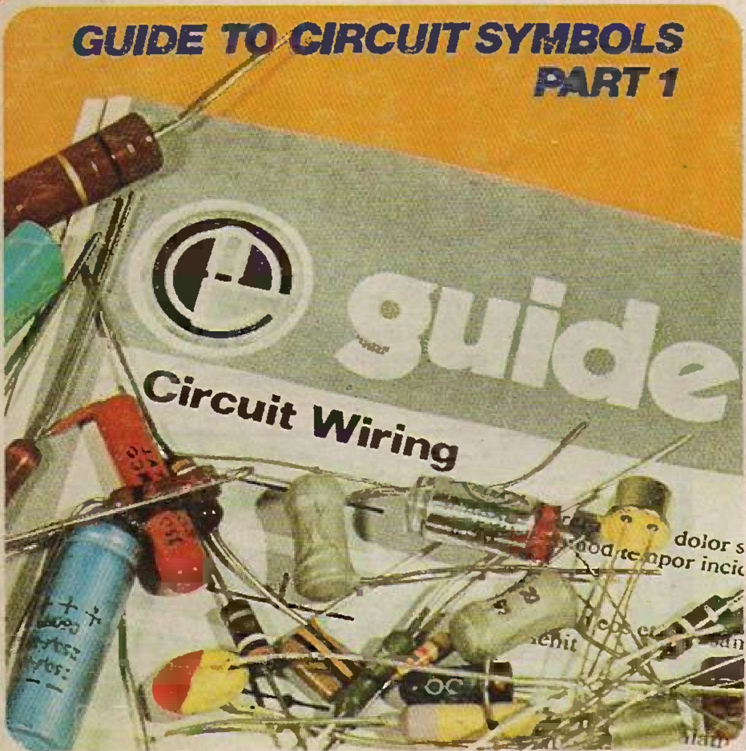
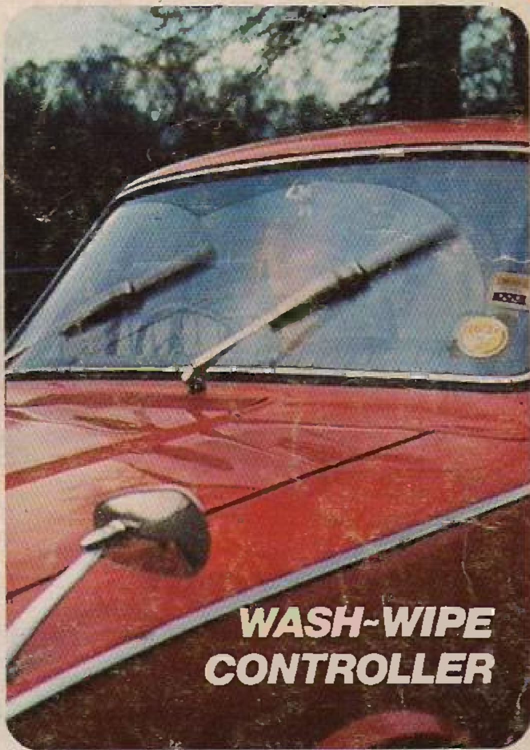
An exciting hobby.... for everyone

everyday electronics

JUNE 72

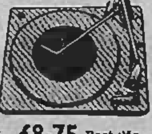
15p





BSR LATEST SUPERSLIM

STEREO AND MONO

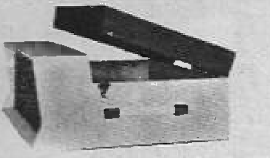


Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13¼ × 11¼in. Above motor board 3¼in. below motor board 2½in. with STEREO and MONO XTAL **£8·75** Post 25p.

MONO-COMPATIBLE Plays all records **£7·75** Post 25p.

RCS 3 WATT AMPLIFIER. Ready made tested. 2-stage triode pentode valve UCL82. 3 watts output. Tone and volume controls. Rectifier valve UY85. Knobs. With high performance Loudspeaker. Response 50-12,000 cps. Sensitivity 200mV. Post 25p **£4**

R.C.S. PORTABLE PLAYER CABINET



£4 Post 25p.

Really smart appearance with space for R.C.S. Amplifiers and most modern autochangers. Size 18 × 15 × 8in. Metal fittings. Carrying handle. Popular colours. Two-tone rexine covered.

GARRARD SINGLE PLAY TA MK II Complete with stereo/mono plug in head. Ideal Discotheque or Hi-Fi. **£10**

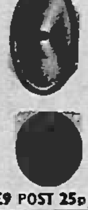
GARRARD AUTOCHANGERS with Sonotone Cartridges Stereo Diamond and Mono Sapphire. Model 1025 £10. Model 3500 Stereo and Mono Autochanger £14. Post 25p.

BSR JUNIOR SINGLE PLAYER Turntable, 4-speed motor and separate pick-up **£4·50**

EMI PICK-UP ARM with mono xtal and stylus £1·25. HI-FI PICK-UP CARTRIDGES. Diamond LP/Stereo Stereo/Mono 9TA £2·50; GP94 £2·50; GP93 £2·00; Sapphire Mono GP91 £1·50; Power-point LP/78. 60p.

E.M.I. WOOFER AND TWEETER KIT

£5·75 Post 25p



Comprising a fine example of a Woofer 10¼ × 6¾in. with a massive Ceramic Magnet, 44oz, Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3¾in. square has a special lightweight paper cone and magnet flux 10,000 lines.

Impedance Standard .... 8 ohms
Maximum Power.......... 12 watts
Useful Response.... 35 to 18,000 cps
Base Resonance .... 45 cps

SUITABLE ENCLOSURE 20 x 13 x 9in, £9 POST 25p

WEYRAD P50—TRANSISTOR COILS

RA2W Ferrite Aerial	72p	Spare Cores	3p
Osc. P50/1AC	33p	Driver Trans. LFDT4	58p
I.F. P50/2CC 470 kc/s.	36p	Printed Circuit, PCA1	58p
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P51/1 or P51/2	36p	Weyrad Booklet	10p
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Mullard Ferrite Rod 8 × ⅜in. 20p, 6 × ⅜in. 20p.

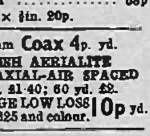
VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p

80ohm Coax 4p. yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2. FRINGE LOW LOSS Ideal 625 and colour. **10p** yd.

8in ELAC HI-FI SPEAKERS



Dual cone plasticised roll surround. Large ceramic magnet. 50-16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 10 watts music power. **£4·80**

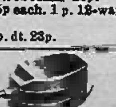
BLANK ALUMINIUM CHASSIS 18 s.w.g. 2in. sides. 7 × 4in. 45p; 9 × 7in. 60p; 11 × 7in. 70p; 13 × 9in. 90p; 14 × 11in. 95p; 15 × 14in. 99p; 11 × 3in. 50p; 16 × 10in. £1

ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 9p; 8 × 6in. 16p; 14 × 3in. 16p; 10 × 7in. 19p; 12 × 5in. 20p; 12 × 8in. 28p; 16 × 6in. 28p; 14 × 9in. 24p; 12 × 12in. 40p; 16 × 10in 50p.

1½ inch DIAMETER WAVE-CHANGE SWITCHES 25p. 2 p. 2-way, or 2 p. 6-way or 3 p. 4-way 25p each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way 25p.

TOGGLE SWITCHES, sp. 14p; dp. 18p; dp. dt. 23p.

"THE INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER



200/250v. A.C. Leaflet S.A.E. **£2·35** Post 15p

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240v. AC. Output voltages available 6 or 9 or 12 or 15 or 18 or 20v. DC at 100mA or less. PLEASE STATE VOLTAGE REQUIRED. **£2** POST FREE Details S.A.E. Size 3½ × 1½ × 1½in.

GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape, P.U., Guitar. Can be used with Battery 9-12v or H.T. line 200-300v D.C. operation. Size 1½" × 1¼" × ½". Response 25 c.p.s. to 25 Kc/s. 26db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **90p** Post 10p

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	50+50/350V	35p
4/350V	14p	500/25V	20p	60+100/350V	58p
8/450V	14p	1000/25V	35p	32+32/250V	18p
16/450V	15p	1000/50V	47p	32+32/450V	33p
32/450V	20p	8+8/450V	18p	350+50/325V	50p
25/25V	10p	8+16/450V	20p	32+32+32/350V	43p
50/50V	10p	16+16/450V	25p	100+50+50/350V	48p
100/25V	10p	32+32/350V	25p		

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SILVER MICA. Close tolerance 1% 2·2-500pF 8p; 500-2·200 pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p; each.

TWIN GANG. "0-0" 208pF+176pF, 65p; Slow motion drive 365+365 with 25+25pF, 50p 500pF slow motion, standard 45p; small 3-gang 500pF £1·60.

SHORT WAVE, SINGLE. 10pF 30p; 25pF 55p; 50pF 55p.

NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p.

RESISTORS, ¼ w., ½ w., 20% 1p; 2 w. 5p 10 ohms to 10 meg

HIGH STABILITY. ½ w. 2% 10 ohms to 1 meg., 10p. Ditto 5% Preferred values 10 ohms to 10 meg., 4p.

WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt 10 ohms to 100K. 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p

DECCA DECCADEC GARRARD MOTOR UNIT MKII

Single play Stereo Mono Deram transcription head and arm Four speeds. 10½in. turntable. Anti-rumble filter Bias compensation. Laboratorymotor.

