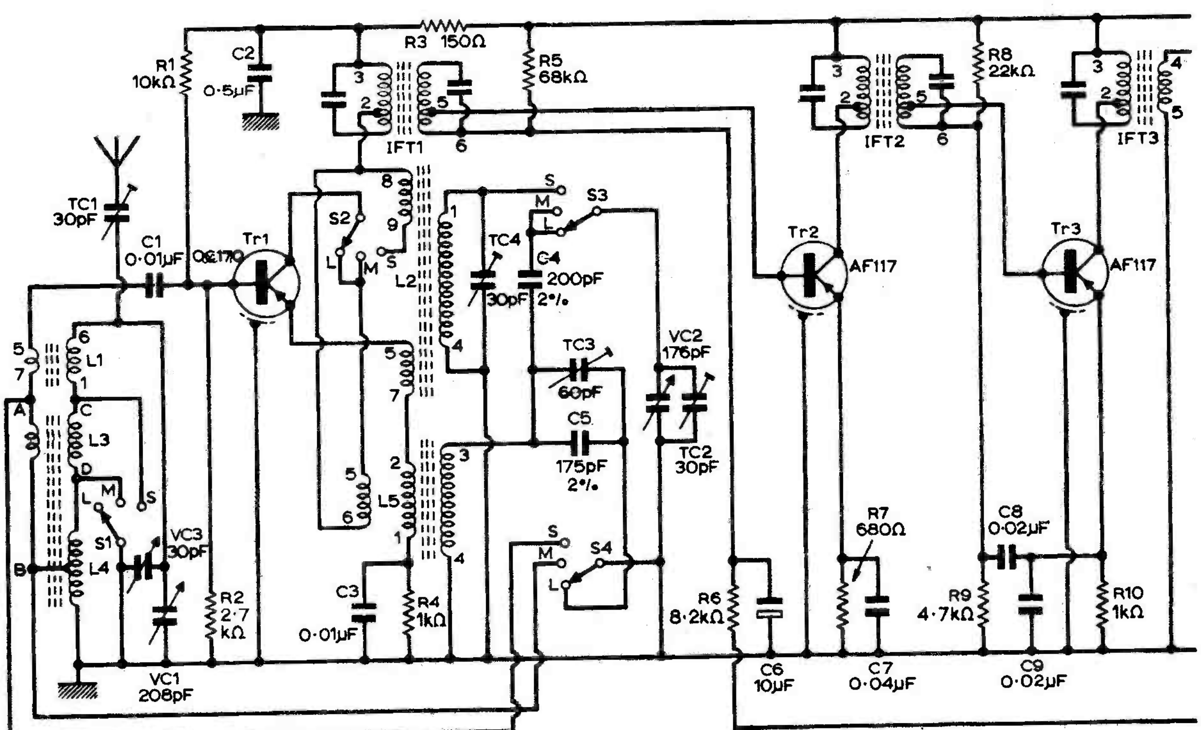


Fig: 1. The Transet theoretical circuit. The aerial, oscillator and i.f. stages—

The telescopic aerial is coupled through T1, and also operates on m.w. and l.w., if extended, though it is normally not required on these bands.

T4 is the s.w. oscillator trimmer, T2 the m.w./l.w. trimmer, and T3 allows adjustment of l.w. oscillator coverage. To give maximum efficiency on all frequencies, a small manually operated panel trimmer VC3 is used in the aerial circuit. This avoids loss of results due to poor trimming, and also compensates for changes caused by extending the aerial, or using an external aerial. VC3 is simply rotated for best results, and only need be adjusted occasionally.

IF AMPLIFIER

I.F.T.1 and i.f.t.2 are both double tuned, the diode i.f.t. being single tuned. This results in high gain and selectivity, with enough sensitivity for good reception of many transmissions. The i.f. is 465kHz.

AUDIO AMPLIFIER

Tr4 is the first a.f. stage, followed by Tr5 as driver. Tr6/7 are the output pair, with feedback and base bias via R21 and R22. This type of circuit has the advantage that suitable transistors are readily available, and the operating conditions of each stage are independent of other stages. This avoids difficulties sometimes arising in directly-coupled and similar circuits. There is plenty of amplification and enough power output for loudspeaker reception of most signals, with good tonal quality.

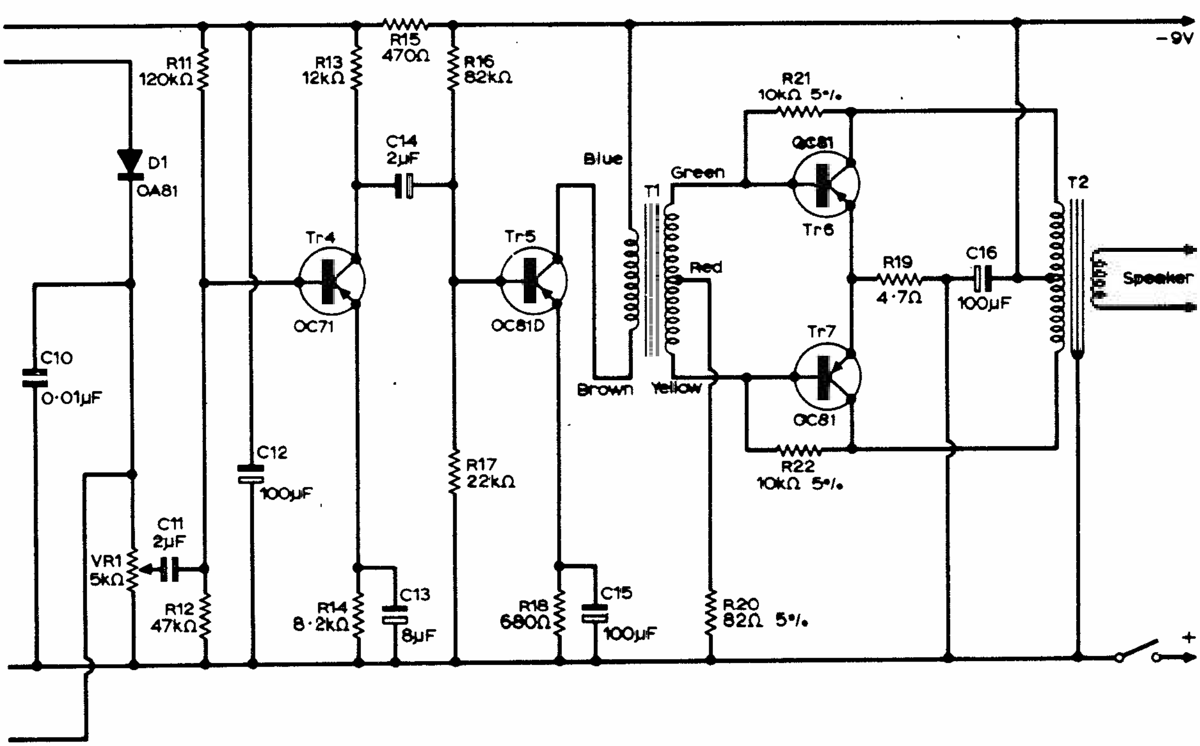
The volume control VR1, ganged capacitor VC1/2, trimmer VC3, and switch are fixed to a 7 × 3in. flanged aluminium plate, also used as a positive line or earth return. Other parts are fitted to a paxolin circuit board 7 × 2¾in., which is bolted to the flanged plate.

CONSTRUCTION

Figure 2 is a top view of the paxolin board. VC3 is directly under VC1/2, and the fixed plates tag of VC3 is connected to the underneath tag of VC1. VR1 fits on the aluminium plate to the left of VC1/2, and the four-pole three-way switch occupies a similar position to the right.

The paxolin board was prepared by scribing lines at ¼in. intervals with a sharply pointed tool, then drilling $\frac{1}{16}$in. holes for all leads. L1 and L2 need ¼in. holes. The board is also drilled to clear the pins of L5, i.f.t.1, i.f.t.2, i.f.t.3, and the fixing feet of T2. Drilling positions for the i.f. transformers and L5 can be marked by pressing paper against the pins, holding this on the paxolin, and marking through with a sharply pointed tool. A central hole to allow core adjustment is needed under each i.f.t. Two bolts secure the paxolin to the flange, and tags were put under the nuts to provide the MC points.

A slow-motion action is essential with VC1/2, and is provided by concentric spindles in the component listed. A ball drive could be fitted to the ordinary type of capacitor, a little extra space then being needed between the aluminium plate and the inside of the cabinet front. The tuning capacitor also had trimmers fitted. The trimmer for VC1 is fully unscrewed, then ignored. The other trimmer is TC2, Fig. 1. A capacitor without trimmers is equally suitable, and TC2 would then be a separate trimmer, connected from frame to VC2. A 100-470 ohms resistor may be needed between 9, L2, and S2, if the circuit is trimmed for maximum s.w. coverage.



—and above, the detector, first a.f., driver and output stages.

WIRING

This can be carried out with 22 s.w.g. or similar tinned copper wire, with insulated sleeving where necessary. In most places the wire ends of the resistors and capacitors are long enough to reach the various connecting points.

The diode D1, and electrolytic capacitors, must be fitted with the polarity shown. C6 lies under C2 and C16 is underneath C15.

Figure 3 shows all connections under the paxolin board.

L5 and the i.f.t.s have small tags which earth the screening cans. These are connected as in Fig. 3. The core of T2 is also earthed.

A red flexible lead from the switch of VR1 is fitted with a positive battery clip. Battery negative is the centre-tap of the primary of T2, Fig. 3. Twin flexible leads from T2 secondary will go to the loudspeaker.

TRANSISTORS

It is probably as well to leave these until most other wiring has been done. Tr1 is behind the four-pole switch, allowing short leads from collector to S2, and emitter to tag 5 of L2. The base lead goes to C1, R1, R2.

Tr2 and Tr3 can have ½in. lengths of coloured sleeving on emitter, base and collector leads, for insulation, and to identify them. These wires should not be unnecessarily long.

The remaining transistors can conveniently have about ¾in. of lead above the circuit board. Many alternatives will operate satisfactorily in this type of audio amplifier. A poor transistor should on no account be used for Tr4, as noise generated in this stage is considerably amplified. As the listed transistors are readily available, it is recommended they be used if transistors are to be purchased. But this does not mean that equivalents already to hand could not be fitted. Some might need different base or emitter resistor values.

FERRITE ROD

This may be 6in. or 7in., of the usual type for m.w./l.w. ferrite aerials. A bracket is bolted to the paxolin board, Fig. 2. This supports a vertical strip of paxolin 3in. high and ¾in. wide. A strip of flexible insulating material passes round the ferrite rod, and is bolted to the paxolin strip.

When connecting the ferrite rod windings, note that the m.w. tuned section is from points C to D, Fig. 1. The m.w. base coupling winding is from A to B. The l.w. tuned section L4 is from D to earth line. Should a rod with separate base winding be used, instead of a tapping on L4, this winding is connected between the m.w. winding at B, and earth line. Should tuning difficulties arise on l.w., this might be caused by L4 being in the reversed phase to L3, and this can be corrected by reversing connections to L4. Windings intended for 208pF tuning capacitance and OC44 type transistors are usually satisfactory provided the base coupling is reduced by removing a few turns. Four turns should suffice for m.w. base coupling. L.W. coupling need not be changed unless instability arises.

★ components list

Resistors:

R1	10kΩ	R12	47kΩ
R2	2·7kΩ	R13	12kΩ
R3	150Ω	R14	8·2kΩ
R4	1kΩ	R15	470Ω
R5	68kΩ	R16	82kΩ
R6	8·2kΩ	R17	22kΩ
R7	680Ω	R18	680Ω
R8	22kΩ	R19	4·7Ω
R9	4·7kΩ	R20	82Ω 5%
R10	1kΩ	R21	10kΩ 5%
R11	120kΩ	R22	10kΩ 5%

VR1 5kΩ log. pot. with switch
All 10% ¼ watt except where stated

Capacitors:

C1	0·01μF
C2	0·5μF
C3	0·01μF
C4	200pF 2% silver mica
C5	175pF 2% silver mica
C6	10μF 6V
C7	0·04μF
C8	0·02μF
C9	0·02μF
C10	0·01μF
C11	2μF 6V
C12	100μF 12V
C13	8μF 6V
C14	2μF 6V
C15	100μF 6V
C16	100μF 12V
VC1/VC2	Jackson 00 208/176pF slow motion
VC3	25pF or 30pF miniature air-spaced variable
TC1	30pF pre-set
TC2	30pF pre-set
TC3	60pF pre-set
TC4	30pF pre-set

Inductors:

L1	s.w. aerial coil, Denco transistor range 4 Blue
L2	s.w. oscillator coil, Denco transistor range 4 Red
L3/L4	l.w./m.w. ferrite rod aerial
L5	l.w./m.w. oscillator coil, Weyrad P50/1AC
IFT1	Denco IFT18/465
IFT2	Denco IFT18/465
IFT3	Denco IFT14
T1	Osmor QXD1
T2	Osmor QXO2

Semiconductors:

Tr1	OC170
Tr2	AF117
Tr3	AF117
Tr4	OC71
Tr5	OC81D
Tr6	OC81 } Matched pair
Tr7	OC81 } Matched pair
D1	OA81

Miscellaneous:

2/3 ohm 3½in. or similar speaker; four-pole three-way rotary switch; 7 x 3in. flanged plate (Home Radio); 7 x 2¾in. paxolin sheet; four knobs; 6½/35in. telescopic aerial.

Note that the receiver can be tested on s.w. with the ferrite rod omitted, and on m.w. with L4 omitted. This may help localise wiring faults, if any arise.

BANDSWITCH

The position of this allows short leads from 1, L1, to S1 and earthed return to VC1/2, from 1, L2 to S3 and VC2, and from 4, L2 to VC1/2.

C4 and C5 are mounted vertically on the paxolin board, to reach the switch tags. There should be no difficulty if tags and connections are correctly identified.

When first testing the receiver, a meter may be included in one battery lead. Current should be around 9mA to 12mA with no signal or at low volume. If it is excessive, switch off at once and look for an error in wiring or other fault. During normal listening, current peaks will be about 20mA to 40mA, according to volume.

IF AMPLIFIER

This is most readily aligned with a signal generator, set to give a modulated signal at 465kHz. Adjustments can then be for maximum battery

continued on page 262

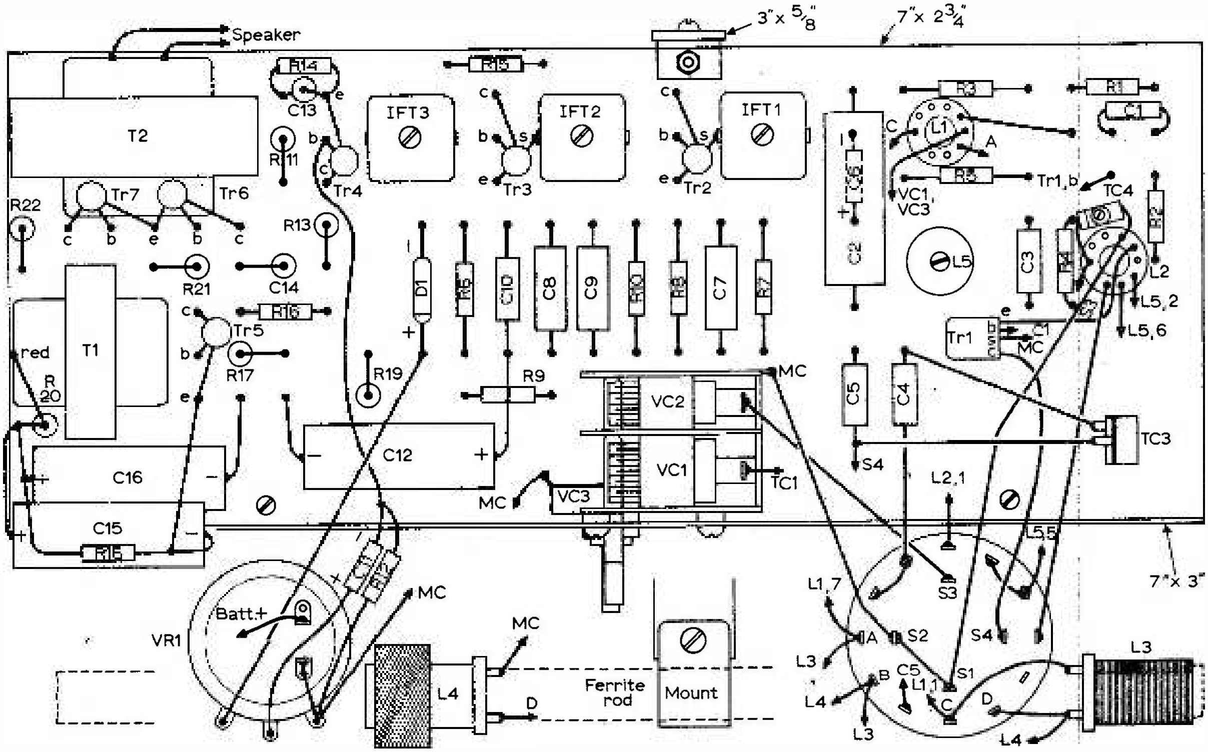


Fig. 2: View of components on the upper side of the paxolin board.

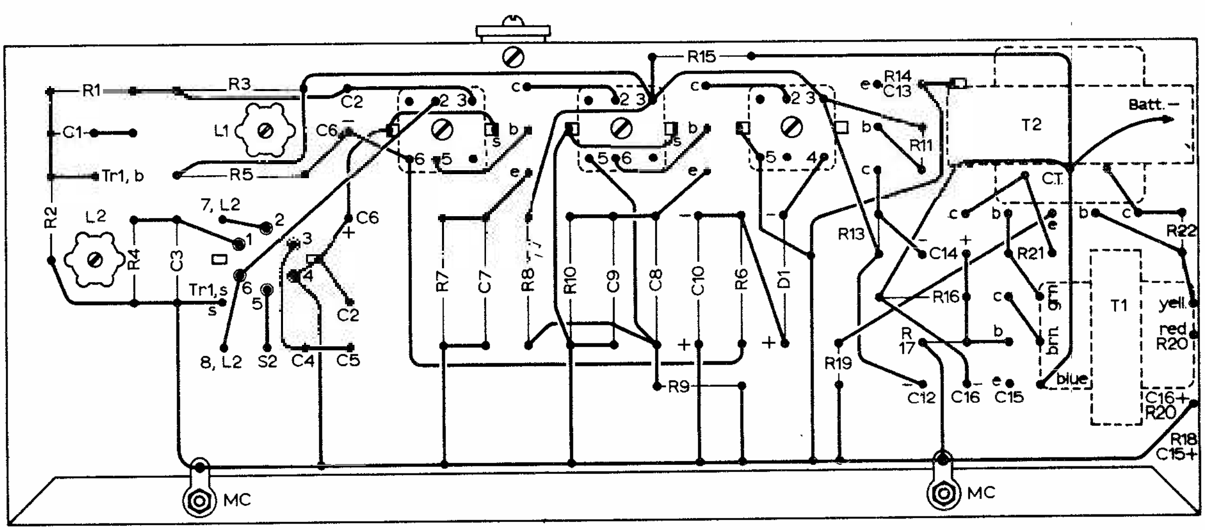


Fig. 3: Wiring on the underside of the paxolin component board.

THE CULT OF THE JUNK BOX

JAMES HOSSACK

THE modern meaning of the word "cult", like that of others such as "juvenile", etc., has become debased by common usage in association with a more sinister partner (e.g. "juvenile delinquent"), and one imagines the adherents of a cult as supporting it with a sort of fanatical, and frequently misplaced, semi-religious fervour. It is useful to remember that the word itself shares a common origin with "cultivate", which basically means to "make good use of", and this is precisely what possession of a junk-box (or perhaps one ought to use the more elegant term "spares box") implies to those readers who have come, to a greater or lesser degree, to rely on one as providing a valuable addition to the resources available for pursuing their favourite hobby.

To many experimenters, who may have been introduced to radio construction via the influence of a big brother, the junk-box comes, in a sense, ready-made. In other words, virtually a family heirloom. Other less fortunate (or more affluent) members of the radio fraternity commence operations by purchasing everything the hard way, down to the smallest nut, bolt, or resistor. Gradually, however, even those who pursue their hobby in a very modest way will acquire, over the years, a small stock of components which, while perhaps not quite as good as new, will serve them adequately for all normal constructional purposes. There is no doubt that a junk box of this type has much to recommend it.

There is, however, a more positive approach to this subject which was pursued some time ago by the writer, and which has paid handsome dividends in terms of component acquisition at bargain prices, and, what may be even more important to those residing in rural areas, complete and immediate availability of components "off the shelf" as and when these are required.

The plan is quite simply the purchase, or similar legitimate acquisition, of unwanted electronic gear, followed by a careful, painstaking, and thorough dismantling of all the usable components therein. Sources of such components are many and varied. Some dealers, for example, will gladly dispose of old TV equipment for a nominal sum. On the other hand, constructors are frequently presented with the opportunity of procuring quite complex pieces of electronic gear which have ceased to function, or merely become obsolete, on the understanding that these are removed from the premises forthwith and "broken up"—hardly a euphemistic term for the extremely delicate dismantling operation to which they will be subsequently subjected on arrival back at the "shack".

A word of warning should, perhaps, be given here about all equipment containing c.r.t.s of any description. In general, these are not worth salvaging, but it is imperative, before commencing operations on any chassis, that they be carefully removed and placed on one side for subsequent disposal via the refuse collection.

Do not succumb to the temptation to break a c.r.t. in order to facilitate its subsequent disposal, since the danger of flying glass from the resultant explosion (more correctly, implosion, since the tube collapses inwards) can be a very real one. The same advice applies to large glass valves, with the additional consideration that they may, in fact, prove worth preserving with a view to possible future use as transmitting tubes.

Having discussed how to collect, we now come to the question of what to collect. The answer would appear to be, whatever can be easily removed from a discarded chassis, but one or two points must be borne in mind, and it will be advantageous to consider the dismantled items in turn.

Transistors

While examples of discarded gear containing transistors are, of course, comparatively limited at the present time, there are excellent opportunities for procuring, very cheaply, surplus computer panels and such like which often consist of masses of identical transistors embedded in a printed circuit matrix. These transistors are frequently mounted in such a position that by "unwinding" the transistor, so to speak, the wires can be cut off close to the board, leaving 1 inch or more of connecting lead. A snag with most boards of this type is that no details are generally available regarding the components, but, frequently, a meter check, or insertion of one transistor into a simple amplifying circuit (a.f. or r.f.) will be sufficient to identify the type satisfactorily. A number of excellent transistor testers, suitable for determining beta, leakage current, and other characteristics of unknown transistors, have been described in past issues of PW.

Valves

The position as regards reclaimed valves is less satisfactory, particularly when one remembers that, after a few years' hard wear, the average rectifier or power output valve has completed perhaps two-thirds of its useful life, although its characteristics may still be entirely satisfactory for use in experi-

TABLE 1

Valve	Description	Heater Voltage	Heater Current	Anode Volts	Screen Volts	Maximum Rectified Current	Peak Inverse Volts (Rect.)	Base Connections
807	Power Tetrode	6·3	0·9A	500	200	—	—	A
6L6	a.f. Power Tetrode	6·3	0·9A	350	250	—	—	B
6F6 } 6V6 }	a.f. Power Pentode	6·3	0·7A 0·45A	250	250	—	—	
6X5	Rectifier	6·3	0·6A	325	—	70mA	750	C
83V	Rectifier	5	2A	575	—	175mA	1100	D
5R4	Rectifier	5	2A	750	—	250mA	2800	E
5V4	Rectifier	5	2A	375	—	175mA	1100	F
5Z4	Rectifier	5	2A	350	—	125mA	1100	

TABLE 2

Valve Type	Description	Heater Volts*	Pin 1	2	3	4	5	6	7	8	9
PCC 85	v.h.f. double triode	9·0	a″	g″	k″	h	h	a′	g′	k′	s
PCF 80	Triode-pentode mixer	9·0	a_t	g_1	g_2	h	h	a_p	k_p	k_t	g_t
PCF 82	Triode-pentode mixer	9·5	as above								
PCL 82	Triode output-pentode	16	g_t	k	g_1	h	h	a_p	g_2	k_t	a_t
PCL 83	Triode output-pentode	12·6	a_t	g_t	k_t	h	h	a_p	k_p	g_2	g_1
PCL 84	Triode video output-pentode	15	g_t	a_t	k_t	h	h	a_p	k_p	g_1	g_2
PCL 85	Triode output-pentode	18	a_t	g_t	k_t	h	h	a_p	g_2	k_p	g_1
PCL 86	Triode output-pentode	13·3	g_t	k_t	g_2	h	h	a_p	k_p	g_1	a_t
PL 82	Output pentode	16·5	—	g_1	k	h	h	—	a	—	g_2
PY 82	Rectifier (half-wave)	19	—	—	k	h	h	—	—	—	a

*Heater current is 0·3A in all cases.

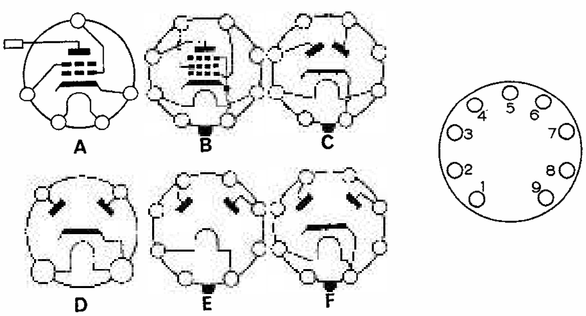


Fig. 1: Valve base connections A-F are for Table 1. All valves in Table 2 have 9 pin bases (B9A.).

mental hook-ups, or as test replacements for the diagnosis of circuit faults. Unless one is an ardent collector of vintage components (see, for example, *The Radio Collector* by P. N. Wood in the June 1966 issue of PW), it is probably wisest to consign all valves of the pre-octal-base era to the dustbin before they have the opportunity to ruin a perfectly good circuit. The same may be said to apply to most octal-base specimens, with the exception of a few such as 6L6, 6X5, 807, and some others; also, power rectifiers of the 5 volt series, such as 5Z4, may come in useful, provided they are known to be in good condition. Characteristics and base connections for some of these are given in Table 1. Miniature battery valves based on B7A may prove of some interest to the radio control enthusiast. B9G television valves are sometimes designed to operate from a standard 6 volt heater supply; more often they are designed to run from a higher voltage, and can be neatly pressed into experimental service by adapting a suitable transformer (see next section).

Transformers

Unlike valves, these seldom deteriorate with age, and, in fact, probably represent the most valuable components in any chassis, from the reclamation point of view. A good mains transformer can cost anything from £2 upwards, so that the initial price of an old chassis is repaid several-fold if it happens to contain a mains transformer likely to be suitable to one's requirements. Television line and field transformers are unlikely to be of great use unless one is especially interested in audio oscillators, but the output transformer should certainly be salvaged, particularly if it is one of the multi-tapped variety.

Table 2 shows the heater voltages and general applications of some popular television valves, and it is frequently possible to utilise two or even more heater windings, connected in a suitable manner to obtain the required power for circuits using such valves, as described earlier. Sometimes, other low-voltage windings can be interconnected to provide between 12 and 20 volts at a few amps., a useful feature for those interested in building their own transistor power supplies.

I.F. transformers were generally designed for 465kc/s operation, and are therefore worth preserving unless they happen to incorporate the old-style compression trimmers, which were notoriously unreliable. Television i.f.t.s are usually somewhere in the 20—30Mc/s region, and as such can prove of interest to potential constructors of amateur v.h.f. equipment. In this context, old f.m. mixers or TV turret tuners can sometimes be dismantled as complete units, and are very easily adapted for 70 or 144Mc/s amateur band operation.

Coils

Unless these are of fairly modern design, the trouble of removing them is scarcely justified, although, if a complete unit with wavechange switch can be salvaged intact, it may well come in handy at a later date. Old wafer switches, by themselves, are seldom of much value, since they will almost certainly be badly worn.

Potentiometers

These have the merit of being amenable to direct assessment with a simple test meter. They will usually fall into two classes—good and bad—the worn track of the latter showing up immediately the control is turned backwards and forwards a few times. Keep the good ones carefully, since a wide selection of values on the experimenter's shelf is a very decided asset at all stages of construction. (The writer has a circuit in operation at present with about a dozen variable resistors—most of which will finally be replaced by fixed values once the optimum circuit constants have been determined.

Variable Capacitors

Check these, also, with a meter, to locate faulty insulation, rubbing vanes, etc. Do not, in this case, be in too much of a hurry to dispose of ancient types. Many of the best transmitters use tank coils whch are tuned by components once gracing the panel of a 1930 battery two-valver, whose designers appeared to imagine that the presence of 120 volts across the vanes rendered a spacing of less than $\frac{1}{8}$ in. completely unacceptable. Needless to say, you will be unlikely to recover any components small enough to incorporate in that projected transistor portable, although occasionally, old valve-operated car radios can be found which were provided with astonishingly small, neat, and efficient tuning mechanisms and capacitors, which are well worth saving for future use.

Switches

Test routine is the same as for potentiometers. Subject the switch to a continuity test *and also an insulation test to earth,* especially if it is likely to be used for mains switching. Into this category we can include relays, which may be found on some old television sets, or more probably on surplus or ex-W.D. equipment of more recent vintage. Do not neglect the possibility of using these on, for example, radio control equipment, or for similar purposes—the experimental potentialities of a sensitive relay coupled with a photo-cell or photo-sensitive transistor are endless.

Metal Rectifiers

These can provide useful accessories, together with *heavy duty resistors,* for receiver and even transmitter power supplies, although, with the advent of silicon rectifiers at very reasonable prices, their potential usefulness is likely to be less than it might otherwise be.

Resistors and Capacitors

These should be cut off as near the terminals as possible (not unsoldered), but unless at least 1 inch wire ends remain after this operation, they are unlikely to be worth keeping. There is undoubtedly a point where thrift ends and parsimoniousness begins, and it may be that we are in danger of reaching that point now. The fact remains that, with the low cost and high reliability of new components of this sort, it may prove false economy to store what may turn out to be less than 95% perfect material—remember that a good junk-box must never live up to its name!

Other Components

Finally, an example of one component which it is usually wise to hang on to, and, in contrast, one which is almost never worth storing. The former is the loudspeaker, especially if it is the small elliptical type popular in most TV receivers. These actually improve with age, since the cone suspension becomes less stiff with use, and the undesirable bass resonance can therefore drop, sometimes by as much as an octave. The component to avoid is the high-voltage electrolytic capacitor. Even when these test satisfactorily, their subsequent failure rate, when incorporated into constructional projects, can be alarmingly high, and they are best consigned to the dustbin forthwith—new ones, besides being considerably smaller than their older counterparts, are surprisingly cheap nowadays, and represent extremely good value for money.

In conclusion, a word about storage. Even the smallest "shack" can accommodate a reasonably wide range of components, provided these are stored in a methodical manner. Shelves are a necessity, as are stout wooden boxes for all heavier pieces of equipment such as transformers, etc. The best guide here is commonsense, the point being that the "junk-box" must never consist of a single large container into which material is deposited haphazardly. Far better a series of small, neatly labelled boxes, even if these do take up a little more space. Sensibly handled, the cult of the junk-box, besides reducing costs, can add considerably to the pleasure of all aspects of radio construction. ■

BASIC SEMICONDUCTOR TECHNOLOGY

PART THREE

by M. F. DOCKER, M.Sc.

IN Part 2 the processes involved in the production of pure semiconducting materials were described. This leaves the device manufacturer in possession of his basic raw material, a uniformly doped slice of germanium or silicon. With this he can produce an enormous range of devices, from simple diode rectifiers to complex integrated circuits. This month the principles involved in the theory and manufacture of the diode will be discussed.

In Part 1 it was shown that the energy states in a semiconductor are arranged in bands separated by a certain band gap. At a temperature of −273°C, or absolute zero as it is called, electrons in all atoms are in the valence band and none are in the conduction band. In this case it may be said that there is a one hundred per cent certainty of a level in the valence band being filled but a zero probability of a level in the conduction band being filled. Consequently a curve like the one in Fig. 1(a) can be drawn. At higher temperatures electrons are excited into higher energy states so that the probability of an electron being in the conduction band is increased, as shown at (b) in the same figure for a temperature of 27°C.

The Fermi level

As can be seen, both curves go through the same energy level at the point where there is a fifty per cent probability of this level being filled. This energy level is called the *Fermi level* and in the case of intrinsic (i.e. undoped) semiconductor material it is as shown midway between the valence and conduction bands.

The curves are symmetrical about the Fermi level as can be seen. This is because the probability of occupancy of conduction band levels increases as the probability of occupancy of the valence band levels decreases. In practical terms this means that electrons which reach the conduction levels have come from the valence band since the number of electrons in the material is constant.

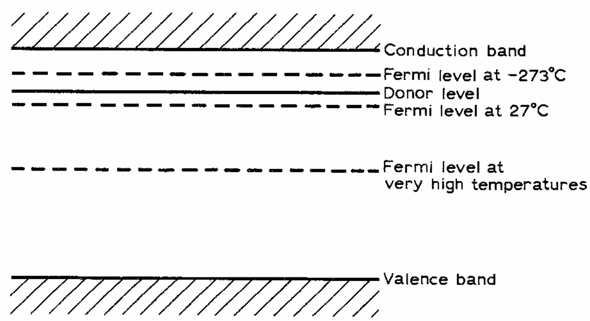


Fig. 2: Movement of Fermi level with temperature in doped semiconductor material.

With doped semiconductors however the Fermi level moves as the temperature is raised. With n-type material at absolute zero all the donor states are filled so that these behave like the valence band and the Fermi level lies between the donor level (see Fig. 2) and the conduction band. At higher temperaures however these states become vacant as electrons move to the conduction band and the Fermi level moves towards the level it has in intrinsic material. An analogous situation exists in p-type material. Here at low temperatures the Fermi level lies between the valence and acceptor levels.

The rate at which the Fermi level moves downwards depends on the doping level and on the host material. In typical combinations of these the Fermi level lies at room temperature just below the donor level or just above the acceptor level.

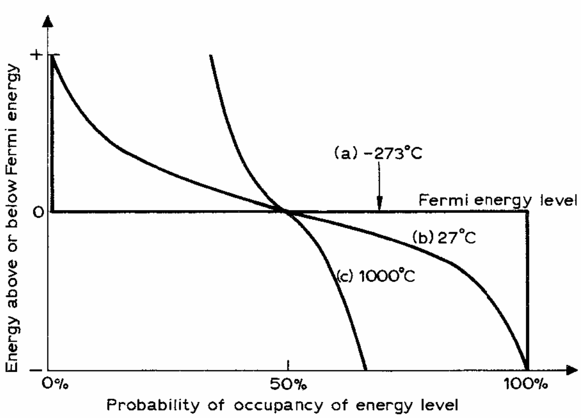


Fig. 1: Probability of occupancy of energy levels at different temperatures.

The p-n junction

If a piece of p-type material and a piece of n-type material could be brought together it could be shown that their Fermi levels would coincide, as shown in Fig. 3(a). Initial contact would not show this correspondence, as the Fermi level of the n-type material would be higher than that of the p-type material. However when contact is established on the atomic scale electrons diffuse from the material of n-type which has a high concentration of excess electrons to the p-type material which has a deficit

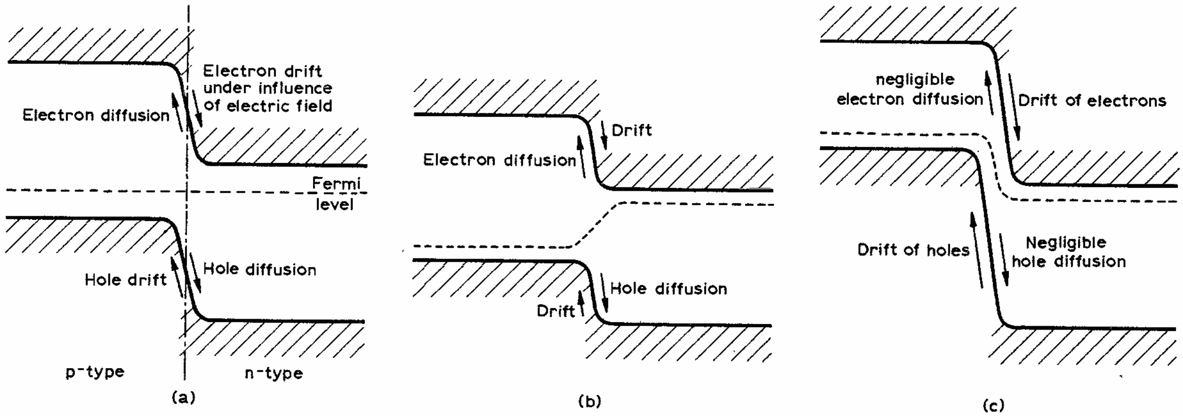


Fig. 3: (a) Energy levels and carrier flow in an unbiased diode. (b) Conditions at the p-n junction with forward bias applied. (c) Conditions with reverse bias applied to the diode.

of electrons. These electrons set up an electric field, the n-type side having a more *positive* potential than the p-type side. This is because the region to the right of the junction in the diagram then contains ionised donor atoms whilst the region to the left of the junction contains ionised acceptor atoms, with positive and negative charges respectively.

This field opposes the diffusion of electrons, itself giving rise to a drift of electrons in the opposite direction to the diffusion. Eventually an equilibrium is set up when the number of electrons diffusing from the n-type is equal to the number returning from the p-type material by the drift process. When this situation is established it is found that the Fermi levels at each side of the junction are equal (as shown in Fig. 3(a)). At the same time that the motion of electrons is under consideration it is also necessary to consider the diffusion and drift of holes in the opposite directions.

Depletion region

The positive donor ions and the negative acceptor ions are fixed in the crystal lattice and consequently in the region of the junction there is a deficiency of mobile current carriers and the term "depletion layer" is usually applied to the region. The ionised atoms compose a space charge which extends mostly into the region with lowest impurity, that is into the region of higher resistivity. Some consequences of this will be seen later when the punch-through effect in transistors is discussed.

Although there is an electric field across the junction this cannot be measured with a voltmeter because of effects which occur at the metal-semiconductor junctions. If it were possible to make this measurement the system would constitute a form of perpetual motion machine which unfortunately is not feasible.

Forward bias

Consider now what happens when a voltage source is connected across the junction with the positive terminal attached to the p-type material and the negative terminal attached to the n-type material. The Fermi levels will be displaced by a potential proportional to the voltage applied, as shown in Fig. 3(b). In this situation electrons from the n-type material have a much smaller potential hill to climb and consequently a much larger current will flow due to diffusion. However the thermally generated electrons from the other side will still produce the same drift current since their number depends on the temperature alone and they are all collected by the drift field. A current will flow through the p-n junction diode when it is connected in this *forward direction.* This current consists of electrons and holes although only the electrons have been considered here.

Reverse bias

If the voltage is connected in the opposite direction the potential hill against which electrons from the n-type region have to flow is increased as shown in Fig. 3(c). This results in a reduction of the diffusion current. Again the current due to thermally generated electrons from the p-side remains constant. Consequently when a reverse bias is applied to the system in this way only a small current flows, this time in the opposite direction to the current flow with forward bias. When a large reverse bias is applied this current approximates that due to thermally generated electrons alone and is independent of the bias. This is called the *saturation current* of the diode.

Diode characteristics

A typical voltage-current curve for a silicon and a germanium junction diode is shown in Fig. 4. It can be seen that the reverse saturation current I_{sat} is several times larger for germanium than for silicon; this is a consequence of the larger band gap of silicon. The *offset voltage* V_{os} is the value of forward bias for which the forward current is greater than some small threshold.

The current through the diode can be shown to be given by the equation:

$$I = I_{sat}\,(e^{aV_{app}} - 1)$$

where a is a constant which increases with temperature, V_{app} is the voltage applied to the diode and $e=2{\cdot}7$. This exponential increase explains the appearance of the offset voltage, and the larger value of

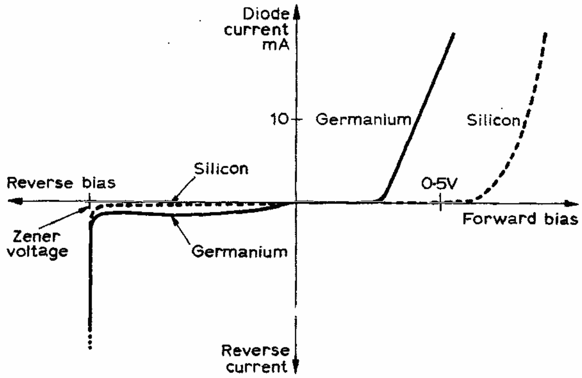


Fig. 4: Typical current/voltage characteristic curves for silicon and germanium junction diodes.

I_{sat} for germanium explains why it has a lower offset voltage.

At high reverse bias voltages breakdown of the junction occurs. There are two main effects responsible for the breakdown. First the process called *avalanche multiplication,* which is caused by thermally generated electrons being accelerated across the depletion layer. During their passage they collide with unionised atoms and liberate more electrons by ionising these atoms. This process is repeated by the greater number of electrons now existing and results in a large current flowing across the junction. A voltage of more than 6V is required to produce the *avalanche breakdown effect.* At lower voltages another effect can produce breakdown of the junction; this is the *zener effect* which is caused by the strong field across the junction. Because of its narrow width a voltage of 6V can lead to a large potential gradient which is what the breakdown relies upon.

The manufacture of diodes

In Part 2 the production of a crystal of semiconducting material with a uniform impurity concentration was described. Because of the different segregation coefficients of different dopents various quantities of dope have to be added to the melt from which the crystal is being grown. To obtain the same doping concentration with different dopents appropriate amounts are required. If equivalent amounts of n- and p-type dopents are added it is possible to produce compensation, with acceptors and donors balancing exactly, giving no net doping.

This can be utilised in preparing a p-n junction during crystal growth. If n-type dope is added to the melt from which the crystal is being grown then the first part of crystal to be grown would be n-type. Now if sufficient p-type material is added to the melt the n-type dopent will be over-compensated so that the next part of the crystal to be grown will be p-type. By doing this it is possible to produce a p-n junction.

The segregation coefficient for different dopents changes as the rate at which the crystal is grown from the melt is changed. For antimony in germanium the segregation factor increases quickly with growth rate but with gallium it changes more slowly. If correct amounts of these dopents are added to the melt it is found that a rapid growth rate results in antimony doped n-type material but a slow growth rate leads to gallium p-type doping. So, variation of the growth rate can also be used to produce successive n- and p-type regions giving a chain of junctions. These are subsequently sliced to give discs of perhaps 1 in. diameter which are made into hundreds of diodes.

Diffused junction diodes

It has been described how impurity atoms will diffuse rapidly into the body of a semiconductor at a high temperature. This fact is utilised in one type of diffused junction diode. A coating of a p-type impurity is applied to one surface of a slice of n-type material. This is subsequently heated to 800-900°C for a defined time whilst the impurity diffuses into the slice. A p-n junction will be formed across the plane reached by the impurity.

The process of heating results in a decrease in the lifetime of the minority carriers and consequently to an increase in the forward resistance of the diode, making it less suitable for high current applications. However it also results in a decrease in the diffusion capacity which improves the switching characteristics. A gradient of impurity ions is obtained across the junction in this type of device so that the field strength across the junction is reduced and consequently the reverse breakdown voltage is increased. Because of this it is also possible to employ a high impurity concentration with consequent low series resistance whilst still maintaining a high reverse breakdown voltage.

Alloy diodes

Alloying is very frequently used in the manufacture of diodes. A small piece of a suitable impurity such as indium is placed on an n-type germanium slice and heated to about 500°C. The indium melts and dissolves the surrounding germanium. As the slice is slowly cooled the mixture of indium and germanium recrystallises to give a strongly p-type region. An abrupt junction is formed at the boundary region, without any built-in impurity gradient.

Epitaxial planar diodes

Epitaxial planar diffused junction diodes are becoming available as integrated circuit techniques develop. However their method of manufacture will be described together with those of integrated circuits in a later article.

Diode connections

Leads are connected to both sides of the diode to give non-rectifying or ohmic connections so that the diode can conveniently be coupled to an external circuit. The diode is then sealed in a glass or metal case in order to avoid atmospheric contamination occurring.

In the following Part the other types of diode which are available will be described and their individual merits discussed.