SPECIAL PRICE **£18·50** Post 25p

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Cut out ready for Garrard or B.S.R. Will play with cover in position. Latest design. Covered in black leatherette. Antimagnetic. 12½ × 14½ × 7½in. **£5·50** Post 25p

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350-0-350 80 mA. 6·3 v. 3·5 a. 6·3 v. 1 a. or 5 v. 2 a.	£3·00
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MINIATURE 200 v. 20mA., 6·3 v. 1 a. 2½ × 2½ × 2in.	75p
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MINI-MAINS 20v, 100mA. 1½ × 1½ × 1½in.	50p
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Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6·3 v. 1½ amp.	80p

GENERAL PURPOSE LOW VOLTAGE. Tapped Outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £3·25
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LUCAS 2DS500 Bridge 70V 5 amp £1.

E.M I. 13½ × 8in. LOUDSPEAKERS

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

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

Teak Cabinet Size 16 × 10 × 9in. Post 25p **£5**

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in. MAJOR £9

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

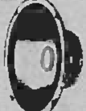
Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11·50**

BAKER "BIG—SOUND" SPEAKERS

'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**
3 or 8 or 15 ohm	3 or 8 or 15 ohm	8 or 15 ohm

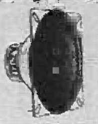
TEAK HI-FI SPEAKER CABINETS. Fluted wood front For 12in. or 10in. dia. speaker 20 × 13 × 9in. £9. Post 25p For 13 × 8in. or 8in. speaker 16 × 10 × 9in. £5. Post 25p For 10 × 6in. or 6in. speaker 16 × 8 × 6in. £4. Post 25p LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft.

GOODMANS 6½ in. HI-FI WOOFER



8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30-12,000 cps. Ideal P.A. Columns, Hi-Fi Enclosures Systems, etc. **£4**

ELAC CONE TWEETER



The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watts. 3 ohm or 15 ohm models. **£1·90** Post 10p.

SPEAKER COVERING MATERIALS. Samples Large S.A.E. Horn Tweeters 2-16kc/s, 10W 8 ohm or 15 ohm £1·60. De Luxe Horn Tweeters 2-18 Kc/s, 15W, 15 ohm £3. TWO-WAY 3000cps CROSSOVERS 3 or 8 or 15 ohm 95p.

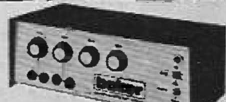
SPECIAL OFFER: 80 ohm 2½in.; 2½in.: 35 ohm, 2in.; 3in 25 ohm, 2½in. dia.; 3in dia.; 6 × 4in.; 8 × 5in. 15 ohm, 3½in. dia.; 6 × 4in.; 7 × 4in.; 3 ohm. 2½in. 3in. 5 × 3in. **£1** EACH TYPE

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8 × 2½in. 90p 8 in. £1·75; 10 × 6in. £1·90.

RICHARD ALLAN TWIN CONE LOUDSPEAKERS. 8in. dia. 4 watt; 10in. dia. 5 watt; 12in. dia. 6 watt 3 or 8 or 15 ohm models £2.00 each. Post 15p.

VALVE OUTPUT TRANS. 25p; MIKE TRANS. 50:1 25p. 5 WATT MULTI-RATIO. 3, 8 and 15 ohms 80p.

BAKER 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER



4 inputs speech and music. Mixing facilities. Response 10-30,000 cps. Matches all loudspeakers. A.C. 200/250V. Separate Treble and Bass controls. Guaranteed. Details S.A.E. **£39** Post Free

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **£4·50**

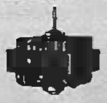
BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. **£3·50** STEREO VERSION OF ABOVE £4·50.

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4inch **£12·50**

BARGAIN FM TUNER as above less cabinet **£8·85**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3·50**

COAXIAL PLUG 6p. PANEL SOCKETS 6p. LINE 18p. OUTLET BOXES, SURFACE OR FLUSH 25p. BALANCED TWIN FEEDERS 5p yd. 80 ohms or 300 ohms. JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS Std. Chrome 15p; 3·5mm Chrome 14p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 25p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS, 5p; CERAMIC 8p; CANS 5p.



E.M.I. TAPE MOTORS Post 15p. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA. Spindle 0·187 × 0·75in. Size 3½ × 2½ × 2½in. (illustrated). **£1·25**

BALFOUR GRAM MOTORS 120v. or 240v. A.C. 1,200 r.p.m. 4 pole 50mA. Spindle ⅛ × 3/20. Size 2½ × 2½. × 1½in. Post 15p **85p**

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AF124	22p	OC28	58p
AF125	19p	OC35	48p
AF126	20p	OC44	12p
AF127	19p	OC45	12p
AF178	67p	OC71	11p
AF179	66p	OC72	12p
AF180	45p	OC75	20p
AF239	32p	OC200	27p
BC107	11p	OC201	38p
BC108	11p	OCP71	42p
BC109	11p	ST140	15p
BC147	12p	ST141	23p
BC148	12p	UT46	35p
BC149	12p	2N696	15p
BC157	15p	2N706A	12p
BC158	14p	2N2926G	14p
BC159	14p	2N2926Y	13p
BD131	75p	2N2926O	12p
BD132	75p	2N3053	25p
BF115	25p	2N3054	60p
BF178	32p	2N3055	72p
BF179	56p	2N3702	15p
BF180	30p	2N3703	14p
BF181	32p	2N3704	15p
BF184	30p	2N3705	14p
BF185	32p	2N3706	14p
BF194	14p	2N3711	14p
BF195	14p	2N3819	35p
BF196	28p	2N4058	17p
BF197	15p	2N5459	60p
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AA119	11p	OA202	10p
OA47	7½p	BY100	15p
OA90	7½p	BY127	22½p
OA91	6p	BYZ12	22½p

ZENER DIODES

From 2 to 33 volts.
400mW, 15p ; 1·5W, 22½p

SILICON BRIDGE RECTIFIERS

40 P.I.V., 1·5A
200 P.I.V., 2·0A

50p

MISCELLANEOUS ITEMS

Mercury Switch, 2 Amp., 25p
B9A valve bases, 2p
5k Ω edge control, fits most small, imported radios, 7p
20 Ω volume control for 3 Ω speakers, 20p
Antex CN240, 15W miniature soldering iron, £1·70
Valve and Transistor Data book, 9th edition, 75p
Transistor equivalent book, BPI, 40p

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For 1¼in. fuses	18p
For 20mm fuses	15p

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Single, less switch, 15p
Single, D.P. switch, 24p
Tandem, less switch, 40p
5k Ω, 10k Ω, 25k Ω, 50k Ω, 100k Ω, 250k Ω, 500k Ω, 1M Ω, 2M Ω

RESISTORS

Carbon
All 5%, high-stability, E12 values.
¼W, 1p, ½W, 1½p; 1W, 4p; 2W, 6p
Wire-wound
5W, 10p ; 10W, 12p

ELECTROLYTICS

1µF	450V	19p	1,000µF	25V	27p
2µF	500V	20p	1,000µF	50V	39p
4µF	350V	14p	2,000µF	25V	36p
8µF	450V	16p	2,000µF	50V	53p
16µF	450V	17p	2,500µF	25V	45p
25µF	50V	8p	2,500µF	50V	60p
32µF	450V	24p	3,000µF	25V	48p
50µF	50V	10p	5,000µF	25V	55p
100µF	25V	10p	5,000µF	50V	98p
100µF	50V	10p	8–8µF	450V	18p
250µF	25V	12p	8–16µF	450V	20p
250µF	50V	17p	16–16µF	450V	27p
500µF	25V	18p	16–32µF	450V	63p
500µF	50V	25p	32–32µF	450V	49p
			50–50µF	350V	38p

MINIATURE ELECTROLYTICS

1µF	25V	10µF	64V
2·5µF	64V	16µF	40V
4µF	40V	25µF	25V
5µF	64V	30µF	15V
8µF	15V	50µF	15V
8µF	40V	100µF	15V
10µF	15V		

7p

VARIABLE POWER SUPPLY

Input : 240V, a.c.
Output : Switched 3, 4·5, 6, 7·5, 9,12 volts d.c. at 500mA **£4·20**

NEW NEW

ILLUSTRATED 1972-73 CATALOGUE

Post Free 15p

VEROBOARD

Size	0·1 matrix	0·15 matrix
2½in × 3¾in	22p	16p
2½in × 5in	24p	25p
3¾in × 3¾in	24p	25p
3¾in × 5in	27p	29p
17in × 2½in	75p	57p
17in × 3¾in	£1	75p

Pins—both sizes : packet of 36, 18p

ALUMINIUM BOXES with lids and screws

Type	Length	Width	Depth	Price
GB7*	2¾in	5¼in	1½in	38p
GB8*	4in	4in	1½in	38p
GB9*	4in	2¾in	1½in	38p
GB10*	4in	5¼in	1½in	44p
GB11	4in	2½in	2in	38p
GB12	3in	2in	1in	33p
GB13	6in	4in	2in	52p
GB14	7in	5in	2½in	63p
GB15	8in	6in	3in	81p
GB16	10in	7in	3in	92p

* These sizes fit standard Veroboards.

CASSETTE OWNERS!

For Philips and similar cassette recorders.
PU12 Power unit for connection to 12V + or − E car electrical systems, giving 7½V, stabilised output. **£3·25**

PP75 Mains power supply, output 7½V. d.c. **£1·95**
Both units are complete with cable and 5 pin D.I.N. plug.