TO BE CONTINUED

practically wireless commentary by HENRY

No. 59 The Peter Principle

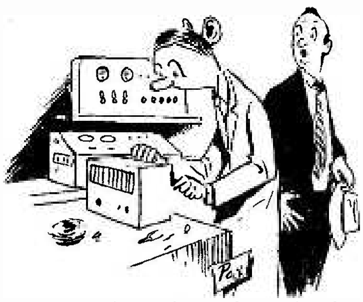
IF you have ever paused to wonder why your ten-transistor portable spends more time going back to the workshop than receiving Radio One; if your brand-new amplifier develops an angry hum; if I-Cs disintegrate in your hand, don't worry—it is probably the Peter Principle at work.

Not so different really from some of the extensions to Henry's Law (inanimate objects subsection), the Peter Principle quests further afield and takes in cybernetics. It is the study of human incompetence.

Dr. Laurence Peter is a Canadian, a university professor, once a prison instructor and a school psychologist. He has collaborated with Raymond Hull, a British writer now living in Canada, to produce a wildly satirical book based on the theory: for every job there is a man somewhere who cannot do it. Sooner or later they will coincide.

In a large organisation, such as the Superset factory where your transistor radio was born, a man who shows promise at his job can expect to be offered promotion. He moves up the ladder each time he proves a success until he reaches the level where his capabilities are blocked by the demands of his new task. And there he sticks.

First of all, he was sorting out the components in the Superset stores. Then, when he had learned the colour codes and other fundamentals, they shifted him up to the production line. Not content with merely soldering bits into chassis, he went to night school and learned a few formulae, so they moved him to the test department.



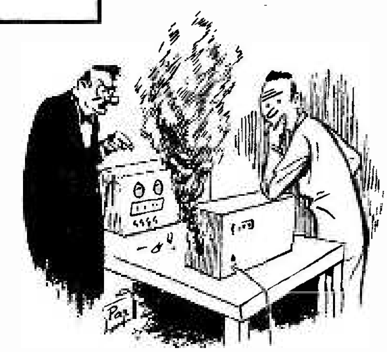
... *ears in the back of their heads*

Now the test department in the average radio factory (or, at least, those few Henry has worked in) consists of the lance-jacks who carry out spot alignment, with instruments set up for them—"You just twiddle this screw till that needle reaches this line, see?"—then the corporals who do alignment and other adjustment checks, then the final test bods, who have to have ears in the back of their heads, and finally the elite warrant officer class who undertake the trouble-shooting.

There are several lines of progress. With his acquired know-how, he may just be capable of entering the planning or design department; in a mundane capacity, making up breadboard lash-ups as instructed.

In time, his breadboard efficiency is noticed and he is given a few minor modifications to do. Being wise in factory ways by now, he keeps his eyes open, follows the trend and doesn't quite make a hash of it. But we all know how late his mods are, don't we? The set we bought is very different from the model Superset market now. It is a corollary to Henry's Fourth Law that our receiver will be the Mark One with the knobs that split, the volume control that rasps, the on/off switch that flips but does not flop, the noisy transistors, the printed circuit without that link that bridges the draughtsman's error . . .

Nobody notices our friend is beginning to flag. He marries the Sales Manager's daughter and becomes a fully-fledged designer. He is the chap that was responsible for the amplifier whose output valves cooked a hole in the



. . . *whose output valves cooked a hole in the cabinet*

cabinet. But that was so long after production, and the design was remarkably cheap to make, so he was once more a success and now leads a subsection team.

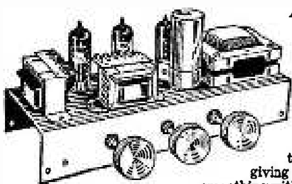
There he sticks—and why? Because he has reached the limit of his capability. New techniques have overtaken him, his mental gate is closed to F.E.T.s, he can't even pronounce quasi-complementary and to him Darlington is just a place where the trains start from.

But the reason he eventually gets the sack—in accordance with the Peter Principle—is not his incompetence. Just the opposite, in fact. In a desperate attempt to redeem his good name he designs a tuner about which the reviewers rave. It has all the station-seeking attributes one could wish for and Superset spend a mint on advertising it before the prototype is completely unwrapped.

Our friend has made his name. He glows with pride as the first ten roll off the line—then sinks into oblivion, for the gold-plated I-C on which he based his i.f. strip can only be made in mid-transvaria and the Customs and Fxcise won't release any more from bond. So the Superset tuner is modified out of all recognition, becomes uneconomic and, like its designer, is dropped.

Henry's Third Law tells us that you and I, Joe, will always get the modified type!

DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 volts. 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 potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A Dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate 'Balance' control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v. for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs. Chassis size 11"w × 4"x. Overall height including valves 5". Ready built and tested to a high standard. PRICE 8 gns. P. & P. 8/-.

TRANSISTOR STEREO 8 + 8 MK II

Now using Silicon Transistors in first five stages on each channel resulting in even lower noise level with improved sensitivity. A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors giving 8 watts push pull output per channel (16W. mono). Integrated pre-amp. with Bass, Treble and Volume controls. Suitable for use with Ceramic or Crystal cartridges. Output stage for any speakers from 3 to 15 ohms. Compact design, all parts supplied including drilled metal work. Cir-Kit board, attractive front panel, knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Freq. response ±3dB. 20–20,000 c/s. Bass boost approx. to +12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 25V at ·6 amp.

PRICES: AMPLIFIER KIT £10.10.0; POWER PACK KIT £3.0.0; CABINET £3.0.0. All Post Free.

Circuit diagram, construction details and parts list (free with kit) 1/6. (S.A.E.).

SPECIAL PURCHASE!
E.M.I. 4-SPEED PLAYER

Heavy $8\frac{1}{2}$in. metal turntable. Low flutter performance 200/250 v. shaded motor (90 v. tap). Complete with latest type lightweight pick-up arm and mono cartridge with t/o stylii for LP/78. ONLY 63/-. P. & P. 6/6.

4-SPEED RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.
B.S.R. UA25 with latest mono compatible cart. £6.19.6
All plus Carriage and Packing 6/6

LATEST GARRARD MODELS

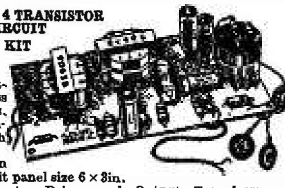
All types available 1025, 2025, SP25, 3000, AT60 etc. Send S.A.E. for latest Prices!

PLINTH UNITS

Cut out for Garrard Models, 1025, 2025, 2000, 3000. AT60, SP25. With rigid perspex cover. OUR PRICE 5 gns. complete. P. & P. 8/6.

LATEST RONETTE T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo/78. Only 32/6. P. & P. 2/-.
LATEST RONETTE T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only 30/-. P. & P. 2/–.
SONOTONE 9TAHC compatible Stereo Cartridge with diamond stylus 50/-. P. & P. 2/–.
FEW ONLY! ACOS High-G Mono Cartridge for EP and LP. Only 10/-. P. & P. 2/-.

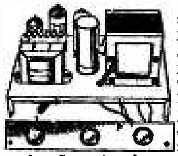
HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT
Type TA1



- Peak output in excess of $1\frac{1}{2}$ watts.
- All standard British components.
- Built on printed circuit panel size 6 × 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 2/6 (Free with Kit). All parts sold separately.

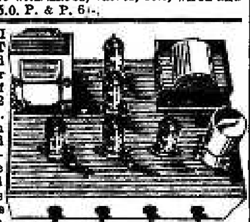
SPECIAL PRICE 45/-. P. & P. 3/-.
Also ready built and tested, 52/6. P. & P. 3/-.

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 $7\frac{1}{2}$" w. × 4" d. × $4\frac{1}{2}$" 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 $4\frac{1}{2}$ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4.15.0. P. & P. 6/-.

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 bass and treble controls are provided giving good lift and cut. Valve line-up 2EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 2/6 (Free with parts). All parts sold separately. ONLY £7.9.6. P. & P. 8/6.
Also available ready built and tested complete with std. input sockets, £9.5.0. P. & P. 8/6.

BRAND NEW 3 OHM LOUDSPEAKERS

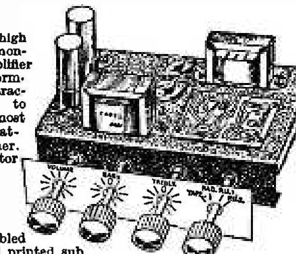
5in. 14/-; $6\frac{1}{2}$in. 18/6; 8in. 27/-; 7 × 4in. 18/6; 10 × 6in. 27/6 E.M.I. 8 × 5in. with high flux magnet 21/-. E.M.I. $13\frac{1}{2}$ × 8in. with high flux ceramic magnet 42/- (15 ohm 45/-). E.M.I. 13 × 8in. with two inbuilt tweeters and crossover network. 3 or 15 ohms 4 gns. P. & P. 5in. 2/-. $6\frac{1}{2}$ & 8in. 2/6 10 & 12in. 3/6 per speaker.

BRAND NEW. 12in. 15w. H/D Speakers, 3 or 15 ohms. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly £5.10.0. P. & P. 5/-. Guitar models: 25w. £6.0.0. 35w. £8.0.0.

E.M.I. $3\frac{1}{2}$in. HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3 or 8 ohms 15/- each; 15 ohms 18/6 each. P. & P. 2/6.

VYNAIR AND REXINE SPEAKER AND CABINET FABRICS. Approx. 54in. wide. Usually 35/- yard. Our PRICE 13/6 per yard length. P. & P. 2/6 (min. one yd.). S.A.E. for samples.

NEW! HSL.700 MONO TRANSISTOR AMPLIFIER



A really high fidelity monaural amplifier with performance characteristics to suit the most discriminating listener. 6 transistor circuit with integrated pre-amplifier assembled on special printed sub panel. AD161-AD162 operating in symmetrical complementary pair. Output transformer coupled to 3 ohm and 15 ohm speaker sockets. Standard phono input sockets. Full wave bridge rectifier power supply for AC mains 200-240v. Controls: Bass, Treble, Volume/on/off. Function selector for PU1, PU2, Tape, Radio. The HSL.700 is strongly constructed on rigid steel chassis bronze hammer enamel finish, size $9\frac{1}{2}$ × 5 × $4\frac{1}{2}$ in.

Performance figures:
Sensitivity: PU1-50m/v. 56K input impedance.
PU2-110m/v, 1 meg input impedance.
Tape—110m/v, 1 meg input impedance.
Radio—110m/v, 1 meg input impedance.

Output power measured at 1Kc—6.2 watts RMS into 3 ohms, 5.8 watts RMS into 15 ohm. Overall frequency response 30 c/s-18 Kc/s: Continuously variable tone controls: Bass, + 8 db to — 12 db at 100 c/s. Treble, + 10 db to —10 db at 10 Kc/s.

The HSL.700 has been designed for true high fidelity reproduction from Radio Tuner, Gramophone deck and Tape Recorder pre amp but is also capable of being used in conjunction with a guitar by connecting to PU1 socket and the peak output power will then be in the region of 15 watts. Supplied ready built and tested, complete with knobs, attractive anodised aluminium front escutcheon panel, long spindles (can be cut to suit your housing requirements) full circuit diagram and operating instructions.

Our Special Price **£7.19.6** P. & P. 7/6.

COLLARO MAGNAVOX 363 STEREO TAPE DECK. 3-speeds 4 track, up to 7in. spools. £16.10.0. Carr. 10/-.
HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE 21/-. P. & P. 1/6.
CARBON MIKE INSERTS. Brand new $2\frac{1}{2}$in. dia. 5/-. P. & P. 1/6.

QUALITY RECORD PLAYER AMPLIFIER MKII

A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7" w. × 3" d. × 6" h. Ready built and tested. PRICE 75/- P. & P. 6/-. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit into cabinet below. PRICE 97/6. P. & P. 7/6.

DELUXE QUALITY PORTABLE R/P CABINET MKII Uncut motor board size $14\frac{1}{2}$ × 12in. Clearance 2in. below. $5\frac{1}{2}$in. above. Will take above amplifier and any B.S.R. or GARRARD autochanger or Single Player Unit (except AT60 and SP25). Size 18 × 15 × 8in, PRICE 79/6. P. & P. 9/6

MAINS TRANSFORMER. Primary 200-240V two separate ½ wave secondaries giving approx 16V at lamp and 20V at 1·2 amp; secs. can be connected in series for 36V at 1·5 amp. Ideal for transistor power supplies. Drop through mounting. Stack size $2\frac{1}{2}$ × $3\frac{1}{4}$ × $\frac{7}{8}$in. 15/-. P. & P. 6/-.
MAINS TRANSFORMER. For transistor power supplies.
Pri. 200/240v. Sec. 9–0–9 at 500 mA. 11/-. P. & P. 2/6.
Pri. 200/240v. Sec. 12–0–12 at 1 amp. 14/6. P. & P. 2/6.
Pri. 200/240v. Sec. 10–0–10 at 2 amp. 27/6. P. & P. 3/6.

Open all day Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station

HARVERSON SURPLUS CO. LTD.
170 HIGH ST., MERTON, LONDON S.W.19 Tel.: 01-540 3985
SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

Please write clearly
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

RADIO TELEMETER UNIT

These are a low frequency Rx working on 120Kc for use on 230v. mains, they can easily be modified to 200Kc Radio 2, or provide basis for Swt tuned radio or gram amp. Uses valves ECF82x3, 6BE6, 12BH7, 6BA8 as $3\frac{1}{2}$"Spk., 2 low speed motors, Tape Rec head with tape loop, 3 relays, 3 Rot swts, 2 solenoids, 2 mains trans., coils, timers, knobs etc. Complete in neat cabinet size 14 x 7 x 6" modern make in good condition with circ & mods for 200Kc. Price **£3.5.0,** plus 7/6 carr.

A. H. SUPPLIES
57 Main Road,
Sheffield 9.

MOBILE S.W. LISTENERS

The Halson Mobile Antenna for
AMATEUR RECEIVING and TRANSMITTING

The most efficient mobile All-Band Whip on the market. COILS FOR ALL BANDS. Complete with one coil **£6.17.6,** plus 3/6. Extra coils **£3.17.6,** plus 3/–.

From leading amateur radio stores or direct from the manufacturers:

HALSON ELECTRICAL SERVICES
Dover Road, off Ansdell Road, Blackpool.

Est. 1943 **JOHNSONS** Tel: 24864

VHF and **Short-Wave kits** for the Amateur enthusiast and constructor. For 2 and 4 metres, the unique two transistor model SR2/P, 70–150Mc/s, **75/-,** p.p. 4s. New super 5V all-wave, all-band kit, also "Mini-Amp" self-contained, cabinet, size a mere $4\frac{1}{2}$ x $3\frac{1}{2}$ x $2\frac{1}{4}$. Write today, enclosing a stamped addressed envelope for interesting free literature, and details, direct to

JOHNSON'S (RADIO)
St. Martin's Gate, Worcester

IT'S all very confusing really. The propagation Confuciuses say: "When sun is spotty, l.f. bands grotty." True as this may theoretically be, it becomes rather difficult to explain the W stations on c.w. regularly heard happily squeaking away on 1·8MHz. The PY stations on 3·5MHz, not to mention the African stations, all seem to indicate that theory and practice do go together—but you need quite an imagination at times to believe it.

John Moore (Leicester) says that LG5LG is near Magnor in Norway. He also tells that this month he logged a station at every hour of the day and night except 0400hrs GMT. Never mind John, I never have any luck at 0400, probably 'cos I'm fast asleep in bed!

Various scribes have written in with titbits of info. One tells of rumours that OY stations are hoping to be on 1·8MHz soon. Foreign parts to tune for when switching on are Tokelau Island (listen for ZM7) and Manahiki (ZK1).

Barry Weston (Poole) informs that Chatham Island is going strong, but this is rather a sore point with me since my Chatham Is. signals were almost certainly emanating from the spotty faced s.w.l. of 12 moons who, I feel sure, is "at it" with a transistor rig about 800 yards from my long wire.

Twenty metres offers an easy way to log half the world in one go. Best times for VK/ZL have been the wee small hours till breakfast time. The JA stations seem to arrive later around lunch time. Twenty's stablemate, 21MHz, is good from breakfast until midnight and peaks very well at times. Ten metres comes and goes, but early mornings to tea time usually produce some good sigs with DX sneaking through and peaking to 5 and 9 plus. Late night listening has produced noises like frying eggs in the cans and has been no good at all.

Nobody listens on 70MHz and 144MHz, or if they do, they keep jolly quiet about it. As soon as you've read this sentence, stand up and shout "Listen on 4 and 2 metres", and then go and do it. Don't forget to let me know what you hear—when I'm sure it's safe, I'll have a listen too. Incidentally, for those who think these are just cross-town bands, the recent SM7/ZL1 2-metre contact would take a bit of explaining.

MULTIBAND LOGS

Most s.w.l.s listen on more than one band, although usually they have a favourite. Because of space considerations I usually put in one-band reports only and select the best one from the log. But, this month, I'm setting down all the logs for a change (Ooh! Isn't he bold).

A. Hall (Kent) lists among his possessions one modified Eddystone 888A plus a.t.u., a 110ft. long wire, and a multiband folded, loaded dipole. On 1·8MHz—GI and GM; 3·5MHz—CT2AT, EP2BQ, GI, GM, GW3XTA, running 6 watts, HB9ABM, HB9ALG, I1AHO, K1CTA, MP4TAF, OH, ON, OZ, OY4OV, OY6NRA (club station), PAØ, PY7ASQ, PY7GV, SK, SM, UA3KAA, UP2TB, VO1FG, VO1FX, W2BL, W4BFA, YO5TI, YU2HPE, ZB2BS, 5A1TN: 7MHz—GB2SM, I1LAI, MP4TAF, YV4IQ, YU3TGI, W4PHE, WA1FKS, WA3FWJ, WA5ORK. All on s.s.b. except the last four W stations.

W. Harper (Staffs) describes 40 metres as ". . . audible fog". The gear comprises an 840C, Joystick plus Joymatch at 36ft. with a 66ft. feeder. Forty s.s.b. —CT1GD, CT2AK, EA3HF, EP2BQ, HC4ME, HB9UD, HI2HH, K4RUG, MP4TAF, OZ5VT, PY8VA, SK5AA, SL3ZV, UF6CR, UV9KAG, W2EWT, W3IGK, W4QR, W5GTP, W5OVR, WA2GLH, WA3PSJ, WA4VWX; 20 s.s.b.—EA1CRP, F2UX, FP8CS, KP4AST, HV3SJ, KV4DL, KR6AF, KZ5NF, OA4JRT, OZ8QX, PI1GHK, PY8MG, SVØDD, TI4JM/P7, UM8IKZ, VE2DC, VE3CRP, VE6AFJ, VK1RD, VK2BSM, VK2DY, VK3TG, VK4UC, VK5MS, VK7AZ, W7SFA, YV4VA, ZC4MA, ZL4BX, ZL4LD, 4S7AS, 9G1YJ, 9E3USA, 9V1PB.

Stephen Cole (Monmouthshire) has a trio JR60. An indoor wire (man that's living) raised these on 28MHz—CX4IX, FG7XT, KV4AD, PZ1DA, VP8KL, VS6AL, YA1AR, ZS1YX, 7Q7WW, 9N1MM, 9X5AA;. 7MHz—CO2DC, K2RTH, MP4TAF, PY7EC, W8UM, YV1BI, ZC4HS, 5A2TR, 9H1BA.

TWENTY METRES

R. Dinning (Ayrshire), HA350 Mk2, PR30X and RQ10, 380ft. long, long wire, logged this lot on 14MHz s.s.b.—CT2AK, CT3AW, DU1ZAG, ET3USA, HR1DB, HV3SJ, JA3GZN, KX6FA, HL9UU, LG5LG, PZ1DD, SU1MA, TI2AP, VK2XG, VK3XI, VK6ID, WA4DUC/HS, XE1DE, ZL1KM, ZL1NB, VP2LA, VP9FE, VR6AL, VU2OLK, 3AØCU, 3V8AC, 5N2AAX, 6Y5DB, 8P6AF, 9E3USA, 9K2AM, 9Q5HS, 9Y4LP.

J. Moore (Leics.), CR100/2, 60ft. end fed, had two weeks off from school. Homework on 20 s.s.b. gets him ten out of ten for logging—CE3FH, CE6CA, CP1GN, CX6CG, DU1FH, F9UC/FC, HK5BDS, HS3RT, JA4AS, K7BCX, KR6KN, LG5LG, M1B, OA4OS, OY6NRA, PJ2CC, PJ7JC, SVØWN, TA1MGP, TA3RF, TF2WLT, TI2MEF, UA9KDL, UF6CR, VE3EQI, VE5BV, VE6XJ, VE7PV, VK2EK VK5MO, VP7NH, VQ8CPR, VR6TC, W2FHO/W7, W5HE, WA4PUC/P/HS, WA6BMG, WB6MOS, W7AEK, XE1IX, XW8AX, YS1O, YS2RAR, YV2HQ/P/3, ZL4BX, 4S7PB, 4Z4HF, 5R8AN, 8P6CV, 9Q5IA.

HAPPENINGS

If you are thinking of having a rest in July, don't bother. It's quite a busy month for the keen types who can stand the pace. July 5th—6th, topband contest; 5th—6th, 2 metre contest; 6th, South Shields mobile rally; 12th—13th, high power field day; 13th, Worcester mobile rally; 20th, 70 cms, contest; 27th, Cornish mobile rally.

Please remember that logs must reach me by the 20th of the month, otherwise they miss out no matter how good they are. Those in alphabetical order are always at the top of the list, while those with no mention of which band or mode etc., are right at the bottom.

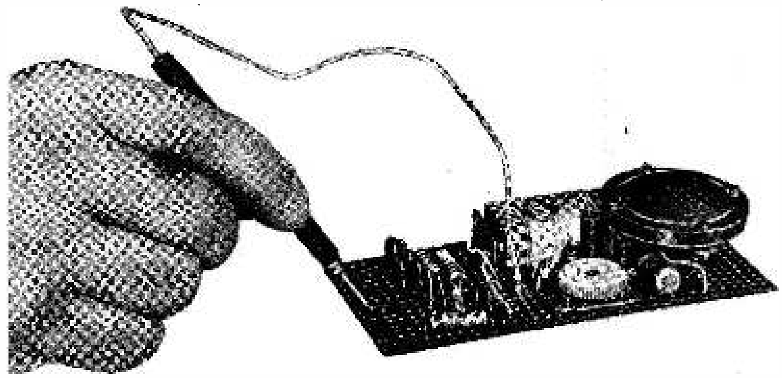
Warning well in advance. A letter from G3FSN says listen for GB3WRA from the annual Wycombe Show, all bands 160-4 metres on Saturday, September 6th.

TAKE 20

JULIAN ANDERSON

No. 4 AN ELECTRONIC ORGAN

A series of simple transistor projects, each using less than twenty components and costing less than twenty shillings to build. This month's project is described more fully than usual and should prove popular with both our musical and unmusical readers.



The Take 20 prototype of the electronic organ.

PERHAPS we are cheating a bit this month as, although we are still within our 20s. limit we are using more than 20 components. As an excuse I offer that if only a single octave version is required we remain strictly within our category.

In building it I had a problem, apart from unsuccessfully attempting to vamp a guitar and successfully reproducing the drone of Lancaster bombers by depressing one note of a foot-pumped organ, I have never played a musical instrument. On seeking advice I learnt that about 15 notes including sharps and flats were necessary to play the simplest tunes and this our project achieves.

Last month a metronome was described and it was while playing about with this that the idea was born. If, instead of using a 30μF capacitor a 0·1μF was substituted, a high note is reached, varying with the setting of the potentiometer. A version based on this circuit however has disadvantages; stability was hard to achieve and the resistance scale followed no known law, probably due to the leakage etc. of the transistors.

THE CIRCUIT

A unijunction transistor 2N2646 was used instead with very much better results and one is used in the final circuit. However, the volume from the unijunction, using 9V and a small speaker, was inadequate and therefore a simple amplifier, consisting of almost any p-n-p germanium transistor, was added. The amplifier transistor should be able to handle a decent collector current and an OC81 or similar type is ideal. Note that Tr2 is drawing a fair current and should be fitted with a small heatsink to protect it.

The working of the unijunction has been described recently in an article in PRACTICAL WIRELESS (Nov. and Dec. 1968) and there is no point in duplicating this information—all that need be said is that the unijunction has two bases and one emitter, but no collector. The amplifier section is completely standard and needs no explanation.

The actual frequency depends on the value of the resistance selected between the positive rail and the emitter of the unijunction; the combination of the resistance and the 0·1μF capacitor determines the note.

THE OUTPUT

Either an 80Ω impedance loudspeaker or a balanced armature earpiece may be used: funnily enough in this circuit the latter was not only louder but produced a more pleasant note (this doesn't apply of course to normal audio). This is probably due to the waveform which takes the shape of a spike when displayed on an oscilloscope.

Although the volume is more than adequate, the battery drain is only about 15mA from a 9V battery. If one wants to use an external amplifier the take-off points are across R16, 100Ω, but the input impedance of any such amplifier should be fairly

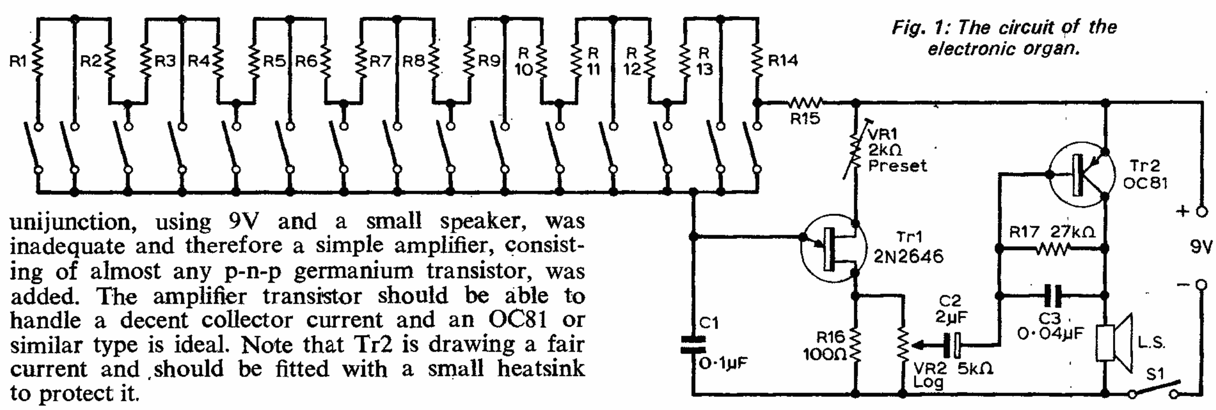


Fig. 1: The circuit of the electronic organ.

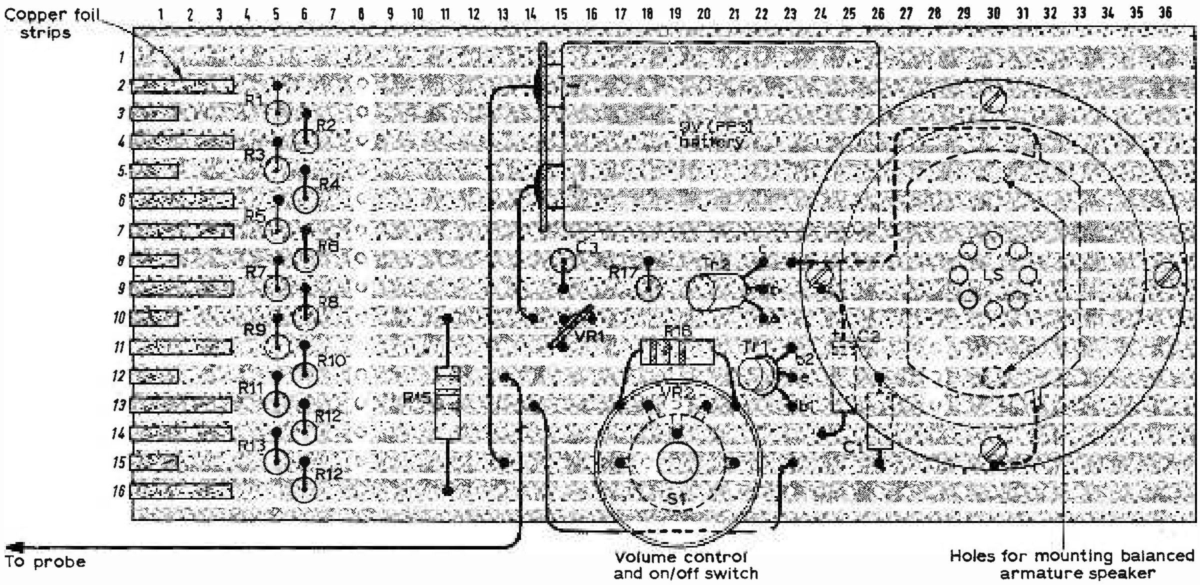


Fig. 2: The layout of the components on the Veroboard. The balanced armature earpiece is held by two short screws.

high otherwise a damping effect takes place on the oscillator.

Difficulty may be experienced in obtaining the correct value resistors as some, such as the 620Ω, 750Ω, 910Ω and 1·1kΩ are not preferred values. One way is to select these values from a batch of 20% tolerance resistors but arrangements have been made with Electrovalue Ltd. of Egham to supply a pack of R1 to R15 to the specification inclusive for 3s. 4d. including postage.

CONSTRUCTION

All the components are mounted on a piece of Veroboard 5½ x 2½ins, one end of this forming the "keyboard", the other holding the battery, the loudspeaker and the main components. The actual keys are made by using short lengths of Cir-Kit adhesive copper strip bent over the end of the board to bring the "keys" to the top. To differentiate between the ordinary notes and the semitones the latter strips were cut shorter than the others.

The layout is completely uncritical and many constructors may wish to build the unit into a small cabinet. Figure 2 shows the suggested layout.

PLAYING THE ORGAN

The actual notes are played using a probe (one from an old testmeter was used by the author) to select the correct notes.

VR1 is a 2kΩ trimmer pot. which will tune the instrument to another such as a piano. A volume control is fitted and unfortunately, because of the simplicity of the circuit, this very slightly affects the note, but no problem will be experienced if the volume is set before tuning up. Extra octaves can be added by placing a carefully matched capacitor either in series or in parallel with C1.

The range of the basic keyboard can be extended by adding further resistors to the chain (these will have to be chosen by experiment). The tone of the instrument can be altered by removing or changing the value of C3, also extra volume will be achieved, but with it removed the notes are harsh and unpleasant—at least to my unmusical ears.

An attractive point that this circuit has because of the use of a unijunction is that the note emitted is virtually independent of battery voltage; the prototype was stable even when the battery was reading only 4·5V.

Next month our project is a transistor tester designed to sort out the good, fair and dud transistors sold in the surplus 10s. packs for leakage and gain in both p-n-p and n-p-n types. In addition it checks its own battery, measures other battery voltages under load, measures resistance between 500Ω and about 50kΩ, acts as an electrolytic capacitor check and checks continuity; in fact it should prove an extremely useful addition to your testgear. For this a moving coil meter with a movement of 3mA or better is needed (details of adapting any meter with a greater sensitivity are given). Meters with a 3mA movement are advertised in this issue for 9s. 6d. and these should be ideal. ■

★ components list

Resistors:

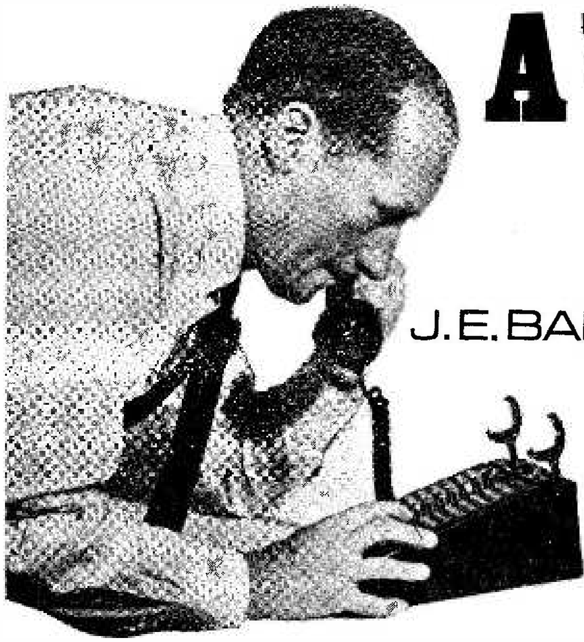
R1, R2 1·2kΩ 5%	R12, R13 680Ω 5%
R3, R4 1·1kΩ 5%	R14 620Ω 5%
R5, R6 1kΩ 5%	R15 10kΩ 5%
R7, R8 910Ω 5%	R16 100Ω 10%
R9, R10 820Ω 5%	R17 27kΩ 10%
R11 750Ω 5%	All ⅛ or ¼ watt miniature
VR1 2kΩ lin. preset	VR2 5kΩ log with switch

Capacitors:

C1 0·1μF 12V	C3 0·04μF (optional)
C2 2μF 12V	

Miscellaneous:

Tr1 2N2646 or equiv. Tr2 OC81 or equivalent
Veroboard, 0·15in. matrix 5½ x 2½in.; Balanced armature earpiece or 80Ω loudspeaker; 9V battery; Cir-Kit strip; test probe; heatsink.



A VERSATILE INTERCOM SYSTEM

J. E. BARRETT

PART 1

THE intercom described in this article has been built up over recent years from a relatively simple arrangement of key switch units, obtained on the surplus market, to a complex system proving invaluable in a large house. The layout of the article allows the reader to start off with any number of units and to enlarge the arrangement with extension units as he wishes. No amplifiers are used in the construction and hence it is a simple job to wire up the units—a soldering iron and patience being all that is required!

The various types of equipment used are:

(i) Three-key units. Each unit has access to four other extensions, i.e. each of the first two keys can be placed in the up or down position. The third key is for ringing.

(ii) Seven-key units—as the three-key unit but having twelve locking key positions and one non-locking *ring* key.

(iii) Fifteen-button units shown in the heading photograph, having access to fourteen units.

(iv) GPO telephones—types 200, 300, 700 etc.

Basic system

Any number of the basic units may be connected together (see Fig. 1) depending upon the availability of the switches. Lifting the receiver causes the rest-switch, A, to change over to the receiver contact. A selector key or button is then operated to select the desired station. Pressing the *ring* key now provides a path between the local battery and the buzzer at the distant end via the appropriate loop wire and the common return wire. When the distant receiver is lifted, switch A changes over to complete the speech circuit. Replacing the receivers causes both switches to revert to normal, and the keys or buttons to cancel. Only the battery at the local end is used for a call, and the person on the extension need not operate any of the keys or buttons to receive an incoming call.

The circuit in Fig. 1 is that for the key units shown in the photograph. For the button units, the *ring* switches (complete depression of the selector button) will need to be paralleled together and coupled between X and Y in Fig. 1.

Wiring of the key units

After removing the outer casing it can be seen that the unit consists of:

(i) The main frame carrying a G block with some 12-20 terminals and two buzzers.

(ii) A front panel carrying the key switches.

(iii) An intermediate portion containing a miscellany of transformers, condensers etc.

The simplicity of the circuit makes the capacitors and transformer unnecessary and these are best removed, also remove the multicore cable and receiver. Next, trace the wires from the key switch contacts to the G block and disconnect all others. It is best to adopt a logical approach to the rewiring of the G block so that faults may be remedied easily at a later date if necessary. The receiver will have four wires connected to it. Strap the Blue and Green on the G block and connect the Red and White to

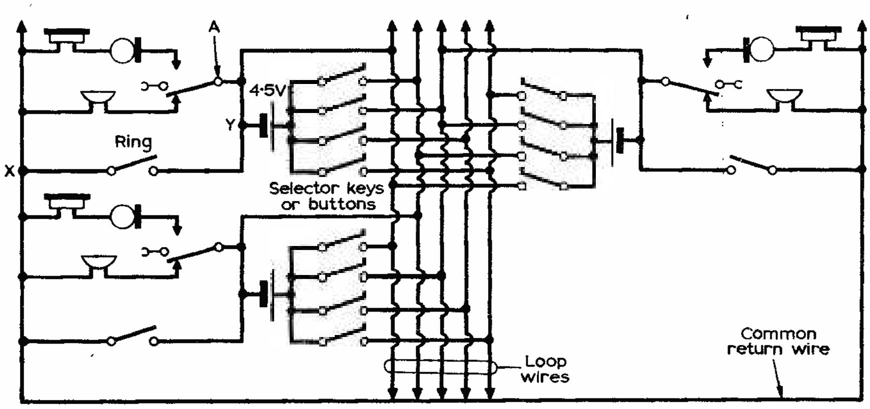


Fig. 1: Circuit of basic system showing three units.

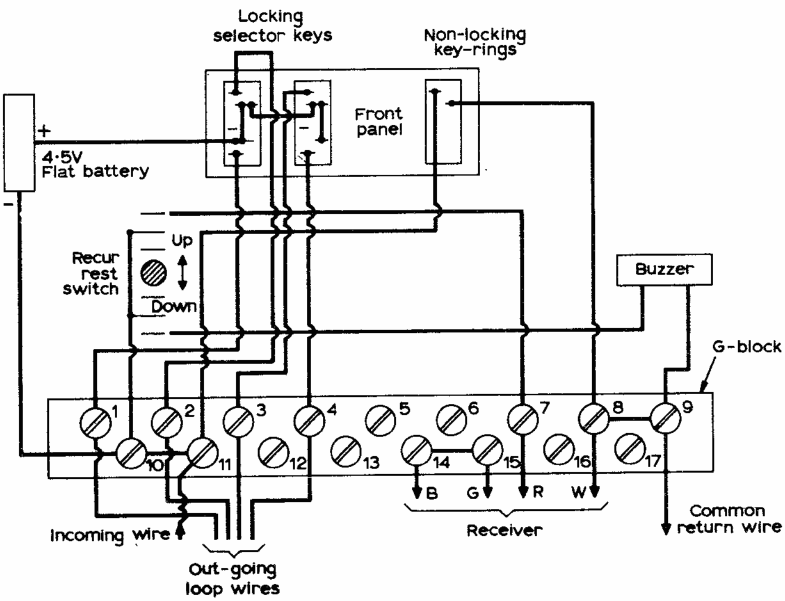


Fig. 2: Wiring diagram for key units.

the unit. The sidetone produced by coupling the transmitter and receiver in series is not too distracting.

The receiver rest switch consists of three leaves each side of a rubber roller which causes the three leaves to short together—the upper set when the receiver is lifted and the lower set when the receiver is "on". In order to make a single-pole change-over switch from this arrangement it will be necessary to common one leaf from each of the sets (see Fig. 2).

Button units

Several types of these units are available but all the later ones incorporate basically the same type of switching facility. Some may have junction boxes containing up to three relays which are not required. The author has found that the variation between these units involves the "receiver rest" switch. In the simpler kind the switch consists of one or two change-over contacts which are actuated when the receiver is lifted. Later versions have a spring set containing two change-over contacts. These change over when the receiver is lifted for an incoming call but revert to normal when a "station select" key is depressed. The wiring diagram in Fig. 1 must therefore be modified to allow for this.

When a caller wishes to contact a button unit of this type 4·5V is applied across the outgoing loop wire and the common return wire. Switch A changes over when the receiver is lifted and conversation may proceed. Should an outgoing call be made from a button unit of this type, the receiver is lifted which results in the switch A changing over and a "station select" key is operated. This switch will cause the switch A to revert to normal by a mechanical arrangement so that ringing and speaking can proceed in the usual way.

None of the button units the author has come across has a spring return "ring button' as such and rather than modify one of the existing buttons it is considered preferable to install a separate "press to make/release to break" button in any convenient position. In the units used one of the pilot indicator lamps was removed to facilitate insertion of such a switch.

The *ring* button is wired to the small G-block within the telephone instrument itself. Whilst in some cases there may be room within the instrument to house a battery, some of the later models do not permit this and the battery must be located in the junction box.

There are nominally four types of extension which the author has incorporated in his system although the variation within these types makes the list almost endless.

Incoming calls only

This extension utilises any of the ordinary GPO type phones with or without a dial. The circuit is arranged so that a call incoming,

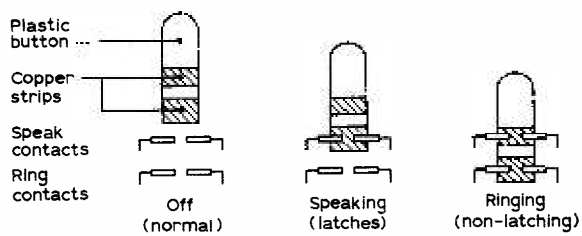


Fig. 3: Typical arrangement of button selectors.

say, to a large room may be answered at the main unit or at the extension on the other side of the room (but not both), it is not possible to make an outgoing call from the extension. The circuit is shown in Fig. 4.

The "works" of the telephone used will vary but are best removed as only the receiver rest switch is required.

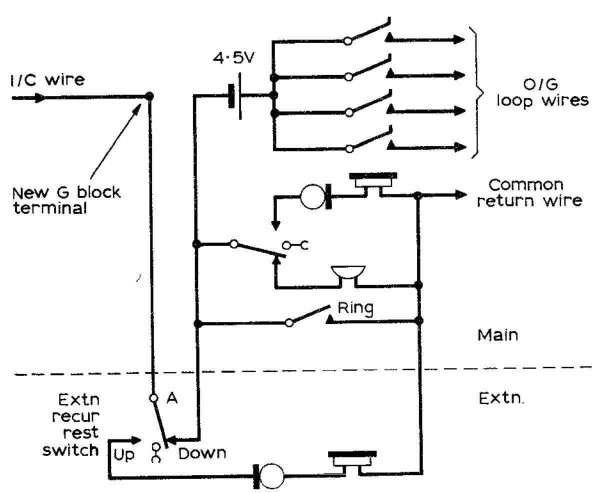


Fig. 4: Circuit for incoming calls only type extension.

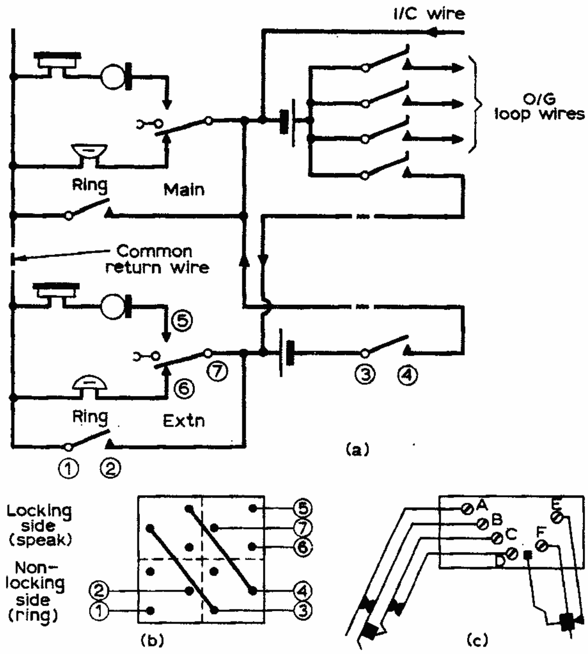


Fig. 5: Wiring for a "parented" extension.

Parented extension

This extension which can be "parented", meaning directly connected to and dependent upon, on to any of the standard units enables the extension to call that unit by using a dial telephone or an auxiliary key switch mounted near the telephone. The circuit for this is shown in Fig. 5.

If a dial phone is used, the method of operation is to lift the receiver and dial 0. Ten rapid pulses of 4·5V will be sent over the line to operate the buzzer at the parent main unit. When wiring up the dial, strap F and D and connect E and C to contacts 1 and 2 in the diagram. The receiver rest switch will be connected so that the bell is in circuit when the receiver is "on". Any number of these extensions may be parented on to one main unit.

TO BE CONTINUED

THE TRANSET

continued from page 245

current (best volume) but signals should be kept down so that continuous current is not over 25mA or so.

If no generator is available, tune in a signal on any band, even if this requires an external aerial. Then adjust the five i.f.t. cores for best volume.

Should no signals be obtained, it is not wise to make large adjustments to the i.f.t. cores at random, as the fault may be elsewhere. It is possible for wrong alignment alone to prevent signals passing through the i.f. amplifier. Should there be no fault except unnecessary disturbance of the cores, the best solution is to inject 465kHz at 5 of i.f.t.2, and adjust i.f.t.3. Then inject at 2 of i.f.t.2, and adjust the secondary of i.f.t.2. Follow by injecting at 5 of i.f.t.1, and adjust both cores of i.f.t.2. Then inject at Tr1 base and adjust i.f.t.1.

When all the i.f.t. cores are peaked, using a reduced signal input or weak signal, they are left untouched during subsequent trimming.

SW range

Unscrew the trimmer across VC1, and set TC2 about half-closed. With VC1/2 nearly fully open, adjust T4 until the trimmer VC3 can be peaked for best results, and is well open when this is done.