BONDED ACRYLIC FIBRE

B.A.F. wadding, 18in wide, 1in thick. The ideal lining for speaker enclosures. 25p per yard.

LOW-OHM RESISTORS

2½ watt wire-wound.
1Ω, 1·8Ω, 2·7Ω, 3·3Ω, 3·9Ω, 4·7Ω, 5·6Ω, 6·8Ω, 8·2Ω

10p

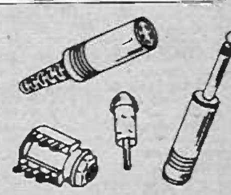
CAPACITORS

2·2pF	500V	S/M	7½p
3·3pF	500V	S/M	7½p
5pF	500V	S/M	7½p
10pF	125V	P.S.	5p
10pF	500V	S/M	7½p
15pF	125V	P.S.	5p
15pF	500V	Cer.	4p
18pF	500V	S/M	7½p
22pF	125V	P.S.	5p
22pF	500V	S/M	7½p
25pF	500V	S/M	7½p
27pF	500V	Cer.	4p
33pF	125V	P.S.	5p
33pF	500V	S/M	7½p
39pF	500V	S/M	7½p
47pF	125V	P.S.	5p
47pF	500V	Cer.	4p
50pF	500V	S/M	7½p
56pF	500V	S/M	7½p
68pF	125V	P.S.	5p
68pF	500V	S/M	7½p
75pF	500V	S/M	7½p
82pF	500V	S/M	7½p
100pF	125V	P.S.	5p
100pF	500V	S/M	7½p
100pF	500V	Cer.	5p
120pF	500V	S/M	7½p
150pF	125V	P.S.	5p
150pF	500V	S/M	7½p
150pF	500V	Cer.	5p
180pF	500V	S/M	7½p
200pF	500V	S/M	7½p
220pF	125V	P.S.	5p
220pF	500V	Cer.	5p
250pF	500V	S/M	8p
270pF	500V	Cer.	5p
300pF	500V	S/M	8p
330pF	125V	P.S.	5p
330pF	500V	S/M	8p
390pF	500V	S/M	8p
470pF	125V	P.S.	5p
470pF	750V	Disc	5p
500pF	500V	S/M	8p
560pF	500V	S/M	8p
680pF	125V	P.S.	6p
680pF	500V	S/M	8p
820pF	500V	S/M	8p
0·001µF	100V	Mylar	3p
0·001µF	125V	P.S.	6p
0·001µF	400V	Poly.	3p
0·001µF	500V	S/M	10p
0·001µF	500V	Cer.	5p
0·001µF	1,000V	MDC	6p
0·0015µF	400V	Poly.	3p
0·0015µF	500V	S/M	10p
0·0015µF	500V	Cer.	5p
0·0018µF	500V	S/M	10p
0·002µF	100V	Mylar	3p
0·002µF	500V	Cer.	5p
0·0022µF	125V	P.S.	6p
0·0022µF	500V	S/M	10p
0·0022µF	1,000V	MDC	6p
0·0027µF	500V	S/M	15p
0·003µF	500V	Cer.	5p
0·0033µF	125V	P.S.	6p
0·0033µF	500V	Poly.	6p
0·0033µF	1,000V	MDC	6p
0·0036µF	500V	S/M	15p
0·0047µF	125V	P.S.	9p
0·0047µF	500V	Poly.	6p
0·0047µF	500V	S/M	20p
0·0047µF	1,000V	MDC	6p
0·005µF	100V	Mylar	3p
0·005µF	500V	Cer.	5p
0·0068µF	125V	P.S.	10½p
0·0068µF	500V	S/M	30p
0·0068µF	500V	Poly.	6p
0·0082µF	125V	P.S.	10½p
0·0082µF	500V	S/M	30p
0·01µF	18V	Disc	4p
0·01µF	125V	P.S.	10½p
0·01µF	160V	Poly.	4p
0·01µF	250V	M.F.	3p
0·01µF	400V	Poly.	3p
0·01µF	500V	Cer.	5p
0·01µF	500V	S/M	30p
0·01µF	600V	MDC	7p
0·01µF	1,000V	MDC	9p
0·015µF	160V	Poly.	3p
0·015µF	400V	Poly.	3p
0·02µF	100V	Mylar	3p
0·022µF	18V	Disc	5p
0·022µF	250V	M.F.	3p
0·022µF	400V	Poly.	3p
0·022µF	600V	MDC	7½p
0·022µF	1,000V	MDC	9p
0·033µF	250V	M.F.	4p
0·033µF	400V	Poly.	4p
0·047µF	12V	Disc	6p
0·047µF	160V	Poly.	3p
0·047µF	250V	M.F.	3p
0·047µF	400V	Poly.	4p
0·047µF	600V	MDC	8p
0·047µF	1,000V	MDC	10p
0·1µF	30V	Disc	6p
0·1µF	250V	M.F.	4p
0·1µF	400V	Poly.	5p
0·1µF	600V	MDC	10p
0·1µF	1,000V	MDC	13p
0·15µF	250V	M.F.	5p
0·22µF	160V	Poly.	6p
0·22µF	250V	M.F.	5p
0·22µF	400V	Foil	10p
0·22µF	1,000V	MDC	15p
0·33µF	250V	M.F.	8p
0·47µF	250V	Foil	8p
0·47µF	400V	Foil	15p
0·47µF	1,000V	MDC	20p
1·0µF	250V	M.F.	15p

Note :
S/M = silver mica 1% tol.
P.S. = polystyrene 2½% tol.
MDC—a.c. rating—300V.
M.F. = Mullard min. foil.
Cer. = ceramic.

PLUGS

Car aerial	14p
Co-axial	8p
D.I.N. 2 pin (speaker)	10p
D.I.N. 3 pin	13p
D.I.N. 4 pin	14p
D.I.N. 5 pin, 180°	13p
D.I.N. 5 pin, 240°	15p
D.I.N. 6 pin	15p
Jack, 2½mm unscreened	9p
Jack, 2½mm screened	10p
Jack, 3½mm unscreened	8p
Jack, 3½mm screened	12p
Jack, ¼in unscreened	12p
Jack, ¼in screened	20p
Jack, stereo, unscreened	20p
Jack, stereo, screened	35p
Phono, plastic top	5p
Phono, plated metal	12p
Phono, fitted 4ft lead	8p
Wander, red or black	3p
Banana 4mm, red or black	6p



LINE SOCKETS

Car aerial	14p
Co-axial	17p
D.I.N. 2 pin (speaker)	15p
D.I.N. 3 pin	16p
D.I.N. 5 pin, 180°	16p
D.I.N. 5 pin, 240°	16p
Jack, 3½mm	15p
Jack, ¼in screened	49p
Jack, stereo, screened	30p
Phono, plated metal	14p

SOCKETS

Car aerial	8p
Co-axial, surface	8p
Co-axial, flush	9p
D.I.N. 2 pin (speaker)	10p
D.I.N. 3 pin	9p
D.I.N. 5 pin, 180°	9p
D.I.N. 5 pin, 240°	9p
Jack, 2½mm	10p
Jack, 3½mm	10p
Jack, ¼in unswitched	15p
Jack, ¼in switched	17p
Jack, stereo, switched	24p
Phono, single	5p
Phono, 2 on a strip	7p
Phono, 3 on a strip	9p
Phono, 4 on a strip	10p
Wander, single, red or black	5p
Wander, twin strip	7p
[illegible] black	6p

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Garrard SL72B	£23·50
Garrard SL75B	£25·50
Garrard SL95B	£34·25
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Thorens TD150A Mk. II	£33·25

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Armstrong 521 (teak cased)	£43·90
Alpha Highgate 212	£25·00
Alpha Highgate FA300	£27·95
Alpha Highgate FA400	£31·95
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Metrosound ST60	£45·95
Pioneer SA600	£58·00
Pioneer SA700	£66·50
Pioneer SA800	£73·95
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Rogers R/brook (Chassis)	£35.00
Rogers R/brook (Cased)	£37.00
Rogers R/bourne (Chassis)	£41.95
Rogers R/bourne (Cased)	£47.50
Sinclair PRO60 2 x Z30/PZ5	£14·95
Sinclair PRO60 2 x Z30/PZ6	£17·00
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Sinclair AFU (Filter Unit)	£4·40
Sinclair 605	£18·50
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Teleton SAQ206B	£20·50
Teleton SAQ306B	£22·50
Europhon 10 + 10	£16·95

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Please add 75p P. & P.

Armstrong 253	£39·50
Armstrong 524	£30·95
Rogers Ravensbrook FET4 (Chassis)	£31·00
Rogers Ravensbrook FET4 (Cased)	£35·00
Rogers Ravenbourne FET4 (Chassis)	£43·00
Rogers Ravensbourne FET4 (Cased)	£48·00
Sinclair PRO60 (Module)	£17·95
Sinclair 2000/3000 Tuner	£32·75
Philips RH690	£33·00
Leak Delta FM (Cased)	£54·75
Leak Delta AM/FM (Cased)	£64·50

TUNER/AMPLIFIERS

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Alpha Highgate 150	£44·25
Armstrong 525 (Teak cased)	£67·95
Armstrong 526 AM/FM (Teak cased)	£77·75
Leak Delta 75	£127·95
Philips RH781	£50·00
Philips RH702	£82·50
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Rogers R/brook (Chassis)	£72.75

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Please add £1·25 P. & P. per pair

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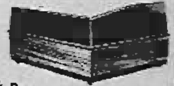

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Shure M44E	£5·70
Shure M55E	£5·85
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AC 142	16p	BC 149	10p	ME 6102	15p	OC 28	30p	1N 4003	6p
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AC 142K	20p	BC 183L	8p	MP 8112	34p	OC 35	28p	1N 4005	11p
AD 142	39p	BC 184L	8p	MP 8511	34p	OC 36	36p	1N 4006	12p
AD 149	40p	BC 212L	8p	MP 8513	45p	2N 697	18p	1N 4007	13p
AD 150	44p	BC 213L	8p	OC 41	13p	2N 1171	24p	W005	30p
AD 140	40p	BC 214L	8p	OC 44	13p	2N 1304	25p	W02	35p
AD 161 }	m/p	BD 121	50p	OC 45	13p	2N 1305	25p	OA 90	6p
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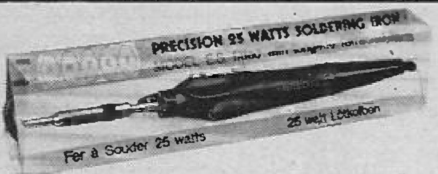

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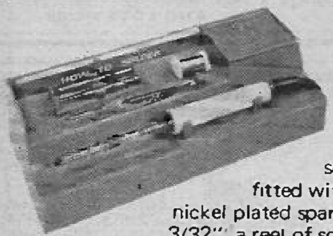

SK.1 SOLDERING KIT

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

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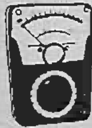

MODEL CT-620 MULTITESTER
RANGES—DC Voltages: 0, 5, 25, 100, 500/1,000V (20,000 ohms/V). AC Voltages: 0, 5, 25, 100, 500, 1,000V (10,000 ohms/V). DC Current: 0, 50μA, 0, 5, 50, 500mA. Resistance: 0, 6k, 600k, 6M, 60M ohms. Decibels: —20 db to +62 db in 5 ranges. £5·62. P. & P. 25p.

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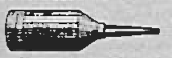

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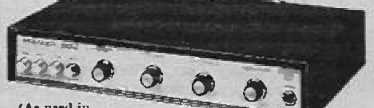

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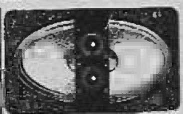

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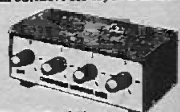

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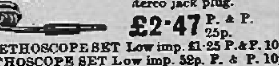

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100v	0·33 μF	9p	25v	10μF	7p
100v	0·47 μF	10p	25v	100 μF	9p
100v	0·68 μF	15p	25v	220 μF	11p
250v	0·01 μF	5p	25v	170 μF	14p
250v	0·015 μF	5p	25v	1000 μF	22p
250v	0·022 μF	5p	25v	2200 μF	42p
250v	0·033 μF	6p	35v	4·7 μF	7p
250v	0·047 μF	6p	35v	220 μF	14p
250v	0·068 μF	6p	100v	10 μF	8p
250v	0·1 μF	6p	100v	22 μF	9p
			100v	47 μF	14p

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BC107	9p	8p	NKT214	19p	17p	1N4006	12p	11p
BC108	8p	7p	NKT218	24p	19p	1N4007	18p	16p
BC109	9p	8p	NKT219	24p	19p	1N4148	4p	3p
BC147	8p	7p	NKT223	26p	20p	2N1302	16p	15p
BC148	8p	7p	NKT224	21p	19p	2N1304	21p	20p
BC149	8p	7p	NKT242	14p	12p	2N1613	14p	13p
BCY70	14p	13p	NKT243	51p	44p	2N1711	15p	14p
BCY71	20p	19p	NKT401	70p	56p	2N2904	29p	28p
BCY72	14p	12p	NKT402	75p	59p	2N2905	24p	22p
BDY20	91p	73p	NKT403	64p	50p	2N2906	19p	18p
BFX29	24p	23p	NKT453	41p	33p	2N2907	22p	21p
BFX30	24p	23p	OA47	6p	5p	2N3053	17p	16p
BFY50	19p	18p	OA79	6p	5p	2N3054	49p	47p
BFY51	18p	17p	OA90	5p	4p	2N3055	57p	52p
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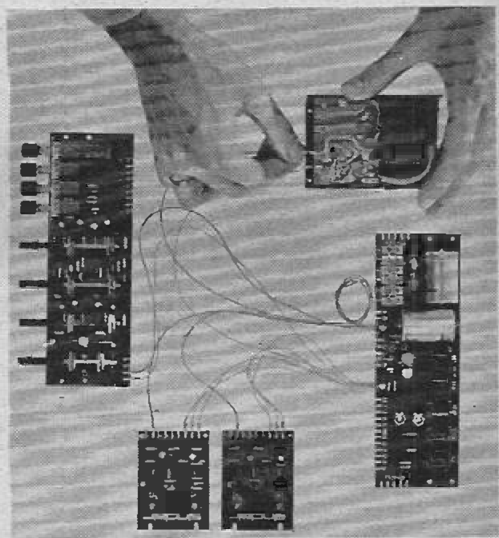
Project 605 the new simple way to assemble Sinclair high fidelity modules



For several years now you have been able to assemble your own high fidelity system to world beating standards using Sinclair modules. We have progressively improved these technically but hitherto the method of assembly at your end has remained the same – there has been no alternative to a soldering iron. Now for those who prefer not to solder, there is an alternative – Project 605.

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sinclair

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Specifications

Output – 30 watts music power (10 watts per channel R.M.S. into 3 Ω).
Inputs – Mag. P.U. – 3mV correct to R.I.A.A. curve 20–25,000 Hz ± 1dB. Ceramic pick-up – 50mV. Radio – 50 to 150mV. Aux. adjustable between 3mV. and 3V.
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Project 605 comprises Stereo 60 pre-amp/control unit, two Z-30 power amplifiers, PZ-5 power supply unit, the unique new Masterlink, leads and instructions manual complete in one pack. Post free

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PROJECTS....
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GETTING FAMILIAR

It is our aim to dispel the mystique of electronics.

One of the very first steps the beginner must take is to become fully acquainted with the symbols used in circuit diagrams. He must also familiarise himself as soon as possible with the more commonly used components—their general physical form and any peculiar or distinguishing features.

We make this point deliberately, knowing that numerous people are now becoming attracted to electronics for the first time. It is probable that the majority of such new recruits will not previously have handled or even seen at close quarters a resistor, capacitor, or transistor—the very stuff electronics is made of. To ease the task of familiarisation we have planned a *Guide to Circuit Symbols* and the first part appears this month.

SYMBOLIC AND REAL

In this guide, the symbol is shown with an outline drawing of a typical component of that class, so aiding rapid identification of the actual part. Included against each symbol is its Circuit Reference. This provides a link between the theoretical circuit diagram and the practical component layout and wiring diagrams which are included in all our constructional articles. Also, this reference is a convenient "shorthand" label for use in the accompanying text and, of course, in the components list.

NO MALE MONOPOLY

Our slogan is electronics . . . *for everyone.*

Electronics is not entirely a man's world. As we had suspected, this hobby has its keen followers amongst members of the fair sex. This month we are pleased to include letters from two lady enthusiasts who responded to our appeal a couple of months ago. By this token there must be a number of other electronic Eves who are reluctant or too shy to reveal themselves.

To exploit electronics in and around the home —for everyone's benefit—we look particularly to the womenfolk to suggest some new applications. The man of the house may believe he knows all the answers, but the housewife must often encounter situations that her mate is oblivious of. Some of these give rise to problems or needs that could perhaps be solved or satisfied by some simple electronic gadget.

HOUSEWIFE'S CHOICE

So think about it all you lady readers, and let us have your suggestions. All will be carefully investigated and those capable of being carried out efficiently and effectively by relatively simple electronics will, it is hoped, be presented in due course as constructional projects in this magazine.

Fred Bennett

Our July issue will be published on Friday, June 16

EDITOR F. E. BENNETT • M. KENWARD • B. W. TERRELL B.Sc.
ART EDITOR J. D. POUNTNEY • P. A. LOATES • S. W. R. LLOYD
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..EASY TO CONSTRUCT
..SIMPLY EXPLAINED

VOL. I NO. 8 JUNE 1972

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Sorry-but no back numbers

The publishers regret to advise readers that copies of past issues are no longer available. Nor will they be able to supply back-numbers in the future.

Sorry about this—but to avoid possible disappointment we can only urge our readers to place a regular order with their normal supplier; or alternatively to take out an annual subscription (for details see foot of facing page).

EVEN though you may be a beginner you are sure to need an instrument to measure voltages. Sometimes the most simple circuit will not work first time—this is usually caused by a wiring error. A few quick checks on voltage levels frequently solves the problem; even if it was simply that the battery was flat!

The instrument to be described can be made by the absolute beginner and is capable of measuring most of the usual levels one is likely to encounter. You can make several versions of the meter depending on the quality you want and the amount you can afford.

This article will detail construction of the cheapest version but it is straightforward to follow the data given and make a better quality version. Variables are: (a) size of meter (b) sensitivity—ohms per volt (c) accuracy of reading to be expected.

Those who want to make the meter for odd jobs about the house or on the car are advised to make the cheap version but those who really want to use the instrument to measure "electronic" levels should preferably go for the higher sensitivity and best accuracy.

RANGES

Construction has been kept as simple as possible—using sockets to select ranges instead

Components....