Tune towards the l.f. end of this band, meanwhile adjusting the core of L1 for best results, and to minimise the need for any readjustment of VC3. Actual band coverage depends also on the cores of L1 and L2, which should be locked with 6BA nuts.

If T2 is adjusted for m.w. trimming, T4 may need resetting. This is unavoidable with T2 incorporated in VC1/2, but would not arise if T2 is separate and connected for L5 only.

MW range

Adjust the core of L5 for suitable frequency coverage, and slide L3 on the rod for best volume at the l.f. end of the band. At the h.f. end, VC3 should peak up for best volume near the fully open position. If VC3 needs to be completely open, screw TC2 down slightly. Check the position of L3 on the rod, so that much adjustment of VC3 is not required when tuning over the band.

LW range

Adjust TC3 for a suitable tuning point for 200kHz, or near the l.f. end of the band. Move L4 on the rod, for best volume, and least need to readjust VC3 when tuning over the band.

It should be found that normal m.w. and l.w. tuning can be obtained with no need to adjust VC3, but that it is almost impossible to find alignment which does not result in some improvement, at some frequencies, by means of VC3. This is quite usual.

On the extreme h.f. end of the s.w. band, adjustments to VC3 tend to become sharp, and to pull tuning slightly. This cannot be avoided here, and is not important.

The trimmer TC1 can be set to about one-third of maximum capacitance, for the telescopic aerial. For a long aerial, such as an outdoor wire, it should be reduced. The telescopic aerial is normally sufficient. Alignment should allow VC3 to be peaked up for best volume with the aerial extended, or closed, on m.w. and l.w.

Cabinet

This is about 7in × 8in. inside dimensions, and 3½in. deep. It was made from $\frac{3}{16}$in. plywood, glued at all joints. It is glass-papered, well dusted, then covered with self-adhesive material of any preferred colour.

The telescopic rod bracket is fixed with two bolts through the side of the case. T1 is soldered to a short, stiff lead from VC1, and the second tag of T1 has a lead which is taken to one bolt holding the aerial. The receiver is used with a PP9 or similar 9 volt supply. ■

P.W. GUIDE TO COMPONENTS

PART 8

M. K. TITMAN, B.Sc.(Eng)

Most meters are retailed for specific requirements and consequently have series resistors or shunts incorporated to give the required voltage or current range required, with the scale suitably engraved. The accuracy of most meters is between $\pm 1\%$ and $\pm 2\%$ of full-scale deflection. It must be remembered that this figure does not account for reading errors which may be between $\pm 1\%$ and $\pm 5\%$ depending on the type of scale and engraving. Generally a meter is only as accurate as the smallest division on the scale. Another point worth noting is that accuracy is based on full-scale deflection (f.s.d.) and thus a reading at 1/10 of full scale has a percentage accuracy of $\pm 10\%$, i.e. measuring with a 10A 1% f.s.d. meter, a 1A reading can be within the actual limits of 0·9 to 1·1A and this excludes further errors due to reading inaccuracies.

Meters are available at a wide variety of prices which rise with quality and also figure of merit. Thus 1–10mA (1000–100Ω/V) meters can be obtained at from 10s. to £3 depending on mirror scale and size whilst 20–100μA (50,000–10,000Ω/V) meters cost from £1 to £10. Precision series resistors are available from 1s. to 10s. depending on value and tolerance whilst meter shunts are available from 5s. to £1.

Loudspeakers

Loudspeakers are devices which convert electrical energy into acoustical energy by utilising electromagnetic forces to provide physical movements. A very considerable amount of work has been carried out into the improvement of loudspeakers with the result that there are many different varieties and configurations. Since the permanent magnet, moving-coil or electrodynamic loudspeaker is by far the most widely used, only this type will be considered here.

The basic features of a moving-coil loudspeaker are illustrated in Fig. 1 and the circuit symbol shown in Fig. 2(a). The electrical audio output is fed to a voice coil suspended by means of a cone in a magnetic field generated by the permanent magnet. The electromagnetic field interacts with the permanent magnetic field to produce a movement of the coil and cone.

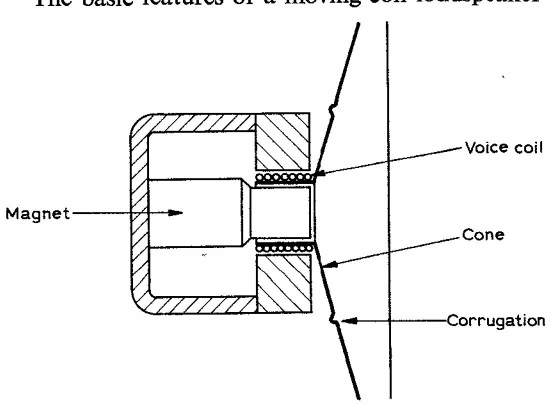


Fig. 1: Basic features of a moving-coil loudspeaker.

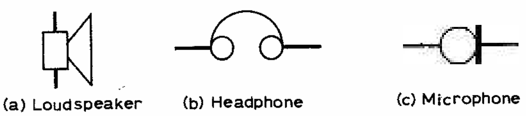


Fig. 2: Circuit symbols for acoustic transducers.

Ideally the acoustical power output should be identical to the electrical signal fed to the voice coil but unfortunately this cannot occur except over a very limited frequency range. The deficiency is due to the mechanical construction of the speaker as a whole. If the cone is large then the mass and inertia of the cone damp out the higher frequencies whilst a small cone results in a loss of low frequency tones due to the compliance (inverse of stiffness). The coil mounting and cone stiffness characteristics lead to a bass resonant frequency which varies from 20–30Hz for large cone speakers to 200–300Hz for smaller stiffer cones. Below this frequency damping forces reduce the acoustical output.

Large cone speakers however suffer at high frequencies due to the mass of the cone and phasing of the sound waves which can be more than 180 deg. out of phase between the coil and periphery of the cone. For this reason corrugations are introduced to reduce the effective cone area at high frequencies. Alternatively changes in cone thickness can be used to increase efficiency at high frequencies. In all cases the transient response is increased by increasing the permanent magnetic field in order to damp out oscillatory tendencies.

Essentially therefore loudspeaker design is a compromise between large size and cone stiffness (compliance) together with voice coil mountings and permanent magnetic strength. To give wide frequency coverage the most popular means is to use two speakers in parallel, together with a crossover network, or a double cone speaker. The double cone speaker has a small cone attached directly to the voice coil whilst the large cone is flexibly coupled. At low frequencies the large cone gives the required output, whilst at high frequencies the flexible coupling ceases to operate and the small cone alone produces the acoustical output.

For efficient operation loudspeakers must be operated on baffles which eliminate the out-of-phase sound component from the rear of the speaker. Loudspeaker enclosures are many and varied since over-all efficiency, particularly the bass response, can be increased by suitably mixing low frequency components from the rear of the speaker such that addition is caused by the phase relationship.

We have seen how loudspeaker performance depends largely on mechanical considerations; let us now look at parameters and prices of speakers. The standard voice coil impedances are 3Ω, 8Ω, and 15Ω with some 35Ω–75Ω speakers available for transistor circuits. Standard sizes vary from 2½in., having a bass resonance of 400Hz, to 14in., having bass resonances of 20–50Hz. Low cost units have flux densities of 5,000 to 8,000 gauss (G) whilst wide frequency range speakers have flux densities of 10,000 to 14,000G and employ both single and double cone construction.

Maximum power depends upon size and construction and is usually 1–2W for small low cost speakers and 2–4W for larger (5in.–8in.) low cost units. Wide frequency, high gauss speakers are capable of handling power levels up to 20W although it must be remembered that the maximum power is the value which if exceeded results in physical damage to the coil and cone assembly and consequently bears no relation to the distortion. For example for 7W power at 30Hz the cone must move 2·3in. for a 5in. speaker, 1in. for an 8in. speaker or 0·6in. for a 10in. speaker.

Loudspeaker prices vary widely and largely depend upon power capability and frequency response. General purpose speakers are available from 10s. to £2 depending upon size, whilst high flux, wide frequency response speakers vary from £3 to £15. Twin cone and other complex cone and coil construction speakers can be obtained in the price range £3 to £25.

Headphones

Headphones consist of an earpiece behind which is a diaphragm. The earpiece traps a small volume of air and consequently the power requirements to give satisfactory acoustic power levels are very low. Many forms of drive for the diaphragm are utilised, including: direct electromagnetic action on the diaphragm; moving-armature types; moving-coil; crystal; ribbon (for high fidelity reproduction) and inductor. Headphones vary in price in the range 10s. to £5 depending on quality and availability. The British Standard symbol is shown in Fig. 2(b).

Microphones

Microphones are essentially transducers which convert sound pressure waves into electrical energy and the circuit symbol is shown in Fig. 2(c). Many different types of microphone are used and unlike loudspeakers no one type is pre-eminent. Basically microphones can be divided into two categories: those which are pressure operated and velocity operated types. The pressure operated microphones are by far the most common and operate by the displacement of a diaphragm. The velocity operated types have a response to the particle velocity or pressure gradient. The velocity ribbon microphone, which consists of a free ribbon suspended in a magnetic field, has by far the best frequency response characteristics and is widely used in studio hi-fi systems, but is very expensive. The great majority of microphones are of the pressure operated variety.

The common forms of pressure operated microphone are the carbon, crystal, dynamic (or moving-coil), and condenser microphones. All incorporate a diaphragm which is physically moved and consequently alters the electrical characteristics of the microphone.

Carbon microphones are used in telephone systems and the output is derived from a change in the carbon resistance. Crystal microphones are common for radio and other uses and derive an output through an effective capacitance change. Condenser microphones similarly derive an output from capacitance variations between two plates, one of which is the diaphragm.

Dynamic or moving-coil microphones operate essentially as loudspeakers in reverse and indeed loudspeakers can be used as dynamic microphones. Most portable radio links use this interchangeability to advantage. Moving-coil microphones are widely used for general purpose and domestic applications, particularly in conjunction with semiconductor circuits, where their low impedance properties allow effective matching. Condenser and crystal microphones are high impedance devices and their performance is degraded by long cable lengths or low input impedance circuits.

Moving-coil microphones have essentially similar frequency characteristics to loudspeakers and consequently the average domestic microphone has a relatively poor response of from 200Hz to 6kHz. They are however universally available at prices ranging from 15s. to £5. High quality, wide frequency versions using special coil mountings and acoustical matching horn and diaphragm assemblies are available at prices from £5 to £100 depending largely on quality. Of the other forms of microphone both carbon and crystal types are very cheap—from 7s. 6d. upwards—and easily available whilst condenser types are expensive.

Moving-coil indicators

Moving-coil indicators are becoming popular as replacements for lamps in situations where extremely low power is required or where a greater reliability is required. Generally however they are not used simply as lamp replacements but for fail safe and enunciator applications.

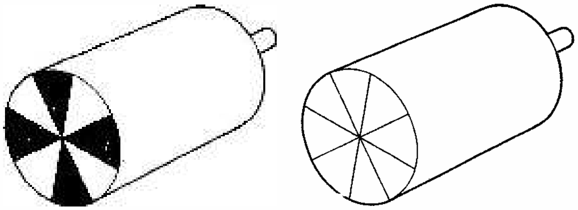


Fig. 3: Moving-coil indicator.

Basically they consist of a dial face which revolves as shown in Fig. 3 by the action of a moving-coil. The face may show any colour or design but those generally available for use in process control display units have crosses or lines which appear when activated to show the opening of a valve or closing of a switch. Such devices require d.c. levels of 1–10mA which is a considerably reduced power requirement than filament bulbs. When used as indicators they are fail safe since any loss of power can result in the display of a line or cross in the fail-safe condition. They are therefore a modern approach to the flag indicators used in switchgear. Prices vary but are generally in the region £1 to £5 depending largely upon the design of the legend and quality.

Solenoids and counters

Electromagnetic counters are basically mechanical ratchet driven counters which are operated by a solenoid. A typical counter is shown in Fig. 4. The driving mechanism is a solenoid which consists of a movable core of magnetic material surrounded by a coil. The

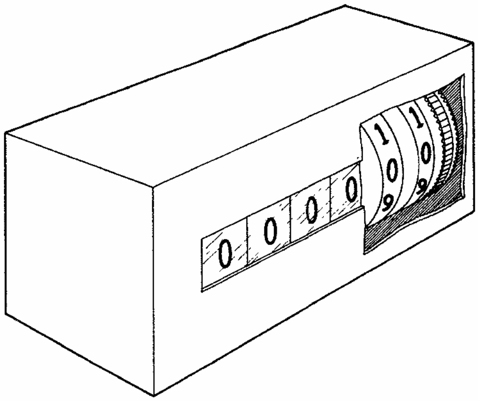


Fig. 4: Electromagnetic counter.

core is generally spring loaded off centre from the coil so that excitation of the coil attracts the core to the centre of the solenoid. This movement is then utilised in the counter to drive a ratchet arm. The counter is essentially a totaliser but can usually be reset either electrically or mechanically. Prices of such devices vary from £3 to £20 depending largely upon the number of digits required and the type of reset. Lifetimes of such counters can be very high, up to 10^8 counts, but they are inherently unreliable since they have a definite mechanical lifetime.

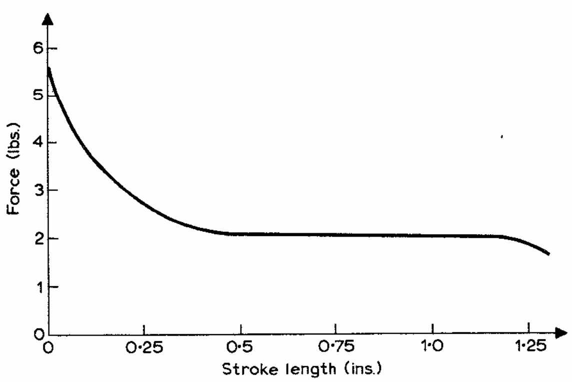


Fig. 5: Solenoid force-stroke characteristic.

Solenoids are available in many forms and are used widely for electrical activation of mechanical control circuits. The distance and force associated with the core movement is related to solenoid size, whilst the stroke length against force characteristic follows the inverse square law and is illustrated in Fig. 5. Solenoids designed for specific stroke lengths should always be used only for the design stroke since on every application of power the force-stroke characteristic applies and if the stroke is shortened excessive force levels may damage either the solenoid or the controlled object.

Prices and availability vary widely. For relatively small solenoids giving a force of 2 lb. at $\frac{1}{4}$in. prices vary from £2 to £10 whilst high power solenoids are considerably more expensive. Low power solenoids of the type used to operate chime door bells are available from 10s. to £4.

The future

We have seen how essential electromagnetic devices are to electronic circuits where often they provide the only practical interface between mechanical effects and electrical signals. Thus they are unlikely to be superseded despite many problems of reliability. Reliability can however be increased by improved materials and constructional techniques and it is in this direction that future trends lie. Speakers will be made of better materials to give greater life and frequency response, reed relays will improve in power capability and supersede standard relays, meters will improve in accuracy and clarity although eventually they may be superseded by electronic readouts such as digital tubes. Improvements are the keynote and due to size and unreliability it is likely that large strides may be made in the field of electromagnetic devices.

TO BE CONTINUED

RECMF 1969

THIS year's London Electronic Component Show, held at Olympia towards the end of May, was the 21st of its kind and by far the biggest ever staged. Sponsored as usual by the Radio and Electronic Component Manufacturers' Federation, it was international for the first time, with 75 foreign firms represented.

The reasons behind the change-over to an international exhibition were clearly stated by Mr. A. F. Bulgin, chairman of the Exhibition Committee:

"The possibility of national self-sufficiency to provide all the components a country needs is now an unlikely one. The speed of progress and increase in complexity as the electronics industry gets more and more sophisticated means that no one country can provide all its own needs. Even America cannot exist as a "solo" unit: last year they bought more than £14 million-worth of components from Britain and represented our second biggest market after the European free-trade area countries, whose trade with the UK was £18 million.

"Today, no one country can expect to be the leader in all techniques—which is another reason why international co-operation is necessary."

Each Component Show seems to be more successful than its predecessors, and this year there were 436 exhibitors.

The show is very much a technical one, and some of the latest developments were not obvious to the casual observer walking round from stand to stand. However, what struck us was the greater emphasis on integrated circuits both for domestic equipment and for items such as computers. Prices of established i.c.s are coming down, while new developments give the promise of simplified circuitry and construction, and eventual reduction in the price of equipment.

PICK-UP CARTRIDGE

Acos (Cosmocord) showed a new stereo cartridge, the 104 ceramic. This is designed for the latest slim-line pick-up arms and has a weight of only 2gm with the standard bracket. The tracking weight is 3gm to 4gm.

Cosmocord Limited, Eleanor Cross Road, Waltham Cross, Hertfordshire.

CLEANING FLUIDS

Two types of aerosol cleaning fluid were shown by **Automation Facilities.** "Ultraclene" is a universal general cleaner, harmless to most insulating varnishes and lacquers, which rapidly removes oil, and grease. It evaporates quickly and leaves no residue. "AF-Spray" contains ICI's Arklone P, a non-flammable highly penetrating solvent which instantly removes oils, greases, and most contaminants, without harming plastics and surface coatings.

"Ultraclene" costs 30s. for three 16oz. aerosols, and "AF-Spray" costs 20s. for a single sample aerosol (prices are reduced for larger quantities).

Automation Facilities Limited, Oxford Avenue, Slough, Buckinghamshire.

ELECTRONIC MULTIMETER EA113

On the **Avo** stand, an electronic Avometer was revealed. This has a d.c. sensitivity of 1MΩ/V, a basic accuracy of 1·25%, and may be operated up to 100kHz. There is a centre-zero facility, and resistance measurements may be made up to 100MΩ.

Avo Limited, Avocet House, Dover, Kent.

TRANSFORMERS

The **Belclere** Company showed a new range of miniature stabilised power supplies. These units are hermetically sealed and intended for printed-circuit mounting.

The three versions available are the P.S.2009, P.S.2012, and P.S.2020, which have outputs of 9V 40mA, 12V 30mA, and 20V 15mA respectively. The overload points in each case are at 5mA over the rated output, and the output potentials are within ±5% of nominal. Ripple is less than 500μV r.m.s.

The Belclere Company Limited, 385-7 Cowley Road, Oxford.

INSTRUMENTS

The universal meter TVM1070 by **B.P.L.** is a versatile instrument with f.s.d.s from 100mV to 300V d.c. and 100mV to 300V a.c. Centre-zero ranges are available on d.c. volts, from 50mV-0-50mV to 150-0-150V. On d.c., the input resistance is 1MΩ/V up to 10V, and 10MΩ above 10V, while on a.c., it is 200kΩ on ranges up to 30V, and 2MΩ on the 100V and 300V ranges.

The meter also measures direct current, the most sensitive range being 1μA f.s.d., and the least sensitive 100mA. Centre-zero direct current ranges are also a feature, from 0·5μA-0-0·5μA to 50mA-0-50mA.

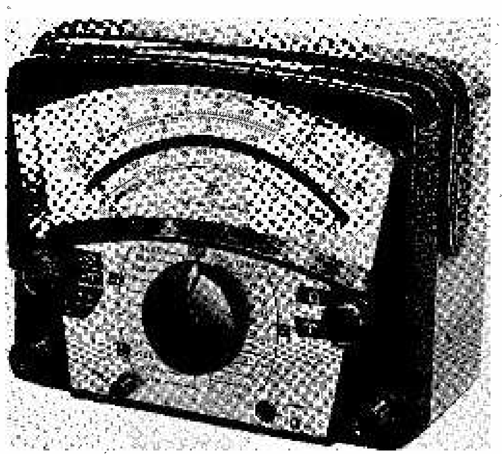
Three resistance ranges are included: 0-10kΩ, 0-1MΩ, and 0-100MΩ, with mid-scale values of 150Ω, 15kΩ, and 1·5MΩ respectively.

A plug-in r.f. test-probe is supplied with each meter and gives four ranges: 0-1V; 0-3V; 0-10V; and 0-30V. The frequency range is 100kHz to 300MHz for −3dB points, with an input resistance of 140kΩ on each range (shunt capacity, 3pF).

B.P.L. (Instruments) Limited, Radlett, Hertfordshire.

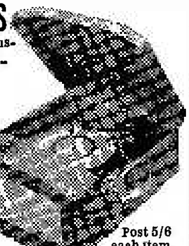
WIDE-RANGE RECEIVER

A professional receiver, the EC958, was the main feature of the **Eddystone** stand. This fully transistorised



The AVO Electronic Avometer EA113

DE LUXE PLAYERS



PORTABLE CABINET As illustrated. To fit standard player or autochanger. **75/-**

RCS AMPLIFIER 3 WATT. Ready made and tested This is a 2-stage unit using a triode pentode condenser coupled valve giving 3 watts output into a 3 ohm loudspeaker. Tone and volume controls mounted on chassis with knobs. Supplied with loudspeaker and valve UCL82. Frequency response 50-12,000 cps. Sensitivity 200mV. **59/6**

Post 5/6 each item

SINGLE PLAYERS	MONO	AUTOCHANGERS	MONO
EMI Junior Mains	£2.19.6	Balfour Princess	£5.19.6
Garrard SRP22 ..	£6.19.6	BSR Superslim UA25	£6.19.6
Garrard SP25 MkII	£14.19.6	UA70 Transcription	£13.19.6
		Garrard 3000	£12.19.6

All fitted LP/78 stylii and pickup cartridge complete. Stereo/mono pickup 20/- extra except 3000.

GARRARD TEAKWOOD BASE WB.1. Ready cut out for mounting 1025, 3000, SP25, AT60, etc. **65/-**

GARRARD PERSPEX COVER SPC.1 for WB.1 BASE. Durable tinted attractive appearance. **65/-**

E.M.I. PICK-UP ARM Complete with mono cartridge 29/6; Xtal GP67 17/6; Stereo Ceramic 35/-. Powerpoint 56 15/-.

CRYSTAL MIKE INSERTS

$1\frac{1}{2}$in. dia. 6/6; ACOS $1\frac{3}{4}$in. dia. 9/6. BM3, 1in. dia. 9/6
MOVING COIL MIKE with Remote Control Switch 19/6

PORTABLE TRANSISTOR AMPLIFIER PLUS DYNAMIC MICROPHONE

A self-contained fully portable mini p.a. system. Many uses — ideal for Parties, or as a Baby Alarm, Intercom, Telephone or Record Player Amplifier, etc Attractive rexine covered cabinet, size 12 × 9 × 4in. with powerful 7 × 4in. speaker and four transistor one watt power amplifier plus ultra sensitive microphone Uses PP9 battery. Brand new in Makers' carton with full makers' guarantee. World famous make. Only **90/-** Post Free

WEYRAD P50—TRANSISTOR COILS

RA2W 6in. Ferrite Aerial with car aerial coil	12/6	Spare Cores	6d.
Osc. P50/1AC	5/4	Driver Trans. LFDT4.	9/6
I.F. P50/2CC 470 kc/s.	5/7	Printed Circuit, PCA1.	9/6
3rd I.F. P50/3CC	6/-	J.B. Tuning Gang	10/6
		Weyrad Booklet	2/-

Telescopic Chrome Aerials 6in. extends to 23in. 5/-.
Ferrite Rods Only. 8 x $\frac{5}{16}$in. 4/-; 6 x $\frac{1}{4}$in. 5/-.

VOLUME CONTROLS

Long spindles. Midget Size 5K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/-. STEREO L/S 10/6. D.P. 14/6. Edge. 5K. S.P. Transistor 5/-.

80 Ohm Coax 8D yd.

BRITISH AERIALITE AERAXIAL AIR SPACED 40 yd. 20/-; 60 yd. 30/-. FRINGE LOW LOSS Ideal 625 lines **1/6** yd.

WIRE-WOUND 3-WATT POTS. T.V. Type. Values 10 ohms to 30K., Carbon 30K to 2 meg. **4/6**

WIRE-WOUND 4-WATT STANDARD SIZE POTS. LONG SPINDLE 50 OHMS to 100K.. **7/6**

VEROBOARD 0·15 MATRIX
$2\frac{1}{2}$ × 5in. 3/8. $2\frac{1}{2}$ × $3\frac{3}{4}$in. 3/2. $3\frac{3}{4}$ × $3\frac{3}{4}$in. 3/8. $3\frac{3}{4}$ × 5in. 5/2.
EDGE CONNECTORS 16 way 5/-; 24 way 7/6.
PINS 36 per packet 3/4. FACE CUTTERS 7/6.
S.R.B.P. Board 0·15 MATRIX $2\frac{1}{2}$in. wide 6d. per 1in. $3\frac{3}{4}$in. wide 9d. per 1in.; 5in. wide 1/- per 1in. (up to 17in.).
S.R.B.P. undrilled $\frac{1}{16}$in. Board. 10 × 8in. 3/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. $2\frac{1}{2}$in. sides 7 × 4in., 5/6; 9 × 7in., 6/6; 11 × 3in., 6/6; 11 × 7in. 7/6; 13 × 9in., 9/6; 14 × 11in., 12/6; 15 × 14in., 15/-.
ALUMINIUM PANELS 18 s.w.g. 12 × 12 in. 6/6; 14 × 9 in. 5/6; 12 × 8 in. 4/6; 10 × 7 in. 3/6; 8 × 6 in. 2/6; 6 × 4 in. 1/6.

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key

$\frac{1}{2}$in.	16/-	$\frac{7}{8}$in.	17/6	$1\frac{1}{8}$in.	19/6	$1\frac{1}{2}$in.	24/-	$2\frac{3}{32}$in.	44/3
$\frac{5}{8}$in.	16/-	1in.	19/6	$1\frac{1}{4}$in.	20/6	$1\frac{3}{4}$in.	29/-	$2\frac{1}{2}$in.	57/3
$\frac{3}{4}$in.	16/9	$1\frac{1}{16}$in	19/6	$1\frac{3}{8}$in.	21/6	2in.	39/-	1in. sq.	36/6

'SONOCOLOR' CINE RECORDING TAPE

5" reel, 900' with LP strobe markings, also cine light deflector-mirror for synchronisation. 14/- each.
UNIVERSAL TAPE CASSETTES C60. THREE FOR 30/-.

Tape Spools 2/6. Tape Splicer 5/-. Leader Tape 4/6.
Reuter Tape Heads for Collaro models 2 track 21/- pair.

ALL PURPOSE HEADPHONES

H.R. HEADPHONES 2000 ohms Super Sensitive ..	35/-
LOW RESISTANCE HEADPHONES 3-5 ohms	39/6
DE LUXE PADDED STEREO PHONES 8 ohms	79/6

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER **42/6** Post 2/6.
200/250 v. A.C. Leaflet S.A.E.

BARGAIN STEREO/MONO SYSTEM

Attractive Slim PLAYER CABINET with B.S.R. STEREO Autochanger 4 + 4 AMPLIFIER and TWO matched $6\frac{1}{2}$in. LOUDSPEAKERS Carr. 10/6 (Only 4 pairs of wires to join). **£19.19.6.**

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V ..	2/3	100/25V ..	2/-	8/600V ..	9/6
4/350V ..	2/3	250/25V ..	2/6	16/600V ..	12/6
8/450V ..	2/3	500/25V ..	4/-	16+16/500V	7/6
16/450V ..	3/-	8+8/450V ..	3/6	32+32/250V	3/6
32/450V ..	3/9	8+16/450V ..	3/9	50+50/350V	7/-
25/25V ..	1/9	16+16/450V	4/3	60+100/350V	11/6
50/50V ..	2/-	32+32/350V	4/6	32+32+32/350V	8/6

SUB.MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 250mF 15V 2/-; 500, 1000mF 12V 3/6; 2000mF 25V 7/-.
CERAMIC. 500V 1pF to 0.01mF, 9d. Discs 1/-.
PAPER 350V-0·1 9d; 0·5 2/6; 1mF 3/-; 2mF 150V 3/-. 500V-0·001 to 0·05 9d; 0·1 1/-; 0·25 1/6; 0·5 3/-. 1,000V-0·001, 0·0022, 0·0047, 0·01, 0·02, 1/6; 0·047, 0·1, 2/6.
SILVER MICA. Close tolerance 1%. 5-500pF 1/-; 560-2,200pF 2/-; 2,700-5,600pF 3/6; 6,800pF-0·01, mfd 6/- each.
TWIN GANG. "0-0" 208pF + 176pF, 10/6; 365pF, miniature 10/-; 500pF standard with trimmers, 12/6; 500pF midget less trimmers, 7/6; 500pF slow motion, standard 9/-; small 3-gang 500pF 19/6. Single "O" 365pF 7/6. Twin 10/6.
SHORT WAVE. Single 10pF, 25pF, 50pF, 75pF, 100pF, 160pF, 200pF, 10/6 each.
TUNING. Solid dielectric. 100pF, 300pF, 500pF, 7/- each.
TRIMMERS. Compression ceramic 30, 50, 70pF 1/-; 100pF, 150pF, 250pF, 1/6; 600pF, 750pF, 1000pF, 2/6.

250V RECTIFIERS. Selenium $\frac{1}{2}$ wave 100mA 5/-; BY100 10/-.
CONTACT COOLED $\frac{1}{2}$ wave 60mA 7/6; 85mA 9/6.
Full Wave Bridge 75mA 10/-; 150mA 19/6; TV rects. 10/-.
NEON PANEL INDICATORS. 250v. AC/DC, 3/6.
RESISTORS. Preferred values, 10 ohms to 10 meg.
$\frac{1}{4}$w., $\frac{1}{2}$w., 1w., 20% 3d.; $1\frac{1}{2}$w. 8d.; 2w. 1/-; $\frac{1}{2}$w. 10% 6d.
HIGH STABILITY. $\frac{1}{2}$w. 1%. 10 ohms to 10 meg. 2/-.
Ditto 5%. Preferred values 10 ohms to 22 meg., 9d.

5 watt	0·5 to 8·2 ohm 3w.	2/-
10 watt	WIRE-WOUND RESISTORS	2/-
15 watt	10 ohms to 6,800 ohms	2/-

10K, 15K, 20K, 25K, 68K, 10W. 3/-

FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. $1\frac{1}{2}$ amp. 8/9; 2a., 11/3; 4a., 17/6.
CHARGER TRANSFORMERS, P. & P. 5/-. Input 200/250v. for 6 or 12v., $1\frac{1}{2}$ amps., 17/6; 2 amps., 21/-; 4 amps., 30/-.

VALVE HOLDERS, 9d; CERAMIC 1/-; CANS 1/-

BRAND NEW TRANSISTORS 6/- each

OC71, OC72, OC81, OC44, OC45, OC171, OC170, AF117
MAT 100, 7/9; MAT 101, 8/6; MAT 120, 7/9; MAT 121, 8/6.
REPANCO TRANSISTOR TRANSFORMERS
TT45. Push Pull Drive, 9:1 CT, 6/-. TT46 Output, CT8:1, 6/-.
TT49. Interstage 4·5:1, 6/-; TT52 Output 3 ohms, 20:1, 6/-.
TT23/4 PAIR 10 watt Amp. Transformers and circuit 45/-.

TRANSISTOR MAINS POWER PACKS. FULL WAVE 9 volt 500mA Size $4\frac{1}{2}$ × $2\frac{1}{2}$ × 2in. Output terminals. Switched. Metal case, crackle finish. On/off switch. **49/6**
Half Wave 9 volt 50mA Size $2\frac{1}{2}$ × $1\frac{1}{4}$in. Snap terminals 32/6.
9 volt 500mA TRANSFORMER ONLY. $2\frac{1}{4}$ × $1\frac{3}{4}$ × $1\frac{3}{4}$in. 10/6.
BENCH POWER PACK 230-250v. A.C. Mains with Meter. Supplies 6-9-12v. 1 amp D.C. **£7**

MAINS TRANSFORMERS

Post 5/- each

250-0-250 50 mA. 6·3v. 2a. Centre tapped........	19/6
250-0-250 80mA. 6.3v. 3.5a. 6.3v. 1a. or 5v. 2a...	30/-
350-0-350 80mA. 6.3v. 3.5a. 6.3v. 1a. or 5v. 2a....	35/-
300-0-300v. 120mA., 6.3v. 4a. C.T.; 6.3v. 2a.	45/-
MINIATURE 200v. 20mA., 6.3v. 1a. $2\frac{1}{2}$ × 2 × $1\frac{3}{4}$in.	12/6
MIDGET 220v. 45mA., 6.3v. 2a. $2\frac{3}{4}$ × $2\frac{1}{4}$ × 2in......	17/6
HEATER TRANS. 6.3v. $1\frac{1}{2}$a., 8/6; 6.3v. 4a.	12/6
Ditto tapped sec. 1.4v., 2, 3, 4, 5, 6.3v. $1\frac{1}{2}$ amp....	12/6
GENERAL PURPOSE LOW VOLTAGE, Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30v. at 2a.....	30/-
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	35/-
3 amp., 0–12v. and 0–18v.	19/6

AUTO TRANSFORMERS 0–115–230v. Input/Output, 60w. 18/6; 150w. 30/-; 500w. 92/6; 1000w. 195/-.

COAXIAL PLUG 1/3. PANEL SOCKETS 1/3. LINE 2/-. OUTLET BOXES, SURFACE OR FLUSH 4/6.
BALANCED TWIN FEEDERS 1/- yard 80 or 300 ohms.
JACK SOCKETS Std. open-circuit 2/6, closed circuit 4/6. Chrome Lead Socket 7/6. Phono Plugs 1/-. Phono Socket 1/-.
JACK PLUGS Std. Chrome 3/-; 3·5mm Chrome 2/6.
DIN SOCKETS Chassis 3-pin 1/6; 5-pin 2/-. Lead 3-pin 3/6; 5-pin 5/-. DIN PLUGS 3-pin 3/6; 5-pin 5/-.

WAVE-CHANGE SWITCHES WITH LONG SPINDLES.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 4/6 each.
1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way, 4/6 each.
Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way, 1 wafer 12/-, 2 wafer 18/-, 3 wafer 24/-.
Additional wafers 6/- each wafer up to 5 max.
TOGGLE SWITCHES, sp. 2/6; sp. dt. 3/6; dp. 3/6; dp dt. 4/6.

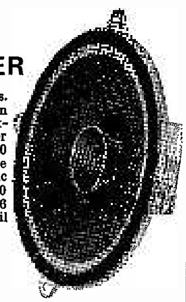
MINI-MODULE LOUDSPEAKER KIT

10 WATT **55/-** CARR. 5/-

Triple speaker system combining on ready cut baffle. $\frac{1}{2}$ in. chipboard 15 in. × $8\frac{3}{4}$ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 8 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE $17\frac{1}{2}$ × $10\frac{1}{2}$ × $7\frac{1}{2}$ in. Specially designed for Mini-Module above. **£5.10.0** extra

BAKER 12in. "SUPERB" LOUDSPEAKER



Suitable for all Hi-Fi Systems. Provides rich clear reproduction of the deepest bass and remarkable efficiency in the upper register. Response 20-17,000 cps. "Baker" double cone with special "Ferroba" ceramic magnet. Flux density 16,500 gauss. Bass resonance 22-26 cps. 20 watts rating. Voice coil 8 ohms or 15 ohms. **£15** Post Free

48 page Enclosure Manual 5/9 post paid

LOUDSPEAKER CABINET WADDING 18in. wide, 2/6 ft.

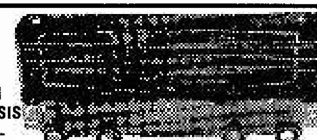
BAKER "GROUP SOUND" SPEAKERS—POST FREE

'Group 25'	'Group 35'	'Group 50'
12in. 25 watt **6 gns.**	12in. 35 watt **$8\frac{1}{2}$ gns.**	15in. 50 watt **18 gns.**

ALL MODELS "BAKER SPEAKERS" IN STOCK

Goodmans Cone Tweeter 3in. square, 2-18kc/s. 10W 35/-. Quality Horn Tweeters 2-18kc/s, 10W 29/6. Crossover 16/6.
LOUDSPEAKERS P.M. 3 OHMS. $2\frac{1}{2}$in, 3in, 4in, 5in, 7 × 4in. 17/6 each; $6\frac{1}{2}$ in 22/6; 8 × 5in. 21/-; 10 × 6in. 30/-; 8 × $2\frac{1}{2}$in. 21/-
10in or 12in. Double cone 3 or 15 ohm 39/6; E.M.I. Double Cone $13\frac{1}{2}$ × 8in., 3 or 15 ohm models, 45/-, or with twin tweeters, crossover and ceramic magnet, 79/6.
SPECIAL OFFER! 8 ohm, $2\frac{1}{2}$in; 6 × 4in; 80 ohm, $2\frac{1}{2}$in, $2\frac{3}{4}$in;
15/6 EACH TYPE 25 ohm, 6 × 4in; 35 ohm, 3in; 15 ohm, 10 × $2\frac{1}{2}$in. 7 × 4in.
8in. LOUDSPEAKER UNITS 3 ohm 27/6, 15 ohm 30/-;
8in. De Luxe Ceramic 3 ohm 45/-; 15 ohm 50/-.
8in. LOUDSPEAKER TWIN CONE 3ohm 35/-.
5in. WOOFER. 8 watts max. 20-10,000 cps. 8 or 15 ohm 39/6.
OUTPUT TRANS. EL84 etc. 4/6; MIKE TRANS. 50:1, 3/9.
SPEAKER FRET Various Tygan samples. Send S.A.E.

1969 GRAM CHASSIS



Post 6/-

Three Wavebands: Long, Med., Short, Gram. Five Valves: ECH81, EF89, EBC81, EL84, EZ80. 12-month guarantee. A.C. 200-250v. Ferrite Aerial 5 watts 3 ohm. Chassis $13\frac{1}{2}$in. × 7in. × 5in. dial size 13in. × 4in. Two pilot Lamps. Four Knobs. Aligned calibrated. Chassis isolated from mains. **£11.18.6**

DE LUXE STEREO GRAM CHASSIS V.H.F., MW, SW 19-50m. SW 60-180m. Magic eye, push buttons. 6 valve plus rect. Size 15 × $7\frac{1}{2}$ × 6in. high. **£22.10**

ALL EAGLE PRODUCTS

SUPPLIED AT LOWEST PRICES
45-page Eagle catalogue 5/- Post free.

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial, 9 volt. **79/6**

BARGAIN DE LUXE TAPE SPLICER Cuts, trims, joins for editing and repairs. With 3 blades. **17/6**

BARGAIN 4 CHANNEL TRANSISTOR MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **59/6**

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. Ready built. Printed Circuit. Calibrated slide dial tuning. Size 6 × 4 × $2\frac{1}{2}$in. 9 volt. **£6.19.6.**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **69/6**

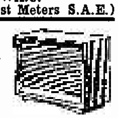
★ RADIO BOOKS ★ (Postage 9d.)

Practical Transistor Receivers	5/-
Practical Stereo Handbook	3/6
Supersensitive Transistor Pocket Radio	3/6
High Fidelity Speaker Enclosures and Plans	5/-
Radio Valve Guide, Books 1, 2, 3, or 4 ea. 5/- No. 5 ea.	6/-
Practical Radio Inside Out	4/6
Shortwave Transistor Receivers	5/-
Transistor Communication Sets	6/-
Modern Transistor Circuits for Beginners	7/6
Sub-Miniature Transistor Receivers	5/-
Wireless World Radio Valve Data	9/6
At a glance valve equivalents	6/-
Valves, Transistors, Diodes equivalents manual	10/6
Receive Foreign T.V. by simple modifications	5/-
Transistor Circuits Radio Controlled Models	7/6

POCKET MOVING COIL MULTIMETER. 0-1,000 AC./DC. ohms 0 to 100k, etc. **49/6**

SUPERIOR MOVING COIL MULTIMETER 0-2-500v. D.C. 20,000 ohms per volt, 0-1,000v. A.C. Ohms 0 to 6 meg. 50 Microamps (Full list Meters S.A.E.) **99/6**

BRAND NEW QUALITY EXTENSION LOUDSPEAKER



Handsome plastic cabinet, 20ft. lead and adaptors. For any radio, intercom, tape recorder, etc. 3 to 15 ohms. Size: $7\frac{1}{2}$ × $5\frac{1}{4}$ × 3in. POST 2/6 **30/-**

Minimum Post and Packing 2/6. RETURN OF POST DESPATCH. HI-FI STOCKISTS CUSTOMERS FREE CAR PARK CALLERS WELCOME

RADIO COMPONENT SPECIALISTS 337 WHITEHORSE ROAD, WEST CROYDON

Full list 1/- Written guarantee with every purchase. *(Export—remit cash and extra postage, no C.O.D.)* Buses 133, 68 pass door. S.R. Stn. Selhurst Tel. 01-684-1665 unit provides gap-free coverage between 10kHz and 30MHz in ten overlapping ranges.

Shown in conjunction with the receiver was the panoramic display unit, EP961, which provides a visual display of all signals which are received in a selected frequency spectrum. The spectrum covered by the display may be up to 10MHz wide.

Further details of the receiver are given in "News and Comment" on page 241.

Eddystone Radio Limited, Alvechurch Road, Birmingham, 31.

RECORD-CHANGER

The GC10 automatic record-changer by **Garrard** was unveiled for its first British showing. This unit has a one-piece control panel offering simultaneous selection of record speed and size for the 12in. 33⅓ rev./min. and 7in. 45 rev./min. settings, and its facility for playing single records automatically if required.

The unit also has a self-engaging pick-up arm retaining clip which operates automatically when the arm returns to rest after playing a single record or the last of a stack. The clip disengages automatically when the "manual" or "automatic" play control is operated.

Garrard Engineering Limited, Newcastle Street, Swindon, Wiltshire.

TRANSFORMER SAFETY

Transformers incorporating a double-bobbin system were shown by **Hinchley Engineering.** These designs, to meet international safety standards, feature thermal fuses embedded in the windings to give short-circuit protection, and a secondary bobbin carrying a moulded skirt which completely surrounds the primary mains winding when the assembly is complete.

Hinchley Engineering Company Limited, Pans Lane, Devizes, Wiltshire.

AUDIO AMPLIFIER

Much of **Mullard's** display this year concerned itself with the impact of integrated circuits and thyristors on domestic TV, but also shown was experimental 30W Class D audio amplifier. The unit shown used 30dB of feedback and had harmonic distortion of only 0·25%. Previously published circuits operated at switching speeds in the 100kHz to 200kHz region, but the system shown operated at any desired frequency up to 2MHz. The high speed enables smaller, cheaper, filters to be used with very low radiation levels, and gives reduced intermodulation distortion.

Mullard Limited, Torrington Place, London, W.C.1.

RESISTORS

Muirhead were showing what they believe to be the smallest wire-wound resistor offering a range of 1kΩ to 100kΩ at an accuracy of 0·1% to 0·5%. Another of the four precision wire-wound resistors announced is mounted in the popular TO-5 transistor can, with standard lead spacing.

All four resistors use a new type of wire which enables temperature coefficients of ±5p.p.m./°C (0°C to 100°C) to be achieved as standard.

Muirhead Limited, Beckenham, Kent.

SCOPE

SE Laboratories revealed their portable oscilloscope SM111, which may be powered from 95V to 130V a.c. and 190V to 260V a.c., 45Hz to 440Hz, and from an external 24V d.c. source.

The SM111 uses a rectangular high brightness c.r.t. with built-in graticule. The bandwidth of the two Y-amplifiers is from d.c. or 3Hz to 18MHz (−3dB) at 20mV/cm, depending on the setting of the d.c./a.c. switch. The timebase speeds are calibrated from 200ns/cm to 1sec/cm in 21 ranges. The circuitry features solid-state design, and uses a total of eight plug-in integrated circuits.

SE Laboratories (Engineering) Limited, North Feltham Trading Estate, Feltham, Middlesex.

VOLTAGE REGULATOR

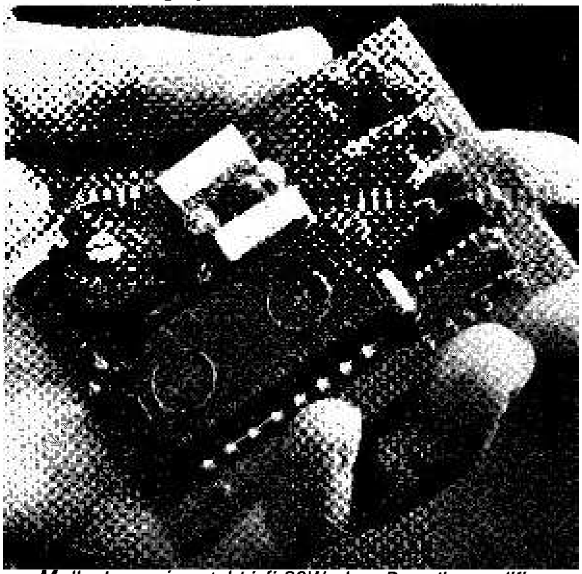
A TO-5 linear microcircuit by **SGS** can be used as a series regulator, shunt regulator, switching regulator, floating high voltage regulator, or a regulated current source for both positive and negative supplies. The L123 is believed to be the first linear circuit with an *n*-channel f.e.t. directly on the chip.

SGS (United Kingdom) Limited, Planar House, Walton Street, Aylesbury, Buckinghamshire.

METERS

A range of meters for back-of-panel mounting was shown by **Sifam.** The meters are clamped behind the panel without the need for the usual fixing holes, and the panel cut-out is framed by a separate matt-black die-cast surround which is also held by the clamp. Three sizes are available with scale lengths of 2·2in., 2·75in., and 3·75in.

Sifam Electrical Instrument Company Limited, Woodland Road, Torquay, Devon.



Mullard experimental hi-fi 30W class D audio amplifier.

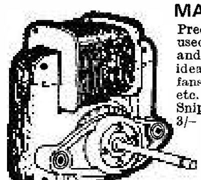
DUAL-BEAM OSCILLOSCOPES

Two new products from **Telequipment** are the D51 and D54 dual-beam oscilloscopes. The D51 is a general purpose scope with a 5in. flat-faced tube. It is suitable for use by students working on A-level courses, or studying at technical colleges.

The D54 uses solid-state design with f.e.t. input circuitry and features wide timebase range, wide bandwidth, and calibrated deflection amplifiers. The D54 is suitable for a variety of laboratory work.

Telequipment Limited, 313 Chase Road, London, N14. ■

MAINS MOTOR

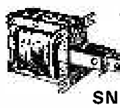


Precision made — as used in record decks and tape recorders—ideal also for extractor fans, blower, heater, etc. New and perfect. Snip at **9/6.** Postage 3/- for first one then 1/- for each one ordered. 12 and over post free.

ROTISSERIE MOTOR

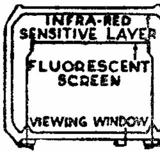
Very powerful 7 r.p.m., operates from standard A.C. mains. **29/6,** plus 3/6 P. & P.

230 VOLT SOLENOID



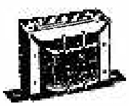
⅝in. stroke. Size 2⅜in. × 2in. × 1¾in. **14/6,** postage 2/9.

SNIPERSCOPE



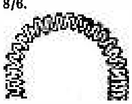
Famous war-time "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver cacsium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. A golden opportunity for some interesting experiments. **7/6** each, post 2/6. Data will be supplied with cells, if requested.

MAINS TRANSFORMER SNIP



Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/240v.) and isolated secondaries two types (1) 12v. 500mA. at **8/6**; (2) 15v. 500mA. at **8/6.**

SPRING COIL LEADS



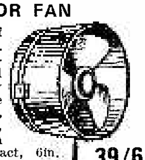
as fitted to telephones, 4 core **2/6** each, 3 core **2/-** each.

PP3 ELIMINATOR. Play your pocket radio from the mains! Save £s. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions, only **6/6** plus 1/- post.

QUADRUPLE TAPE

Quadruple tape on 3in. spool giving 600ft. Of the finest quality by very famous maker. Especially suitable for message tapes and portable equipment. Regular price 30/- per spool. Our price **7/6** plus 2/9 p. & p. or 3 for **22/6** post paid.

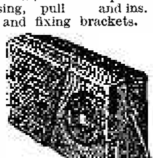
EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic feet per hour. At the pull of a cord it extracts grease, grime and cooking smells before they dirty decorations. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 6in. casing with 5⅜in. fan blades. Suitable wherever it is necessary to move air fast. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector and fixing brackets.

39/6 + 6/6 post and ins.

TRANSISTOR SET CASE



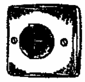
Very modern cream cabinet, size 5½ × 3 × 1⅝in. with chrome handle, tuning knob and scale. Price **4/6,** plus 2/- postage. Printed circuit board for this case **2/6.**

SOIL WARMING ELEMENT, 30 yards, heavy PVC covering. **12/6.**

BATTERY CHARGER FOR NICADS

This is in plastic case, size 5 × 4 × 3in. approx. All wired up with 3 core output lead and 3 core mains input lead. Contains mains transformer with 40v. 250mA secondary and standard 200/240 primary. Also contains full wave bridge rectifier, neon indicator, wired up with resistors to charge 2 Nicad batteries simultaneously. Charge rates of 50mA and 25mA respectively. Batteries up to 30 volts may be charged. Price **39/6** each, plus 3/6 postage and insurance.

VARYLITE

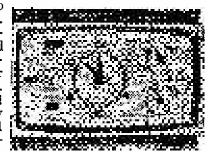


Will dim fluorescent or incandescent lighting up to 600 watts from full brilliance to out. Fitted on M.K. flush plate, same size and fixing as standard wall switch so may be fitted in place of this, or mount on surface. Price complete in heavy plastic box with control knob **£3.19.6.**

NICAD RECHARGEABLE BATTERIES

3·6V 500mA size 1⅞ × 1⅜in. dia. type ref. DKZ500 really powerful will deliver 1 amp for ½ hour. Regular price 32/6 our price **17/6** each. New and guaranteed. Other voltages available, single cell 1·2V **6/6.** 5 cell 6V **29/6.**

ELECTRIC CLOCK WITH 20 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—also on the left is another timer or alarm—this may be set in minutes up to **4** hours. At the end of the period a bell will sound. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **45/-**, less than the value of the clock alone—post and insurance 2/9.

THIS MONTH'S SNIP

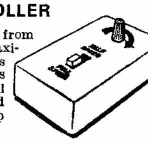
BATTERY OPERATED TAPE DECK

With Capstan control. This unit is extremely well made and measures approx. 6 × 5 × 2in. deep. Has three piano key type controls for Record, Playback and Rewind. Motor is a special heavy duty type intended for operation off 4/5 volts. Supplied complete with 2 spools ready to install. Record, Replayhead is the sensitive M4 type intended for use with transistor, amplifier. Price **59/6.** Post and insurance **4/6.**

DISTRIBUTION PANELS

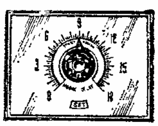
Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs. Supplied complete with 6 feet of heavy cable and 13 amp plug. Similar advertised at £5. Our price **39/6,** plus 3/6 post and insurance.

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. **19/6** plus 2/6 post and insurance. Or available made up **29/6,** plus 2/6 post.

PROCESS TME CONTROLLER



Made by Smiths, motorised and mains driven, enables 15A circuit to be started up to 18 hours in advance and to stay on for a period from 15 minutes to 3 hours. Totally enclosed in metal box with glass front and chrome surround. **49/6** plus 4/6 post and ins.

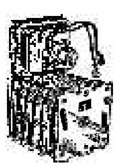
REED SWITCH

Suitable for dozens of different applications, such as burglar alarms, conveyor belt switching. These are simply glass encased switches which can be operated by a passing permanent magnet coil. A special buy enables us to offer these at **2/6** each, or **24/-** a dozen. Suitable magnets are **1/-** each.

MOVING COIL METER BARGAIN

Panel meters are always being needed and they are jolly costly when you have to buy them in a hurry—so you should take advantage of this offer: 2in. moving coil flush mounting meters only **9/6.** These are actually R.F. meters and cost about **£3** each but if you don't want them for R.F. then all you have to do is to remove the thermocouple and you will have a 2-3 ma. meter which you can make into almost anything by adding shunts or series resistor. New and unused.

MOTORISED CAM SWITCH



Made by the famous meter company Chamberlain and Hookham, these have a normal mains 200–240V motor which drives a ratchet mechanism so geared to give one ratchet action per minute on a wheel with 60 teeth thus a complete revolution of the cam takes place in one hour. The cam operates 8 switches (6 changeover and 2 on/off thus 480 circuit changes per hour are possible). Contacts, rated at 15 amps have been set for certain switch combinations but can, no doubt, be altered to suit a special job. Also other switch wafers or devices can be attached to the shaft which extends approximately one inch. **47/6,** p. & ins. **4/6.**

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only **16/6,** plus 3/6 postage.

FLEX CABLE BARGAIN

23/0076 triple core P.V.C. covered, circular, normally sold at 1/6 yd. Our price 100 yd. coil **£3.19.6.** Post and Insurance 6/6.

Multi Purpose Neon Test Unit. Robust, useful and instructive tests insulation, capacity, continuity, resistor, volume controls, also acts as signal injector and L.T. fault finder, kit comprises neon indicator, 4-way wafer switch, ebonite tubes, resistors-condensers, terminals etc., with diagram, only **9/6,** plus 2/- post and insurance.

Tuning Condenser, solid di-electric .0005m.f.d. variable **2/6** each, **24/-** dozen.

A.E.I. Fractional H.P. Motor. 200/250v. 50/60 c.p.s. enclosed, continuous rating 1/40 h.p., ex. equip. Perfect order, **19/6,** plus 4/6.

G.E.C. Black Light Tube for experiments and special lighting effects—40 watt 2ft. tubes only, **14/6** each; holders and control gear, **19/6,** plus 4/6 post.

Clock Motor. 230v. 50 c.p.s. synchronous—self starting **6/6**

Pentode Output Transformer. Standard size, 40–1, **5/6** each.

E.H.T. Condenser. 0–1 mfd. 5 kV, **8/6** each.

Neon Mains Tester, 1/3 each, **12/-** doz.

Flood Lamp Control. Our dim and full switch is ideal for controlling photo flood lamps; it gives two lamps in series, two lamps full brilliance and lamps off. Similar control of other appliances can be arranged where used in pair or where circuit can be split exactly in half. Technically the switch is known as a double-pole change over with off. Our price **6/6.**

Sub-Miniature Silicon Diodes. General purpose type with gold-plated leads, **1/-** each or **7/6** per dozen.

Message Tapes. 225ft. Tape on 3in. spools, normally 4/6 each, we offer 4 tapes for **12/6.**

Circular Flex. Non-kink. Ideal for vacuum cleaners etc., twin made by BICC. Usually 8d. yd., 100 yd. coil for **30/-,** plus 6/- postage.

Edgewise Control. Morganite, as fitted many transistor radios, 2K or 5K with switch, **2/6** each or **24/-** per dozen.

12V Inverter. Full transistorised for operating a 20-watt fluorescent tube, size 6in. long × 1⅝ × 1⅝. **£3.10.0.** Post and insurance 3/-.

Silicon Rectifier. Equiv. BY100 750mA 400V., 10 for **20/-.**

Miniature Pickup for 7in. records made by Cosmocode, crystal cartridge with sapphire stylus only **3/9** or **36/-** dozen.

Headphones. Ex WD, unused and perfect, low resistance. Single with headband **4/6,** Double with headband **8/6.**

Midget Neons for mains indicators, etc., **1/3** each or **12/-** dozen.

Compression Trimmers. Twin 100pF, **1/-** each, **9/-** per dozen.

3in. PM Loudspeakers. 3 ohm, **12/6;** 80 ohm, **8/6.**

Rotary Cam Operated Switch. 12 positions each of which close a separate pair of contacts except the last which leaves them all open. Contacts rated at 250v. 16 amps, **15/-** each.

Rotary Cam Operated Switch. 4 positions: 1st position all contacts open; 2nd contact 1 closed; 3rd contacts 1 and 2 closed; 4th contacts 1, 2 and 3 closed. Contact rated 250v. 16 amps, **8/6** each.

Pocket Test Meter, measures AC volts (3 ranges), DC Volts (3 ranges), ohms, milliamps, ideal to carry around. Complete with instructions and test prods. **39/6** plus 2/6 p. & p.

Breast Microphone. Fine American made dynamic type, adjustable on breast plate with neck straps, **7/6,** post 4/6.

Circular Fluorescent. 22 watt, 9in. diam. tube complete with choke, starter, holders and chrome clips, **29/6,** post, etc., 4/6.

Midget Relay twin 250 ohm coils, size approx. 1½ × 1 × 1in. 4 pairs changeover contacts, **7/6** each.

1,000W Fire Spiral, replacement for most fires, **1/3** each, **12/-** dozen.

50 ohm 50 watt Wire Wound Pot-meters, 8/6 each,

1 Meg Miniature. Pot-meter Morganite standard ¼in. spindle, **1/-** each; **9/-** per dozen.

1 Meg Miniature. Pot-meter Morganite preset screwdriver control. **9d.** each; **8/-** per dozen.

Pre-Set 100K by Welwyn with intrical bakelite knob, **1/-** each; **9/-** per dozen.

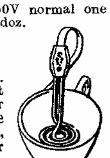
100K Pot-Meter. Miniature type with double pole switch and standard ¼in. spindle, by Morganite, **2/-** each; **18/-** per dozen.

Battery Motor. 1½in. long, ⅞in. dia., operates from 3V upwards, reversible, speed variable by changing voltage or resistance **4/6** each; **50/-** doz.

Thermal Relay. Can be used to delay the supply of HT while heaters warm up, or will enable 15A loads to be controlled by miniature switches or relays. Regular list price over £2, price **7/6** each.

Toggle Switch Bargain. 10A 250V normal one hole fitting **2/9** each; or **30/-** per doz.

QUICK CUPPA



Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **19/6,** post and insurance 1/6. **12v. car model also available.**

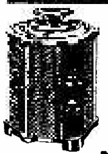
Where postage is not stated then orders over £3 are post free. Below £3 add 2/9. Semi-conductors add 1/- post. Over £1 post free. S.A.E. with enquiries please

ELECTRONICS (CROYDON) LTD

Dept PW 266 London Road, Croydon CRO-2TH

Also 102/3 Tamworth Road, Croydon

VARIABLE VOLTAGE TRANSFORMERS

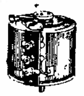


◄ 50 AMPS

INPUT 230/240v. A.C. 50/60— **OUTPUT VARIABLE** 0-260v.

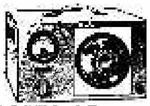
BRAND NEW
Keenest prices in the country. All Types (and Spares) from ½ to 50 amp. from stock.

SHROUDED TYPE
1 amp, **£5.10.0**, 2·5 amps, **£6.15.0.** 4 amps, **£9.0.0.** 5 amps, **£9.15.0.** 8 amps, **£14.10.0.** 10 amps, **£18.10.0.** 12 amps, **£21.0.0.** 15 amps, **£25.0.0.** 20 amps, **£37.0.0.** 37·5 amps, **£72.0.0.** 50 amps, **£92.0.0.**



½ AMP ► **£3.10.0.**

OPEN TYPE (Panel Mounting) ½ amp, **£3.10.0.** 1 amp, **£5.10.0.** 2½ amps, **£6.12.6.**

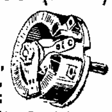


PORTABLE TYPE
1·5 amp. portable fitted metal case, voltmeter, lamp, switch, etc. **£9.5.0.** Similar to above 2·5 amp. **£11.7.6.**

PORTABLE TYPE £9. 5. 0.

100 WATT POWER RHEOSTATS (NEW)

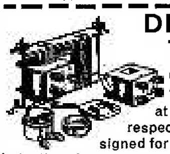
AVAILABLE IN THE FOLLOWING VALUES



1 ohm, 10 a.; **5 ohm,** 4·7 a.; **10 ohm,** 3 a.; **25 ohm,** 2a.; **50 ohm,** 1·4 a.; **100 ohm,** 1 a.; **250 ohm,** ·7 a.; **500 ohm,** ·45 a.; **1,000 ohm,** 280 mA; **1,500 ohm,** 230 mA; **2,500 ohm,** ·2 a. Diameter 3½in. Shaft length ¾in., dia. $\frac{1}{16}$in. All at **27/6** each. P. & P. 1/6.
50 WATT. 1/5/10/25/50/100/250/500/1,000/1,500/2,500/ohm, **21/-.** P. & P. 1/6.
25 WATT. 10/25/50/100/250/500/1,000/1,500/2,500 ohm, **14/6.** P. & P. 1/6.

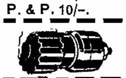
DEMONSTRATION TRANSFORMER

(STENZYL TYPE)



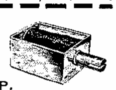
Two separate removable coils tapped at 0. 110. 220 volts, and 6. 12. 36 volts respectively. A composite apparatus designed for class demonstration. Electro magnetic induction, jumping ring, induction lamp, relationship between field intensity and ampere turns, induction melting, are just a few of the possible experiments. New modified model. **£14.10.0.** P. & P. 10/-.

INSULATED TERMINALS



Available in red, white, yellow, black, blue and green. New **17/-** per doz. 2/- P. & P.

230/250V. A.C. SOLENOID

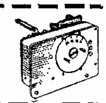


Heavy duty type, approx. 3 lbs. pull. Price **17/6** plus 2/6 P. & P.

12/24V. D.C. SOLENOID

Approx. 8 oz. push. Price **8/6** plus 1/6 P. & P.

PRECISION INTERVAL TIMER



From 0-30 seconds (repetitive). Jewelled balanced movement. Lever re-set. Operates 230V. A.C. 5 amp. c/o Microswitch. New Price **17/6** plus 2/6 P. & P.

CONDENSERS 2,500 mfd. 100v. **12/6** 1/6 P. & P. 4,000 mfd. 25v. **10/-** 1/6 P. & P. 4,000 mfd. 50v. **15/-** 1/6 P. & P. 10,000 mfd. 35v. **15/-** 1/6 P. & P.

CONSTANT VOLTAGE TRANSFORMER

Input 185-250 v. A.C. Output 230 v. A.C. Capacity 250 watt. Attractive metal case. Fitted red signal lamp. Rubber feet. Weight 17 lb. Price **£11.10.0.** P. & P. 15/-.

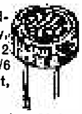
L.T. TRANSFORMERS

All primaries 220-240 volts.

Type No.	Sec. Taps	Price	Carr.
1	30, 32, 34, 36 v. at 5 amps.	£4.5.0	6/-
2	30, 40, 50 v. at 5 amps.	£6.5.0	6/6
3	10, 17, 18 v. at 10 amps.	£4.10.0	4/6
4	6, 12 v. at 20 amps.	£5.17.6	6/6
5	17, 18, 20 v. at 20 amps.	£6.12.6.	6/6
6	6, 12, 20 v. at 20 amps.	£6.5.0	7/6
7	24 v. at 10 amps.	£4.15.0	5/6
8	4, 6, 24, 32 v. at 12 amps.	£6.10.0	6/6

DOUBLE WOUND VARIABLE L.T. TRANSFORMER
Input 230 v. A.C. OUTPUT CONTINUOUSLY VARIABLE 0-36 v. A.C.
0-36 v. at 5 amp. £9.12.6. P. & P. 8/6.
0-36 v. at 20 amp. £21.0.0. P. & P. 15/-

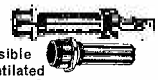
LIGHT SENSITIVE SWITCH



Kit of parts, including ORP12 Cadmium Sulphide Photocell, Relay, Transistor and Circuit, etc., 6-12 volt D.C. op. price **25/-** plus 2/6 P. & P. ORP 12 including circuit, **10/6** each, plus 1/- P. & P.

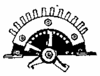
A.C. MAINS MODEL Incorporates Mains Transformer. Rectifier and special relay with 3, 5 amp mains c/o contacts. Price inc. circuit **47/6** plus 2/6 P. & P.

LIGHT SOURCE AND PHOTO CELL MOUNTING



Precision engineered light source with focusible lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP 12 or similar cell. Both units are single hole fixing. Price per pair **£2.15.0.** P. & P. 3/6.

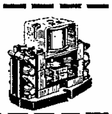
MINIATURE UNISELECTOR SWITCH



3 banks of 11 positions plus homing bank. 40 ohm coil. 24-36 v. D.C. operation. Tested. **22/6**, plus 2/6 P. & P.

NICKEL CADMIUM BATTERY. Sintered Cadmium Type 1·2 v. 7AH. Size height 3½in., width 2⅜ x 1$\frac{3}{16}$in. Weight approx. 13 oz. Ex-R.A.F. Tested. **12/6.** P. & P. 2/6.

A.C. CONTACTOR



2 make + 2 break (or, 2 c/o.). 15 amp. contacts. 230/240V. A.C. operation. Brand new. Price **22/6** plus 1/6 P. & P.

STROBE! STROBE! STROBE!

Three easy to build Strobe Units using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250v. A.C. operation.

ECONOMY KIT. Flash rate 1–36 flash per second. All components including Unijunction, thyristor, tube and circuit. **£5.5.0** plus 3/6 P. & P.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories etc. Roller tin printed circuit. New trigger coil, plastic thyristor and new improved type of tube. 1-80 f.p.s. Price **9 gns.** 7/6 P. & P.

HY-LYGHT STROBE
This strobe has been designed and produced, in response to wide public demand, for use in large rooms, halls and the photographic field. It has 4 times the light output at 30 f.p.s. and utilizes a silica plug in tube for longer life expectancy, printed circuit for easy assembly also a special trigger coil and output capacitor. Light output approx. 4 joules. Price **£10.17.6.** P. & P. 7/6.

RELAYS

Bulk purchase enables us to offer the following new **SIEMENS, PLESSEY,** etc. miniature plug in relays complete with base, at a fraction of maker's price.

Coil Ω	Working Voltage	Contacts	Price
280	6–12	2 c/o	14/6
280	9–18	4 c/o	15/6
700	12–24	2 c/o	12/6
700	16–24	4 c/o	15/6
700	16–24	4M 2B	12/6
1250	20–40	2 c/o H.D.	12/6
2500	30–50	2 c/o H.D.	12/6
5800	50–70	4 c/o	10/-
9000	40–70	2 c/o	10/-

H.D. – Heavy Duty. POST PAID

SELENIUM BRIDGE RECTIFIERS

30 volt 3 amp., **11/-**, plus 2/6 P. & P.
30 volt 5 amp., **16/-**, plus 2/6 P. & P.

SERVICE TRADING CO

All Mail Orders—Also Callers—Ample Parking Space
57 BRIDGMAN ROAD, LONDON, W.4 Phone 995 1560
SHOWROOM NOW OPEN CLOSED SATURDAY

Personal callers only
9 LITTLE NEWPORT STREET LONDON, WC.2. Tel. GER 0576

JASON KITS

FANTASTICALLY POPULAR

★ TAPE ★

We offer you fully tensilised polyester/mylar and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more coppers than acetate, sub-standard, jointed or cheap imports. TRY ONE AND PROVE IT YOURSELF

Standard Play			Long Play		
3in	150ft.	2/3	3in	225ft.	2/9
4in.	300ft.	4/6	4in.	450ft.	5/6
5in.	600ft.	7/6	5in.	900ft.	10/6
5¾in.	900ft.	10/6	5¾in.	1,200ft.	13/-
7in.	1,200ft.	12/6	7in.	1,800ft.	18/6
Double Play			**Triple Play**		
3in.	300ft.	4/-	4in.	900ft.	13/-
4in.	600ft.	8/-	5in.	1,800ft.	25/-
5in.	1,200ft.	15/-	5¾in.	2,400ft.	34/-
5¾in.	1,800ft.	19/6	7in.	3,600ft.	44/-
7in.	2,400ft.	27/-	**Quadruple Play**		
			3in.	600ft.	8/6

Postages 1/- *reel.*
Post Free less 5% on three reels.
Quantity and Trade enquiries invited.
NOTE: *Large tape stocks at all branches.*

TUBES

Highest Quality—Compare Our Prices

Carr. & Ins. 12/6	GUARANTEED 6 Months	12 Months
14in.	£2.10.0	£3.10.0
17in. & 19in.	£3. 5.0	£4. 5.0
21in. & 23in.	£3.15.0	£5.15.0

SATISFACTION GUARANTEED
Most Mullard, Mazda, Cossor, Emitron, Emiscope, Brimar, Ferranti types processed in our own factory.
NOTE: ALL tube orders only to Portsmouth branch please.

NEW and SPECIAL Lines at the keenest prices

AM/FM STEREO MULTIPLEX RECEIVERS
18 transistors, 9 diodes, 1 variable diode, 2 Silicon Rectifiers. Push-pull Stereo Amplifiers. FM Stereo Separation 15dB. AM Medium Wave 180-550 Metres. Power output 10W R.M.S., 220/240V A/C Mains. Beautiful wooden plinth case—approximately 15″(w) × 6″(h) × 9″(d). Controls: Function Switch, Balance, Base/Treble Control, Volume, Tuning. Fine finish. Special purchase enables us to offer these superb machines of famous make at a ridiculously low price. Unrepeatable offer at a fraction of list price . . . only 26 GNS. POST FREE.

SHARP	RD504 Mains Battery Tape Recorder, List 36 gns	**28 gns**
HITACHI	Marine D/F Receivers SW/MAR/MW/LW	**27 gns**
GARRARD	1025 Changers with Stereo Cartridge	**£8 10s**
JASON	12in. Diecast full range twin cone Speakers	**£4 10s**
AJAX	Mains/Battery, AM/FM larger Radio	**12 gns**
WELESMERE	AM/FM High Sensitivity Black Leather	**7 gns**
HITACHI	WH837E All-Wave, full size. Excellent Short Wave	**13 gns**
HI-FI	By Leak, Wharfedale, Goodmans, WB, Dulci, Arona, Teleton, etc., etc.	

All items previously advertised available. Huge Hi-Fi and Component stocks at all branches. Please call and view without obligation.

TECHNICAL TRADING

RETAIL BRANCHES:
LONDON, 10 Tottenham Court Rd. (MUS 2639)
PORTSMOUTH, 350-352 Fratton Road (Tel. 22034)
SOUTHAMPTON, 72 East Street (Tel. 25851)
BRIGHTON, 6 Queen's Road (Tel. 23975)

MAIL ORDER WAREHOUSE:
Devonian Court, Park Crescent Place, Brighton. (Tel. 680722)

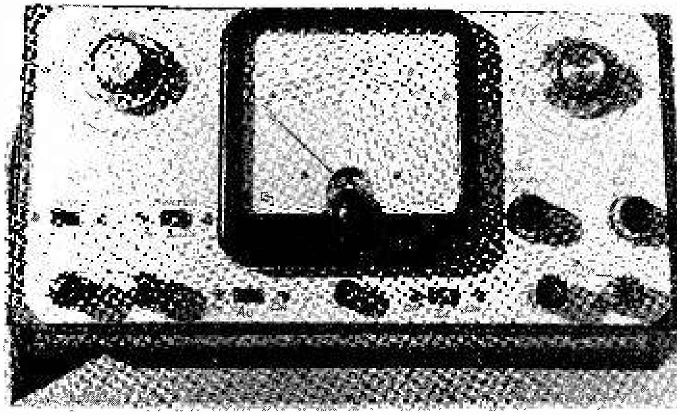
BARGAIN PARCELS

Including variable condensers, i.f. coils, loudspeaker plug/sockets, knobs, pots, condensers, resistors, nuts, bolts, cabinet fittings, switches, transformer choke, rectifier, transistors at a small fraction of list value. Due to heavy demand we now pack them in several sizes—be amazed—try one now.

3 lbs. (post 3/-)	9/-
7 lbs. (post 5/-)	17/6
14 lbs. (post 6/-)	29/-

AC-DC METER

H.T. KITCHEN



continued from the July issue

THE meter was an expensive item, and some form of protection circuit was considered mandatory. The meter protection circuit comprises D8 D9 R43 and R44, the *modus operandi* being somewhat as follows. The diodes on their own do not conduct until a potential difference of 600 to 700mV exists across them. Being connected in parallel, though oppositely phased, either one or the other will conduct irrespective of the polarity of the voltage impressed across them. This property is only required when connected into the d.c. amplifier, where the terminals can be connected into an incorrect polarity circuit. The meter requires 60mV for f.s.d., which means a current some 10 to 12 times f.s.d. would pass through the meter before the diodes conducted. This does not represent an adequate safety margin, and so the resistors R43 and R44 were included. This means that the voltage now required for f.s.d. is 250mV or one-third of the conduction voltage of the diodes, the measure of protection afforded being proportionally greater. The resistors could be further increased to improve the degree of protection, but we are then in danger of incurring scale non-linearity as well as a further loss in the sensitivity of both amplifiers. With the selected components, the meter has only to pass a current $\times 3$ f.s.d. or $150\mu A$ before the diodes conduct.

The purpose of C11 is to "damp" the meter needle against constantly varying outputs, such as an audio signal from the a.c. amp and therefore provide a more easily read "average" voltage.

It also serves to slow the meter needle in its progression over the scale, so that in the event of an overload it comes to rest fairly gently against the end stop.

Constructional Details

The "active" part of the complete instrument, the a.c. and d.c. amplifiers, are built on a printed circuit board to the dimensions and layout given in Fig. 4.

The passive parts of the instrument are the attenuators, incorporated round S1a-b and S3a-b. On the prototype, these consisted of Radiospares Makaswitch shafting assemblies. To ease the problem of connecting the various components associated with the a.c. attenuator, a spare single-pole ten-way wafer was pressed into service, this being suspended by means of appropriate spaces between the two twelve-way wafers. The wiring of these attenuators is shown in Figs. 5 and 6.

The meter scaling is in the now familiar, almost standard 1-3-10 sequence, the range resistors being chosen to suit. There is, quite clearly, no reason why any other sequence preferred by the individual constructor should not be used, the range resistors being altered as necessary.

The front panel carries the moving coil meter, and the various switches and potentiometers; the wiring of these are straightforward and are therefore not illustrated.

The complete instrument is built into a cabinet of 20 gauge aluminium to the dimensions given in Fig. 7 and held together by self-tapping screws. The cabinet, in turn, is suspended in a "U" bracket of 10 gauge aluminium by means of $\frac{1}{4}$in. UNF bolts, washers and shakeproof nuts as detailed in Fig. 9.

The front panel is drilled and cut to the dimensions of Fig. 8. The legends for the front panel were drawn on white cartridge paper with red and black ballpoint pens, the red begin used only for the mV sections of the two input attenuators. This was then faced, for protective purposes, by a sheet of $\frac{1}{16}$in. Perspex.

Construction should not be commenced until all the components are to hand, in order to allow for dimensional differences between the components used in the prototype, and those to be used by the individual constructor. Both circuits are quite stable and there was little difference between the breadboard experimental circuits and the finished article. Other forms of construction are therefore quite suitable, provided some simple precautions are observed. These consist, for the a.c. amplifier, of

SWITCH FUNCTIONS

S1 — Range switch — d.c.
S2 — On/off switch — d.c.
S3 — Range switch — a.c.
S4 — On/off switch — a.c.
S5 — AC/DC selector
S6 — Norm/rev. switch.

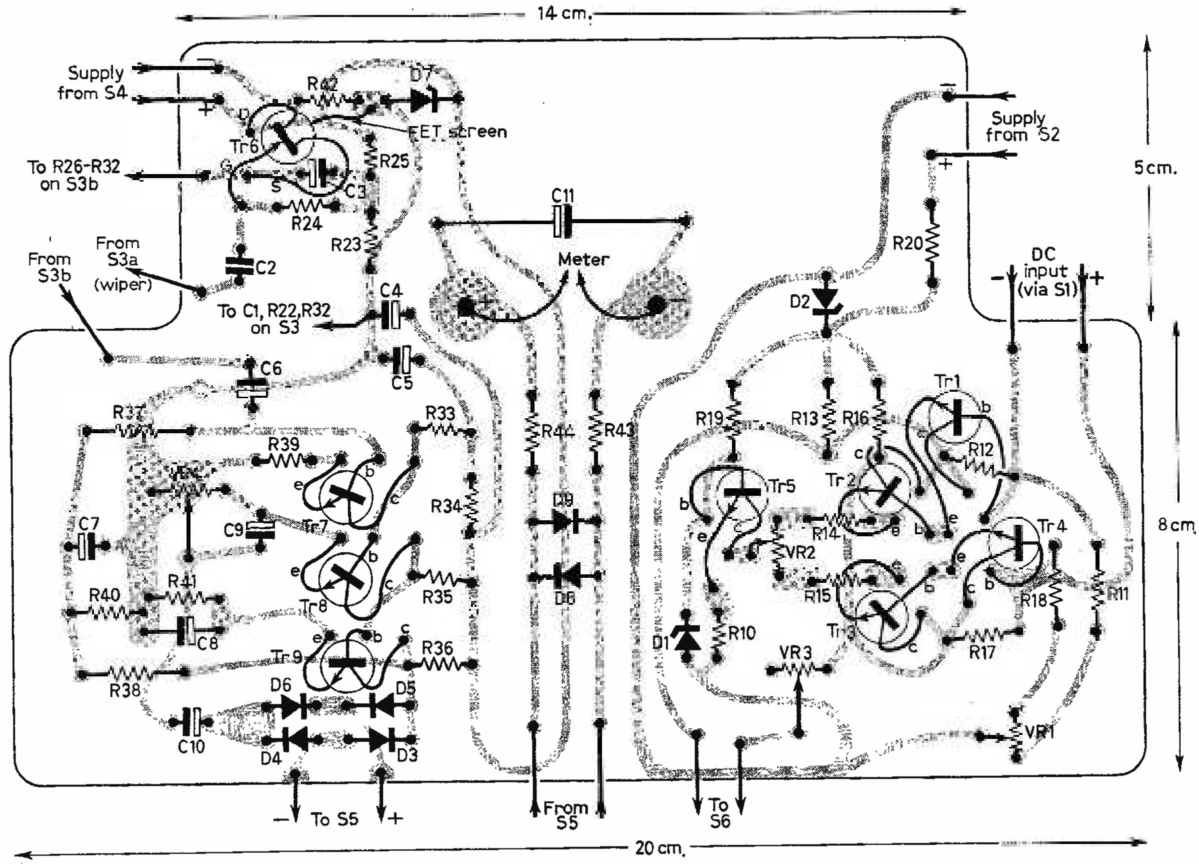


Fig. 4: The printed circuit board for the a.c. and d.c. amplifiers, as etched by the author. The a.c. section is on the left, the d.c. section on the right.

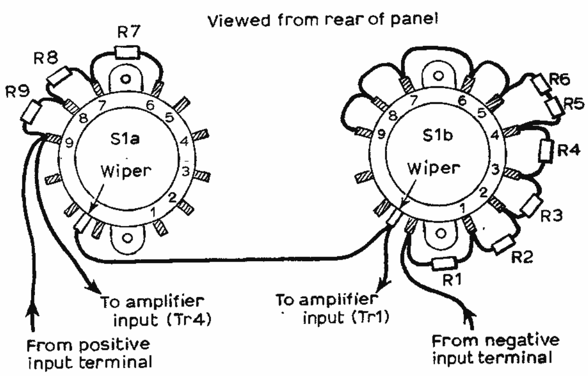


Fig. 5: Wiring and components associated with the d.c. input attenuator.

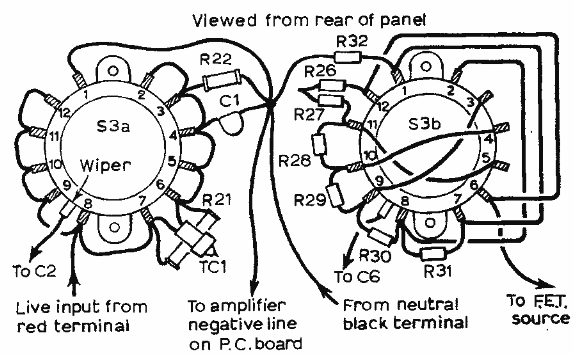


Fig. 6: The a.c. attenuator switch. The wafer numbering corresponds with that given in the circuit diagrams.

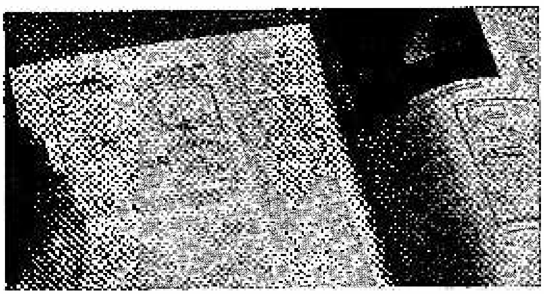
keeping the input stage and attenuator well screened to obviate the picking-up of hum and other extraneous signals and, for the d.c. meter, of keeping the input terminals and circuitry well isolated from each other to obviate the leakages that exist undetected and unsuspected, in many circuits. The input resistance is very high, and leakage resistances can exist, of magnitudes sufficient to upset the working of the amplifier.

As far as components are concerned, there is only one thing to remember. This is a measuring instrument, the yardstick of the future. Therefore only the best components must be used; components of unknown origin, of dubious characteristics, must be ruthlessly discarded. The use of "bakelite" switches for the input attenuators is to be deprecated, as the leakage resistance between adjacent pins and contacts is low enough to adversely affect the working of the d.c. amplifier.

Only the best grade of printed circuit board should be used. When the instrument is fully and satisfactorily operational, the copper side and, if desired the

Open the pages of The RADIO CONSTRUCTOR this month for - - -

THESE SPECIAL FEATURES



TRANSISTOR REVERBERATION UNIT

MAIN FEATURE ARTICLE

Add a "third dimension" to reproduced music with the aid of this simple-to-build reverberation unit, which can take its input from electric guitars, medium or high impedance microphones, or any other normal sound source. The output of this unit can feed into a standard amplifier or tape recorder, and results are particularly impressive when it is employed with an electronic organ.

other articles include

COIL COVERAGE TEST UNIT

★ ★ ★

SIMPLE VOLTAGE TO FREQUENCY CONVERTER

A neat circuit which provides linear change of frequency with change of input voltage.

★ ★ ★

TRANSISTOR SUPERHET FOR TOP BAND

This receiver incorporates Seven Transistors and One Diode and can be operated from a 9v dry or 12v car battery.

JULY ISSUE

RADIO CONSTRUCTOR

ON SALE NOW 3/-

TECHNICAL TRAINING

in radio television and electronics

Whether you are a newcomer to radio and electronics, or are engaged in the industry and wish to prepare for a recognized examination, ICS can further your technical knowledge and provide the specialized training so essential to success. ICS have helped thousands of ambitious men to move up into higher paid jobs—they can help you too! Why not fill in the coupon below and find out how?

Many diploma and examination courses available, including expert coaching for:

- **C. & G. Telecommunication Techns'. Certs.**
- **C. & G. Electronic Servicing**
- **R.T.E.B. Radio/T.V. Servicing Certificate**
- **Radio Amateurs' Examination**
- **P.M.G. Certs. in Radiotelegraphy**
- **General Certificate of Education, etc.**

Examination Students coached until successful

NEW SELF-BUILD RADIO COURSES

Learn as you build. You can learn both the theory and practice of valve and transistor circuits, and servicing work while building your own 5-valve receiver, transistor portable, and high-grade test instruments, incl. professional-type valve volt meter—all under expert tuition. Transistor Portable available as separate course.

POST THIS COUPON TODAY

for full details of ICS courses in Radio, T.V. and Electronics.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 171, Intertext House, Stewarts Road, London, S.W.8

Please send me the ICS prospectus—free and without obligation.

(state Subject or Exam.) ....

....

NAME ....

ADDRESS ....

.... 8/69

INTERNATIONAL CORRESPONDENCE SCHOOLS

BIGGEST BREAKTHROUGH IN RADIO KITS!

Because of the fantastic demand we have been unable to offer this kit since the initial advertisement on March 7th.

THE REVOLUTIONARY APOLLO "6" CAN BE BUILT FOR 59/6

SPECIALLY made for the thousands of discriminating people who want the finest easy-to-build radio . . . at a reasonable price! *This is a different breed—it will startle you!* **EIGHT MONTHS AGO** our two designers were briefed to produce a radio kit that would fill these technical demands:—**DEMAND—A. IT SHOULD BE POSSIBLE TO BUILD PAINLESSLY IN ONE EVENING . . . ANSWER**—the Apollo "6" has simplified, well illustrated step-by-step plans.

CONTAINS FEATURES THAT CAN'T BE BOUGHT IN READY MADE SETS—AT ANY PRICE

- receives medium wave & trawler broadcasts.
- every component brand new—no surplus rejects or "seconds".
- uses latest Silicon Planar Epitaxial Epoxy transistors.
- six stage stable reflex—2 R.F., 1 Diode demodulation, 3 A.F.
- simplified illustrated plans.
- from parts to programmes in an evening

. . . PLUS MANY MORE!

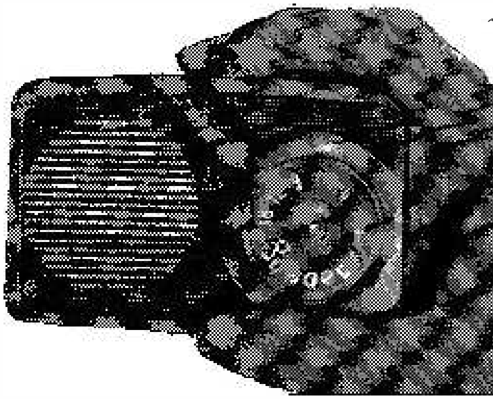
No soldering iron is necessary and you don't have to have a magnifying glass and a pair of tweezers. **DEMAND—B. IT SHOULD WORK FIRST TIME . . . —ANSWER—** Apollo "6" uses latest rugged Silicon Transistor Circuitry and every single transistor, diode, capacitor, resistor, inductance etc. is brand new and fully tested—no surplus parts, no manufacturers rejects, no manufacturers "seconds", and uses "Ever Ready" battery. **DEMAND—C. IT MUST HAVE THE POWER TO OPERATE OPTIONAL LOUDSPEAKER . . . DEMAND—D. IT MUST GIVE GOOD RECEPTION IN DIFFICULT AREAS . . . DEMAND—E. IT MUST WORK ON ITS OWN INTERNAL FERRITE ROD AERIAL . . . ETC. ETC. ANSWER**—The Apollo "6" does all this—and much more!

REVOLUTIONARY SILICON PLANAR EPOXY CIRCUIT DESIGN

Apollo "6" will probably be bang up-to-date well into the seventies! it bristles with latest technical innovations. Six stage stable reflex N.P.N. and P.N.P. circuit consisting of 2 Radio Frequency stages, 1 Diode demodulation stage and 3 Audio Frequency stages. Uses latest Silicon Planar Epitaxial Epoxy transistors (similar to types used in America's Space Project). *The first two transistors give amplification of* 100 *to* 400 *each,* (at only 100 Microamps collector current approx). *Output transistor gives amplification of* 235 *to* 470. Stable reflexing gives the Apollo "6" staggering selectivity, uncanny sensitivity, true-to-life sound reproduction—in fact its range, power and selectivity must be experienced to be believed. Enter a new magic world of reception—station after station (home and abroad).

IRON CLAD GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full, at once and without quibble or question . . .



THRILLING SOUND OF AN S.O.S. AT SEA

Listen to the thrilling sound of an S.O.S. at sea—tune in to a world you've never heard before . . . **NOTE.** Because members of our own Staff (and their friends) are enthusiastic and have already bought Apollo "6" parts we know demand will be enormous. **DON'T DELAY—SEND FOR YOURS NOW,** send 59/6+3/6 P. & P. for all parts, illustrated plans, personal listening earpiece etc. (all parts can be bought separately) **MONEY BACK GUARANTEE** (see panel).

Orders despatched in strict rotation.

PHOENIX ELECTRONICS (Dept. PW2) 18 Little Preston St, Brighton, 1. Sussex.

R.S.T. VALVE MAIL ORDER CO.