Resistors

R1	10kΩ
R2	10kΩ
R3	100kΩ
R4	100kΩ
R5	1MΩ
R6	47kΩ
R7	470kΩ
R8	2·2kΩ

All ± 1% or 2% ¼W high stability. See Table 1 for alternative sensitivity values.

SEE SHOP TALK

Variable Resistor

VR1 2kΩ or 2·5kΩ linear carbon or wirewound

Diodes

D1 IN 4006
D2 IN 4001

Meter

500μA f.s.d. moving coil meter SEW type MR52P. See Table 1 for alternative types.

Miscellaneous

B1 1·5V HP7 battery and holder (Eagle type —see text)
SKI-SK9 Wander plug sockets 9 off (colours as required).
Battery connector, suitable metal or plastic case—see text. Wander plugs, wire and test probes for test leads (one black, one red set of each). 22 s.w.g. tinned copper wire for connections.

Simple Multimeter

By Mike Hughes

A basic design for beginners and constructors

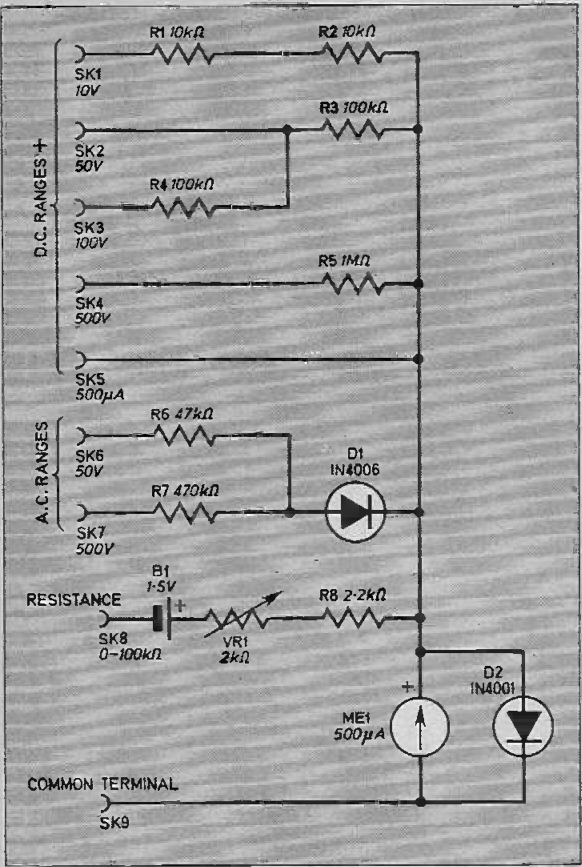
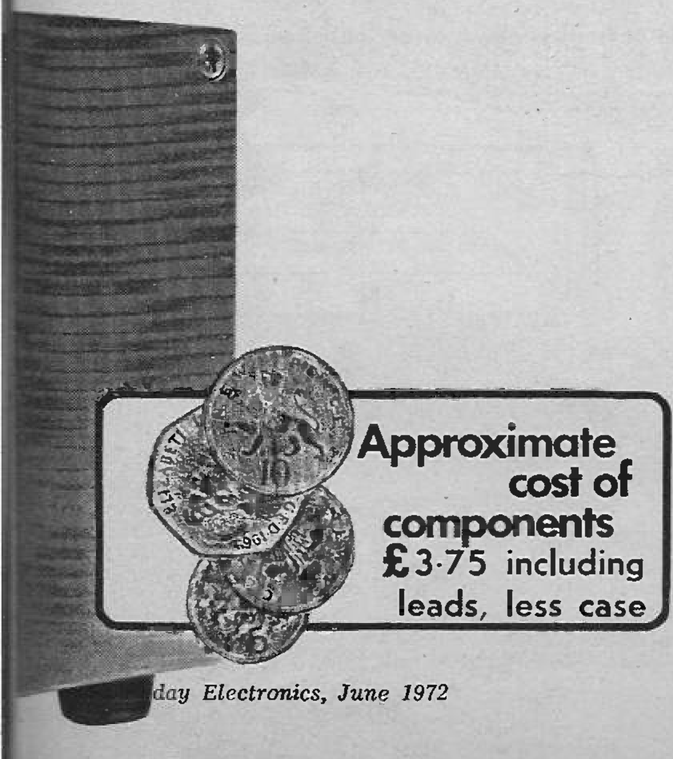


Fig. 1. Circuit diagram of the complete multimeter using the 500μA meter movement. For the more sensitive design Table 1 gives alternative resistor values.



of the usual switch; this is at the expense of more ranges and the ability to measure currents —other than that given by the basic meter movement. Ranges are; d.c. volts 10V, 50V, 100V, 500V; a.c. volts 50V, 500V; d.c. current—basic meter movement (500μA or 50μA); resistance 0-100 kilohms. Sensitivity of the cheaper unit is 2,000 ohms per volt and the better quality version 20,000 ohms per volt.

The values of components shown in Fig. 1 are for the cheaper unit; see Table 1 for alternative values for higher sensitivity. For either unit it is not possible to obtain a preferred value resistor for the 10V and 100V ranges so use is made of two resistors in series to make up the correct value. One of the series resistors for the 100V range (R5) is used to provide a 50V input.

The a.c. ranges use a single diode giving half wave rectification—this is not conventional but helps simplify construction. You should not expect absolute accuracy when measuring a.c. because the meter will be measuring an approximate root mean square value the precise display of which will depend to some extent on the mechanics of the movement itself; nevertheless it is sufficiently accurate for checking the approximate level of mains voltage and transformer output voltage.

Resistors R1 to R5 are series connected for d.c. voltage ranges, R6 and R7 likewise for a.c. Full scale deflection for zero ohms is effected by R8 and VR1. Diode D2 is a silicon device and prevents the potential difference across the meter exceeding 600mV hence affording some degree of protection.

ACCURACY

Ultimate accuracy depends on the tolerances of resistors selected. For those requiring the best make sure that 1 per cent tolerance devices are used. To cut costs you can use 2 per cent, 5 per cent or even 10 per cent resistors, but remember the reading will only be as accurate as the resistors used.

The size of the meter movement will have an indirect bearing on the accuracy—the larger the meter the easier it is to read. The actual physical size used will not change the values of any of the components. The approximate cost of components given for the meter is based on the cheapest design using ±2 per cent resistors.

Remember that the diode you use for D1 must be capable of withstanding the peak reverse voltage of the supply you are measuring (for 500 volts r.m.s. (root mean square) this would be 750V). The prototype uses an 800V device for both a.c. ranges—a 1N4006.

CONSTRUCTION

The prototype meter is housed in a commercial case measuring $6\frac{1}{2}$ x 4 x 4 inches. The smallest case size would be approximately $6\frac{1}{2}$ x 4 x 2 inches, and if a larger size meter is used

Simple Multimeter

Photograph showing front panel designations.

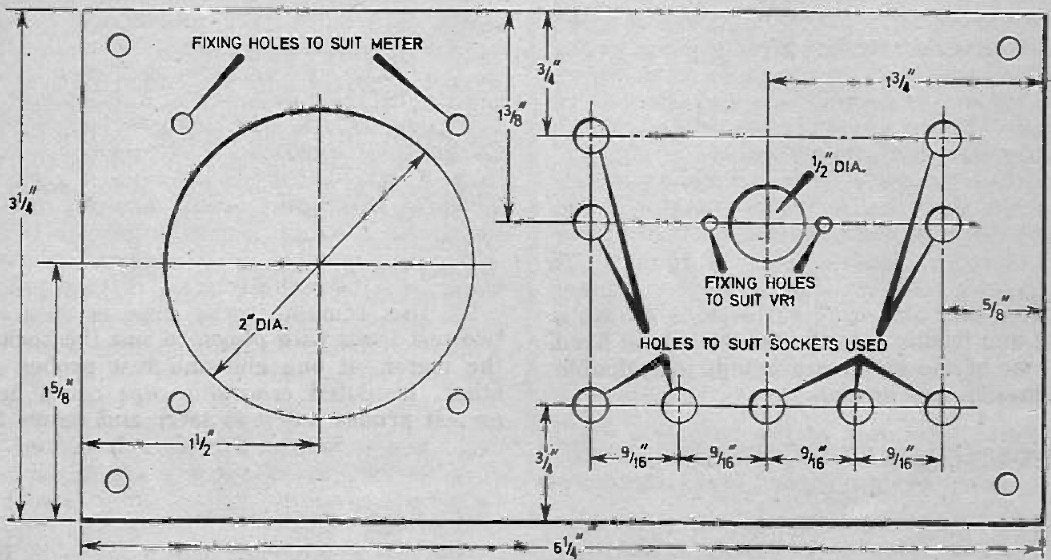


Fig. 2. Layout and drilling details of the Multimeter front panel. A larger panel would be required for larger type meters.