BLACKWOOD HALL, 16a WELLFIELD ROAD, STREATHAM S.W.16

Mon.—Sat. 9 a.m. —5.30 p.m.
Closed Sat. 1.30—2.30 p.m.
Open Daily to Callers

Tel. 769-0199/1649

1A7	7/9	6BQ7A	7/-	6K7G	2/-
1D5	7/6	6BR7	17/-	6K7GT	4/6
1H5	7/-	6BR8	12/6	6K8M	11/6
1LD5	6/-	6BS7	25/-	6K8G	3/-
1N5GT	8/-	6BW6	14/6	6K8GT	7/-
1R5	6/-	6BW7	13/-	6K25	15/-
1S4	5/6	6C4	5/-	6L1	12/-
1S5	4/6	6C5G	5/-	6L6G	7/9
1T4	4/-	6C6	3/9	6L18	6/-
3A4	4/-	6C8G	6/-	6Q7G	6/-
3Q4	7/9	6CD6G	24/-	6Q7GT	8/6
3Q5	7/-	6CH6	7/6	6SA7M	7/-
3S4	6/3	6CW4	12/-	6SC7	7/-
3V4	6/9	6D6	3/9	6SG7	6/-
5R4GY	10/6	6E5	7/6	6SH7	3/3
5U4G	5/6	6F1	12/6	6SJ7	6/-
5V4G	8/-	6F5G	8/-	6SK7GT	4/9
5Y3GT	6/-	6F6G	5/-	6SL7GT	6/-
5Z4G	7/-	6F8G	5/6	6SN7GT	5/6
6/30L2	15/-	6F11	6/6	6SQ7	7/6
6A7	15/-	6F13	6/6	6U4GT	12/-
6A8G	12/6	6F14	12/6	6U5G	7/6
6AC7	4/-	6F23	16/-	6V6M	12/-
6AK5	5/-	6F24	14/-	6V6G	4/6
6AL5	3/-	6F25	15/-	6V6GT	6/6
6AM5	4/6	6F28	14/-	6X4	4/6
6AM6	3/6	6G6	2/6	6X5G	4/6
6AQ5	6/3	6H6	3/-	6X5GT	6/-
6AS7G	16/-	6J5M	9/-	7B6	11/6
6AT6	4/9	6J5G	4/-	7B7	7/6
6AU6	5/-	6J5GT	5/6	7C5	22/6
6B4G	20/-	6J6	3/6	7C6	15/-
6B8G	2/-	6J7M	8/6	7D5	8/-
6BA6	5/-	6J7G	6/-	7H7	6/6
6BE6	5/-	6J7GT	7/6	7R7	13/-
6BH6	9/-	6K6GT	5/-	7S7	45/-
6BJ6	9/-	6K7M	6/6	7Y4	8/6

9BW6	7/-	20P5	20/-	80	7/6
10C1	12/6	25A6	5/9	85A2	7/3
10C2	12/6	25L6GT	7/-	150B2	11/6
10F1	14/9	25Y5	6/-	150C4	9/6
10F3	18/-	25Z4	6/3	801	9/6
10F9	10/6	25Z5	8/-	807	9/-
10F18	8/-	25Z6	8/6	813USA	120/-
10L1	8/-	28D7	9/3	813	75/-
10LD11	10/6	30C1	6/9	866A	15/-
10P13	13/6	30C15	15/-	954	5/3
11E3	70/-	30C17	16/-	1625	6/6
12AT6	4/9	30C18	15/-	4022AR	67/-
12AT7	6/-	30F5	17/-	5763	12/-
12AU6	5/9	30FL1	16/-	7193	2/-
12AU7	5/9	30FL12	19/-	7475	14/-
12AX7	6/3	30FL14	15/6	A61	9/6
12BA6	6/-	30L15	17/-	ATP4	2/3
12BE6	6/3	30L17	17/-	ATP5	12/-
12C8GT	5/-	30P12	16/-	ATP7	8/6
12E1	20/-	30P19	15/-	AU2	80/-
12J5GT	2/6	30PL1	16/-	AU5	8/9
12J7GT	6/6	30PL13	18/6	AZ1	8/-
12K7GT	7/-	30PL14	15/-	AZ31	10/-
12K8GT	8/-	35A5	11/6	CBL31	16/-
12Q7GT	6/-	35L6	9/-	CCH35	15/-
12SA7	8/-	35W4	4/6	CL33	20/-
12SG7	6/-	35Z3	10/-	CY30	12/6
12SH7	3/-	35Z4GT	8/6	CY31	8/6
12SJ7	3/9	35Z5	6/-	DAC32	7/-
12SK7	4/9	37	6/6	DAF91	4/6
12SR7	5/-	42	6/-	DAF96	7/6
14H7	9/6	50B5	6/6	DCC90	10/6
19AQ5	5/-	50C5	6/3	DF33	8/-
20D1	10/-	50CD6G	31/-	DF70	9/-
20F2	14/-	50L6GT	8/-	DF91	4/-
20L1	20/-	75	9/6	DF92	3/6
20P4	20/-	78	5/-		

DF96	7/6	ECF80	6/6	EM80	7/6
DH77	4/9	ECF82	6/6	EM81	8/3
DK32	7/9	ECH21	12/6	EM84	7/6
DK91	6/-	ECH35	11/6	ESU150	20/-
9K92	9/-	ECH42	11/-	EY51	7/6
DK96	7/9	ECH81	5/9	EY86	7/-
DL66	25/-	ECH83	8/6	EZ35	6/-
DL92	6/3	ECL80	7/-	EZ40	8/3
DL93	4/-	ECL82	7/-	EZ41	9/6
DL94	6/9	ECL83	10/3	EZ80	5/6
DL95	7/9	ECL86	9/-	EZ81	5/6
DL96	7/6	ECLL800	30/-	GZ30	10/-
DM70	6/-	EF9	20/-	GZ32	10/-
DY86	6/-	EF37A	7/-	GZ34	11/-
DY87	6/6	EF39	8/-	KT36	18/-
E88CC	12/-	EF41	10/-	KT61	17/6
EA50	3/6	EF50	5/-	KT66	21/-
EABC80	6/6	EF80	5/-	KT81	35/-
EAF42	10/-	EF85	7/-	KT81 (7C5)	15/-
EB41	10/-	EF86	6/6	KT88	30/-
EB91	3/-	EF89	5/6	KTW61	8/6
EBC33	8/6	EF91	3/6	KTZ41	6/-
EBC41	9/9	EF92	2/6	ML4	17/6
EBC90	4/9	EF98	15/-	ML6	7/6
EBF80	7/6	EF183	6/6	MSP4	10/-
EBF83	9/-	EF184	7/-	MU14	7/6
EBF89	6/6	EL32	3/6	MX40	12/6
EBL1	14/-	EL33	12/6	N78	19/-
EBL21	12/-	EL34	10/6	N108	25/-
EBL31	27/6	EL41	10/6	NGT1	3/6
EC90	5/-	EL42	10/6	NGT7	55/-
ECC81	6/-	EL84	4/9	OA2	6/-
ECC82	5/9	EL90	6/3	OC3	5/-
ECC83	6/3	EL95	6/6	OZ4	4/6
ECC84	5/6	ELL80	20/-	PC86	11/6
ECC85	5/-	EM34	21/-	PC88	11/6
ECC88	7/6				

PC97	8/9	RG5/500	80/-	UF89	7/6
PCC84	6/6	S130	40/-	UL41	12/-
PCC89	10/6	SP4	8/-	UL84	7/-
PCC189	10/6	SP41	5/6	UM80	5/6
PCF80	6/9	SP61	5/-	UU6	21/-
PCF82	6/6	STV280/80	95/-	UU7	21/-
PCF84	8/-	SU25	19/6	UU8	21/-
PCF86	9/-	SU2150	12/6	UU9	8/3
PCF801	9/9	T41	17/6	UY21	9/6
PCF802	9/9	TDD4	8/6	UY41	8/6
PCF805	15/-	U10	7/6	UY85	6/6
PCF806	13/-	U14	7/6	VMP4G	17/-
PCF808	15/6	U19	35/-	VP4B	25/-
PCL82	7/9	U25	15/6	VR105/30	6/6
PCL83	10/3	U26	15/6	VR150/30	6/-
PCL84	8/6	U78	4/6	VT25	15/-
PCL85	9/3	U191	13/9	VT31	80/-
PCL86	9/3	U251	16/3	VU111	8/9
PENA4	20/-	U301	12/6	VU120	12/6
PENB4	20/-	U403	6/6	VU508	35/-
PEN45	7/-	U404	7/6	W81M	12/6
PEN46	4/-	U801	23/6	XH1·5	5/-
PL36	10/9	UABC80	6/6	XP1·5	5/-
PL81	8/-	UAF42	10/6	XSG1-5	10/-
PL82	8/6	UBC41	9/3	Y63	7/6
PL83	7/6	UBC81	9/3	Tubes	
PL84	7/-	UBF80	7/-	3EG1	65/-
PL500	14/6	UBF89	7/6	3FP7	29/-
PX4	14/-	UCC84	8/6	5CP1	55/-
PY33	10/9	UCC85	7/6	CV1526	40/-
PY81	5/9	UCF80	8/6	ACR131	100/-
PY82	5/3	UCH42	10/6	VCR97	35/-
PY83	7/-	UCH81	7/-	VCR517B	46/-
PY800	9/6	UCL82	7/6	VCR517C	46/-
PY801	9/6	UCL83	10/-		
R2	7/6	UF41	10/6		
R19	7/9				

SPECIAL 24 HOUR SERVICE

OBSOLETE TYPES A SPECIALITY

QUOTATIONS FOR ANY VALVE NOT LISTED

Express postage 9d. per valve.
Ordinary postage 6d. per valve. C.W.O. No C.O.D.
Complete range of T.V. Tubes available from £4.5.0.
Manufacturers and Export Inquiries Welcome

Special 24 Hour Express Mail Order Service

SETS OF VALVES

DAF91, DF91, DK91, DL92 or DL94 . . . . 19/- plus postage
DAF96, DF96, DK96, DL96 . . . . 27/6 plus postage

TRANSISTORS

AC127	7/6	OC25	11/-	OC71	4/6	OC81	4/-	OC82D	6/-
AF114	7/-	OC28	16/-	OC72	6/-	OC81D	4/-	OC83	6/-
AF115	7/-	OC35	11/6	OC75	6/-	OC81DM	6/-	OC170	7/-
AF116	7/-	OC44	4/6	OC76	6/-			OC171	8/-
AF117	7/-	OC45	4/-	OC77	8/-	OC82	6/-	OC200	7/6

SEND S.A.E. FOR LIST OF 2,000 TYPES

component side, should be painted over with one of the special printed circuit board varnishes. This has the effect of insulating the circuits against the dust that invariably seems to collect and that can, in time, affect the working of the circuits.

The semiconductors used have proved to be satisfactory, and whilst it is not unreasonable to suppose that similar semiconductors will work just as well, their use has not been investigated.

It was stated earlier that it is very desirable for the transistors of the d.c. amplifier, Tr1-Tr4, to be in close proximity, even to the extent of being physically bonded together in a common heat sink. This latter condition, quite safe with many transistor encapsulations, is not possible with the 2N2484 transistors used, as the TO-18 case is internally connected to the collector lead. If these cases are physically touching, the circuit will not be damaged (provided "opposite" pairs are involved) but will refuse to work.

It is suggested that one circuit at a time be built, and checked for correct functioning before the other is built and checked. Final calibration can best be carried out when the instrument is fully completed and ready for mounting in the cabinet. Thus, the d.c. amplifier can be built and checked to see that VR1 and VR2 can satisfactorily zero the meter. Ideally, they should zero the meter at the mid-point of their travel, thereby denoting component equality. If means are at hand the hfe of Tr1 and Tr4 also Tr2 and Tr3 should be equal. If zero cannot be obtained by adjustment of VR1 and VR2, the transistors if not accurately matched could be changed about. Alternatively, the values of R11 R12 and R17 R18 or R15 R14 could be altered in value. Once this is achieved, then attention can be directed to the construction of the a.c. meter.

Test and Calibration

The a.c. meter can be roughly checked by replacing the secondary attenuator resistors by a 1kΩ fixed resistor, as the f.e.t. must not be operated without a source load. "Tickling" the input with a screwdriver will, in the absence of a more refined signal, denote operation of the circuit. A steady reading on the meter will denote either, or both, a noisy transistor or hum pickup.

For final calibration, an accurate a.c. and d.c. meter will be required, as well as an a.f. signal generator having a level output between 50Hz and 10kHz. Briefly, the procedure for voltage calibration is to feed in a known a.c. or d.c. voltage and adjust VR3 or VR4 as necessary to give the requisite voltage reading on the meter.

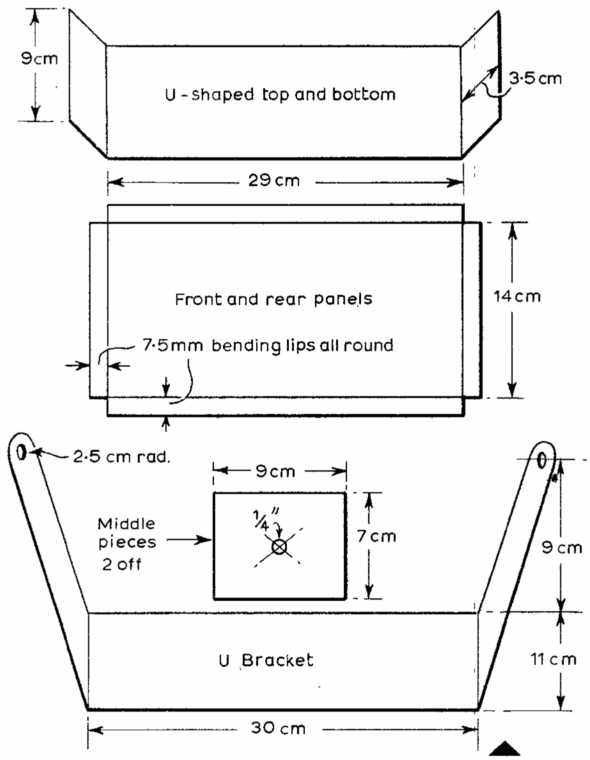


Fig. 7: Cabinet and "U" bracket dimensions. It is recommended that all metal work is carried out in 20 s.w.g. material. The "U" bracket however, should be in 10 s.w.g. if possible.

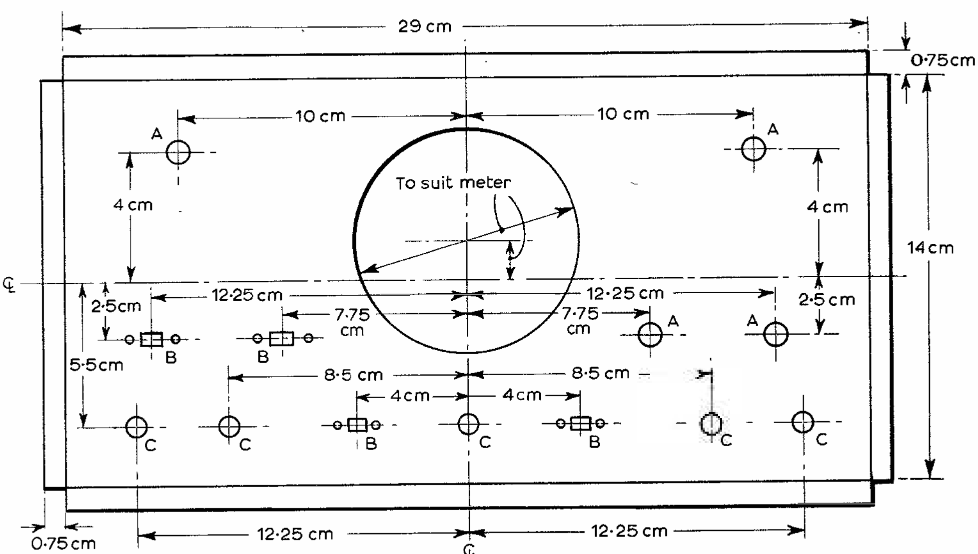


Fig. 8: The instrument front panel fabricated in 20 s.w.g. material, preferably aluminium. The cut-out for the meter will depend upon the size of unit used.

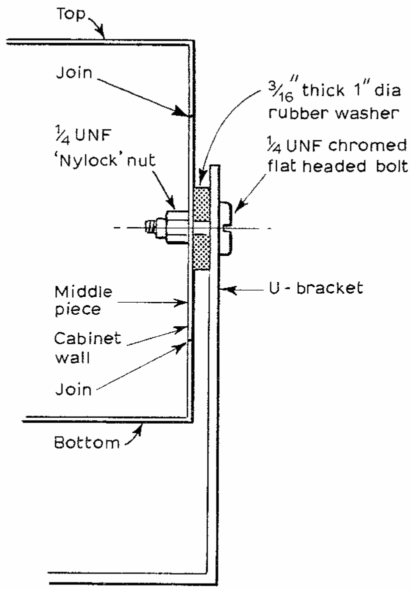


Fig. 9: Showing method of "suspending" the metal cabinet in the "U" bracket. The use of a form of lock nut for the mounting bolts is essential.

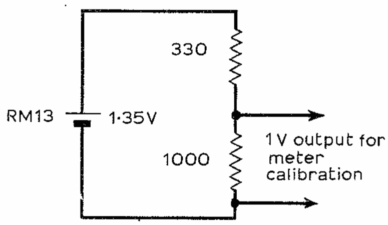


Fig. 10: Suggested circuit for calibration of the d.c. amplifier using a mercury cell.

For owners of a CdS exposure meter, or of a camera incorporating one, a very convenient and accurate way is illustrated in Fig. 10. In this method, an RM13 or similar 1·35V mercury cell is used. The 330Ω resistor drops the 0·35V leaving 1V across the 1kΩ resistor. The d.c. meter is set to 1V f.s.d. and is connected across the 1kΩ resistor and VR3 is set for f.s.d. If close tolerance resistors are used for the other ranges, these will automatically be correct.

The a.c. meter requires the use of an accurate a.f. signal generator having an output constant between some 50Hz and 10kHz minimum, higher if possible. The output is fed into the a.c. meter amplifier and VR4 is adjusted to give an appropriate reading on the meter at 50Hz. In order to set TC1, the frequency is next increased to at least 10kHz and TC1 is adjusted so that the meter reading at 10kHz is the same as that obtained at 50Hz. The reading will be higher than the 50Hz reading if the capacity of TC1 is excessive, lower if the capacity is insufficient. Only when the time constant of TC1 × R21 is equal to the time constant of R22 × C1 plus strays will the two readings be equal. In order to ensure accuracy, the higher frequency should be at least 20 times the lower frequency, and the audio generator output *must* be constant over the frequency range. In order to ensure absolute accuracy, the strays (capacitance) imposed by the enclosure of the circuit within the cabinet must be checked when the front panel is screwed into the cabinet. These usually cause the high frequency response to drop slightly, necessitating an increase in TC1. Accurate setting of TC1 will ensure a response extending well into the multiple kilohertz region. ■

NEW PRICES ON NEW COMPONENTS

ELECTROLYTIC CAPACITORS (Mullard).—10% to + 50%.

Working Voltage (V)—Capacitance (μF)							Price	Pack Prices		
4V	6·4V	10V	16V	25V	40V	64V	each	10 off	25 off	100 off
8	6·4	4	2·5	1·6	1	0·64	1/4	12/4	26/6	89/6
32	25	16	10	6·4	4	2·5	1/2	10/6	23/-	80/3
64	50	32	20	12·5	8	5	1/2	10/4	22/6	77/9
125	100	64	40	25	16	10	1/-	8/9	18/9	63/6
250	200	125	80	50	32	20	1/1	9/6	20/9	70/9
400	320	200	125	80	50	32	1/2	10/4	22/6	77/9
800	640	400	250	160	100	64	1/6	13/4	29/6	102/9
1250	1000	640	400	250	160	100	2/-	18/10	37/9	134/4
2000	1600	1000	640	400	250	160	2/6	22/3	44/3	165/6
3200	2500	1600	1000	640	400	250	3/-	26/9	59/-	204/3
				800	500	320	5/3	46/6	101/-	343/9
				1250	800	500	6/6	57/6	125/4	427/-
				2000	1250	800	8/-	71/4	157/-	541/8
				4000	2500	1600	12/6	91/6	194/9	843/9
				6400	4000	2500	15/-	133/4	291/8	1000/-

RESISTORS
High stability, carbon film, low noise. Capless construction, molecular termination bonding.
Dimensions (mm.): Body: ¼W; 8×2·8
½W; 10×4·3
Leads: 35
10% ranges; 10 Ohms to 10 Megohms (E12 Renard Series).
5% ranges; 4·7 Ohms to 1 Megohm (E24 Renard Series).
Prices—per Ohmic value.

		each	10 off	25 off	100 off
¼W	10%	2d.	1/6	3/3	10/4
¼W	5%	2½d.	1/9	3/8	11/8
½W	10%	2½d.	1/9	3/8	11/7
½W	5%	3d.	2/-	4/-	12/10

CAPACITORS
Subminiature Polyester film, Modular for P.C. mounting. Hard epoxy resin encapsulation. Radial leads.
±10% tolerance. 100 Volt Working.
Prices—per Capacitance value (μF)

0·001, 0·002, 0·005,	each	10 off	25 off	100 off
0·01, 0·02	6d.	4/3	8/4	30/-
0·05	8d.	6/-	12/6	41/8
0·1	10d.	7/1	15/6	51/-
0·2	1/2	10/-	20/10	68/6
0·5	2/-	17/6	37/6	125/-

Polystyrene film, Tubular, Axial leads. Unencapsulated. ±5% or ±1pf tolerance. 160 Volt Working.
Prices—per Capacitance value (μμF)

10, 12, 15, 18, 22, 27, 33,	each	10 off	25 off	100 off
39, 47, 56, 68, 82, 100, 120, 180, 220, 270, 330, 390 ..	5d.	3/7	7/9	24/-
470, 560, 680, 820, 1,000, 1,500	6d.	4/-	8/8	26/8
2,200, 3,300, 4,700, 5,600 ..	7d.	5/-	10/10	33/4
6,800, 8,200, 10,000, 15,000	8d.	6/-	13/-	40/-
22,000	9d.	6/9	18/-	45/4

POTENTIOMETERS (Carbon)
Miniature, fully enclosed, rear tags, carbon brush wiper. Long life, low noise. Body dia., ⅝in. Spindle, 1in. × ¼in. ¼W at 70°C. ±20% below ½M, ±30% over ½M. Lin. 100 ohms to 10 Megohms. Log. 5 Kohms to 5 Megohms.

Prices—per ohmic value	each	10 off	25 off	100 off
	2/-	18/4	41/8	150/-

GANGED STEREO POTENTIOMETERS (Carbon)
¼W at 70°C. Long Spindle.
Logarithmic and Linear: 5k+5k to 1M+1M.

Prices—per ohmic value	each	10 off	25 off	100 off
	8/-	70/-	162/6	575/-

SKELETON PRE-SET POTENTIOMETERS (Carbon)
High quality pre-sets suitable for printed circuit boards of 0·1in. P.C.M. 100 ohms to 5 Megohms (Linear only). Miniature: 0·3W at 70°C. ±20% below ½M, ±30% above ½M. Horizontal (0·7in. + 0·4in. P.C.M.) or Vertical (0·4in. × 0·2in. P.C.M.). Subminiature: 0·1W at 70°C. ±20% below 2·5M, ±30% above.

Prices—per ohmic value	each	10 off	25 off	100 off
Miniature (0·3W)	1/-	8/9	18/9	66/8
Subminiature (0·1W) ..	10d.	7/1	14/7	46/8

POLYESTER CAPACITORS (Mullard)
Tubular, 10%, 160V: 0·01, 0·015, 0·022μF, 7d. 0·033, 0·047μF, 8d. 0·068, 0·1μF, 9d. 0·15μF, 11d. 0·22μF, 1/-. 0·33μF, 1/3. 0·47μF, 1/6. 0·68μF, 2/3. 1μF, 2/8.
400V: 1,000, 1,500, 2,200, 3,300, 4,700pF, 6d. 6,800pF, 0·01, 0·015, 0·022μF, 7d. 0·033μF, 8d. 0·047μF, 9d. 0·068, 0·1μF, 11d. 0·15μF, 1/2. 0·22μF, 1/6. 0·33μF, 2/3. 0·47μF, 2/8.
Modular, metalised, P.C. mounting, 20%, 250V: 0·01, 0·015, 0·022μF, 7d. 0·033, 0·047μF, 8d. 0·068, 0·1μF, 9d. 0·15μF, 11d. 0·22μF, 1/-. 0·33μF, 1/5. 0·47μF, 1/8. 0·68μF, 2/3. 1μF, 2/9.

JACK PLUGS
¼in. Type P1. Standard. Screened. Heavily chromed.
¼in. Type SE/P1. Side-entry version of Type P1.
¼in. Type P2. Standard. Unscreened. Unbreakable moulded cover.
¼in. Type P3. Tip-Ring-Sleeve Stereo version of Type P1.
¼in. Type P4. Tip-Ring-Sleeve Stereo version of Type P2.
3·5mm. Type P5. Standard. Screened. Aluminium cover.
3·5mm. Type P6. Standard. Unscreened. Unbreakable moulded cover.

Prices	each	10 off	25 off	100 off
P1	3/-	26/8	62/6	233/4
SE/P1	3/6	30/10	66/8	280/-
P2	2/6	23/4	54/2	200/-
P3	6/6	60/-	137/6	500/-
P4	6/2	59/6	127/6	455/-
P5	2/2	19/2	43/9	158/4
P6	1/8	15/-	33/4	116/8

JACK SOCKETS
¼in. Type S3. Stereo version for use with P3 or P4 plugs.
¼in. Type S5. Standard. Moulded body. Chrome insert.
3·5mm. Type S6. Standard. Moulded body. Chrome insert.
Available with make or break contacts on Tip. Ring and Sleeve.

Prices	each	10 off	25 off	100 off
S3	3/3	30/-	68/9	250/-
S5	2/9	25/-	56/8	216/8
S6	1/6	13/4	33/4	100/-

SEMICONDUCTORS: OA5, OA81, 1/9. OC44, OC45, OC71, OC81, OC81D, OC82D, 2/-. OC70, OC72, 2/3. AC107, OC75, OC170, OC171, 2/6. AF115, AF116, AF117, ACY19, ACY21, 3/3. OC140, 4/3. OC200, 5/-. OC139, 5/3. OC25, 7/-. OC35, 8/-. OC23, OC28, 8/3.

SILICON RECTIFIERS: (0·5A). 170 P.I.V., 2/9. 400 P.I.V., 3/-. 800 P.I.V., 3/3. 1250 P.I.V., 3/9. 1500 P.I.V., 4/-. (0·75A); 800 P.I.V., 3/3. (6A); 200 P.I.V., 3/-. 400 P.I.V., 4/-. 600 P.I.V., 5/-. 800 P.I.V., 6/-.

THYRISTORS (5A): 100 P.I.V., 8/-. 200 P.I.V., 10/-. 400 P.I.V., 15/-.

SWITCHES (Chrome finish, Silver contacts): 3A 250V, 6A 125V. Push Buttons: Push-on or Push-off, 5/-. Toggle Switches: SP/ST, 3/6. SP/DT, 3/9. SP/DT (with centre position) 4/-. DP/ST, 4/6. DP/DT, 5/-.

PRINTED CIRCUIT BOARD (Vero).
0·15in. Matrix: 3¾in. × 2½in., 3/3. 5½in. × 2½in., 3/11. 3¾in. × 3¾in., 3/11. 5in. × 3¾in., 5/6.
0·1 Matrix: 3¾in. × 2½in., 4/-. 5in. × 2½in., 4/6. 3¾in. × 3¾in., 4/6. 5in. × 3¾in. 5/3.

SEND S.A.E. FOR 1969 CATALOGUE

DUXFORD ELECTRONICS (PW)

97/97A MILL ROAD, CAMBRIDGE

Telephone: CAMBRIDGE (0223) 63687

(Visit us—at our new Mail Order, Wholesale and Retail Premises)

MINIMUM ORDER VALUE 5/-

C.W.O. Post and Packing 1/6

BI-PAK SEMICONDUCTORS
500 CHESHAM HOUSE, 150 REGENT ST., LONDON, W.1.

KING OF THE PAKS
SUPER PAKS

Unequalled Value & Quality
BI-PAK NEW—UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

PAK NO.			
U1	120	Glass Sub-min. General Purpose Germanium Diodes	10/-
U2	60	Mixed Germanium Transistors AF/RF	10/-
U3	75	Germanium Gold Bonded Diodes sim. OA5, OA47	10/-
U4	40	Germanium Transistors like OC81, AC128	10/-
U5	60	200mA Sub-min. Sil. Diodes	10/-
U6	40	Silicon Planar Transistors NPN sim. BSY95A, 2N706	10/-
U7	16	Silicon Rectifiers Top-Hat 750mA up to 1000V	10/-
U8	50	Sil. Planar Diodes 250mA OA/200/202	10/-
U9	20	Mixed Volts 1 Watt Zener Diodes	10/-
U11	30	PNP Silicon Planar Transistors TO-5 sim. 2N1132	10/-
U12	12	Silicon Rectifiers EPOXY BY126/127	10/-
U13	30	PNP-NPN Sil. Transistors OC200 & 2S104	10/-
U14	150	Mixed Silicon and Germanium Diodes	10/-
U15	30	NPN Silicon Planar Transistors TO-5 sim. 2N697	10/-
U16	10	3-Amp Silicon Rectifiers Stud Type up to 1000 PIV	10/-
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	10/-
U18	8	6-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	10/-
U19	30	Silicon NPN Transistors like BC108	10/-
U20	12	1.5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	10/-
U21	30	A.F. Germanium alloy Transistors 2G300 Series & OC71	10/-
U22	10	1-Amp Glass Min. Silicon Rectifiers High Volts	10/-
U23	30	Madt's like MAT Series PNP Transistors	10/-
U24	20	Germanium 1-Amp Rectifiers GJM up to 300 PIV	10/-
U25	25	300 Mc/s NPN Silicon Transistors 2N708, BSY27	10/-
U26	30	Fast Switching Silicon Diodes like 1N914 Micro-min	10/-
U28		Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc. 8 Assorted Pieces	20/-
U29	10	1 Amp SCR's TO-5 can up to 600 PIV CRS1/25-600	20/-
U30	15	Plastic Silicon Planar trans. NPN 2N2924-2N2926	10/-
U31	20	Sil. Planar NPN trans. low noise 2N3707	10/-
U32	25	Zener diodes 400mW DO-7 case mixed Vlts. 3-18	10/-
U33	15	Plastic case 1 Amp silicon rectifiers W4000 series	10/-

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

FULLY TESTED

AC107	3/6
AC126-7-8	2/6
AF116-117	3/6
AF139	10/-
AL102	15/-
BC107-8-9	5/-
BFY50-51-52	7/6
BSY26-7	3/6
BSY28-9	4/6
BSY95-95A	4/6
OC22-25	5/-
OC26-35	5/-
OC28-29	7/6
OC44-45	1/9
OC71-81	1/6
OC72-75	2/6
OC81D-82D	2/3
OC82	2/6
OC140	5/-
OC170	2/6
OC171	3/6
OC201	7/6
ORP12-60	8/6
OCP71	8/6
OA5-10	1/9
OA47	2/-
OA70	1/3
OA79	1/9
OA81-85	1/6
OA91	1/3
OA95	1/9
OA200	3/-
OA202	3/6
2N696-7	5/-
2N706	3/6
2N708	5/-
2N2160	15/-
2N2646	15/-
2N2712	5/6
2N2926	2/6
MAT100-101	3/-
MAT120-121	3/6
ST140	3/-
ST141	4/-

SIL. RECTS TESTED

PIV	750mA	3A	10A	30A
50	1/-	2/9	4/3	9/6
100	1/3	3/3	4/6	15/-
200	1/9	4/-	4/9	20/-
300	2/3	4/6	6/6	22/-
400	2/6	5/6	7/6	25/-
500	3/-	6/-	8/6	30/-
600	3/3	6/9	9/-	37/-
800	3/6	7/6	11/-	40/-
1000	5/-	9/3	12/6	50/-
1200	6/6	11/6	15/-	—

PRINTED CIRCUITS
EX-COMPUTER

Packed with semiconductors and components, 10 boards give a guaranteed 30 trans and 30 diodes. Our price 10 boards 10/-. Plus 2/- P. & P.

UNIJUNCTION

UT46 Eqvt. 2N2646, Eqvt. TIS43 7/6

FET's

2N3819	10/-
2N3820	25/-
MPF105	8/-

AD161-162 NPN-PNP Comp. Pair 12/6 pr.

2SO34 15/- ea.

TESTED SCR's

PIV	1 AMP	7A	16A	30A
25	—	7/6	—	30/-
50	7/6	8/6	10/6	35/-
100	8/6	10/-	15/-	45/-
200	12/6	15/-	20/-	55/-
300	15/-	20/-	25/-	—
400	17/6	25/-	35/-	80/-
500	30/-	40/-	45/-	95/-
600	—	40/-	50/-	—

INTEGRATED CIRCUITS

I.C. Operational Amplifier with zener output.

Type 701C. Ideal for P.E. projects. 8 Lead TO-5 case. Full Data. Our Price 12/6 each. 5 off 11/- each. Large qty prices quoted for.

Fairchild Epoxy TO-5 8 Lead. I. C.

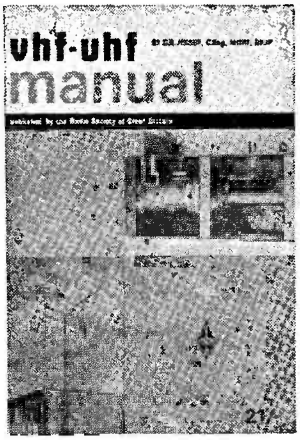
uL900 Buffer	10/6
uL914 Dual Gate	10/6
uL923 J.K. Flip-Flop	14/-
I.C. Data Circuits etc.	1/6
Mullard I.C. Amplifiers TAA243 ORP.AMP.	70/-
TAA263 Min AF Amp	18/6
TAA293 G.P. Amp	26/-
RCA CA3020 Audio Amp	30/-

TRANSISTOR EQUIVALENT BOOK
52 pages of Cross References for transistors and diodes, types include British, European, American and Japanese. Specially imported by BI-PAK 10/- each.

PLEASE NOTE.—To Avoid any further Increased Postal Charges to our Customers and enable us to keep our "By Return Postal Service" which is second to none, we have re-organized and streamlined our Despatch Order Department and we now request you to send all your orders together with your remittance. Direct to our Warehouse and Despatch Department, postal address:—BI-PAK SEMICONDUCTORS, Despatch Dept., P.O. BOX 6, WARE, HERTS. Postage and Packing Still 1/- per order. Minimum Order 10/-.

Announcing

The VHF/UHF Manual
by George Jessop, G6JP



If you have any interest in the frequencies above 30 MHz then you need this book. It is the first complete manual for the metre and decimetre bands ever published outside of North America. It is probably the most comprehensive work of its kind ever produced, ranging from advanced material to simple circuits for the rank beginner to VHF. Illustrated with over 600 drawings.

Like all of RSGB's technical books, it is British produced and thus all parts are available in this country An attractive layout and clear style make the VHF/UHF Manual equally suitable for construction or just reading.

21/- over the counter or 22/6 by post from:—

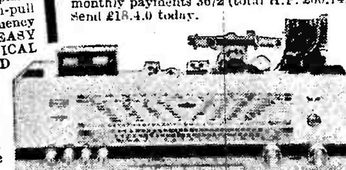
R S G B Publications
35 DOUGHTY STREET, LONDON, WC1

Fabulous Value

STEREOPHONIC KUBA "ROYAL" RADIOGRAM
This radiogram chassis is offered complete with carefully matched loudspeaker system, two 10in. speakers, two 4in. Cone Tweeters and latest BSR UA70 Mono/Stereo record changer—a complete quality stereophonic radiogram at half normal price.
4 wavebands—AM/FM—8 piano keys control. 8 watt push-pull output per channel—frequency response 30-20,000 cycles. EASY TO INSTALL, NO TECHNICAL KNOWLEDGE REQUIRED ONLY **£79.19.6.**
H.P. terms available. Deposit £26.13.2 and 24 monthly payments of 55/7 (total H.P. £93.7.2). Send £27.10.8 today or write for free leaflet.

Fantastic Bargain Offer

KUBA "IMPERIAL 666" STEREOPHONIC HI-FI RADIOGRAM CHASSIS—complete with two 10in. x 6in. speakers and the latest BSR Mono/Stereo record changer—a complete radiogram at half normal price. 4 Waveband AM/FM chassis with the very latest printed circuitry—7 push button control, 12 watts total output. Provision for stereo decoder. Only $49\frac{1}{2}$ Gns. plus P. & P. 17/6. EASILY FITTED, NO TECHNICAL KNOWLEDGE NECESSARY. H.P. available £17.6.6 deposit plus 24 monthly payments 36/2 (total H.P. £60.14.6). Send £18.4.0 today.



CALLERS WELCOME

POST THIS COUPON NOW!

PLEASE SEND ME FREE DETAILS OF YOUR RANGE
Name ....
Address ....
....

LEWIS radio
100 CHASE SIDE, SOUTHGATE. Dept. P869A, LONDON, N.14
TELEPHONE 01-886 3733/9666

LETTERS...

The Editor does not necessarily endorse the views expressed by correspondents.

HI-Q!

Allowing that Mr. Floyd is entitled to his viewpoint, I feel that the letter in May's P.W. was rather harsh in its sweeping criticism. As one who works almost entirely with f.e.ts and m.o.s f.e.ts and am designing an "All-Band" "Phase-Locked" Receiver, I think my IQ is of an average level; but so far have not been upset by the content of either P.W. or P.E. which I have taken for years.

Of course many articles are "simple" and descriptive, but many are of a reasonably advanced nature as well. This is how it should be in a magazine catering to such a wide gap between newcomers and the more experienced readers. As for being too descriptive, even the advanced reader who often tries a dozen or more projects each month —simple and otherwise—can save time by broadly following the basic layout as illustrated in the articles, instead of starting from the circuit alone.

If articles and projects of an advanced nature are wanted, there are many "specialist" magazines published which contain them. I personally take 10 radio magazines each month but still find PRACTICAL WIRELESS a good "three-bob's worth."—**M. J. Shepherd** (*Essex*).

* * *

In reply to M. Floyd's letter I would like to say that the so called "spoon-feeding" of readers is quite often just.

I am quite keen on radio but as yet I have not indulged in it enough to fully understand the full principles of it, and I find the description in many articles very useful.

I would suggest that either M. Floyd realises that there are people like me who benefit from "spoon-feeding" or he tries to do better and make a success of it.—**P. Yates** (*Staffs.*).

* * *

In reply to M. Floyd on the subject of articles published in P.W. and P.E. all I can say is that if he does not like the articles which are printed then he does not have to buy the books.

I think myself that most of the articles printed are varied and suit all tastes. After all there are not many monthly radio magazines on sale so you really have to cater for beginners as well as those who can undertake more ambitious projects.

As to spoon-feeding the readers I agree to a slight degree that there is quite a bit of emphasis on the way projects are constructed, but to those who don't want to build up a project using the construction details they can use the construction details as a guide line and proceed from these — **S. R. Cole.** (*Birmingham*).

Write your own

As a reply to Mr. Floyd's letter, I regard his attitude as one of entire selfishness. I am sure that there are many other people like myself who prefer plodding along to streaking straight to the uttermost limits of radio success, which Mr. Floyd seems to have evidently accomplished.

Although a novice I have had some success in transistors and still prefer PRACTICAL WIRELESS and *Practical Electronics* in their old and well loved forms. There seems to be plenty to suit all tastes at the moment; and if Mr. Floyd thinks it is not intellectual enough he should consider one of the main purposes of such magazines, which, surely is to encourage more people to join in the hobby. If the magazines were to become more intellectual no raw novice or anyone with just a casual interest would be able to understand a word. I suggest that he either designs his own circuits, or, even writes his own magazine ! — **R. Heeley (14)** (*Sheffield*).

Doo wot?

Dere Sur,

I bet that that Mister Floyd of Barks iss two lazi too mak isself a whyless set. Yores trooly, A Barkshire Moron.

[*And on that point we must close the correspondence on this subject—Editor.*]

Heat treatment

In the April issue of PRACTICAL WIRELESS, Mr. P. Hamley writes of the heat treatment of silver steel. He says that the easiest way of tempering is to heat away from the cutting edge until the straw colour reaches this edge. This is very easy with, say, sections over ⅜in. dia., but on sections of say ⅛in. dia. or less, e.g. for small pin punches, the colours will run too fast for the man with little or no experience, to see. I find that if the punch is placed on a steel plate, which is then heated, the conductance between the two is limited, and the tempering colours will easily be seen, as they will run slowly.

This method also applies to larger sections when heating over a coal fire.

This method was shown to me by a very experienced blacksmith during my apprenticeship.—**P. G. Howson** (*Preston, Lancashire*).

Pleasing to the eye

Recently I have been experimenting with various materials from this point of view. Many materials have come to my attention, and these following notes may, I hope, prove useful to others.

Perspex can be shaped somewhat more easily than aluminium, although it is best to drill it at a fairly low speed. Various finishes can be applied, polished, satin, or an effect something like milled metal can be obtained by rubbing in small circles with a very fine emery paper. An added advantage is that it is semi-transparent, and therefore pilot lights, etc. need not be mounted through the material.

Leather cases can be obtained very cheaply from ex-govt. sources and are usually in good condition. Many of these are sufficiently rigid not to need any additional stiffening, although with some a light framework may be advisable to support component boards, etc.

Plywood makes strong rigid boxes, as long as the corners are reinforced, and looks extremely good if sanded and coated with polyurethane, or painted with "hammer" finish paints, providing the surface is sealed with a mid-grey undercoat.

Aluminium foil can be stuck on the inside of all these to provide r.f. screening, and in the case of Perspex, also enhances the colour of the material.

Amateur radio has suffered too long from the "Tony Hancock" image, let's make a start on changing it with brighter cases.—**C. Warwick** (*Birmingham*, 16).

pulse circuits in operation

I. J. KAMPEL

PART 3: THE MONOSTABLE FAMILY

IN the past two articles on the subject of pulse circuits, saturation switching and various forms of multivibrator have been discussed. We shall now discuss the monostable family of circuits, which, although closely related to the multivibrator family, are at the same time distinctly different.

The multivibrator oscillates between its two quasi-stable states without any external stimuli, whereas the monostable requires external influence to change states. It has one stable state and one quasi-stable state, and with no external stimuli will continue to rest in the stable state. Upon the application of a pulse of the right sense, the circuit will "flip" into its quasi-stable state for a predetermined period of time, to then "flop" back into its stable state. Hence the monostable is often referred to as the *flip-flop*.

The input pulse must be long enough for the circuit to switch, but once removed, the circuit will not return to the stable state until the programmed time period has elapsed. Uses of the flip-flop are in pulse shaping—a trigger pulse of any shape will deliver a square-wave output pulse; pulse amplification—a small pulse will give maximum output pulse; and as a delay—if a following circuit is triggered from the rear edge of the output pulse. The flip-flop can be useful also as a buffer trigger stage—where an input pulse in not long enough to trigger a following circuit, the flip-flop will provide the longer pulse for the shorter input pulse. The flip-flop can act as a reset in this mode, where a short trigger must cause a longer reset action, or the flip-flop may simply be used to provide an indication of long time duration upon application of a rapid triggering pulse.

The multivibrator, or astable circuit, may be made monostable by replacing one of the capacitive couplings be a resistive coupling, and this is shown in Fig. 3.1 if C2 is ignored for the moment. It will be seen that

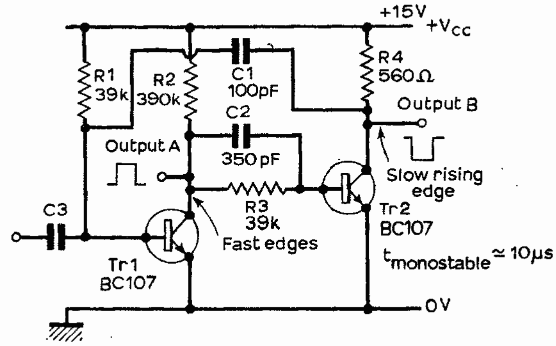


Fig. 3.1: Simplest monostable with single supply.

resistor R3 provides base bias for Tr2 as long as Tr1 is in the OFF state, since then the top end of this bias resistor will be at line potential, $+V_{cc}$. In the stable state, however, Tr1 is on, and since it is driven into saturation, $V_{C1}=V_{CE}\text{sat}\simeq 0{\cdot}1$V. There is thus not enough voltage to allow Tr2 to switch on and this transistor remains off. R1 programmes sufficient base current in Tr1 to ensure that this transistor is normally in saturation, and with $V_{B1}\simeq 0{\cdot}7$V, the normal V_{BE}, and $V_{C2}=V_{cc}$, capacitor C1 charges to line potential $(-V_{BE1})$.

To switch off Tr1, since this transistor is in saturation, sufficient triggering current must be made available to remove the stored charge in the base region, and the coupling capacitor C3 must be large enough to ensure this, while the trigger pulse must be longer than the switching time. When a negative pulse is applied to Tr1 base, Tr1 is cut off, its collector rising to line potential, thus turning on Tr2 as base bias is now provided through resistor R3. C2 is in fact a speed-up capacitor, and provides additional current during switching to drive Tr2 hard into saturation, this current reducing after the initial transient until, with C2 charged, only the current provided by R3 flows through Tr2 base, this being $I_{B2}\text{sat(min)}$ to reduce power dissipation. The subject of speed-up capacitors was dealt with in Part One of this series.

When Tr2 switches on, V_{C2} drops to the level $V_{CE}\text{sat}$, i.e., nearly ground potential, and with C1 charged to approximately V_{cc} volts, Tr1 base is taken down to $-V_{cc}$ volts. When the input pulse which drove Tr2 base slightly negative is removed, C1 keeps the base negative. This capacitor charge will gradually decay, however, just as in the case of the multivibrator, and in fact C1 now tries to charge in the reverse polarity up to the line voltage through R1. Eventually, when Tr1 base has gone from its negative bias to about $+0{\cdot}7$V, Tr1 switches on again, the falling collector potential cuts off the base bias to Tr2, and the circuit then goes back to its stable state until another trigger pulse disturbs it.

The characteristics of output B in this circuit are similar to those discussed in the case of the multivibrator, and there is the same limitation in line voltage. That is to say a slow rising edge will be seen at output B, and since Tr1 base is taken to the potential of the line voltage in the negative direction, V_{cc} should not exceed the maximum reverse bias rating of the emitter-base of the transistor used for Tr1. It is pointed out that Tr2 base will not go to this negative potential without capacitor C2, but with C2, when Tr2 is cut off, the speed-up capacitor can cause Tr2 base to be taken negatively beyond earth potential which, incidentally, also helps the turn-off time. For low frequency operation this enables a saving in components as will be seen later. For the cir-

BENTLEY ACOUSTIC CORPORATION LTD.

Suppliers to H.M. Government **38 CHALCOT ROAD, LONDON, N.W.1** **Telephone 01-722-9090**

EXPRESS POSTAL SERVICE. SAME DAY DESPATCH BY FIRST CLASS MAIL.

All goods are offered subject to the standard three month guarantee.

OA2	5/9
OB2	6/-
OZ4	4/3
1A3	4/6
1A5	5/-
1A7GT	7/-
1C1	5/6
1C2	7/9
1C3	7/-
1C5	4/9
1D5	6/9
1D6	9/6
1FD1	6/-
1FD9	3/9
1G6	6/-
1H5GT	7/-
1L4	2/6
1LD5	5/-
1LN5	8/-
1N5GT	7/9
1P1	7/-
1P10	4/9
1P11	5/6
1R5	5/6
1S4	4/9
1S5	3/9
1T4	2/9
1U4	5/9
1U5	6/9
2A7	12/6
2D13C	7/-
2D21	5/6
2X2	4/9
3A4	3/6
3A5	10/-
3B7	5/-
3D6	3/9
3Q4	6/6
3Q5GT	6/-
3S4	4/9
3Y4	5/6
4D1	3/9
5R4GY	8/9
5U4G	4/9
5V4G	7/6
5Y3GT	5/6
5Z3	8/-
5Z4G	6/9
6/30L2	12/6
6A8G	5/6
6AC7	3/-
6AG5	3/6
6AJ5	8/6
6AK5	4/6
6AK6	6/-
6AK8	6/-
6AL5	2/3
6AM5	2/6
6AM6	3/3
6AQ5	4/9
6AR6	20/-
6AT6	4/-
6AU6	5/-
6AV6	5/6
6B8G	2/6
6BA6	4/6
6BE6	4/3
6BG6G	20/5
6BH6	7/6
6BJ6	6/9
6BQ5	4/6
6BQ7A	7/-
6BR7	8/6
6BR8	8/-
6BS7	16/6
6BW6	12/9
6BW7	11/-
6BX6	4/6
6BZ6	6/-
6C4	2/9
6C5GT	6/-
6C6	3/9
6C9	11/-
6CD6G	19/6
6CH6	6/-
6CW4	12/-
6D3	7/6
6D6	3/-
6E5	7/6
6F1	8/9
6F6G	4/-
6F6M	12/6
6F12	3/3
6F13	3/6
6F15	9/6
6F18	7/6
6F23	13/3
6F24	11/9
6F25	11/9
6F28	10/6
6F32	3/-
6G6G	2/6
6H6GT	1/9
6J5G	3/9
6J5GT	4/6
6J6	3/-
6J7G	4/9
6J7GT	6/6
6K6GT	5/-
6K7G	2/-
6K7GT	4/6
6K8G	3/-
6K8GT	7/-
6L1	19/6
6L6GT	7/9
6L7	12/6
6L18	5/-
6L19	19/-
6LD20	8/6
6N7GT	6/6
6P1	12/-
6P25	12/-
6P26	12/-
6P28	25/-
6Q7G	6/-
6Q7GT	8/6
6R7G	7/-
6R7M	11/-
6SA7GT	7/-
6SA7	7/-
6SC7GT	6/6
6SG7	6/-
6SH7	3/-
6SJ7	6/6
6SK7GT	4/6
6SN7GT	4/6
6SQ7GT	6/-
6SS7	3/-
6U4GT	12/-
6U7G	7/-
6V6G	3/6
6V6GT	6/-
6X4	3/6
6X5GT	5/-
6Y6G	8/-
6Y7G	12/6
7A7	12/6
7AN7	6/-
7B6	10/9
7B7	7/-
7C6	6/-
7D6	15/-
7H7	5/6
7R7	12/-
7S7	20/-
7V7	5/-
7Y4	6/6
7Z4	4/6
9BW6	7/-
9D7	9/-
10C1	12/6
10C2	10/-
10D1	8/-
10D2	14/7
10F1	15/-
10F9	9/-
10F18	7/6
10LD3	7/6
10LD11	10/-
10P13	13/-
10P14	12/6
12A6	3/6
12AC6	7/-
12AD6	6/-
12AE6	7/6
12AT6	4/6
12AT7	3/9
12AU6	4/9
12AU7	4/6
12AV6	5/6
12AV7	8/-
12AX7	4/6
12AY7	9/9
12BA6	6/-
12BE6	5/9
12BH7	6/-
12E1	17/-
12J5GT	2/6
12J7GT	6/6
12K5	10/-
12K7GT	5/9
12K8GT	7/6
12Q7GT	4/6
12SA7GT	6/9
12SC7	4/-
12SG7	3/-
12SH7	3/-
12SJ7	4/6
12SK7	4/9
12SQ7GT	7/6
12Y4	2/-
13D1	5/-
13D3	9/-
14H7	9/6
14S7	15/-
18	12/6
19	10/6
19AQ5	4/9
19H1	40/-
20D1	13/-
20D4	20/5
20F2	14/-
20L1	13/-
20P1	17/6
20P3	18/-
20P4	18/6
20P5	18/-
25A6G	7/6
25L6G	5/6
25Y5	6/-
25Y5G	8/6
25Z4G	6/-
25Z5	7/-
25Z6G	8/6
30C1	6/6
30C15	13/6
30C17	12/6
30C18	8/9
30F5	13/6
30FL1	15/-
30FL12	16/-
30FL13	8/-
30FL14	12/6
30L1	6/-
30L15	13/9
30L17	13/-
30P4	12/-
30P4MR	17/6
30P12	13/-
30P19	12/-
30PL1	15/-
30PL13	15/-
30PL14	15/-
30PL15	15/-
35A5	15/-
35L6GT	8/-
35W4	4/6
35Z3	10/-
35Z4GT	4/9
35Z5GT	6/-
42	5/-
43	10/-
50B5	6/3
50C5	6/3
50CD6G	41/-
50L6GT	6/-
52KU	14/6
53KU	14/6
72	6/6
77	6/6
78	4/9
85A2	8/6
90AG	67/6
90AV	67/6
90CG	34/-
90CV	33/6
90C1	16/-
150B2	14/6
150C2	5/9
301	20/-
302	16/6
303	15/-
305	16/6
306	13/-
807	11/9
956	2/-
1821	10/6
5763	10/-
6060	5/6
7193	10/6
7475	4/-
A1834	20/-
AC2PEN	19/6
AC2PEN/DD	19/6
AC6PEN	4/9
AC/PEN (5)	19/6
AC/PEN (7)	19/6
AC/TH1	10/-
AC/TP	19/6
AC/VP2	10/6
ARP3	7/-
ATP4	2/3
AZ1	8/-
AZ31	8/9
AZ41	7/6
B36	4/6
B319	6/-
B339	4/6
B729	12/6
BL63	10/-
CK506	6/6
CL4	19/6
CL33	18/6
CV6	10/6
CV63	10/6
CV271	12/6
CV428	19/-
CY1	16/4
CY1C	10/6
CY31	7/6
D1	1/3
D41	10/6
D63	5/-
D77	2/3
DAC32	7/-
DAF91	3/9
DAF96	6/-
DCC90	10/-
DD4	10/6
DDT4	8/3
DF33	7/9
DF72	30/-
DF91	2/9
DF96	6/-
DF97	10/-
DH30	15/6
DH63	6/-
DH76	4/6
DH77	4/-
DH81	10/9
DH101	25/-
DH107	17/11
DK32	7/-
DK40	10/-
DK91	5/6
DK92	7/9
DK96	7/-
DL33	6/-
DL35	4/9
DL72	15/-
DL75	30/-
DL92	4/9
DL94	5/6
DL96	7/-
DL810	9/6
DM70	6/-
DM71	7/6
DW4/350	8/3
DW4/500	8/-
DY86	5/9
DY87	5/9
E80F	24/-
E83F	24/-
E88CC	12/-
E180CC	8/-
E180F	17/6
EA50	1/6
EA76	13/-
EABC80	6/-
EAC91	3/-
EAF42	8/9
EB34	7/6
EB41	4/6
EB91	2/3
EBC41	8/6
EBC81	5/9
EBC90	4/-
EBC91	5/6
EBF80	6/-
EBF83	8/-
EBF89	6/3
EBL21	11/-
EC53	12/6
EC54	6/-
EC70	4/9
EC86	10/3
EC92	6/6
ECC31	15/6
ECC32	4/6
ECC33	29/1
ECC34	29/6
ECC40	9/6
ECC81	3/9
ECC82	4/6
ECC83	4/6
ECC84	5/6
ECC85	5/-
ECC88	7/-
ECC91	3/-
ECC189	9/6
ECC804	12/6
ECC807	27/-
ECF80	6/6
ECF82	6/6
ECF86	9/-
ECF804	42/-
ECF805	12/6
ECH21	12/6
ECH35	5/9
ECH42	10/-
ECH81	5/9
ECH83	8/-
ECH84	7/-
ECL80	6/6
ECL82	6/-
ECL83	9/-
ECL84	12/-
ECL85	11/-
ECL86	8/-
ECLL800	30/-
EF22	12/6
EF36	3/6
EF37A	7/-
EF39	5/-
EF40	8/9
EF41	9/6
EF42	3/6
EF54	10/-
EF73	6/6
EF80	4/6
EF83	9/6
EF85	5/3
EF86	6/-
EF89	4/9
EF91	3/3
EF92	2/6
EF94	5/-
EF95	4/6
EF97	10/-
EF98	10/6
EF183	6/-
EF184	6/-
EF804	20/5
EH90	6/6
EL32	3/6
EL33	12/-
EL34	9/6
EL35	10/-
EL37	17/3
EL41	9/3
EL42	9/9
EL81	8/-
EL83	6/9
EL84	4/6
EL85	7/6
EL86	8/-
EL91	2/6
EL95	5/-
EM71	14/-
EM80	5/9
EM81	6/9
EM84	6/-
EM85	11/-
EM87	7/3
EY51	6/9
EY81	7/-
EY83	8/3
EY84	7/6
EY86	6/-
EY87	6/-
EY88	7/6
EY91	3/-
EZ35	5/-
EZ40	7/3
EZ41	7/3
EZ80	4/3
EZ81	4/6
EZ90	3/6
FC4	12/6
FW4/500	6/6
FW4/800	10/-
GZ30	7/-
GZ32	9/-
GZ33	12/6
GZ34	10/-
GZ37	14/6
H30	5/-
HABC80	8/-
HL2	7/6
HL13C	4/-
HL23	6/-
HL23DD	5/-
HL41	3/9
HL41DD	19/6
HL42DD	8/-
HN309	27/4
HVR2	8/9
HVR2A	8/9
IW3	5/6
IW4/350	5/6
IW4/500	6/-
KT2	5/-
KT8	34/6
KT32	5/6
KT41	19/6
KT44	20/-
KT61	12/-
KT63	4/-
KT66	17/3
KT74	12/6
KT76	7/6
KT88	29/-
KTW61	8/6
KTW62	10/-
KTW63	5/9
KTZ41	6/-
LN152	6/6
LN309	9/-
LN319	15/-
LN339	15/-
LZ319	6/6
LZ329	6/6
LZ339	13/6
ME1400	14/9
MHD4	8/3
MHL4	12/6
MHLD6	7/6
MU12/14	4/-
MX40	12/6
N78	38/4
N108	27/4
N152	7/3
N308	17/6
N339	25/-
N359	7/3
N379	6/3
N389	12/-
N709	4/6
P61	2/6
PABC80	7/3
PC86	9/6
PC88	9/6
PC95	8/3
PC97	8/6
PC900	8/3
PCC84	6/-
PCC85	6/6
PCC88	9/9
PCC89	9/6
PCC189	9/6
PCF80	6/6
PCF82	6/-
PCF84	8/-
PCF86	9/-
PCF801	7/-
PCF802	9/-
PCF805	8/9
PCF806	11/6
PCF808	12/6
PCL81	9/-
PCL82	7/-
PCL83	9/-
PCL84	7/6
PCL85	8/3
PCL86	8/6
PCL88	15/-
PEN45	7/-
PEN45DD	12/-
PEN46	4/-
PEN453DD	19/6
PENA4	19/6
PEN/DD 4020	17/6
PFL200	12/-
PL33	19/6
PL36	9/6
PL81	7/3
PL81A	10/6
PL82	6/6
PL83	6/6
PL84	6/3
PL302	12/-
PL500	12/-
PL504	12/6
PL509	28/9
PL802	15/-
PM84	7/9
PX4	14/-
PY31	6/6
PY32	9/6
PY33	9/6
PY80	5/3
PY81	5/3
PY82	5/-
PY83	5/6
PY88	6/3
PY301	12/6
PY800	6/6
PY801	6/6
PZ30	9/6
QP21	5/-
QQVO3/10	27/6
QS75/20	10/6
QS150/15	9/6
QVO4/7	8/-
R10	15/-
R11	19/6
R12	6/9
R16	34/11
R17	17/6
R18	9/6
R19	6/6
R20	11/9
RK34	7/6
SP4	9/-
SP13C	12/6
SP42	12/6
SP61	3/3
TDD4	8/3
TH4B	10/-
TH233	7/-
TP22	5/-
TP25	5/-
TP2620	8/9
UABC80	5/9
UAF42	9/6
UB41	6/6
UBC41	7/6
UBC81	7/-
UBF80	5/9
UBF89	6/9
UBL21	9/-
UC92	5/6
UCC84	8/-
UCC85	6/6
UCF80	8/3
UCH21	9/-
UCH42	9/9
UCH81	6/6
UCL82	7/-
UCL83	10/-
UF41	9/6
UF42	9/-
UF80	6/9
UF85	6/9
UF86	9/-
UF89	6/3
UL41	9/6
UL46	12/6
UL84	6/6
UM80	5/-
URIC	10/6
UU5	7/-
UU8	14/-
UU9	7/3
UU12	4/6
UY1N	9/-
UY21	9/6
UY41	6/9
UY85	5/6
U10	9/-
U12/14	7/6
U16	15/-
U17	5/-
U18/20	10/-
U19	34/6
U22	7/9
U25	13/-
U26	11/9
U31	6/-
U33	29/6
U35	16/6
U37	34/11
U43	6/9
U45	15/6
U47	13/-
U49	11/9
U50	5/6
U52	4/9
U76	4/9
U78	3/6
U107	18/3
U151	6/9
U153	5/3
U154	5/-
U191	12/6
U192	5/-
U193	6/6
U251	16/-
U281	8/-
U282	8/-
U291	9/6
U301	11/-
U329	16/-
U339	12/6
U403	6/6
U404	7/6
U709	4/6
U801	18/-
U4020	6/9
VP4B	10/6
VP13C	7/-
VP23	2/6
VR75	24/-
VR105	5/-
VR150	5/-
VT61A	7/-
VT501	8/-
VU111	7/3
VU120	12/-
VU120A	12/-
VU133	7/-
W42	10/6
W63	10/6
W76	5/9
W77	2/6
W81M	6/-
W101	26/2
W107	7/-
W729	10/-
X24	16/6
X41	10/-
X61	5/9
X63	5/6
X64	12/6
X65	5/-
X66	7/6
X76M	7/6
X81M	30/6
X101	29/1
X109	26/-
X119	6/6
X719	5/9
Z63	4/9
Z77	3/3
Z152	4/6
Z329	13/6
Z719	4/6
Z729	6/-
Z749	13/3
Transistors and diodes	
2G225	10/6
2N404	6/-
2N1756	10/-
2N2147	17/-
2N2297	4/6
2N2369A	4/3
2N2613	7/9
2N3053	6/6
2N3121	50/-
2N3703	3/9
2N3709	4/-
2N3866	20/-
2N3988	10/-
2S323	10/-
AA119	3/-
AA120	3/-
AA129	3/-
AAZ13	3/6
AC107	3/-
AC113	5/-
AC114	8/-
AC127	2/-
AC154	5/-
AC155	6/6
AC156	4/-
AC157	5/-
AC165	5/-
AC166	5/-
AC167	12/-
AC168	7/6
AC169	6/6
AC176	11/-
AC177	5/6
ACY17	3/-
ACY18	3/8
ACY19	3/9
ACY20	3/6
ACY21	3/9
ACY22	3/6
ACY28	4/-
AD140	7/6
AD149	8/-
AF114	4/-
AF115	3/-
AF119	3/-
AF124	7/6
AF125	3/6
AF126	7/-
AF139	11/-
AF178	13/6
AF179	13/6
AF180	9/6
AF181	14/-
AFZ12	5/-
ASY27	8/6
ASY28	6/6
ASY29	10/-
B1181	10/-
BA102	9/-
BA115	2/8
BA116	9/-
BA129	2/6
BA130	2/-
BCY10	5/-
BCY12	5/-
BCY33	5/-
BCY34	4/6
BCY38	5/-
BCY39	4/6
BCZ11	3/6
BC107	4/-
BC108	3/6
BC113	5/-
BC115	3/-
BC116	5/-
BC118	4/6
BD119	9/-
BFY50	4/-
BFY51	4/-
BFY52	4/6
BF154	5/-
BF159	5/-
BF163	4/-
BF180	12/-
BF181	8/-
BF185	8/-
BTX34/400	40/-
BY100	3/6
BY101	11/6
BY105	10/6
BY114	6/6
BY126	5/-
BY127	5/-
BY234	4/-
BY236	4/-
BY238	4/-
BYY23	20/-
BYZ10	5/-
BYZ11	5/-
BYZ12	5/-
BYZ13	5/-
BYZ15	35/-
CG12E	4/-
CG64H	4/-
GD4	6/6
GD5	5/6
GD6	5/6
GD8	4/-
GD9	4/-
GD10	4/-
GD11	4/-
GD12	4/-
GD14	10/-
GD15	8/-
GD16	4/-
GET103	4/-
GET105	18/-
GET113	4/-
GET115	17/-
GET116	6/6
GET118	4/-
GET119	4/-
GET573	7/6
GET587	8/6
GET872	10/-
GET873	3/-
GET882	10/-
GET887	4/6
GET889	4/6
GET890	4/6
GET896	4/6
GET897	4/6
GET898	4/6
GEX13	3/6
GEX35	4/6
GEX36	10/-
GEX45	6/6
GEX66	15/-
GT3	5/-
M1	2/10
M3	2/10
OA5	5/6
OA9	2/6
OA47	2/-
OA70	3/-
OA73	3/-
OA79	1/9
OA81	1/9
OA85	1/6
OA86	4/-
OA90	2/6
OA91	1/9
OA182	2/-
OA200	1/-
OA202	2/-
OA210	9/6
OA211	13/6
OAZ200	12/-
OAZ201	10/6
OAZ202	9/-
OAZ203	9/6
OAZ204	9/-
OAZ205	9/-
OAZ206	9/-
OAZ207	10/6
OAZ210	7/-
OAZ213	7/-
OAZ224	16/6
OC19	25/-
OC22	5/-
OC23	5/-
OC24	5/-
OC25	5/-
OC26	5/-
OC28	5/-
OC29	23/6
OC30	5/-
OC35	5/-
OC36	7/6
OC38	11/6
OC41	10/-
OC42	6/9
OC43	23/6
OC44	2/-
OC44PM	3/3
OC45	1/9
OC45M	3/-
OC46	3/-
OC65	22/6
OC70	2/3
OC71	2/-
OC72	2/-
OC73	16/-
OC74	2/6
OC75	2/-
OC76	2/6
OC78	3/-
OC78D	3/-
OC79	3/-
OC81	2/-
OC81D	2/-
OC81M	5/-
OC82	2/3
OC82D	2/3
OC83	2/-
OC84	3/-
OC123	4/6
OC139	12/-
OC140	19/-
OC169	3/6
OC172	4/-
OC200	4/4
OC201	5/6
OC202	4/6
OC203	4/6
OC204	5/6
OC205	7/6
OC206	10/-
OC812	8/-
OCP71	27/6
SM1036A	10/-
ST1276	10/-
SX1/6	8/6
MAT100	7/9
MAT101	8/6
MAT120	7/9
MAT121	8/6
ZE12V7	1/9

MATCHED TRANSISTOR SETS 1—OC44 and 2—OC45 8/6; 1—OC81D and 2—OC81 7/6; 1—OC82D and 2—OC82 8/6; Set of three—OC83 (GET118/119) 8/6; LP15 package (AC113, AC154, AC157, AA120) 10/6; Postage 6d. per set. S.T.C. 1 watt Zener diodes. 2·4v: 2·7v: 3·0v: 3·6v: 4·3v: 13v: 15v: 16v: 18v: 30v. All 3/6d. each.

WE REQUIRE FOR PROMPT CASH SETTLEMENT ALL TYPES OF ABOVE GOODS LOOSE OR BOXED, BUT MUST BE NEW

ELECTROLYTICS. Can types: 8×8mfd/500v 7/6; 8×16mfd/500v 7/9; 16mfd/500v 6/-; 16×16mfd/500v 8/9; 16×32mfd/450v 9/9; 32mfd/500v 8/-; 32×32mfd/450v 5/9; 50×50mfd/350v 5/6; 60×250mfd/275v 9/9; 50×50mfd/275v 8/6; 64×100mfd/450v 21/-; 64×120mfd/350v 8/6; 100×200mfd/275v 8/-; 100×200mfd/350v 10/6; 100×200×60mfd/300v 18/6; 100×300×100×16mfd/275v 24/9; 100×400mfd/275v 12/9; 100×400×16mfd/275v 23/3; 100mfd/100v 5/6; 200mfd/350v 12/3; 200×200×100mfd/350v 27/9; 300×300mfd/300v 31/6; 1000mfd/50v 9/8; 2000mfd/50v 13/3; 5000mfd/25v 15/-; 5000mfd/50v 27/9; 8mfd/600v 11/3; 16×16×16mfd/275v 7/-; 50×50×50mfd/350v 12/3; 16mfd/600v 15/9; 10000mfd/30v 29/6.
Tubular types: 1mfd/25v 2/-; 1mfd/500v 2/6; 2mfd/150v 2/-; 2mfd/500v 2/9; 4mfd/150v 2/-; 4mfd/500v 3/-; 5mfd/50v 2/-; 8mfd/150v 2/3; 8mfd/450v 1/9; 8mfd/500v 3/6; 8×8mfd/450v 2/9; 8×16mfd/450v 3/-; 10mfd/50v 2/3; 16mfd/450v 2/6; 16mfd/500v 4/6; 16×16mfd/450v 3/6; 25mfd/25v 1/6; 25mfd/50v 2/6; 32mfd/350v 3/-; 32mfd/450v 3/6; 32×32mfd; 350v 4/9; 50mfd/12v 1/6; 50mfd/25v 1/6; 50mfd/50v 1/9; 50mfd/350v 6/-; 64mfd/450v 9/6; 100mfd/12v 1/6; 100mfd/25v 1/6; 100mfd/50v 1/9; 100mfd/450v 10/9; 250mfd/25v 2/-.

SAVE POSTAL COSTS. CASH AND CARRY CALLERS WELCOME!

Terms of business—Cash with order only. Post/Packing 6d. per item. Orders over £5 post free No C.O.D. Any parcel insured against damage in transit for 6d. extra per order. Hours of business, Mon.—Fri. 9 00 to 5 30 p.m. Sats 9 00 to 1 p.m. Complete list of modern and obsolete valves, resistors, condensers, transformers, etc., with terms of business 10d. Please enquire for any item not listed with S.A.E. Please note that no enquiries can be answered unless a S.A.E. is enclosed for reply.

Fully guaranteed Individually packed VALVES

PERSONAL CALLERS WELCOME

Open 9-12.30, 1.30-5.30 p.m. Thursday 9-1 p.m.

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. Orders up to 10/-, 1/-; 10/- to £1, 2/-; over £1, 2/- per £1; over £3 post free. C.O.D. 4/- extra

COLOMOR brand — **ALL valves guaranteed**

A2134	8/-
AR8	5/-
ARP3	3/-
ARP12	3/6
ARTP1	6/-
ATP4	2/3
AZ31	9/6
BD78	40/-
BL63	10/-
BT35	15/-
BT45	150/-
BT83	35/-
CV102	3/-
CV103	4/-
CV315 (matched pairs)	120/-
CV315 (Single)	50/-
CY31	7/6
D41	3/3
D77	3/-
DA100	£6
DAF90	7/6
DD41	4/-
DET20	2/-
DET25	10/-
DF91	3/-
DF92	2/6
DF96	7/6
DK92	9/-
DK96	8/-
DL63	8/-
DL92	4/-
DL93	4/-
DL94	6/6
DL96	8/-
DL810	12/-
DY86	6/-
DY87	6/6
E80F	18/-
E88CC	8/-
E90CC	8/-
E91H	7/-
E92CC	5/-
E180CC	7/-
E182CC	18/-
E1148	2/6
EA76	7/-
EABC80	6/-
EAC91	3/-
EAF42	9/3
EB91	2/-
EBC33	8/-
EBC41	9/-
EBC81	6/6
EBF80	7/6
EBF83	8/6
EBF89	6/-
EC53	8/-
EC70	4/-
EC90	4/-
EC91	8/-
ECC33	12/-
ECC35	15/6
ECC40	10/9
ECC81	4/-
ECC82	4/3
ECC83	5/6
ECC84	6/-
ECC85	5/6
ECC86	8/-
ECC88	7/-
ECC91	4/-
ECC189	9/9
ECF80	6/6

ECF82	6/6
ECH35	11/-
ECH42	10/-
ECH81	5/9
ECH83	8/6
ECL80	7/6
ECL82	6/-
ECL83	10/9
ECL86	8/6
EF36	3/6
EF37A	8/-
EF39	6/-
EF40	9/9
EF41	9/9
EF42	13/6
EF50	4/6
EF80	4/6
EF85	6/6
EF86	6/3
EF89	5/-
EF91	3/-
EF92	2/6
EF95	5/-
EF183	6/6
EF184	7/-
EH90	7/6
EL31	15/-
EL32	3/9
EL34	10/3
EL35	5/-
EL38	24/-
EL41	10/3
EL42	11/-
EL50	8/-
EL81	9/9
EL84	4/9
EL85	5/-
EL91	5/-
EL95	5/3
EL360	22/-
EM31	5/-
EM80	7/-
EM81	8/-
EM84	7/-
EM87	11/-
EN92	5/-
ESU74	80/-
EY51	7/6
EY86	8/6
EY88	8/6
EY91	2/6
EZ40	7/6
EZ41	8/6
EZ80	5/-
EZ81	5/-
FW500	6/-
FW4/800	10/-
G/371K	57/6
G1/370K	20/-
G50/2G	20/-
G120/1B	35/-
GM4	45/-
GU50	28/-
GZ32	9/6
GZ34	11/6
H30	3/6
HL23DD	5/-
HL41	4/-
HVR2	9/-
KT8C	32/6
KT63	4/-

KT66	18/6
KT67	45/-
KT71	7/6
KT76	7/-
KT88	27/-
KTZ63	7/-
L63	6/-
MH4	5/-
MH41	8/-
MHLD6	7/6
ML6	6/-
N34	8/-
N78	25/-
OA2	6/-
OB2	6/-
O3B	7/-
OC3	6/-
OD3	6/-
OZ4A	5/-
P41	7/-
PABC80	7/6
PC86	10/3
PC97	9/-
PC900	9/3
PCC84	6/6
PCC89	9/6
PCC189	10/9
PCF80	6/6
PCF82	6/3
PCF84	9/3
PCF86	9/3
PCF801	9/-
PCF802	9/-
PCF805	12/6
PCF806	14/6
PCF808	14/6
PCL81	9/-
PCL82	7/-
PCL83	10/3
PCL84	8/6
PCL85	8/6
PCL86	8/6
PFL200	13/-
PL36	10/9
PL81	10/9
PL82	8/-
PL83	6/9
PL84	6/6
PL500	13/6
PX4	14/-
PX25	12/6
PY33	9/3
PY80	6/-
PY81	5/6
PY82	5/9
PY83	6/6
PY88	7/-
PY800	9/-
PY801	9/-
QQVO3-10	19/-
QQVO6-40	85/-
QQVO6-40A	100/-
QS150-15	7/6
QS95/10	5/-
QS1200	10/-
QS1202	8/-
QVO4/7	8/-
QQZO4-15	57/6
R10	17/6
R17	8/6
R19	7/6

RG1-240A	28/-
SP61	3/3
STV280/40	60/-
STV280/80	90/-
SU2150A	10/-
TDO4-20	70/-
TP22	5/-
TP25	5/-
TT11	3/-
TT15	55/-
TTR31	45/-
TZO502	4/-
TZ20	16/-

UU5	7/-
UY21	10/6
UY41	7/-
UY85	5/9
V246A/1K	190/-
VLS631	35/-
VP23	3/6
VP133	9/-
VR99	7/6
VR105/30	6/-
VR150/30	6/-
VU39	7/-
W118	8/-
W119	9/-
X65	5/-

X66	7/6
X76M	7/-
X118	8/-
X145	8/-
Y63	6/6
Y65	4 -
Z800U	29/-
Z801U	25/-
Z900T	12/-
1B22	30/-
1G5GT	6/-
1D8GT	6/-
1G6GT	6/-
1L4	2/6
1LA6	6/-
1LC6	7/-
1LH4	4/-
1R5	6/-

184	5/-
1S5	4/6
1T4	3/-
2A3	5/-
2D21	4/9
3A4	4/-
5R4WGA	27/6
3B7	5/-
3B24	14/-
3D6	3/-
3E29	50/-
3Q4	8/-
3Q5GT	6/-
3S4	5/9
3V4	6/6
4D1	4/-
5A173G	5/-

5A174G	5/-
5B251M	40/-
5B252M	35/-
5B254M	40/-
5B/255M	35/-
5R4GY	9/-
5T4	7/-
5U4G	4/6
5V4G	7/6
5X4G	8/6
5Y3GT	5/6
5Y3WGB	15/-
5Y3WGTB	9/-
5Z4G	7/6
6AB7	4/-

6AC7	3/-
6AG5	2/6
6AG7	6/-
6AH6	11/6
6AJ7	3/-
6AK5	5/-
6AK6	12/6
6AK7	6/-
6AK8	6/-
6AL5	3/-
6AL5W	7/-
6AM5	5/-
6AM6	3/-
6AN5	20/-
6AN8	10/-
6AQ5	5/6
6AQ5W	9/-
6AS6	6/-

TRANSISTORS, ZENER DIODES etc.

OA5	3/-
OA7	4/-
OA10	3/-
OA47	2/6
OA70	2/-
OA71	3/-
OA73	2/6
OA74	2/-
OA79	2/6
OA81	2/-
OA90	2/-
OA200	2/6
OA202	3/6
OA210	7/6
OA211	9/6
OAZ200	11/-
OAZ201	10/-
OAZ202 to OAZ206	8/6
OAZ207	9/6
OAZ208 to OAZ213	6/6
OAZ223 to OAZ225	10/-
OC16	15/-
OC22	10/-
OC23	12/6
OC25	7/6
OC26	6/-

OC28	12/6
OC29	15/-
OC35	10/-
OC36	12/6
OC38	5/-
OC41	6/-
OC42	5/-
OC44	4/-
OC45	3/6
OC70	4/-
OC71	3/-
OC72	5/-
OC73	6/-
OC75	6/-
OC76	5/-
OC81	5/-
OC81D	5/-
OC81DM	3/-
OC82	5/-
OC82DM	3/-
OC83	5/-
OC83B	3/-
OC84	5/-
OC122	10/-
OC139	7/6
OC140	9/6
OC169	5/-
OC170	5/-
OC171	6/-

OC172	7/6
OC200	7/6
OC201	10/-
OC202	12/6
OC203	10/6
OC204	17/6
OC206	17/6
IN21	3/6
IN21B	5/-
IN25	12/-
IN43	4/-
IN70	4/-
2N456A	7/-
2N585	7/6
2N1090	7/6
2N1091	9/6
2N1306	7/6
2N1307	7/6
2S303	10/-
AAZ12	4/-
AC126	6/6
AC127	7/6
AC128	6/6
AC176	7/6
ACY17	8/6
ACY18	5/6
ACY19	6/6
ACY28	4/6
AD140	16/-

AD149	16/-
AEY11	15/-
AEY12	12/6
AF114	6/6
AF115	6/-
AF116	6/6
AF117	5/-
AF118	10/-
AF124	7/6
AF125	6/6
AF126	6/-
AF127	6/-
AF139	10/-
AF178	12/6
AFY19	22/6
ASY26	6/6
ASY28	6/6
ASZ21	12/6
ASZ23	30/-
BC107	6/-
BCY31	8/6
BFY51	5/-
BFY52	5/-
BSY27	6/6
BSY28	5/-
BSY51	7/6
BYZ13	6/-
BYZ15	20/-
BYZ16	15/-

CRS1/10	5/-
CRS1/20	9/6
CRS1/30	10/-
CRS1/35	11/6
CRS1/40	12/6
CRS3/05	6/-
CRS3/20	10/-
CRS3/30	11/6
CRS525/025	15/-
CRS3/40	12/6
C84B	25/-
GET103	4/6
GET115	9/-
GET116	8/6
GET872	6/-
GET880	9/-
GEX54	2/6
GJ6M	4/6
GT43	5/-
GT106	10/-
HG5001	2/-
JK10A	15/-
JK10B	15/-

JK11A	12/6
JK19A	22/6
JK20A	17/6
JK21A	12/6
JK100B	15/-
MAT100	7/9
MAT101	8/6
MPF102	11/-
MPF103	9/6
MPF104	10/-
MPF105	10/6
RAS508AF	12/6
RAS310AF	7/6
XS101	15/-
ZR11	5/-
Z Range Zener diodes	3/6 ea.
Z2A range	7/6 ea.
Z3B Range	5/- ea.
ZL range	5/- ea.
Z8 range	7/6 ea.

U12/14	7/-
U18	6/-
U25	14/6
U26	14/6
U27	8/-
U52	4/6
U81	8/-
U191	14/-
U404	6/-
U801	19/6
UABC80	6/-
UAF42	10/6
UBC41	9/3
UBF80	6/6
UBF89	7/-
UCF80	9/6
UCH42	10/-
UCH81	7/-
UCL82	7/6
UCL83	10/3
UF41	10/6
UF80	7/-
UF89	6/9
UL41	9/9
UL84	6/6

DC MOVING COIL METERS

200μA	2″ round panel sealed	22/6
1mA	2″ round panel sealed	27/6
5mA	2″ round clip fix panel or proj.	20/-
10-0-10mA	2½″ round panel	17/6
0-30mA	2½″ round panel	17/6
75mA	2½″ plug-in	14/-
100mA	1½″ proj...	17/6
100mA	1½″ round panel	17/6
100mA	2½″ round panel	19/-
2 amp	2″ round panel	22/6
25 amp	3½″ round proj.	27/6
50 amp	2½″ round panel	27/6
20V DC	2″ square panel	19/-

R.F. METERS

120mA	2½″ round panel	32/-

29/41ft. AERIALS each consisting of ten 3ft. ⅞in. dia. tubular screw-in sections. 11ft. (6-section) whip aerial with adaptor to fit the 7in. rod, insulated base, stay plate and stay assemblies, pegs, reamer, hammer, etc. Absolutely brand new and complete ready to erect. In canvas bag. **£3.9.6.** P. & P. 10/6.

FIELD TELEPHONES TYPE "F" housed in portable wooden cases. Excellent for communication in- and out-doors for up to 10 miles. For pair including batteries and 1/6th mile field cable on drum. Slightly used, **£6.10.0.** Carriage 10/-.

6AS7G	14/-
6AT6	4/6
6AU6	5/9
6AX4	8/-
6B7	5/6
6B4G	15/-
6B8G	2/6
6BA6	4/6
6BA7	12/6
6BE6	5/3
6BJ6	8/6
6BJ7	7/-
6BL7GTA	11/-
6BQ7A	4/-
6BR7	9/-
6BR8	10/-
6BW6	18/6
6BW7	13/-
6C4	3/6
6C5G	2/6
6C5GT	6/-
6C6	4/-
6C8G	6/6
6CH6	7/-
6CL6	9/9

6CW4	13/-
6D6	3/-
6E5	8/-
6EA8	9/-
6EU7	7/-
6F23	13/-
6F5GT	8/-
6F6G	4/-
6F7	6/-
6F8G	5/-
6F12	4/-
6F13	5/-
6F17	5/-
6F32	3/-
6F33	20/-
6G6G	2/6
6H6GT	1/9
6H6M	3/-
6J4WA	12/-
6J5	7/-
6J5GT	5/-
6J6	3/6
6J6W	6/-
6J7G	5/-
6J7M	8/-
6K6GT	8/-
6K7	6/-
6K7G	2/-
6K7GT	4/9
6K8G	4/-
6K8GT	7/3
6K25G	16/-
6L5G	6/-
6L6WGB	12/-
6L7G	4/-
6L34	8/-
6N7G	5/9
6P25	13/-
6S7	7/-
6SA7	7/-
6SA7GT	6/6
6SC7	7/-
6SC7GT	5/-
6SG7	6/-
6SJ7	5/-
6SJ7GT	6/6
6SJ7Y	6/6
6SK7	7/-
6SL7GT	6/6
6SN7GT	6/-
6SQ7GT	7/6
6SS7	2/-
6V6G	3/6
6V6GT	6/-
6V6M	8/-
6X4	4/9
6X5G	5/-
6X5GT	5/6
6Y6G	8/-
6-30L2	14/-
6Z4	5/-
7B7	7/-
7C5	12/6
7C6	6/-
7C7	6/-
7F8W	12/6
7H7	5/6
7Q7	7/-
7V7	5/-
7Y4	9/3
7Z4	4/6
9D6	2/6
10F9	9/-
10P14	17/3
11E2	30/-
12A6	3/6

12AT6	4/6
12AT7	4/-
12AT7WA	6/6
12AU7	4/3
12AV6	5/6
12AX7	6/-
12AX7WA	10/-
12AY7	10/-
12BA6	6/-
12BE6	5/9
12BH7	3/6
12C8	3/-
12E1	17/-
12H6	3/-
12J7GT	6/6
12K7GT	7/6
12K8M	8/-
12Q7GT	5/-
12SC7	7/-
12SG7	4/6
12SH7	3/-
12SJ7	4/-
12SK7	5/6
12SL7GT	7/-
12SN7GT	6/6
12SR7	5/-
13D1	4/-
13D5	5/6
14S7	15/-
19AQ5	5/9
19E2	12/6
19G3	40/-
19G6	20/-
19H4	70/-
20A1	35/-
20P4	20/6
25L6GT	7/3
25Z4G	9/3
25Z5	8/6
25Z6GT	6/-
28D7	6/-
30C15	15/-
30C17	16/-
30C18	15/-
30F5	16/-
30FL1	12/6
30FL12	19/-
30FL13	9/3
30FL14	15/6
30L15	17/3
30L17	17/3
30P12	16/3
30P19	14/-
30PL1	14/-
30PL13	16/-
30PL14	15/-
33A/101K	9/-
35L6GT	8/-
35W4	5/-
35Z3	10/-
35Z4GT	7/6
35Z5GT	6/-
37	4/-
38	4/-
42	5/-
50CD6G	27/6
50EH5	12/-
50L6GT	8/6
57	6/-
58	6/-
59	6/-
75	5/6
76	5/-

77	6/6
78	5/-
80	5/6
81	9/-
83	14/-
84	5/-
85A2	7/6
282A	£5
307A	5/6
313C	25/-
357A	70/-
368AS	30/-
393A	27/6
446	8/-
703A	30/-
705A	20/-
715B	50/-
717A	3/-
803	30/-
807	9/-
808	8/-
813	75/-
815	35/-
829B	50/-
832A	45/-
843	5/-
866A	15/-
884	10/-
954	4/6
955	2/6
956	2/-
957	5/-
958A	4/-
991	6/-
1622	17/-
1625	6/-
1629	4/6
2051	5/-
2729	25/-
4043C	85/-
4313C	20/-
5676	10/-
5678	10/-
5696	6/-
5704	9/-
5726	7/-
5933	22/6
6057	10/-
6060	5/6
6064	7/-
6065	8/-
6080	27/6
6146	28/-
8013A	35/-
8020	30/-
9001	3/-
9002	4/6
9003	8/6
9004	2/6
9006	2/6
C.R. Tubes	
E4504/B/16	70/-
O9J	75/-
VCR97	32/6
VCR517	50/-
VCR517B	55/-
VCR517C	45/-
5CP1	30/-
5FP7	26/7
Photo Tubes	
GS16	12/6
6M625	45/-

P. C. RADIO LTD.
170 GOLDHAWK RD., W.12
(01) 743 4946

ALL OVERSEAS ENQUIRIES AND ORDERS
Please address to
Colomor (Electronics) Ltd.
170 GOLDHAWK ROAD, LONDON W12.
Tel.: 01-743 0899

TRADER SERVICE SHEETS

5/– each plus postage

We can supply Trader Service Sheets for most makes and types of Radios, Tape Recorders and Televisions—Manuals for some.

Cheques and open P.O.s returned if sheets not available.

OAKFIELD ENTERPRISES
LIMITED
30 CRAVEN STREET, STRAND
LONDON WC2

Make	Model	Radio/TV

1969 List available at 2/– plus postage

If list is required indicate with X

From ....

Address ....

....

enclose remittance of....................

(and a stamped addressed envelope)
s.a.e. with enquiries please
MAIL ORDER ONLY (August PW)

PLEASE MENTION

"PRACTICAL WIRELESS"

WHEN REPLYING TO

ADVERTISEMENTS

cuit as it stands in Fig. 3.1, the line voltage should not exceed the maximum V_{EB} for the transistors (usually about 5V for silicon transistors).

The circuit is basically similar for p-n-p transistors, the chief difference being that the reference rail will be of opposite polarity.

The time the flip-flop spends in its quasi-stable state may be determined approximately from $t \simeq 0{\cdot}7.C_1.R_1$, and the derivation of this formula was given in Part Two of this series.

Since the speed-up capacitor is small, if an output is taken from A an improved rising edge may be achieved, this output 180° out of phase with output B.

The chief disadvantage of the circuit of Fig. 3.1 is that in high frequency operation, the stored base charge is not always removed sufficiently rapidly, and the leakage current through Tr2 collector may be too high if the circuit has to operate in high ambient temperatures. To reduce this current it is necessary to apply negative bias to Tr2 base. The simplest way this may be achieved is with a negative supply as well as the normal positive supply, the former being only a low voltage supply, usually $-1{\cdot}5$V (for n-p-n circuit, $+1{\cdot}5$V for p-n-p).

Figure 3.2 shows this, where R4 and R5 act as a potential divider between V_{CE1}sat and $-V_{bb}$, and these may be so arranged that Tr2 base is always negatively biased. Operation of this circuit is just as previously described for Fig. 3.1, except that when Tr1 cuts off, the potential divider of R4 and R5 now sets a new base voltage for Tr2 of approximately $+0{\cdot}7$V, set between the potentials of $+V_{cc}$ and $-V_{bb}$.

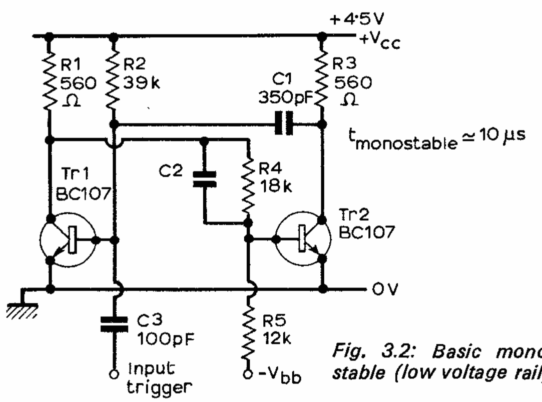


Fig. 3.2: Basic monostable (low voltage rail).