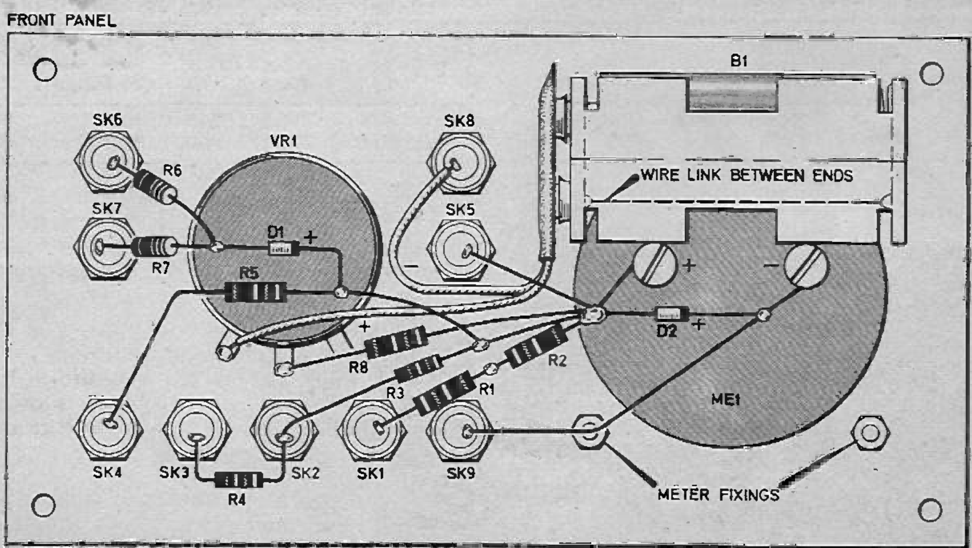


Fig. 3. Layout and wiring of the complete Multimeter. Note the wire link on the battery holder.

this case size would need to be increased. The case can be any suitable plastic or metal type. Construction enables all the wiring to be supported on the front panel, the drilling details for this panel are shown in Fig. 2. Very few flying leads are used as the resistor leads are—on the whole— long enough to go from point to point, see Fig. 3.

The wires may be sleeved if required but this is not essential as the wiring is fairly robust and provided care is taken during assembly to keep a sensible distance between wires there should be no problem with short circuits. When connecting D1 in series with the respective resistors cut the lead of each to about half an inch, lay these leads side by side giving an overlap and quickly solder them together then solder the other ends of the resistors to their respective sockets keeping them as close to the sockets as possible. The sockets can be of different colours to provide easy identification of the ranges. The front cover illustration shows the colours used in the prototype.

Alternative makes of moving-coil meter can be used but the drilling layout may vary. The 1·5V pen torch cell is held in a plastic battery holder. As only one cell is used, the connections for the second cell (in this particular holder) are shorted out. Mounting batteries is always a problem and in this case the holder can be fixed to the rear of the meter movement with double sided adhesive tape or glue.

CALIBRATION

Calibration is quite straightforward. There is no need to have a standard instrument or standard cell provided you are confident in the meter movement purchased and that all the resistors were bought new.

If one of the specified movements is used carefully remove the front cover and by undoing the two small screws remove the dial. Take a wooden cocktail stick; moisten one end and "fluff" it up into a stiff brush then using this brush with a small amount of household abrasive powder and water you can work on the silk screened lettering until it is removed.

Remove all numbers and lettering but leave the scale untouched. Using a compass you can draw in the extra concentric arcs for the different scales and then mark in the designations and calibrations as shown in the photograph opposite. Use Letraset for the printing; colour can be added with water colour or felt tip pens if required.

The resistance scale is calibrated at a few points by trial with a few known 1 per cent resistors. Sockets SK8 and SK9 should be shorted together and VR1 adjusted to give a full scale reading before measuring any resistance values.

You can check calibration of the 10V scale using a new multitap 9V battery but remember that a new battery will read slightly high. Provided this scale reads correctly the other scales should automatically do so.

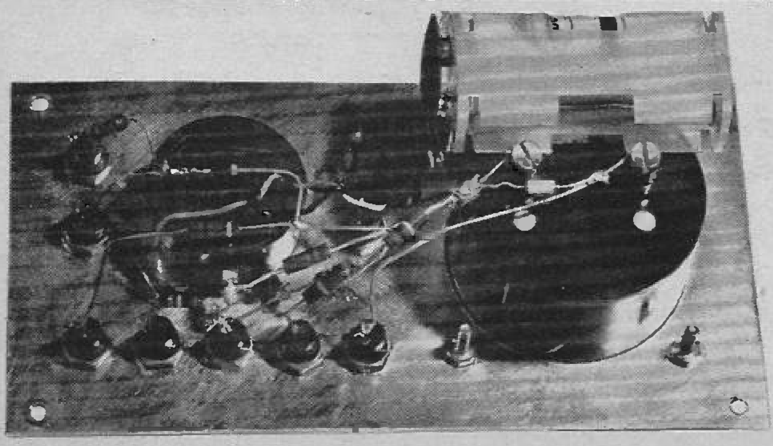
The front panel of the meter can be designated using Letraset as shown in the photographs.

All that remains to be done is to make up two test leads with plugs, to suit the sockets on the meter, at one end and test probes at the other. Insulated crocodile clips could be used as test probes but it is safer and easier to buy some proper insulated probes. Insulated probes of some kind must always be used where high voltages are employed e.g. on mains powered equipment.

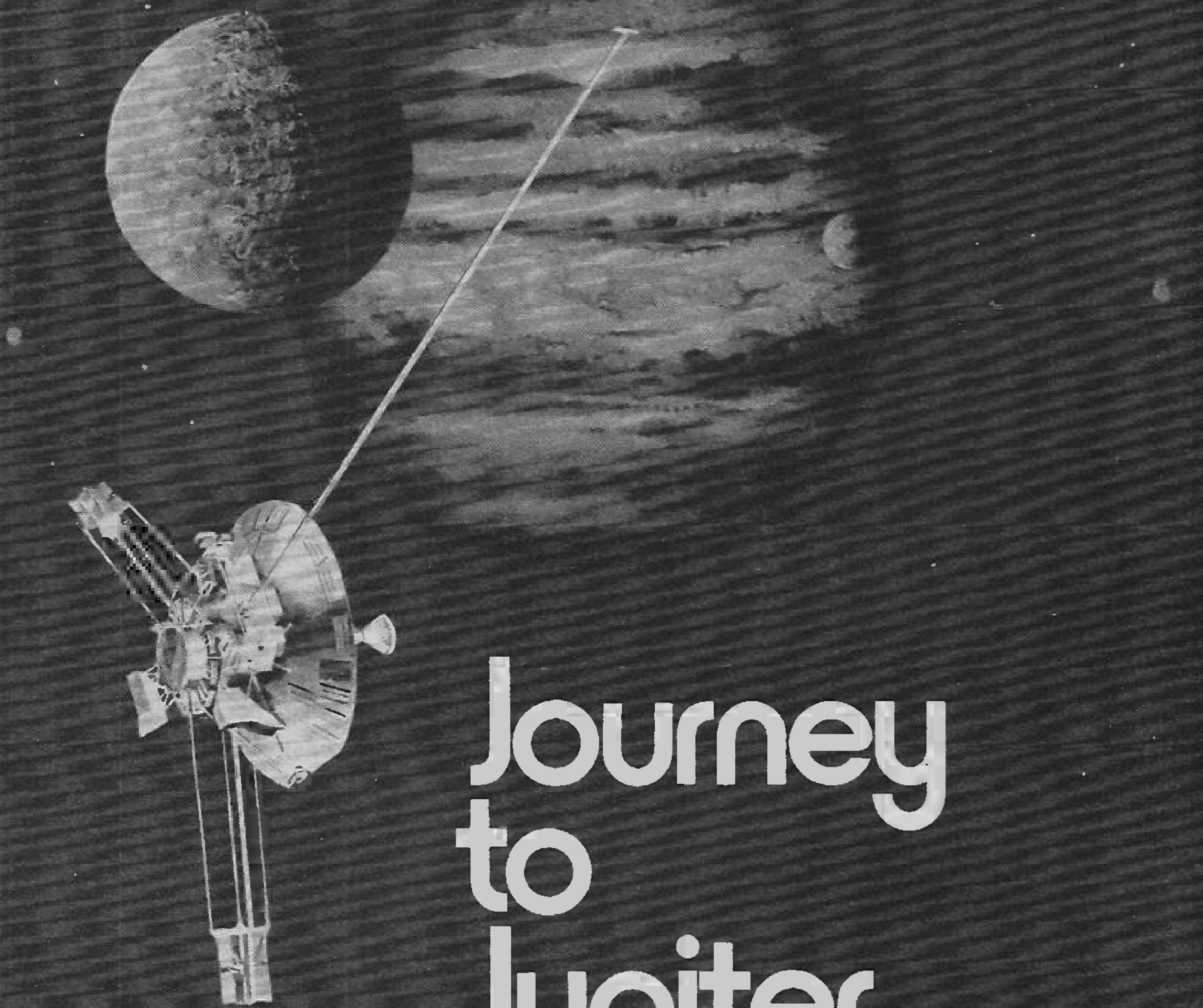
The test leads should be red and black for easy polarity observation—the black lead will always be used in the common socket SK9. ▣

Table 1. RESISTANCE VALUES AND METER TYPES FOR DIFFERENT SENSITIVITIES

										MEI (SEW Meter Type)	
Sensitivity	R1	R2	R3	R4	R5	R6	R7	R8	VR1	MR52P 2$\frac{3}{8}$"	MR65P 3$\frac{3}{8}$"
2,000Ω/V	10kΩ	10kΩ	100kΩ	100kΩ	1MΩ	47kΩ	470kΩ	2·2kΩ	2kΩ	500μA	500μA
20,000Ω/V	100kΩ	100kΩ	1MΩ	1MΩ	10MΩ	470kΩ	4·7MΩ	22kΩ	20kΩ	50μA	50μA



Photograph of the complete multimeter showing the construction.