If a line voltage larger than the maximum reverse V_{EB} is to be used, the method previously described with the multivibrator may be employed. By placing diodes in the emitter line of the transistors, as shown in Fig. 3.3, the greater breakdown voltage of the diodes protects the emitter-bases. For low frequency operation it may not be necessary to employ a speed-up capacitor, and if this is done, diode D2 may be omitted since the potential divider formed by R4 and R5 ensures that the base only goes negative by the programmed amount, which should, of course, be less than the maximum reverse rating.

It is frequently not convenient to use two supply lines, and reverse base bias for cut off can be achieved with a single line in a number of ways. By lifting the emitters with diodes the situation is improved, and by lifting them further with say voltage-dependent resistors to just over 1V, potential dividers may be used down to the earth rail.

The voltage-dependent resistor, for those not familiar with it, may be regarded as a low current, low voltage reference diode.

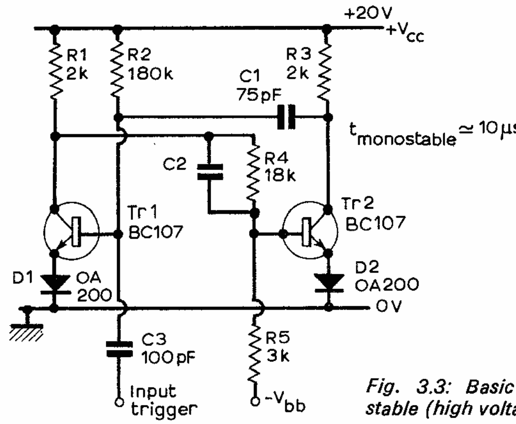


Fig. 3.3: Basic monostable (high voltage rail).

Figure 3.4 shows an alternative method for lifting the emitters enough to allow a potential divider to be used. Resistor R7 is used by both transistors for their current supply, and if the saturation currents of both transistors are made the same, the current through R7 will remain substantially constant throughout the circuit's operation, since either one or the other of the transistors will draw this saturation current. V_x may thus *be regarded* as constant. Now the *sense* of the output at A may be wrong for some applications, or perhaps two outputs 180° apart might be required. In such a situation, a fast rising edge at output B is required, and this should be slightly faster than that at A if the diode coupling resistor method is employed, since C2 must have some effect on output A, however small.

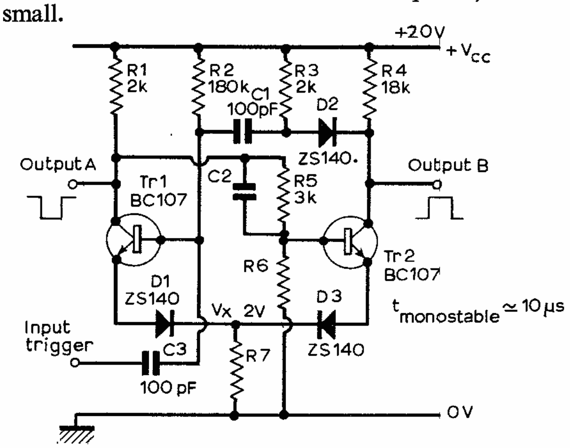


Fig. 3.4: Modified monostable with single supply and both edges fast; for high voltage rail.

For those readers who may not have read the description of how the diode resistor coupling operates in multivibrator circuits, it will be explained again in the case of this monostable. Assume that initially Tr1 is in the ON state, Tr2 in the OFF state. Now $V_{C1} = V_{CE1}\text{sat} + V_F + V_x$, and $V_{B2} \simeq \dfrac{V_{C1} \cdot R_6}{R_5 + R_6}$ and V_{B2} is made $-$ve, but less than $-V_{EB}$max. It might be

DUE TO PRESSURE ON SPACE PART 5 OF "AERIALS" HAS BEEN HELD OVER UNTIL NEXT MONTH

simpler here to consider some specific values, so if $+V_{cc} = 10V$ and in the ON state, $V_{C1} = 2{\cdot}8V$, with $V_x = 2V$, we might make $V_{B2} = +1V$, that is to say 1V less positive than the emitter, or a 1V reverse-bias on Tr2 emitter-base, holding Tr2 hard off. Now a negative input pulse through C3 of say 2V amplitude will turn Tr1 off, Tr1 collector rising to 10V, carrying, via the potential divider, Tr2 base to 2·7V, thus switching on Tr2. Before this switching operation, when Tr1 base was at about 3·4V, and diode D2 reverse biased, capacitor C1 will have charged to the potential $10 - 3{\cdot}4 = +6{\cdot}6V$. When Tr1 collector rises to 10V bringing on Tr2, Tr2 collector falls to about $+2{\cdot}8V$, thus taking Tr1 base down to $2{\cdot}8 - 6{\cdot}6V = -3{\cdot}8V$.

C1 then begins to discharge, and finally charge in the reverse polarity until V_{B1} reaches about $+3{\cdot}4V$, switching on Tr1 again. Now Tr1 collector bottoms, and Tr2 collector rises towards the 10V rail. Without the diode D2, capacitor C1 would normally be connected directly to Tr2 collector, and initially has a potential of $3{\cdot}4 - 2{\cdot}8 = 0{\cdot}6V$ across it, and this voltage would slow the collector up in its rise towards the rail, since the capacitor must charge to the rail potential. Diode D2 acts as a gate, and with the anode at the capacitor potential, when the collector rises towards the +ve rail, the diode goes into reverse bias, blocking off the effect of C1 to the collector, so allowing the collector to rise rapidly towards the rail, giving the improved rise time desired.

Diodes D1 and D2 serve to protect the transistors in cases where a line voltage higher than in the example taken is used. If the maximum reverse emitter-base bias is $-5V$, in the example, it was seen that this was not exceeded. C2 is of course a speed-up capacitor.

The circuit of Fig. 3.5, instead of triggering from the negative edge of the trigger pulse, triggers from the positive edge, and is suitable for narrow pulse width inputs. A positive pulse input is passed by D1 and cuts on Tr2, which is normally held off in the stable state by the low potential of V_{CE1}sat. C1 will be fully charged, and take Tr1 base negative as Tr2 switches on, discharging through R1 until regenerative switching occurs and the circuit flops back to the stable state.

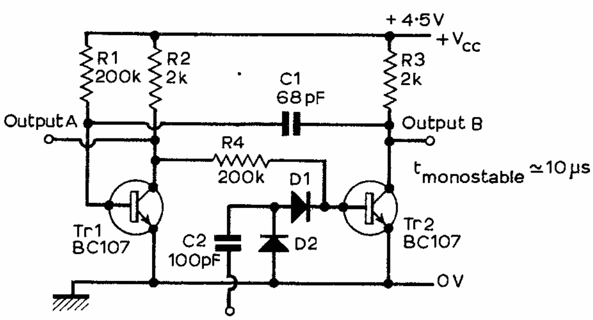


Fig. 3.5: Monostable for narrow trigger pulse.

The circuit of Fig. 3.6 might be triggered from a multivibrator set up as a pulse generator, and be also capable of external triggering. Tr1 is ON in the stable state, and with only about 0·1V at Tr1 collector,

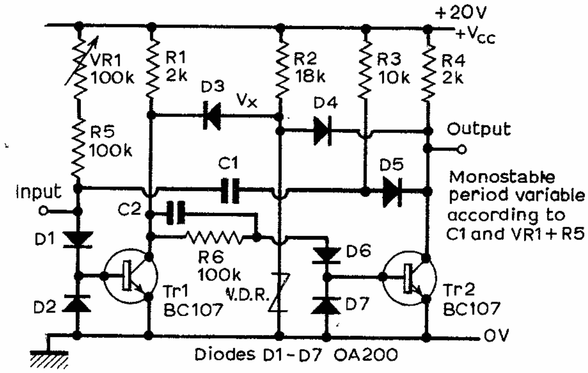


Fig. 3.6: Pulse generator element.

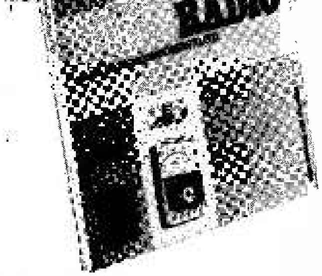
with voltage to be dropped by both D6 and R6 before Tr2 may switch on, it is of course in the OFF state. A negative input pulse switches Tr1 off and causes Tr2 to go into conduction, however, in this modified circuit, while Tr2 collector drops fast *towards* earth potential, it does not go as low as V_{CE}sat. This is prevented this time by diode D4 coming into forward conduction, the point V_x being held at a little over a volt by a voltage-dependent resistor. V_{C2} is thus stopped just short of saturation, and in this way the base does not become flooded with minority carriers as it does when saturation occurs. The diode clamp allows the collector to go as low as possible but just prevents saturation. When this transistor is to be switched off, there is not such a large stored base charge to remove, and for high frequency operation, better switching times can be thus achieved.

Apart from this saturation prevention clamp on both transistor collectors the circuit operates in the normal manner with a diode resistor coupling to improve rise times to the optimum. As a matter of interest, if the v.d.r. is replaced by a higher voltage zener diode and diodes D3 and D4 reversed in polarity, they may be used to act as clamps in the reverse direction. In this mode they prevent the collectors rising to the line potential, restricting them to about 0·7V greater than the zener voltage.

In the circuit of Fig. 3.6 adjustment of VR1 alters the length of the quasi-stable state.

Speed-up capacitors have been used in nearly all of the monostable circuits to be described, and the calculation of the precise value for a speed-up capacitor is quite involved, and is in any case subject to some error in practice. It is quite normal practice to select optimum values by trial and error in a particular circuit, the optimum capacitance being when the cleanest pulse is obtained at the output, i.e., fastest edges. This capacitor will usually be of the order of hundreds or thousands of pFs. As such, it does not present any particular danger in terms of reverse voltages to transistors' emitter-base as it will rapidly discharge on switching, causing only a small spike. Even momentary excess of voltage ratings is not to be recommended, however, for reliable service, particularly if high repetition rates are to be encountered.

In part four of this series, the family of bistable circuits will be discussed, and here it will be seen that the situation is somewhat complicated in the necessity of using a steering circuit for the input pulses. The Schmitt Trigger, complementary trigger, and a triggered ramp generator will also be discussed.

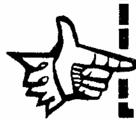


It's the finest, most comprehensive Catalogue we have ever produced—this latest edition. It has 330 pages, over 8,000 items listed, over 1,500 of them illustrated. Everything for the keen constructor—including tools and test gear. With each catalogue we supply a 30-page Price Supplement, a bookmark giving electronic abbreviations, and an order form. All for only 8/6d plus 4/- post, packing and insurance. Moreover, every catalogue contains 6 vouchers, each worth 1/- when used as directed.

... you need the

HOME RADIO CATALOGUE

POST COUPON NOW with P.O. or cheque for 12/6



Please write your Name and Address in block capitals

Name ______________________

Address ______________________

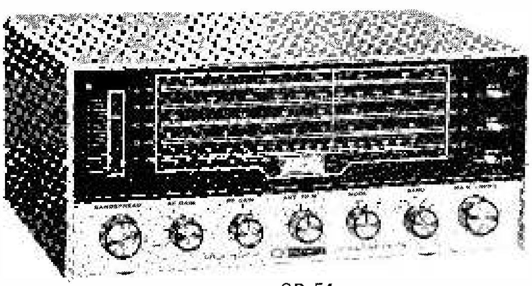
____

HOME RADIO LTD., Dept. P.W., 234-240 London Road, Mitcham CR4 3HD

The price of 12/6 applies only to catalogues purchased by customers residing in U.K.

TREAT YOURSELF TO A WORLD TOUR . . . WITH

HEATHKIT shortwave receivers

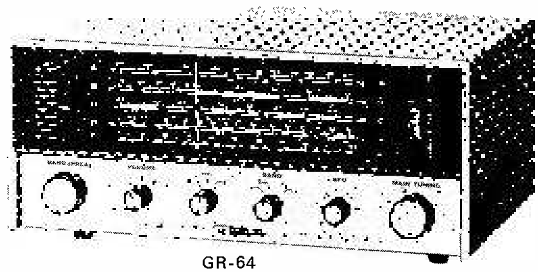


GR-54

DE LUXE 5 BAND MODEL GR-54

It covers 2MHz to 30MHz plus 550KHz to 1550KHz AM broadcast band and 150KHz to 420KHz aeronautical and radio navigation band. Receives AM/CW/SSB, 6 x 4in. PM speaker and sleek, "low-boy" styling. Operates on 115–230v 50Hz AC.

Kit K/GR-54 £44.16.0. Carr. 9/-



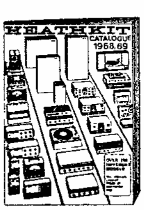
GR-64

LOW COST 4 BAND MODEL GR-64

World-wide reception, shipping, aircraft, radio amateurs plus the popular medium broadcast band. It covers 1MHz to 30MHz plus 550KHz to 1620KHz AM, with sleek "low-boy" styling, operates on 115–250v 50Hz AC.

Kit K/GR-64 £22.8.0. Carr. 9/-

Free Catalogue !



See these models and many more in our 1969 catalogue. Models for Stereo/Hi-Fi, Industry, Education and the Home Workshop. Heathkit—the world's largest selling selection of electronic kits and equipment.

HEATHKIT

To

DAYSTROM LTD., Dept. PW-8, GLOUCESTER, GL2-6EE.

Please send me FREE CATALOGUE ☐

NAME ....

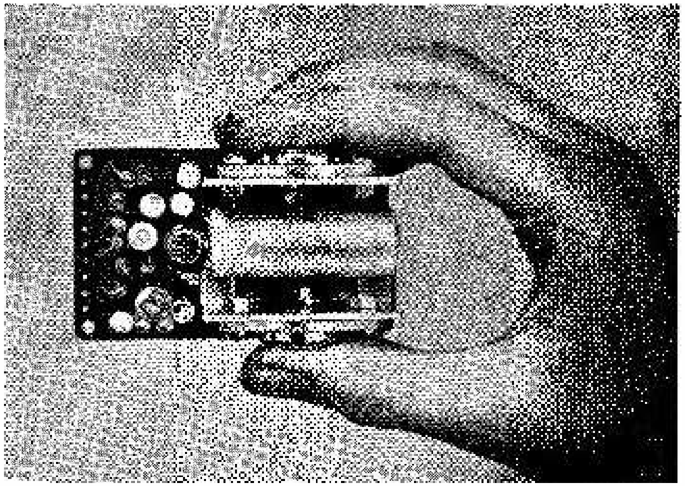
ADDRESS ....

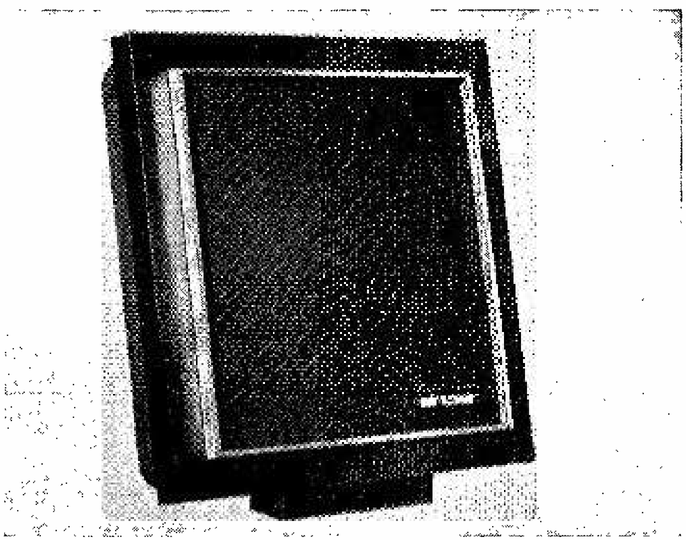
RC/8

....

Prices and specifications may be subject to change without prior notice

sinclair





With Sinclair you can buy a total stereo assembly or choose units to add to or modify existing installations. Each of the products shown here is the result of intensive research and development, representing a new and original approach in each case to users' needs. Each product has achieved unsurpassed standards of performance, quality and value, while for individual radio listening, there is the very efficient Micromatic, Britain's smallest radio.

Z.12 12 watt high-fidelity amplifier and integrated pre-amp

SPECIFICATIONS

Compact, powerful 12 watt high-fidelity amplifier and integrated pre-amp. Eight special transistors are used. The ultra-linear Class B output is suitable for loudspeakers from 3 to 15 ohms (two 3-ohm speakers may be used in parallel). Output power—12 watts R.M.S. continuous sine wave (24 watts peak) 15 watts music power (30 watts peak). Frequency response 15–50,000Hz $\pm$1dB. Input sensitivity 2mV into 2 Kohms. Signal to noise ratio is better than 60dB. With power requirements from 6 to 20V d.c., the Z.12 can be run from a car battery or the PZ.4 for example. Size 3 x 1$\frac{3}{4}$ x 1$\frac{1}{4}$in. Supplied ready built, tested and guaranteed.

APPLICATIONS

Hi-fi system (two required for stereo): car radio: P.A. systems: electric guitar: electronic organ: intercom system: record player: laboratory and industrial use, etc.

89/6

Q.14 high-fidelity loudspeaker

SPECIFICATIONS

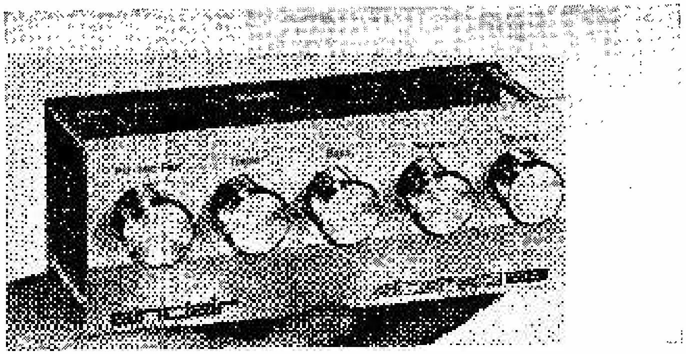
Compact high-fidelity loudspeaker of outstandingly good performance and value, it has smooth frequency response from 60 to 16,000Hz; loading capacity up to 14 watts R.M.S. Input impedance —4 ohms. With special drive unit in a sealed, seamless pressure chamber ensures excellent presence and transient response. Size 9$\frac{3}{4}$in. square x 4$\frac{3}{4}$in. deep on pedestal base; black matt finish with aluminium bar trim. This is the speaker which has won so much praise from reviewers in the technical press.

APPLICATIONS

For good hi-fi audio systems: as hi-fi extension speaker(s): for listening in conditions of restricted space. May be shelf or wall mounted or positioned to maximum advantage in any environment.

£7.19.6

+ 2/11 P.T. Surcharge



Stereo 25 pre-amp and tone control unit

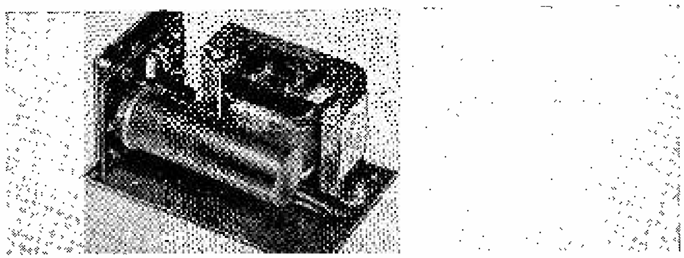
SPECIFICATIONS

Pre-amplifier and tone control unit with treble boost/cut from +12dB to—10dB at 10KHz, bass boost/cut from +15dB to—12dB at 100Hz. Stereo balance, volume and selector switch controls. Inputs—Mic. 2mV into 50 Kohms, PU—3mV into 50 Kohms, Radio 20mV into 20 Kohms. P.U. input corrected to within ±1dB on R.I.A.A. curve from 50 to 20KHz. Front panel in brushed and polished aluminium. Size $6\frac{1}{2}$ x $2\frac{1}{2}$ x $2\frac{1}{2}$in. plus solid aluminium knobs.

APPLICATIONS

For use with two Z.12s and PZ.4, can also be used with other good stereo amplifier systems.

£9.19.6



PZ.4 stabilised power supply unit

SPECIFICATIONS

Stabilised mains power supply unit, delivering 17·5V d.c. at 1·5 amps. Assured constant output under severest operating conditions. For a.c. mains 200/250V 50Hz.

APPLICATIONS

Systems using one or two Z.12s and Stereo 25, etc.

99/6

SINCLAIR MICROMATIC

Britain's smallest radio. Measures only 1 $^4/_5$ x 1 $^3/_{10}$ x $\frac{1}{2}$in. Available as kit or ready built. Tunes by slow motion control over medium waveband with bandspread on higher frequencies for good reception of Radio 1. A.G.C. counteracts fading from distant stations. The powerful output is fed to the high quality magnetic earpiece provided. Power comes from two self-contained Mallory Mercury Cells Type RM675. In black case with aluminium front panel and dial.

Kit is fitted pack with earpiece, solder, etc.

49/6 *+ 11d P.T. Surcharge*

Built and tested with magnetic earpiece.

59/6 *+ 1/1d P.T. Surcharge*

Mallory Mercury Cell RM.675 (2 required). 2/9 each.

YOUR SINCLAIR GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full at once and without question. **Full service facilities available to all purchasers.**

Goods sent post free in U.K. and Overseas by surface mail. Air-freight charged at cost.

Please send POST FREE ....

....

....

For which I enclose cash/cheque/money order

NAME ....

ADDRESS ....

....

PW.869

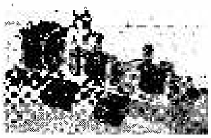
SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE 0233 52731

sinclair

TAPE AMPLIFIER FOR MAGNAVOX TAPE DECKS —2 or 4 TRACK

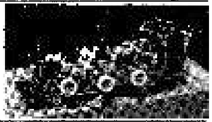
Chassis $12\frac{1}{2}$ x $5\frac{1}{2}$ x $4\frac{1}{2}$in. high. Front panel alum and black—$12\frac{1}{2}$ x $4\frac{1}{2}$in. 200–250 A.C. Mains Trans. Off/On-Tone; Vol./Mic.; Vol./Gram.; Mic. Input; Gram. Input; Monitor; Valves 6BR7, ECC83, EM84, EL84 and Rect. 2 Track **£10.10.0**; 4 Track **£12** (12/6 p. & p.). Ready for bolting direct to Magnavox deck.

STEREO AMPLIFIER type HV— 2 x 3 Watts

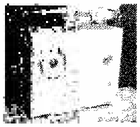


Fully built. On off, sep. vol. and tone each channel. 12 x $4\frac{3}{4}$ x 6in. high. EZ80, 2 x ECL86; for 3 ohm speakers, double wound main trans; fixing flanges and base plate; suitable for crystal cart., tuner etc. **£5.17.6** (8/- p. & p.). Available as kit with full instructions at **£4.17.6** (8/- p. & p.).

STEREO AMPLIFIER type RC— 2 x 3 Watts



Fully built. 2 x UCL82, metal rect; ganged vol. and tone cont; on-off, balance. 11 x $3\frac{1}{2}$ x 4in. high double wound mains trans. with supporting brackets. For 3-ohm speakers. **£6** (8/- p. & p.).



SUPER SIX KIT Mk. 2

MW and LW fully tunable. Wooden cabinet $9\frac{1}{2}$ x $8\frac{1}{2}$ x 3in., carrying handle, two tone cabinet; 4in. speaker; 6 transistors; full book of instructions. 2/6 (free with kit) All parts may be purchased separately. S.A.E. for price list Price of parts **£4.5.0** (6/- p. & p.).

We can accept H.P. orders for our Stereo Radiogram Chassis previously advertised and still available at **£19.19.0.** Terms £7 deposit and 6 monthly payments of 47/6 (by Banker's Order only).

GLADSTONE RADIO

66 ELMS ROAD, ALDERSHOT, Hants.

(2 mins. from Station and Buses). FULL GUARANTEE. **Aldershot 22240**
CLOSED WEDNESDAY. S.A.E. for enquiries please.

YOUR CAREER in *RADIO & ELECTRONICS?*

Big opportunities and big money await the qualified man in every field of Electronics today—both in the U.K. and throughout the world. We offer the finest home study training for all subjects in radio, television, etc., especially for the **CITY & GUILDS EXAMS** (Technicians' Certificates); the Grad. Brit. I.E.R. Exam.; the **RADIO AMATEUR'S LICENCE**; P.M.G. Certificates; the R.T.E.B. Servicing Certificates; etc. Also courses in Television; Transistors; Radar; Computers; Servo-mechanisms; Mathematics and Practical Transistor Radio course with equipment. We have **OVER 20 YEARS'** experience in teaching radio subjects and an unbroken record of exam. successes. We are the only privately run British home study College specialising in electronics subjects only. Fullest details will be gladly sent without any obligation.

To: British National Radio School, Reading, Berks.

Please send FREE BROCHURE *to*

NAME .... Block

ADDRESS .... Caps.

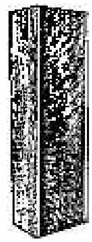
.... Please

8/69

BRITISH NATIONAL RADIO SCHOOL

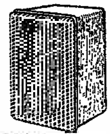
SPEAKER SYSTEMS

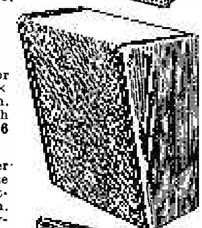
All cabinets are new and speakers are mounted on ½in. chipboard baffles. All speakers ex TV reconditioned hi flux magnet. All carefully tested before despatch.



THE CAXTON COLUMN This is a column cabinet. $23\frac{7}{8} \times 5\frac{1}{4} \times 5\frac{1}{2}$in. wide, fitted with 3 speakers. This will handle 8 watts and will improve the quality of any tape recorder, or record player. Finished in wood grain cloth and sandstone Vynair. A real bargain at **59/6.** P. & P. 10/6.

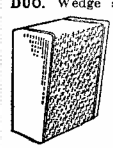
THE MILTON A. Hi-Fi Bookcase Cabinet. Size 9 × 5 × 6in., with 5in. speaker. Finished in Teak cloth with bold silk front **30/-.** P. & P. 4/6.

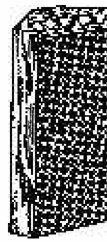




The Tennyson. Wedge shape for table or wall mounting $13\frac{1}{2} \times 16 \times 8\frac{5}{8}$in. Fitted EMI $13\frac{1}{2} \times 8$in. Speaker. Finished in Grey cloth with matching Vynair. **£4.7.6** P. & P. 7/6.

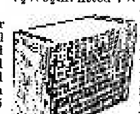
DUO. Wedge shaped Speaker Cabinet. Size $7\frac{3}{4} \times 7\frac{5}{8}$in. fitted 7 × 4in. speaker. Covered in attractive two tone Vynair. Price **32/6.** P. & P. 4/6.





The Cowdrey. Corner Cabinet in natural teak finish. Fitted 8 × 3in., 7 × 4in. and three 5in. round speakers wired in series to match 15 ohm impedance. **£6.6.0.** P. & P. 8/6

THE IMP. Extension Speaker Cabinet. Wedge shaped, size $7\frac{1}{2} \times 6\frac{1}{2}$in. fitted 7 × 4in. speaker. Covered with attractive walnut with fawn Vynair front. Keyhole slot in back. Only **25/6.** P. & P. 4/6.



THE SCOTT. Table top or wall mounting Speaker. Size $16\frac{1}{2}$ × $10\frac{1}{2}$ × $5\frac{1}{2}$in., tapered as illustrated. Fitted $13\frac{1}{2}$ × 8in. Speaker with volume control. Finished in black cloth with matching grey Vynair. (Please state 3 or 15 ohm imp.) **£4.5.0.** P. & P. 7/6.

SPEAKERS: Elac Heavy duty Ceramic Magnets 11,000 line, 10in. round, 10 x 6in. 3 ohm, or 15 ohm, **48/6,** P. & P. 3/6. 8in. round 15 or 3 ohm, **42/6.** P. & P. 3/6. E.M.I. $13\frac{1}{2}$ x 8in. 3 ohm **45/-,** 15 ohm **48/6,** P. & P. 3/6. E.M.I. 3in. tweeter, **17/6.** P. & P. 1/6. E.M.I. $13\frac{1}{2}$ x 8in. fitted two $2\frac{1}{4}$in. tweeters. 15 ohms, **77/6.** P. & P. 4/6. E.M.I. $13\frac{1}{2}$ x 8in. (15 ohm) Hi Fi Quality, **£5.19.6.** P. & P. 4/6. E.M.I. Woofers, $6\frac{1}{2}$ x $6\frac{1}{2}$in. square, 8 ohm, **59/6.** P. & P. 4/6. E.M.I. Crossover, **16/6.** P. & P. 1/-. EAGLE Crossover units, 3 or 16 ohms, **16/-.** P. & P. 1/-. Bakers 12in., 25 watt, 15 ohm, **£6.6.0.** P. & P. 3/6.

TEAK PLINTH AND PERSPEX DUST COVER for SP25 etc. **£5.5.0.** P. & P. 5/-

VYNAIR Widths from 40 to 54in., **17/6** yd. off roll. P. & P. 1/9. ½ yard, **9/-.** P. & P. 1/9. Send **1/-** stamps for samples.

SPEAKER MATCHING TRANSFORMERS. 3, 7, 15 ohms, 8 watt, **11/6** P. & P. 1/6.

MICROPHONES: Xtal Hand Mikes. B1201 with stand, **54/6.** P. & P. 3/6. ACOS Mike 45, **21/-.** ACOS Mike 40, **18/6.** Dyn. Mike DM-391, **30/-.** CM21 Xtal, **12/6.** Telephone Pick-up, **10/6.** P. & P. 1/-. Xtal lapel Mike, **7/6.** Guitar Mike, **12/6.** P. & P. 1/-.

FERROX RODS: 6 x $\frac{5}{16}$in., **2/6**; $4\frac{1}{2}$ x $\frac{3}{8}$in., **2/-**; 6 x $\frac{3}{8}$in., **2/6**; 8 x $\frac{3}{8}$in., **3/-.** P. & P. 1/- each.

FERROX RODS WITH COILS, $4\frac{1}{2}$ x $\frac{3}{8}$in., **3/6**; 8 x $\frac{5}{16}$in., **5/6**; P. & P. 1/- each.

ROTARY SWITCHES: 2 Pole Mains Switch, **3/-**; 1 pole 12 way, 2 pole 2 way, 3 pole 3 way, 3 pole 4 way, 4 pole 3 way, **3/6** each. P. & P. 1/-.

TRANSISTOR SPEAKERS 8 ohm 2in., **8/6.** 3in., **10/6.** $3\frac{1}{2}$in., **12/6.** P. & P. 1/-.

CARTRIDGES

Stereo: Sonotone 9TA H/C Diamond **47/6.** 9TA Sapphire, **37/6.** 8TA Sapphire, **30/-.** Ronette S105 Medium Output, **28/6.** S106 High Output **28/6.** DC284 Stereo Compatible **22/6.** Acos GP93/1 Sapphire, **37/6.** GP94/1 Sapphire, **39/6.** GP81 Diamond **42/-.** GP91 Stereo Compatible (High, Medium or Low Output), **25/-.** TA800 converts Philips AG3301, AG3306 to B.S.R. SX1H. Plug-in head complete with cartridge **50/-.** TA700 equivalent to B.S.R. SX1M, **35/-.** Japanese equivalent to B.S.R. TC8, **35/-.**

Mono: Acos GP67/2 will replace Collaro and Garrard Mono cartridges, **18/6.** T.T.C. Crystal High Gain, **15/-.** B.S.R. TC8H Jap. equivalent, **26/-.** Sonotone 2TSS, **15/-.** Post and Packing 1/6.

EARPIECES WITH CORD and 3·5 mm. plug. 8 ohm magnetic, **3/-.** 250 ohm, **4/-.** 180 ohm with clip, **6/6.** Xtal. P. & P. 6d.

PIANO KEY PUSH BUTTON SWITCHES, 7 button inc. mains on off. 6 banks of 6 P.C.O., **8/6.** P. & P. 1/-.

BROADWAY Electronics

92 MITCHAM ROAD, TOOTING BROADWAY,
LONDON, S.W.17 Telephone 01-672 3984 *(Closed all day Wednesday)*
(Few minutes from Tooting Broadway Underground Station)

RESISTORS

Mixed Parcel 200 fixed **20/-,** p. & p. 2/6
Mixed Parcel 30 variable **20/-,** p. & p. 2/6

CHASSIS UNITS

13 valves. ECC82(5), EB91(6), EF91(2). 60 resistors, capacitors etc. Valve cans and bases. Multicon plugs. **30/-,** p. & p. 6/-.
Flexible Metal Tubing. Galvanised $\frac{3}{8}$in. int. diam. **35/-** 100ft., p. & p. 7/6.
Field Telephones Type F. **32/6,** p. & p. 7/6.
Mixer Units Type 18. HF, MF, LF, Valve 882. **10/-,** p. & p. 2/6.

TRANSFORMERS

SSTR894. PRI. 220-230-250v. SEC. 6·3v(2a), 300-350-390v (35ma), 80-90-100v(10ma). **30/-,** p. & p. 5/-.
SSTR073. PRI. 220-230v. SEC. 35v(0·5a), 6·3v(2a), 225-0-225v (27ma). Oil filled. **25/-,** p. & p. 5/-.
SSTR009. PRI. 230v. SEC 50v(50ma). 4v(1a), 6·3v(8a). **25/-,** p. & p. 5/-.
Two Core Cable rubber covered, **1/-** per yard inc. p. & p.

STATUS SUPPLIES
Status House, Wilkinson Avenue, Blackpool

Practical Wireless Classified Advertisements

The pre-paid rate for classified advertisements is 1/8d. per word (minimum order 20/-), box number 1/6d. extra. Semi-displayed setting £5 2s. 0d. per single column inch. All cheques, postal orders, etc., to be made payable to PRACTICAL WIRELESS and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post*. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, PRACTICAL WIRELESS, IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4 for insertion in the next available issue.

FOR SALE

£6,000 IN VOUCHERS GIVEN AWAY. See free Catalogue for details. Tools, materials, mechanical, electrical, thousands of interesting items. WHISTON, Dept. VW, New Mills, Stockport SK12 4HL.

YUKAN SELF-SPRAY

Get these NOW! air drying GREY HAMMER OR BLACK WRINKLE (CRACKLE) Finishes

Yukan Aerosol spraykit contains 16 ozs. fine quality durable easy instant spray. No stove baking required. Hammers available in grey, blue, gold, bronze. Modern Eggshell Black Wrinkle (Crackle) all at 15/11 at our counter or 16/11, carriage paid, per push-button self-spray can. Also Durable, heat and water resistant Black Matt finish (12 ozs. self-spray cans only) 13/11 carriage paid.
SPECIAL OFFER: 1 can plus optional transferable snap-on trigger handle (value 5/-) for 18/11, carriage paid. Choice of 13 self-spray plain colours and primer (Motor car quality) also available. Please enclose cheque or crossed P.O. for total amount direct to:

Other Yukan Air Drying Aerosols, 16 ozs. at 16/11 carr. paid. include: Zinc Chromate Clear Lacquer Metallics: Grey, Blue, Bronze and Gold.

Dept: M/7 **YUKAN,** 307a, EDGWARE ROAD, LONDON, W.2.
We supply many Government Departments, Municipal Authorities, Institutes and Leading Industrial Organisations—We can supply you too.
Open all day Saturday. Closed Thursday afternoons.

MORSE MADE EASY !!

FACT NOT FICTION. If you start **RIGHT** you will be reading amateur and commercial Morse within a month. (Normal progress to be expected.)
Using scientifically prepared 3-speed records you automatically learn to recognise the code RHYTHM without translating. You can't help it, it's easy as learning a tune. 18 W.P.M. in 4 weeks guaranteed.
For details and course C.O.D. ring, s.t.d. 01-660 2896 send 8d. stamp for explanatory booklet to:
G3CHS (BOX 11), 45 GREEN LANE, PURLEY, SURREY

NUT DRIVERS in 22 sizes. B.A., A/F. & M.M. Send S.A.E. for lists to Bargain Spot, 268 London Road, Croydon.

CODAR CR70A, PR30X RQ10, Speaker. £32. 24, Leigh Sinton Road, Malvern, Worcs.

SURPLUS to requirements various small Electronic Components. S.A.E. for list. Box No 89

CONSIDERABLE quantity of short wave transmission and receiving gear for sale owing to death of owner. Impossible to describe full range. A visit to the house will be necessary. This is in Exeter. Also very large quantity of spares of many kinds. Please write in first instance to Box 88.

EDUCATIONAL

BECOME "Technically qualified" in your spare time, guaranteed diploma and exam. home-study courses in radio, TV servicing and maintenance. T.T.E.B., City and Guilds, etc.: highly informative 120-page Guide—free. CHAMBERS COLLEGE (Dept. 857K), 148 Holborn, London, E.C.1.

CITY & GUILDS (electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, TV., automation, etc., send for 132-page Handbook—FREE. B.I.E.T. (Dept. 168K), Aldermaston Court, Aldermaston, Berks.

EDUCATIONAL *(continued)*

LEC

RADIO AND TELEVISION SERVICING
RADAR THEORY AND MAINTENANCE
TELECOMMUNICATIONS

This private College provides efficient theoretical and practical training in the above subjects. One-year day courses are available for beginners and shortened courses for men who have had previous training.

Write for details to:
The Secretary, London Electronics College, 20 Penywern Road, Earls Court, London, S.W.5. Tel. 01-373-8721

TRAIN FOR SUCCESS WITH ICS

Study at home for a progressive post in Radio, TV and Electronics. Expert tuition for City & Guilds (Telecoms and Radio Amateurs') R.T.E.B., etc. Many unique diploma courses incl. Colour TV, Electronics, Telemetry & Computers. Also self-build kit courses—valve and transistor.

Write for FREE prospectus and find out how ICS can help you in your career.

ICS, DEPT. 541, INTERTEXT HOUSE, STEWARTS ROAD, LONDON, SW8

RADIO OFFICER training courses. Write: Principal, Newport and Monmouthshire College of Technology, Newport, Mon.

WANTED

DAMAGED AVO METERS, Models 7 & 8, any quantity. Send for packing instructions. HUGGETT'S LTD., 2/4 Pawsons Road, West Croydon.

WE BUY New Valves, Transistors and clean new components, large or small quantities, all details, quotation by return. WALTON'S WIRELESS STORES, 55 Worcester Street, Wolverhampton.

WE BUY New Valves and Transistors. State price. A.D.A. MANUFACTURING CO., 116 Alfreton Road, Nottingham.

WANTED NEW VALVES, televisions, radiograms, transistors, etc. STAN WILLETTS, 37 High Street, West Bromwich, Staffs. Tel.: WES 0186.

WANTED: New valves, transistors etc.; state prices. E.A.V. Factors, 202 Mansfield Road, Nottingham.

WANTED *NEW* VALVES ONLY

Must be new and boxed
Payment by return

WILLIAM CARVIS LTD
103 North Street, Leeds 7

BOOKS & PUBLICATIONS

SURPLUS HANDBOOKS

19 set Circuit and Notes	**6/6** p/p 6d.
1155 set Circuit and Notes	**6/6** p/p 6d.
H.R.O. Technical Instructions ..	**5/6** p/p 6d.
38 set Technical Instructions ..	**5/6** p/p 6d.
46 set Working Instructions	**5/6** p/p 6d.
88 set Technical Instructions ..	**7/-** p/p 6d.
BC.221 Circuit and Notes	**5/6** p/p 6d.
Wavemeter Class D Tech. Instr. ..	**5/6** p/p 6d.
18 set Circuit and Notes	**5/6** p/p 6d.
BC.1000 (31 set) Circuit and Notes ..	**5/6** p/p 6d.
CR.100/B.28 Circuit and Notes ..	**10/-** p/p 9d.
R.107 Circuit and Notes	**7/-** p/p 6d.
AR.88D Instruction Manual	**18/-** p/p 6d.
62 set Circuit and Notes	**6/6** p/p 6d.

Circuit Diagram 5/- each post free, R.1116/A, R.1224/A, R.1355, R.F. 24, 25 and 26, A.1134, T.1154, CR.300, BC.312, BC.342, BC.348J, BC.348 (E.M.P.), BC.624, 22 set.

52 set Sender and Receiver circuits **7/6** post free

Resistor colour code indicator **2/6** p/p 6d.

S.A.E. with all enquiries please.

Postage rates apply to U.K. only.

Mail order only to:

INSTRUCTIONAL HANDBOOK SUPPLIES

DEPT. PW, TALBOT HOUSE, 28 TALBOT GARDENS, LEEDS 8

GOVT. SURPLUS WIRELESS EQUIPMENT HANDBOOK

This useful Handbook gives detailed information and circuit diagrams for British and American Government Surplus Receivers, Transmitters and Test Equipment etc; also contained are some suggested modification details and improvements for the equipment. Incorporated in this revised edition is a surplus/commercial cross referenced valve and transistor guide. This book is invaluable to radio enthusiasts, radio clubs, universities and laboratories. The latest edition priced at 45/-. per volume plus 5/-. p & p is obtainable only from us at

GILTEXT (LEEDS) LTD

Dept. P.W., 24 Stansfield Chambers, Gt. George Street, Leeds 1.
s.a.e. with all enquiries, please. Extra postage for foreign orders. **Circuits now available individually for most surplus equipment on request.**

MISCELLANEOUS

AERIALS

ELECTRICAL

SERVICE SHEETS

METAL WORK

RECEIVERS & COMPONENTS

RECEIVERS & COMPONENTS
(continued)

WE ARE BREAKING UP COMPUTERS

EX COMPUTER PRINTED CIRCUIT PANELS 2in. × 4in. packed with semiconductors and top quality resistors, capacitors, diodes, etc. Our price, 10 boards, **10/-**, P. & P. 2/-. With a guaranteed minimum of 35 transistors.

SPECIAL BARGAIN PACK. 25 boards for **£1**. P. & P. 3/6. With a guaranteed minimum of 85 transistors. 100 boards **65/-**. P. & P. 6/6. With a guaranteed minimum of 350 transistors.

GIANT PANELS. 5¼ × 4in., min. 20 transistors, 9 × 56µH inductors, resistors, diodes etc. 3 for **£1**. P. & P. 2/-.

PANELS with 2 power transistors sim. to OC28 on each board + components. 2 boards (4 × OC28) **10/-**. P. & P. 2/-.

TRIM POTS. On 2 × 4in. boards + Ta caps and other components. 100Ω, 500Ω 15K., 20K. State requirements. 5 boards **10/-**. P. & P. 2/-.

NPN GERMANIUM TO5 1 WATT POWER TRANSISTORS. On small heat sink, on 2 × 4in. panel. 5 for **10/-**. P. & P. 2/-.

POWER TRANSISTORS. Sim. to 2N174 ex eqt. Finned Heat Sink (10D). 4 for **£1**. P. & P. 5/-.

ORGAN BUILDERS' SPECIAL 300 TO18 TRANSISTORS + 200 Si DIODE GATES on panels. **£4**. P. & P. 6/-.

OVERLOAD CUT OUTS. Panel mounting in the following values . . . **5/-** each. 2, 3, 4, 10 amp. P. & P. 1/-.

MINIATURE GLASS NEONS, 12/6 doz. P. & P. 1/-.

Ex-Computer **"MEMORY" FERRITE CORE STORES.** 4,000 bits per plane. **25/-**. P. & P. 3/-.

PAPST FANS. Powerful Extractor/Blower fans. 230/250V. 100 c.f.m., 2,800 r.p.m. **35/-**. P. & P. 5/6 ea.

MICRO SWITCHES, miniature button type. **10/-** doz. P. & P. 1/6.

NEW RECORDING TAPE. 900ft. on 5in. reels, low noise ¼in. tape. **£1** per reel post free.

NEW SPRAGUE 0·22µF 250V. small capacitors. **5/-** doz. P. & P. 1/-.

NEW SPRAGUE ELECTROLYTICS, 4µF 150V. **5/-** doz. P. & P. 1/-.

LARGE CAPACITY ELECTROLYTICS
4½in., 2in. diam. Screw terminals.
All at **6/-** each. P. & P. 1/6 each.

4,000mF	72V d.c. wkg.
10,000mF	25V d.c. wkg.
25,000mF	12V d.c. wkg.

KEYTRONICS 52 Earls Court Road, London, W.8. **Mail order only**

COMPLETE RANGE of Amateur, Aircraft, Communications receivers. Chassis, panels, meters, cabinets, microphones, etc. Stephens-James Ltd., 70 Priory Road, Liverpool 4. Tel. 051-263-7829.

FET HI-FI PRE-AMP MODULE

Latest low-noise FET in special circuit. Matches ANY ceramic/Xtal PU, Xtal mike, valve pre-amp, FM tuner, etc. DIRECTLY into ANY transistor power amp. Input impedance 2 Meg. Dist. <0·2%. 25 Hz—200 kHz ± 1 dB. Power 6–15 volts.
With full instructions ONLY 25/-, post free (Stereo pair 45/-). Mail order only, c.w.o.

W. T. MORRIS
1 Birch Drive, Shawbury, Shrewsbury.

COMPONENTS

Samples from our catalogue: Geared motors 300 rpm–1r/24H from 7/6; 15v. 300mW Zeners 3/-, 10K + 10K 2% 3in ganged pots, 20/-, 220 ohm 200 watt resistors 7/6; 6d stamp for catalogue.

F. HOLFORD & CO.
6 Imperial Square, Cheltenham.

RECEIVERS & COMPONENTS
(continued)

VALVE BARGAINS

Any 5–9/-, 10–14/-, 100 £5. 10. 0,
From the list below:-
ECC82, ECC83, ECL80, EF80, EF85, EY86, PCC84, PCF80, PCL82, PCL83, PL36, PL81, PL82, PL83, PY33, PY81, PY82, 30F5, 6-30L2, 30FL1, ALL VALVES SET TESTED P & P 1/-

S. ASHWORTH
Velco Electronics, 62 Bridge Street, Ramsbottom, Bury, Lancs.

INTEGRATED CIRCUITS at lowest price GE Type PA234 1 Watt Audio Amplifier. Few only at 17/6d. each inc. data. P. & P. C.W.O. JEF ELECTRONICS, 12 York Drive, Grappenhall, Warrington, Lancs.
Mail Order Only.

SITUATIONS VACANT

TV and Radio, A.M.I.E.R.E., City & Guilds, R.T.E.B. Certs., etc. on 'Satisfaction or Refund of Fee' terms. Thousands of passes. For full details of exams and home training Courses (including practical equipment) in all branches of Radio, TV, Electronics, etc. write for 132-page Handbook—FREE. Please state subject. **BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 137K), Aldermaston Court, Aldermaston, Berks.**

ENGINEERS. A TECHNICAL CERTIFICATE or qualification will bring you security and much better pay. Elem. and adv. private postal courses for C.Eng., A.M.I.E.R.E., A.M.S.E. (Mech. & Elec.), City & Guilds, A.M.I.M.I., A.I.O.B., and G.C.E. Exams. Diploma courses in all branches of Engineering—Mech., Elec., Auto., Electronics, Radio, Computers, Draughts., Building, etc. For full details write for FREE 132 page guide: BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, (Dept. 169K), Aldermaston Court, Aldermaston, Berks.

RADIO TECHNICIANS

VACANCIES TO BE FILLED BY OCTOBER 1969

A number of suitably qualified candidates are required for unestablished posts, leading to permanent and pensionable employment (in Cheltenham and other parts of the UK, including London). There are also opportunities for service abroad.

Applicants must be 19 or over and be familiar with the use of Test Gear, and have had practical Radio/Electronic workshop experience. Preference will be given to such candidates who can also offer "O" Level GCE passes in English Language, Maths and/or Physics, or hold the City and Guilds Telecommunications Technician Intermediate Certificate or equivalent technical qualifications. A knowledge of Electro-mechanical equipment will be an advantage.

Pay according to age, e.g. at 19—£869 at 25—£1,130 (highest age pay on entry) rising by four annual increments to £1,304.

Prospects of promotion to grades in salary range £1,217–£2,038. There are a few posts carrying higher salaries.

Annual Leave allowance of 3 weeks 3 days rising to 4 weeks 2 days. Normal Civil Service sick leave regulations apply.

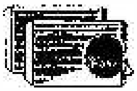
Application forms available from:

RECRUITMENT OFFICER (RT 37/54)
GOVERNMENT COMMUNICATIONS HEADQUARTERS,
OAKLEY, PRIORS ROAD,
CHELTENHAM, GLOS. GL52 5AJ

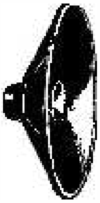
SITUATIONS VACANT
(continued on next page)

BARGAIN BASEMENT

BABY ALARM / INTERPHONE

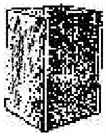


Fully transistorised. Master & sub interphone. Only 5" x 3" x 1". Crystal clear 2-way conversations. Works over ¼ mile (house to house, etc.).
39/11 **Post 3/6.** G'teed 7-day trial offer. Long connecting lead & batt. supp.



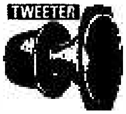
FANTASTIC SPEAKER BARGAIN
Famous English, 12" high flux, heavy cone, 10 watts speaker with built-in tweeter, 3 or 15 ohms.
(P. & I. 4/9) **35/-**

NEW RELEASE
HI-FI COLUMN SPEAKER CABINET



Beautifully made. Suitable for 7–12" speakers. Rosewood finish. Screwed and glued. Attractive grey cloth front measures 24" x 13" x 10" with tweeter hole above.
69/6 (Carr. 10/-)
With 12" speaker as advertised above 99/- (carr. 10/-).

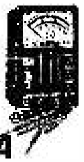
HI-FI HORN 10 watts. Add this 16 ohms unit to your existing speaker system and create real live sound! **ONLY** (P. & I. 3/6) **25/6**



Variable cross-over unit (for Horn) (P. & I. 2/6) **21/-**

HI-FI PICK-UP
Your reproduction is only as good as your pick-up. Our diamond turnover unit assures quality sound.
Mono 16/-; Stereo 26/-; Post 1/9.
Send S.A.E. for Catalogue.

MULTIMETER



Measures AC/DC 0-1,000v., AC/DC 1,000 ohms/v. DC current 150 M/A. Resistance 100 k/ohms. Ideal for checking faults in household and car electrics. Guaranteed.
(P. & I. 3/6) **39/6**

ELECTRAMA
1 George Street, Hailsham, Sussex.

NEW VALVES!

Guaranteed and Tested
24-HOUR SERVICE

IR5	5/6	DL96	6/9	EY86	5/9	PL500	12/9
IS5	4/3	DY86	5/3	EZ80	3/9	PL504	13/3
1T4	2/9	DY87	5/3	EZ81	4/6	PY32	10/-
3S4	5/9	EABC80	5/9	KT61	8/3	PY33	10/-
3V4	5/9	EBC41	9/9	KT66	15/9	PY81	5/-
6AQ5	4/6	EBF80	6/-	N78	14/6	PY82	5/-
6L18	6/-	EBF89	5/9	PABC80	6/9	PY83	5/3
25L6GT	4/6	ECC82	4/-	PC86	10/3	PY88	6/-
30C18	8/6	ECC83	4/9	PC88	10/3	PY800	7/3
30FL1	13/6	ECC85	5/6	PC97	8/3	PY801	6/6
30FL12	14/3	ECH35	5/6	PC900	7/6	R19	6/3
30FL14	11/9	ECH42	10/6	PCC84	6/3	U25	12/9
30P4	11/6	ECH81	5/9	PCC89	9/9	U26	11/6
30P19	11/6	ECL80	6/3	PCC189	11/6	U191	12/3
30PL1	13/6	ECL82	6/3	PCF80	6/3	UABC80	6/6
CCH35	9/9	ECL86	7/6	PCF801	6/6	UBC41	8/3
CL33	17/6	EF37A	6/-	PCF805	8/6	UBF89	6/3
DAC32	6/9	EF39	4/6	PCF808	11/9	UCC84	7/9
DAF91	4/3	EF80	4/9	PCL82	6/9	UCC85	6/6
DAF96	6/3	EF85	5/9	PCL83	8/9	UCF80	8/-
DF33	7/6	EF86	6/3	PCL84	7/-	UCH42	10/6
DF91	2/9	EF89	4/9	PCL85	8/9	UCH81	7/-
DF96	6/3	EF183	5/9	PCL86	8/3	UCL82	6/9
DK32	6/9	EF184	5/3	PFL200	11/9	UF41	10/6
DK91	5/6	EH90	6/-	PL36	9/3	UF89	6/6
DK96	6/6	EL33	8/3	PL81	7/-	UL41	10/3
DL35	4/9	EL41	10/3	PL82	6/9	UL84	6/9
DL92	5/9	EL84	4/9	PL83	6/9	UY41	7/-
DL94	5/9	EY51	7/3	PL84	6/3	UY85	5/3

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any parcel insured against damage in transit 6d. extra. Office address, no callers.

GERALD BERNARD
83 OSBALDESTON ROAD
STOKE NEWINGTON
LONDON, N.16

There is scope, variety and responsibility as a

RADIO TECHNICIAN

in Air Traffic Control

Join the National Air Traffic Control Service, a Department of the Board of Trade, as a Radio Technician and you have the prospect of a steadily developing career in a demanding and ever-expanding field.

Entrance qualifications: you should be 19 or over, with practical experience in at least one of the main branches of telecommunications.

Once appointed and given familiarisation training, you will be doing varied and vital work on some of the world's most advanced equipment, including computers, radar and data extraction, automatic landing systems and closed-circuit television. Work is based on Civil Airports such as Heathrow, Gatwick and Stansted, Air Traffic Control Centres, Radar Stations and other specialist establishments.

Starting salary is £869 (at 19) to £1,130 (at 25 or over): scale maximum £1,304 (higher rates at Heathrow), and some posts attract shift-duty payments. Your career prospects are excellent and every opportunity and assistance is given to study for higher qualifications. The annual leave allowance is good and there is a non-contributory pension scheme for established staff.

Send this coupon for full details and application form:
To: Mr. A. J. Edwards, C.Eng., M.I.E.E., M.I.E.R.E. Room 705, The Adelphi, John Adam Street, London, WC2 marking your envelope 'Recruitment'.

Name...

Address..

....

.... PW/A1

Not applicable to residents outside the United Kingdom

NATCS National Air Traffic Control Service

PADGETTS RADIO STORE

OLD TOWN HALL, LIVERSEDGE, YORKS.
Tel. Cleckheaton 2866

Indicator Unit type 26. Size 12 × 9 × 9in. with outer case. Fitted with $2\frac{1}{2}$" tube C.R.T. type CV1526. Nine B7G valves. Clean condition, but not tested. **32/6,** p. & p. 10/-.

New 12" Speakers with built in tweeter 3 ohm or 15 ohm 6 watts max **28/6,** post paid.

Ex Washing Machine Motors. Single phase 230 volt $\frac{1}{4}$ H.P. 1425 R.P.M. All perfect. **26/-** p. & p. 10/-.

Silicon Rectifier 500mA, 800 P.I.V. No duds. **2/6,** post paid. **24/-** per dozen, post paid.

Jap Ear Piece. Magnetic 8 ohm. Small and large plug. **1/11,** post paid.

Reclaimed TV tubes with six months guarantee. 17in. type AW43/88, AW43/80, **40/-;** MW43/69, **30/-.** 14in. types, **17/-.** All tubes, 12/- carriage.

Speakers removed from TV sets. All PM and 3 ohms.
6in. round, **3/-,** p. & p. 3/-; 6 for **24/-,** post paid.

6 × 4in., **3/-,** p. & p. 3/-; 6 for **24/-,** post paid. 7 × 4in., **5/-,** p. & p. 3/-; 6 for **34/-,** post paid. 5in. round, **3/-,** p. & p. 3/-; 6 for **24/-,** post paid.

Slot Speakers, 8 × $2\frac{1}{4}$in., **5/-,** p. & p. 3/-; 6 for **30/-,** post paid.

Indicator Unit type 116a VCR97 tube. Mu metal screen and EF50 valves, Good condition, but not tested. **22/6.** carriage 10/-. Untested Pye, KB. RDG, Ekco 17in. TV sets. Bush 17in. TV sets, **50/-.** each, carriage 15/-. Passenger train, double rate.

VALVE LIST
Ex Equipment, 3 months' guarantee
Single Valves Post 7d., over 3 Valves p. & p. paid

ARP12	1/6	PCL83	5/–	6BW7	2/6
EB91	9d.	PL36	5/–	6K7	1/9
EF85	3/–	PL38	6/–	6U4	5/–
EBF80	3/–	PL81	4/–	6V6	1/9
ECC81	3/–	PY33	5/–	6P28	5/–
ECC82	3/–	PY81	1/6	10P13	2/6
ECC83	4/–	PY82	1/6	185BT	8/6
ECL80	1/6	PZ30	5/–	20D1	3/–
EF50	1/–	U191	5/–	20P1	5/–
EF80	1/6	U281	5/–	20P3	2/6
EF91	9d.	U282	5/–	30PL1	5/–
EY86	5/–	U301	5/–	30P12	5/–
PCC84	2/–	U329	5/–	30F5	2/6
PCF80	2/–	U251	5/–	30FL1	5/–
PCL82	4/–	6B8	1/8	6/30L2	5/–

WIRECOMP ELECTRONICS

LONDON'S LEADING BARGAIN SPECIALISTS

FOR THE RADIO • HI-FI & ELECTRONICS ENTHUSIAST

Special displays of radios, recorders, record decks, tuners, amps., meters, speakers, etc., etc. ALL faulty or damaged needing repair—

AT GIVE AWAY PRICES!

100's of component bargains from our easy to see and choose from self service racks.

100's OF OLD TYPE VALVES — from 2/– each

ASSORTED TRANSISTORS 9d each. 7/6 per doz

Huge stocks of shop soiled and reconditioned second hand radios, record players, tape recorders, etc.

SPOT CASH PART EXCHANGES

WE OFFER THE HIGHEST RATES IN LONDON

There's something for everyone

COME AND LOOK TODAY ***(Open 6 days a week!)***

ALL THESE ITEMS ARE AVAILABLE TO CALLERS ONLY

PERSONAL CALLERS TO:
48 TOTTENHAM CT. RD., W.1 **Tel. 01-636 0647**

Head Office and Warehouse
44A WESTBOURNE GROVE
LONDON W2
Tel. PARK 5641/2/3

Z & I AERO SERVICES LTD.

Please send all correspondence and Mail-Orders to the Head Office

When sending cash with order, please include 2/6 in £ for postage and handling

MINIMUM CHARGE 2/6. No C.O.D. orders accepted.

Retail Shop
85 TOTTENHAM COURT ROAD
LONDON W1
Tel. LANgham 8403
Open all day Saturday

OA2	6/-
OA3	8/6
OB2	6/-
OB3	9/-
OC3	6/6
OD3	6/-
OM10	11/-
1AX2	12/-
1B3GT	7/-
1C5GT	5/-
1G4GT	8/-
1H5GT	7/-
1L4	3/-
1R5	6/-
1S4	5/-
1S5	4/6
1T4	4/-
1U4	6/-
1U5	8/6
1V2	9/-
1X2B	7/-
1Z2	25/-
2C26A	8/-
2C40	8/-
2C51	8/-
2CW4	12/-
2D21	6/-
2E26	27/6
2X2	5/-
3A4	4/-
3B28	40/-
3Q4	7/6
3S4	6/-
3V4	8/-
4B32	80/-
5R4GY	10/-
5U4G	5/6
5U4GB	7/-
5U8	8/-
5Y3GT	5/6
5Z3	8/-
5Z4G	7/-
6/30L2	14/-
6A8G	5/6
6AB4	6/6
6AB7	4/-
6AC7	4/-
6AD4	15/-
6AF4A	9/-
6AG5	3/-
6AG7	6/9
6AH6	10/-
6AJ5	9/-
6AJ8	5/3
6AK5	5/-

6AK6	11/6
6AL5	3/-
6AM4	22/-
6AM5	5/-
6AM6	4/-
6AM8	8/-
6AN8	10/-
6AQ5	6/-
6AQ6	10/-
6AR5	6/-
6AR6	6/-
6AS5	6/6
6AS6	7/-
6AS7G	15/-
6AT6	4/6
6AU4GTA	9/-
6AU6	5/-
6AU8	10/-
6AV5GTA	12/-
6AV6	5/6
6AW8A	11/-
6AX4GTB	8/-
6AX5GT	12/6
6AX7	10/-
6B4G	15/-
6B8G	2/6
6BA6	4/-
6BA7	15/-
6BC5	3/6
6BE6	4/6
6BF5	15/-
6BF6	9/-
6BF7	12/-
6BG6G	11/-
6BH6	8/-
6BJ6	8/-
6BK4	20/-
6BK7A	9/-
6BL7GTA	11/-
6BN6	7/6
6BQ6GTB	12/-
6BQ7A	7/-
6BR7	16/-
6BR8	12/6
6BS7	25/-
6BW6	15/6
6BW7	13/-
6BZ6	6/-
6BZ7	10/-

6C4	5/6
6C5GT	6/6
6C6	4/-
6C8G	7/-
6C9	17/3
6CB6	5/-
6CD6GA	22/-
6CG7	8/-
6CH6	11/-
6CL6	9/-
6CL8	15/-
6CU6	12/-
6CW4	12/-
6CY5	7/-
6D3	7/6
6D4	17/6
6DC6	13/6
6DK6	8/-
6DQ6B	11/-
6DS4	15/-
6DT6	8/-
6EA8	11/-
6EW6	12/-
6F6GB	6/6
6F7	9/-
6F11	6/-
6F13	6/6
6F14	12/-
6F15	11/-
6F17	9/-
6F18	7/6
6F23	15/-
6F24	13/-
6F25	14/-
6F28	13/-
6GH8	11/-
6GK6	12/-
6GW6	11/-
6J4	9/-
6J5GT	5/6
6J6	3/6
6J7	8/-
6K6GT	9/-
6K7G	2/6
6K23	9/-
6K25	15/-
6L6GT	8/6
6L7	6/-
6L12	5/-
6L18	6/-
6L19	20/-
6LD20	5/6
6N7GT	6/6
6P1	11/6

6P25	13/-
6P28	12/-
6Q7	7/-
6SA7	7/-
6SG7	6/-
6SH7	4/6
6SJ7	7/-
6SL7GT	6/-
6SN7GT	5/6
6SQ7	7/-
6SR7	7/-
6SS7	3/-
6T8	6/-
6U4GT	12/-
6U8	6/-
6V6GT	6/-
6X4	4/6
6X5GT	5/-
6X8	11/-
6Y6G	11/6
7C5	14/6
7S7	22/6
7Y4	11/-
7Z4	7/6
9BW6	7/-
9D2	3/6
10C2	10/-
10D2	8/-
10F1	18/-
10F9	10/-
10F18	7/6
10L1	7/6
10LD11	10/-
10P13	10/-
10P14	16/-
12AC6	7/-
12AD6	6/-
12AL5	7/6
12AQ5	7/-
12AT6	4/6
12AT7	6/-
12AU7	5/9
12AV6	5/6
12AX7	5/6
12AY7	13/6
12B4A	9/6
12BA6	6/-
12BA7	6/-
12BE6	6/-
12BH7	6/-
12BT6	4/6
12BY7	10/-
12CU6	12/-
12DQ7	10/-

First Quality Fully Guaranteed

BRAND

ELECTRONIC VALVES

Combined effect of increase in Purchase Tax and S.E.T. and import restrictions forced us to introduce an increase of 1d. per shilling which must be added to the total of each order.

12E1	20/-
12E14	52/6
12K5	10/-
12K8	8/-
12Q7GT	5/6
12SC7	4/6
12SG7	6/-
12SK7	6/6
12SQ7	7/6
19AQ5	7/6
20CV	62/6
20D1	9/-
20L1	18/-
20P1	10/-
20P3	12/-
20P4	19/-
20P5	19/-
25BQ6GTB	12/-
25C5	9/-
25CU6	12/-
25L6GT	6/6
25Z4G	6/-
25Z5	8/-
25Z6GT	11/-
30A5	7/-
30C15	14/-
30C17	15/-
30C18	14/-
30F5	16/-
30FL1	15/-
30FL12	17/6
30FL13	8/-
30FL14	14/6
30L1	6/-
30L15	16/-

30L17	16/-
30P12	15/-
30P19	14/-
30PL1	15/-
30PL13	17/6
30PL14	17/-
35A5	10/-
35B5	12/-
35C5	6/6
35D5	12/-
35L6GT	8/-
35W4	4/6
35Z3	10/-
35Z4G	4/-
35Z5GT	6/-
50A5	12/-
50B5	12/-
50C5	6/-
50L6GT	8/6
53KU	13/6
75C1	8/-
80	7/-
83A1	12/6
85A2	7/6
85A3	7/6
90AG	46/-
90C1	12/-
90CG	25/-
90CV	25/-
150B2	11/-
150B3	10/-
807	9/-
811A	30/-
812A	60/-
813	75/-
837	15/-

866A	14/-
884	10/-
5670	10/-
5751	11/-
5763	12/-
5886	40/-
6080	27/6
6146	27/6
6146B	47/6
6197	20/-
6360	25/-
6386	75/-
6883	47/6
6939	40/-
7199	15/-
7551	30/-
7581	22/6
7586	22/6
7591A	20/-
7895	22/6
AZ1	8/-
AZ31	9/-
CCH35	9/-
CY1	8/-
CY31	7/-
DAF96	7/-
DF96	7/-
DH81	10/-
DH101	9/-
DK92	8/3
DK96	7/6
DL68	13/-
DL96	7/-
DM70	6/-
DY86	6/-
DY87	6/6
DY802	9/-

E55L	52/6
E83F	20/-
E88C	23/-
E88CC	12/6
E130L	100/-
E180F	17/6
EAF801	10/-
EABC80	6/-
EBC33	8/-
EBC41	9/6
EBC81	6/-
EBF80	7/6
EBF83	8/-
EBF89	6/-
EBL1	12/-
EBL31	24/-
EC86	11/6
EC88	11/-
ECC34	8/-
ECC40	10/-
ECC70	17/-
ECC81	6/-
ECC82	5/9
ECC83	5/-
ECC84	5/6
ECC85	5/-
ECC86	8/-
ECC88	7/6
ECC89	11/-
ECC91	3/6
ECC807	14/-
ECF80	6/6
ECF82	6/6
ECF83	14/-
ECF86	11/6
ECF804	32/-
ECH35	11/-

ECH42	12/-
ECH81	5/3
ECH83	8/-
ECH84	9/-
ECL80	8/6
ECL81	7/6
ECL82	6/-
ECL83	11/6
ECL84	10/-
ECL85	10/6
ECL86	8/-
EF9	8/-
EF39	8/-
EF40	9/-
EF41	11/6
EF42	13/-
EF54	10/-
EF55	12/-
EF80	4/6
EF83	9/6
EF85	6/6
EF86	6/-
EF89	5/-
EF91	4/-
EF92	7/6
EF93	4/-
EF94	5/-
EF95	5/-
EF96	3/6
EF183	6/-
EF184	6/6
EF804	20/-
EH90	7/-
EK90	4/6
EL34	9/6
EL36	8/6
EL38	22/6
EL41	9/6
EL42	10/-
EL81	9/-
EL83	7/6
EL84	4/6
EL85	7/6
EL86	8/-
EL90	6/-
EL95	6/6
EL360	22/-
EL500	17/-
EL821	10/-
EL822	17/-
ELL80	15/-
EM34	16/-
EM71	12/6
EM80	7/-

EM81	7/6
EM84	7/-
EM87	10/-
EN32	30/-
EN91	6/-
EY51	7/6
EY80	8/6
EY81	7/-
EY83	10/-
EY84	9/6
EY86	7/6
EY87	8/-
EY88	8/-
EZ40	8/-
EZ41	8/6
EZ80	5/-
EZ81	5/-
GY501	15/6
GZ32	9/6
GZ34	10/-
HL42DD	8/-
KT66	24/-
KT88	29/-
MH4	7/-
MH41	9/-
ML4	8/-
MSPENT	10/-
N78	19/-
ORP61	5/-
ORP90	22/6
ORP93	22/-
PABC80	7/6
PC86	11/-
PC97	8/-
PC900	9/6
PCC84	6/6
PCC85	7/6
PCC88	11/-
PCC89	9/6
PCC189	10/-
PCC805	16/-
PCC806	16/-
PCE800	15/-
PCF80	6/6
PCF82	6/3
PCF84	8/-
PCF86	9/6
PCF87	15/-
PCF800	14/-
PCF801	9/-
PCF802	9/-

PCF805	14/-
PCF806	12/-
PCF808	14/6
PCL80	15/-
PCL81	9/-
PCL82	7/-
PCL83	12/-
PCL84	8/-
PCL85	8/6
PCL86	8/6
PCL88	17/-
PCL800	17/6
PCL801	15/-
PD500	30/-
PE06-40N	35/-
PEN45	6/6
PEN45DD	12/-
PEN383	9/-
PEN384	9/-
PEN453DD	10/-
PF86	10/-
PF818	14/-
PFL200	13/-
PL33	8/-
PL36	10/-
PL81	9/-
PL83	8/-
PL83	7/-
PL84	6/6
PL500	13/6
PL504	15/-
PL509	30/-
PL802	13/-
PY31	5/-
PY32	10/-
PY33	12/6
PY80	5/6
PY81	5/6
PY82	5/-
PY83	6/6
PY88	7/6
PY500	20/-
PY800	9/-
PY801	9/-
QQV06-40A	105/-
QU37	27/-
SP41	5/6
SP61	5/-
TP22	10/-
TT21	45/-
U19	40/-

U20	12/-
U22	8/-
U25	14/6
U26	14/6
U31	8/-
U33	30/-
U76	4/-
U81	10/-
U281	8/-
U282	8/-
U403	8/-
U404	5/-
UABC80	6/-
UAF42	9/6
UBC41	8/6
UBC81	8/6
UBF80	6/6
UBF89	7/-
UBL1	8/6
UC92	6/-
UCC85	7/-
UCF80	9/6
UCH21	9/6
UCH42	12/-
UCH81	6/6
UCL81	10/-
UCL82	7/-
UCL83	11/-
UF9	10/-
UF41	9/9
UF42	11/-
UF43	10/-
UF80	7/-
UF85	7/3
UF89	7/-
UL41	11/-
UL84	6/6
UM4	10/-
UM84	7/-
UU9	7/6
UY21	9/6
UY41	7/-
UY82	9/6
UY85	6/-
VU39	9/-
VU111	8/6
VU133	8/-
W76	7/-
W107	7/-
W729	10/-
X65	9/-
Z759	25/-
Z700U	8/-
Z803U	15/-

INTEGRATED CIRCUIT AMPLIFIERS

RCA Type CA3020

Integrated Circuit Audio Amplifier in TO5 encapsulation (size of a small transistor), equivalent to seven n-p-n silicon transistors, 3 diodes and 11 resistors. Power output 550mW. Total harmonic distortion ·1%. Will operate on voltage from 3 to 9 volts. **30/-** plus 2/- p.p.

GENERAL ELECTRIC Type PA222

Epoxy moulded in-line package equivalent to six n-p-n transistors, one diode and six resistors. It will provide output of up to 1·2 watts into 15 ohms. Battery operation 22 volts. **40/-** plus 2/- p.p.

The construction of amplifier using the above integrated circuits had been described in March and August issues of P.W. Please note that we only supply the IC's and no other parts are supplied by us.

GENERAL ELECTRIC TYPE PA234

1-watt Audio Amplifier suitable for supply voltage of 9 to 25V and for output loads of 8, 16 or 22 ohms. Only 3 capacitors and 3 resistors are required for making up a complete amplifier delivering 1 watt for an input voltage of 60mW. Epoxy moulded double four-in-line package. **27/6** each, plus 2/- P. & P.

GENERAL ELECTRIC Type PA237

Similar to PA234, but 2 watts, 40/-, plus 2/- p.p.

RCA Type CA3036

Stereo Pre-Amplifier as described in May issue of P.W. **19/-**, plus 2/- p.p.

Motorola MC1709CG

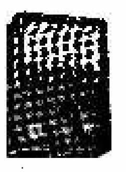
Operational Amplifier. Full data supplied on request. **40/-**

NEW LIST OF TRANSISTORS, INTEGRATED CIRCUITS AND RECTIFYING AND ZENER DIODES IS NOW READY.

The List gives full specifications and prices of over 200 types of Semiconductors.

Available free on request.

MULTIMETERS



TYPE MF16

D.C. voltage range: 0-0·5-10-50-250-500V.
A.C. voltage range: 0-10-50-250-500V.
D.C. current range: 500µ-10-100mA.
Resistance ranges: 100MΩ-1MΩ. The meter is also calibrated for capacity and output level measurements. Sensitivity 2000Ω/V. Accuracy ±2·5% for D.C. and ±4% for A.C. measurements.
Dimensions: 4½ x 3½ x 1⅛in. Price **£4.5.0.**

Type 108-IT: 24 range precision portable meter, 5000 o.p.v. D.C. Volts: 2·5-10-50-250-500-2500V. A.C. Volts: 10-50-100-250-500-2500V; D.C. current 0·5-5-50-500mA Resistance 2000–20,000 ohms; 2–20 megohms. Power output calibration in A.C. for 600 ohms line. Complete with prods and batteries, **£6.5.0.** P. & P. 5/-.

THYRISTORS

Low current:
Blue spot; 200 p.i.v., 5 Amps. Gate voltage 3·25V at 120 mA. **12/6**

Medium current:
BTY79-400R: 400 p.i.v., 6,4A av., 10 Amps r.m.s. Gate volts 3·0V at 30mA. **27/-**

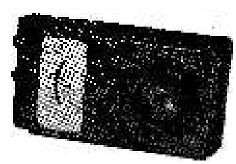
High current:

CR 80-021A, 80 Amps. 25 p.i.v.	25/-
CR 100-151A.	30/-
CR 100-201A, 100 Amps. 200 p.i.v.	35/-
CR 100-215A, 100 Amps. 250 p.i.v.	40/-
CR 100-301A, 100 Amps. 300 p.i.v.	45/-
CR 100-351A, 100 Amps. 350 p.i.v.	50/-
CR 100-401A, 100 Amps. 400 p.i.v.	60/-
CR 100-501A, 100 Amps. 500 p.i.v.	70/-

For all CR series Minimum gate firing voltage is 3V at 150mA.

DRY REED INSERTS

Glass dry reed inserts approx. ⅛in. dia. x 1in. long with axial leads. One "make" contact of 100 mA capacity at 50V. Can be operated by permanent magnet or 30–50 Amp-turns relay coils. PRICE **18/-** per doz. post free.



SLIDEWIRE WHEATSTONE BRIDGE

£15.15.0

Battery Powered Portable Resistance Bridge. Range 0·5 to 50 ohms with multiplier settings of 0·1–1–100–1000, providing a measuring range of 0·05 to 50 000 ohms. Accuracy in the middle 3 ranges—0·5% approx. PRICE **£15.15.0.**

TRIACS TYPE 40432

Gated bi-directional Silicon Thyristors with integral trigger. The triac will control up to 1440 watts at 240V mains frequency. Supplied complete with heat sink data sheet and application sheets for motor control and dimmer circuits. **37/6** each.

UNIJUNCTION TRANSISTORS 2N2646

Power dissipation 300mW R.M.S. Base-to-Base voltage 35V max. Peak emitter current 2·0A. Suitable for triggering of thyristors. **12/6.**

D. C. MOVING COIL METERS

ACCURACY 1·5%

SERIES 70 Rectangular flange 80 x 72 mm flush mounted. Body diameter 68mm. Scale length ca 50mm.

60µA	66/-	600µA	49/-	400mA	46/-
100µA	62/-	1mA	46/-	600mA	46/-
250µA	54/-	40mA	46/-	1A	46/-
400µA	52/-	150mA	46/-	2·5A	46/-
6V	82/-	60V	32/-	250V	53/-
40V	82/-	150V	32/-	600V	58/-

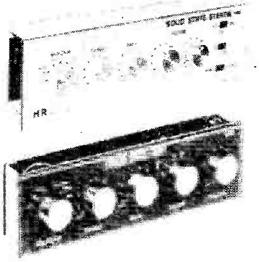
SERIES 120DA. Rectangular flange 120 x 104mm flush mounted. Body diameter 68mm. Scale length ca 95mm.

40µA	82/-	25mA	58/-	15V	62/-
60µA	78/-	60mA	58/-	60V	62/-
100µA	74/-	1A	58/-	100V	62/-
250µA	65/-	1·5A	58/-	250V	65/-
600µA	60/-	10A	60/-	400V	69/-
2·5mA	58/-	40A	64/-	600V	77/-

Published on or about the 7th of each month by I.P.C. MAGAZINES LIMITED, Tower House, Southampton Street, London, W.C.2. at the recommended maximum price shown on the cover. Printed in England by Index Printers, Dunstable, Beds. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia) Ltd. South Africa: CENTRAL NEWS AGENCY LTD. Rhodesia, Malawi and Zambia: KINGSTONS LTD. East Africa: STATIONERY & OFFICE SUPPLIES LTD. Subscription rate including postage for one year: To any part of the World £2.2s.0d.

ENGLANDS LEADING COMPONENT & EQUIPMENT CENTRES

SOLID STATE—HIGH FIDELITY AUDIO EQUIPMENT



Mono or Stereo Audio, Equipment developed from Dinsdale Mk.II—each unit or system will compare favourably with other professional equipment selling at much higher prices.

COMPLETE SYSTEMS FROM £15.5.0

THE FINEST VALUE IN HIGH FIDELITY—CHOOSE A SYSTEM TO SUIT YOUR NEEDS AND SAVE POUNDS

All units available separately

SEND FOR FREE BROCHURE (No. 21) TODAY!

DEMONSTRATIONS DAILY AT '303' EDGWARE ROAD

ELECTRONIC ORGANS KITS TO BUILD YOURSELF AND COMPLETE UNITS

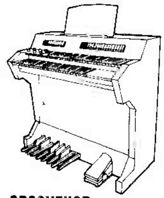
The MAYFAIR *Acclaimed by everyone*

A completely new development in portable electronic musical instruments and a new field for the home constructor. The 'MAYFAIR' produces a multitude of the most pleasing sounds with a wide range of tone colours suitable for classic or popular music. The organ is **fully polyphonic, that is full cords can be played over the entire keyboard.** Supplied as a kit of parts which includes 165 transistors, printed circuit panels, special fully sprung and depth of touch adjusted keyboard, attractive vynair covered cabinet with carry handle.

Deferred terms available
COMPLETE KIT
Deposit £29.19.0
12 monthly payments of £7. Total £113.19.0
BUILT AND TESTED
Deposit £38.8.0 and
12 monthly payments of £9. Total £144.8.0

THE MAYFAIR 99 GNS
BROCHURE 9

The GROSVENOR



The Grosvenor is designed for the more ambitious musician and has a much wider range than most commercial organs. It comprises two four-octave (49 note) keyboards and a thirteen-note pedal board. It has four pitches (i.e., 8ft, 4ft, 2ft, 1ft) on the upper or solo keyboard, three pitches (i.e., 16ft, 8ft, 4ft) on the lower or accompaniment keyboard, two pitches (i.e., 16ft, 8ft) on the pedal board. Variable sustain on the solo keyboard and variable vibrato on both keyboards. It has 15 voices in the solo tone-forming unit, 10 voices in accompaniment tone-forming unit and 4 voices in the pedal tone-forming unit. All components and kit sections are available separately including the Oak Console at £66.18.0

A complete detailed and illustrated construction manual is provided with circuits and full parts list. All items may be purchased separately. All parts supplied are fully guaranteed. Full after sales service and advice freely available.

Once built the 'MAYFAIR' or 'GROSVENOR' will then provide years of enjoyable entertainment.
Call in—See them for yourself.

THE GROSVENOR
KITS FROM **£220** terms available
BROCHURE 9B

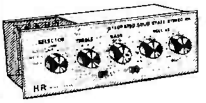
PRACTICAL ELECTRONICS—ELECTRONIC ORGAN KIT

We are able to supply Parts as described in this series. Details on request

ORGAN COMPONENTS: COMPLETE RANGE IN STOCK • 49 AND 61 NOTE KEYBOARDS • 2 TO 5 PAIR GOLD CONTACTS • COILS AND CHOKES • REVERBERATION SPRINGS AND UNITS • STOP TABS AND ASSEMBLIES • PEDAL BOARDS • RHODIUM AND GOLD CLAD WIRE, ALSO PRINTED CIRCUITS ETC. COMPLETE RANGES FOR TRANSISTORISED ORGANS. ASK FOR NEW PRICE LISTS WITH DETAILS
LEAFLET 9B

ALL ENQUIRIES TO: ORGAN DEPT.—MR. ELVINS

INTEGRATED TRANSISTOR AMPLIFIERS



6 WATTS MONO OR 12 WATTS STEREO

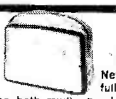
We are pleased to offer two new designs with the choice of either mono or stereo systems. These BRITISH DESIGNED UNITS favour the user in so many ways—with fantastic power and quality with far greater adaptability, with freedom for battery or mains operation.

for complete listening satisfaction choose either the—

MA7 MONO **£8.10.0** POST PACKING 5/- EITHER MODEL OR STEREO MA66 **£16.10.0** OPTIONAL MAINS UNIT PS20 62/6d pp 4/-

Illustrated leaflets 12 and 14 FREE on request

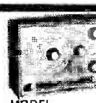
DO IT YOURSELF MW/LW PORTABLE



New printed circuit design with full power output. Fully tunable on both mw/lw bands. 7 transistors plus diode, push-pull circuit. Fitted 5 inch speaker, large ferrite aerial and Mullard transistors. Easy to build with terrific results. All local and Continental stations.

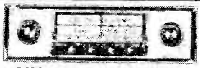
TOTAL COST TO BUILD £6.19.6. P.P. 4/6
Send for Brochure 1

NEW MODELS NOMBREX TRANSISTORISED Test Equipment



MODEL		PRICE £	s.	d.	Leaflet No.
29s	R.F. Generator	21	0	0	—
29x	Xtal R.F. Generator	29	10	0	35
30	Audio Generator	19	10	0	24
31	R.F. Generator	12	10	0	25
32	C.R. Bridge	10	10	0	26
33	Inductance Bridge	20	0	0	29

QUALITY CAR RADIOS

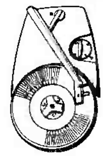


A precision engineered car radio that's perfect company for long hours on the road. Has quick push-button operation for immediate station selection and choice of Medium or Long wave frequency. Output of 3½ watts ensures crisp, top quality sound even at high motoring speeds. Includes full accessories and instructions.

POSITIVE/NEGATIVE EARTH PRICE £12.12.0. pp. 4/6

MANUAL as above £8.19.6. but with single MW/LW Push Button.

*SCOOP! STAAR RECORD PLAYER



Deck. Plays 33, 45, 78 records 9 volt operated. With mono cartridge. Brand new. As illustrated. **59/6** post 3/6

***MULLARD 1 WATT AMPLIFIER**

9 volt, 5 transistor unit complete with volume control. Output to 3 ohms. Ideal for use with Starr Record Deck. **45/-** post 3/-
Send for leaflet 2

BUILD A QUALITY TAPE RECORDER

To get the best out of your MAGNAVOX DECK, you need a MARTIN RECORDAKIT. This comprises a special high quality 6 valve amplifier and pre-amplifier which comes to you assembled on its printed circuit board—in fact everything needed down to the last screw FOR MAKING A SUPERB TAPE RECORDER, which, when built, will compare favourably with instruments costing twice as much, yet you need no experience or technical skill to bring this about. THE INSTRUCTIONS MANUAL MAKES BUILDING EASY AND SUCCESS ASSURED.

2 Track 36 gns. 4 Track 39 gns.
P.P. 22/6 either model

Kit comprises: Deck, Amplifier, Cabinet and speaker, with MICROPHONE 7 in 1,200 ft. tape, spare spool

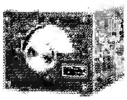
ALL UNITS AVAILABLE SEPARATELY
ASK FOR BROCHURE 6.

Today's Value £60.

VHF FM SUPERHET TUNER MKII

5 MULLARD TRANSISTORS & 4 DIODES . 300 Kc/s BANDWIDTH . PRINTED CIRCUIT CONSTRUCTION . HIGH FIDELITY REPRODUCTION MONO AND STEREO

A popular VHF FM Tuner now used throughout the country for quality reception of monophonic and, with the decoder stereophonic broadcasts. There is no doubt about it—VHF FM gives the *real sound*. Excellent stability, economically priced.



PARTS TOTAL COST £6.19.6.
DECODER £5.19.6.
(CABINET 20/-) ASK FOR LEAFLET 3.

NEW—MALLORY LONG LIFE MERCURY BATTERIES 50% OFF LIST PRICES

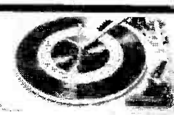
*RM12 1.35 volts 3600 m/aH OUR PRICE 5/- each size 2" x 1" dia.

* RM625 10.35 volts 350 m/aH Pack of 8. Size 2¼ x ¼ dia.
OUR PRICE 10/- each

Easily split into eight 1.35v. cells These cells are ideal for any application where SMALL SIZE HIGH CAPACITY and LONG LIFE are required.

QUANTITIES AVAILABLE

GARRARD RECORD DECKS



ALL BRAND NEW at huge savings

	£	s.	d.
2025 Mono/Stereo GKS 25	8	8	0
3000 LM Mono/Stereo 9 TAHC	9	19	6
SP25 Mk II	11	19	6
AT60 Mk II	13	0	0
AP75	19	0	0
SL55	11	19	6
SL65	14	14	0
SL75	29	0	0
SL95	35	0	0
A70 Mk II	12	12	0
B.S.R. UA25 Mono	6	19	6
B.S.R. MA65	9	19	6
B.S.R. MA70	12	12	0
B.S.R. MA75	15	5	0
401 Garrard	28	10	0

Carriage/Packing 7/6d. all models. Complete range of accessories available. *Send for New 8 page brochures 16 17*

TRANSISTORS

MANUFACTURERS—DISTRIBUTORS

We publish a **QUANTITY, SEMI-CONDUCTOR BULLETIN** listing over 500 different devices available FROM STOCK in medium to large quantities at KEEN PRICES coupled with PROMPT DELIVERIES.

TO OBTAIN YOUR COPY, WRITE TO US (on Company Headed Notepaper please) requesting our SEMI-CONDUCTOR BULLETIN. For TELEPHONE QUOTATIONS, PHONE (01) 723 1008/9 Extn. 4 (01) 723 0401 Extn. 4.

We purchase medium to large quantities of Transistors and Devices excess to Manufacturers' and Distributors' requirements. Write or Phone Extn 4.

TRANSISTORS—SEMICONDUCTORS

COMPLETELY NEW 1969 LIST OF 1000 types. Send for your FREE COPY TODAY. (list 36)
S.C.R.'s from 5/-
Field Effect Transistors from 7/6
Power Transistors from 5/-
Diodes and Rectifiers from 1/-

HI-FI equipment to suit EVERY POCKET

VISIT OUR NEW HI-FI CENTRE at 309 EDGWARE ROAD AND SAVE UP TO £25 ON SEPARATE UNITS OR THE SYSTEM OF YOUR CHOICE

for *all* leading makes

AMPLIFIERS
TUNERS
DECKS
SPEAKERS
MICROPHONES
TEST EQUIPMENT
HEADPHONES
CARTRIDGES, etc.

All with Terrific Savings

It will PAY YOU to pay us a VISIT!

COMPLETE SYSTEMS *from* **£46—Saves £12.10.0!**
SEND FOR NEW 8-PAGE ILLUSTRATED HI-FI LIST 16/17

Fully Illustrated CATALOGUE

COMPLETELY NEW 9th EDITION (1969)

The most COMPREHENSIVE—CONCISE—CLEAR COMPONENTS CATALOGUE

Complete with 10/- worth discount vouchers
FREE WITH EVERY COPY

- 32 pages of transistors and semi-conductor devices, valves and crystals.
- 210 pages of components and equipment.
- 70 pages of microphones, decks and Hi-Fi equipment.

6,500 ITEMS
320 BIG PAGES

Send today 7'6 Post etc 2/-

HENRY'S RADIO LTD HR

OPEN MON.-SAT. 9 a.m.-6 p.m. THURS. 9 a.m.-1 p.m.

303 Edgware Road, London, W.2. Mail Order Dept. all types of Components, Organ Dept. **(01) 723-1008/9**
309 Edgware Road, London, W.2. High Fidelity Sales, P.A. and Test Equipment, Record Decks **(01) 723-6963**