Journey to Jupiter

by David Stefan

After 15 years of space exploration, the world has just embarked on its first-ever venture to the outer reaches of the solar system. America's unmanned research spacecraft, Pioneer 10, which was launched from Cape Kennedy on March 3, is now settling down to a 620 million mile journey to the giant planet Jupiter.

The voyage will last for nearly two years and is expected to set a number of new records, particularly in the field of space communications. There will be hazards too; to accomplish its main task of providing scientists with the first close-up look at Jupiter, Pioneer 10 has to penetrate the 150 million-mile-wide asteroid belt beyond the orbit of Mars, where 50,000 bodies more than a mile in diameter, as well as countless bits of space rock, circle the sun.

If it manages to avoid all these obstacles it will spend four days collecting information as it flies past Jupiter at a distance of 100,000 miles. But that will not be the end of this ambitious mission. Providing all systems are still "go", Pioneer 10 will continue to speed away from earth, eventually becoming the first spacecraft to escape completely from the solar system.

COMMUNICATIONS

The success of the Pioneer mission will hinge on the craft's ability to transmit its data back to earth. Jupiter is so far away that radio messages moving at the speed of light will take 45 minutes in each direction and this fact alone will demand planned command operations. Pioneer has been designed so that it can store five commands, but as it nears its target it will be controlled by frequent instructions from earth.

The spacecraft's communications system, incorporating the "travelling wave-tube" amplifier, transmits with an 8-watt signal to the 210 ft. dish antennas of NASA's deep space network. But because of the distance involved, these great aerials will be strained to the limit to pick up the weakened signals. To give an example in layman's terms, the signal from Pioneer 10, by the time it reaches the antennas, will have the power of only one trillionth of a watt. If this amount of energy was collected for 19 million years, it would just be enough to light a $7\frac{1}{2}$-watt Christmas tree bulb for one-thousandth of a second.

In practical terms it means that whereas Mariner 9, now concluding its remarkable picture-taking mission from Martian orbit, can send back 16,000 "bits" of information on its four experiments, Pioneer can transmit only 1,000 per second on its 11 experiments.

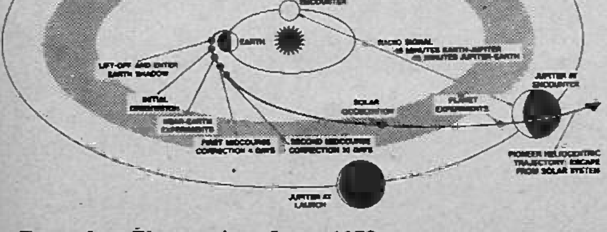
RADIO NOISE

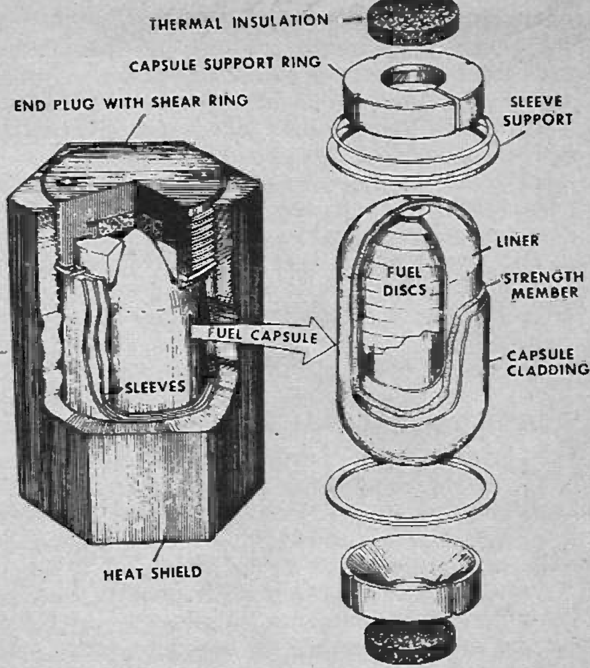
Another possible difficulty is that Jupiter itself is the centre of intense electrical activity. From time to time it emits huge surges of radio noise. Its magnetic field appears to be similar in shape to earth's, but far stronger, and its radiation belts are estimated to be a million times more intense.

All this adds up to forces which could seriously interfere with the spacecraft's electronics, but project officials are confident that Pioneer will come through with flying colours. They have gone as far as to say that the probe may remain in radio contact for seven years, when it will be one and a half thousand million miles from earth. The radio signals from Pioneer 10 cannot be received once the spacecraft has passed this distance.

On board Pioneer 10, communications and control are served by three antennas—a 9ft. dish which will be locked on earth like a big eye throughout the mission, a forward-facing medium-gain horn, and a single-spiral, low-gain antenna, mounted at the rear.

The flight path of Pioneer 10 from earth to Jupiter.





Cutaway view of the plutonium 238 fuel capsule of the SNAP 19 radioisotope thermoelectric generator (atomic battery). Four of these Atomic Energy Commission-developed generators provide a total of 120 watts of electrical power in the Pioneer 10.

SELF-REPAIRING COMPUTER

The spacecraft will be guided on its long journey by a computer that realises when it makes a mistake and can fix itself if it needs repairing. This is a STAR (self-test and repair) computer. In operation, if it finds that it has made a mistake, it turns back and recycles, in order to undo the damage. The STAR computer carries spare parts, and in the event of an equipment failure is capable of patching itself up.

Another feature of Pioneer 10 is a thermonuclear generator which provides power for its instruments. This device converts heat from plutonium fuel directly into electricity with no mechanical processes in between. It is part of the spacecraft's equipment because radiation from the Sun is too weak at Jupiter for an efficient solar-powered system to be used.

Though Pioneer 10 bears scant resemblance to America's earlier probes of the same name, it retains many tested sub-systems of its predecessors, Pioneer 6 to 9. (Incidentally, all four of these craft are still operating in interplanetary space. Pioneer 6 is in its seventh year.)

"CAMERA"

Pioneer 10 is spin-stabilised, so that its instruments have a full-circle scan. This will be especially important to the craft's "camera," a versatile instrument known as an imaging photopolarimeter, which will take images of Jupiter that can be built into photographs of the planet. This camera-like device will use the spin of the spacecraft to scan the planet in narrow strips in both red and blue light. Back on earth investigators will put the elements together to make composite pictures of the planet, taking about one each hour. It may prove possible to superimpose elements taken with the red and blue filters to make colour pictures of Jupiter.

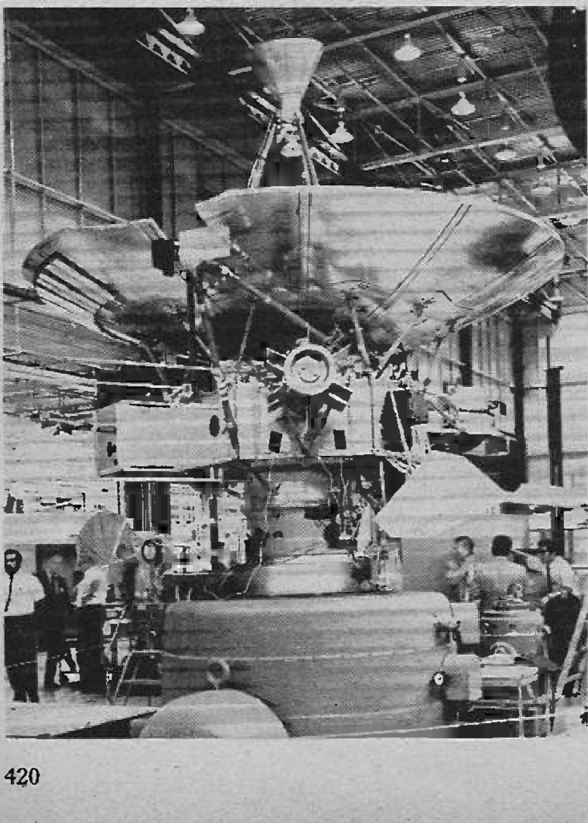
The "camera" will get its first test earlier in the mission when it is used in interplanetary space to measure zodiacal light, and changes in light reflected by the planet which should indicate characteristics of Jupiter's surface.

INSTRUMENT PACKAGE

Pioneer's camera and 10 other instruments make up the most comprehensive scientific payload ever sent towards another planet. But they are relatively light in weight, accounting for only 65lb. of the spacecraft's total weight of 565lb.

The instrument package is designed to conduct 13 different experiments which between them should provide a wealth of new knowledge, not only about Jupiter, but on the outer solar system and the Milky Way galaxy. Specifically they will study and report on the possible hazards of flying through the asteroid belt (a section of the journey that will last for six months); they will make the first report on Jupiter's twilight side, which cannot be seen from earth, and make 20

Test model of the Pioneer 10 mounted on a shake table.



types of measurements to send back data on the planet's atmosphere, radiation belts, heat balance, magnetic fields and moons.

Pioneer 10's instruments will also gather information on the heliosphere, the region of space that is influenced by the Sun. They will look for the boundary where the heliosphere ends and galactic space begins to give scientists a better understanding of the effects of the heliosphere on the earth.

Radio signals figure in one of the spacecraft's two passive experiments. This is Pioneer's S-band occultation research project, in which the analysis of signals cut off as the spacecraft swings behind the planet may provide information on the atmosphere. The other passive experiment involves a study of the craft's trajectory to define more accurately the known position of the planets.

FASTEST EVER

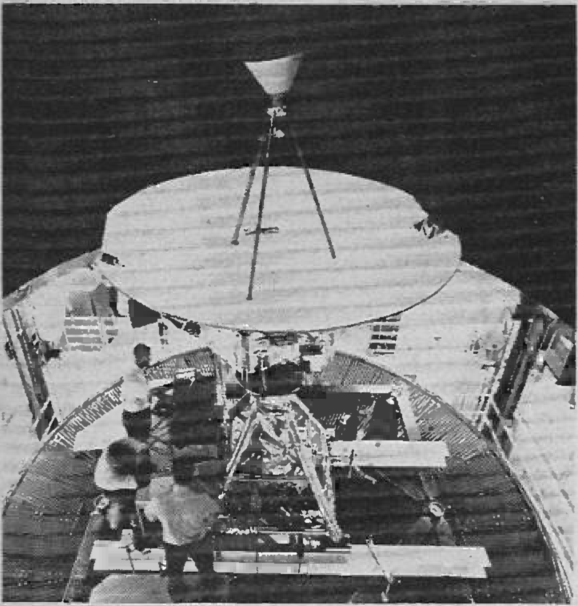
Right at the start of its journey, Pioneer 10 became the fastest-ever spacecraft, when it was accelerated to 32,400 miles an hour to escape the pull of the earth's gravity without first going into orbit. Usually spacecraft first take up a position in orbit round the earth and are then given an extra boost to put them on a trajectory for their target in space.

To give Pioneer 10 the necessary extra power, however, an upper third stage was added to the Atlas-Centaur rocket, which the United States now uses for most of its deep space flights. This was enough to send the compact spacecraft hurtling from the earth's atmosphere at a greater speed than any other craft has flown. Eleven hours after launch Pioneer had intersected the orbit of the Moon, a journey which takes the Apollo astronauts nearly three days. In the first week of its journey it travelled over half a million miles a day.

With most of its propulsion needs taken care of in that initial powerful thrust, little else in the way of fuel was needed on board. Only a few small jets are needed to control the spin rates which stabilise the vehicle and to align the antenna, a task which increases in difficulty as the distance from earth increases.

SPECTACULAR PLANET

Jupiter, the fifth planet from the sun, is among the most spectacular of heavenly bodies. It appears to have its own internal energy source and is so massive that it is almost a small star. It generates more heat than it receives from the distant sun and may have the necessary ingredients to produce life. Its volume is 1,000 times that of earth, and it has more than twice the mass of all the other eight planets combined. Striped in glowing yellow-orange and blue-grey, Jupiter floats in space like a bright-coloured rubber ball. It has a huge red "eye" in its southern



Before launch Pioneer 10 was tested in a simulation chamber which reproduced the conditions of heat, cold, vacuum and radiation expected on the flight to Jupiter and beyond.

hemisphere and spins more than twice as fast as earth.

Jupiter has 12 moons, including three—Ganymede, Io and Callisto—which are larger than the earth's moon. But the planet itself is little understood. Earth-based studies have not yet revealed whether the surface is solid, liquid or gas.

It broadcasts predictably modulated radio signals of enormous power. Though it has only 1/1000th the mass of the Sun, it may have Sun-like internal processes, apparently radiating about four times as much energy as it receives from solar radiation.

The planet's atmosphere is made up of hydrogen with small amounts of ammonia, methane, helium, and probably water—ingredients believed to have produced life on earth about 4,000 million years ago. Because of Jupiter's internal heat source, many scientists believe that large regions below the frigid cloud are around room temperature. These conditions could allow the planet to produce living organisms despite the fact that it receives only 1/27th of the solar energy received by the earth.

Jupiter itself is probably more than 75 per cent hydrogen, the main constituent of the universe. The planet may have no solid surface. Due to its high gravity, it may go from a thick gaseous atmosphere down to oceans of liquid hydrogen, to a slushy layer, and then to a solid hydrogen core. Ideas of how deep beneath its striped cloud layers any solid hydrogen "icebergs" or "continents" might lie, vary by thousands of miles.

Astronomers have long seen violent circulation of the planet's large-scale cloud features. A point on Jupiter's equator moves at 22,000 m.p.h., compared with 1,000 m.p.h. for a similar point on earth's equator.

EYE

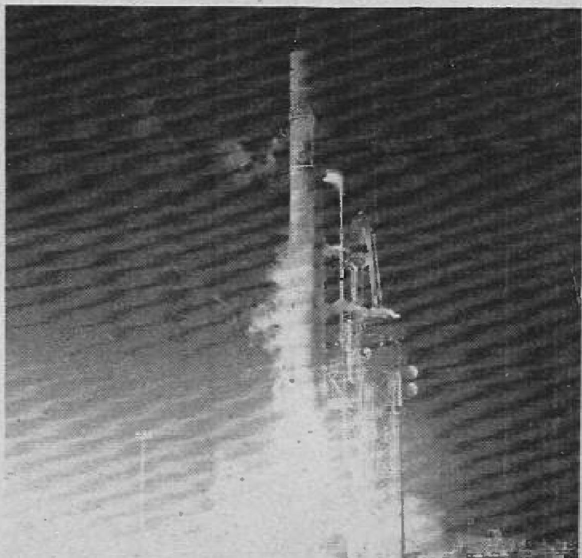
The most bizarre feature of the planet is the Great Red Spot, known as the "Eye of Jupiter." This huge oval is 30,000 miles long and 8,000 miles wide, large enough to swallow up several earths with ease. The Red Spot may be an enormous standing column of gas, or, says one scientist, a "raft" of hydrogen ice floating on a bubble of warm hydrogen in the cooler hydrogen atmosphere, and bobbing up and down at 30-year intervals, so that the Spot disappears and reappears. The Spot appears to rotate at a different speed from the planet. Its red colour may be due to the presence of organic compounds found in a gigantic lightning charge in the Jovian atmosphere, according to one theory.

TWIN SPACECRAFT

Shortly after Pioneer 10 leaves the asteroid belt next April, an identical spacecraft will be launched on a similar mission. These two spacecraft, their scientific instruments, and data processing and analysis, will cost about 100 million dollars.

According to project officials, potential benefits include increased knowledge of what they call the "collisionless plasmas" of the solar wind. This bears directly on the "ultimate" clean system for electric power production, controlled hydrogen fusion. The findings may also lead to better understanding of earth's weather cycles, and to insights into earth's atmosphere. There may also be indications of Jovian resources, such as perhaps a quantity of petrochemicals equivalent to earth's consumption for a million years. ■

Photographs: United States Information Service.



BRIGHT IDEAS

A readers' Bright Idea; any idea that is published will be awarded payment according to its merit. The ideas and designs have not been proved by us.

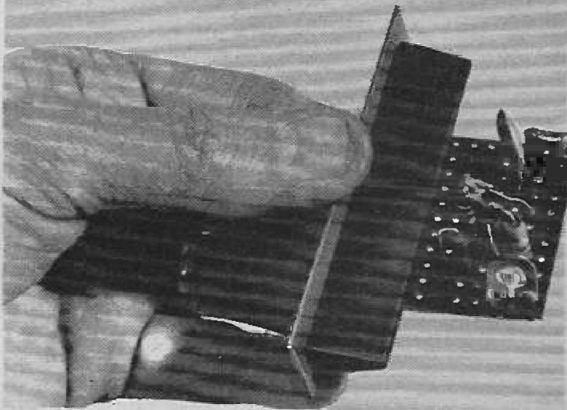
Most electronic projects featured in E.E. pages are made up on strips of Veroboard, which makes a very neat and compact unit in itself but does not seem to have provided any immediate means for attaching to a chassis, box, model or whatever. Bolts are clumsy inconvenient fixtures, edge connectors rather expensive items and often not justified for four or five connections.

Most stationers now sell a plastic "V" shaped strip for holding papers together or the same thing is sold in longer lengths at Ironmongers as saw-guards, in both cases it costs about 4p a foot.

This plastic forms a holder into which Veroboard may be slid and held securely, either vertically or from the side of a chassis or using two strips one on either side, as runners into which completed boards may be slid.

The back of the clip is flat and is of a type of plastic into which self-tapping screws may be successfully driven, so that it is a simple matter to fix the plastic clip to a framework with binders.

G. E. Dunning
Surrey.



Ruminations
By Sensor

Sic transit gloria

REDEVELOPMENT schemes are taking place all around us these days and the glass and concrete structures rising in our towns and cities are, usually, far less interesting than the buildings they replace.

The other day I noticed that yet another row of shops was to be demolished and amongst these was an old style "Cycle and Wireless" shop. I stopped and looked in the window; amongst the bicycle pumps, spanners, spoke keys and oil cans, lay some treasures from the past. There were gramophone sound boxes and clockwork springs, "loudtone" needles and banjo strings, pram hood corners and oil lamp wicks, spade-end terminals and fire lighter bricks.

"Everything must be cleared" declared the painted notice on the window, I had to go in.

Inside the shop, a faint aroma of bicycle oil with admixtures of rubber, paint and leather excited my nostrils. A woman came from the back of the shop and invited me to look around. She explained that the property had been subject of a compulsory purchase order and that she and her husband were, therefore, forced to sell up, much against their wishes.

Condensers

It was clear that the "wireless" side of the business must have started to run down some forty years ago—I found a box of bakelite five pin and four pin valveholders, the baseboard type with screwed terminals. In a glass fronted cabinet, a few variable "condensers" and "h.f. chokes" lay forlornly—overtaken, like the shop itself, by the pace of technology.

What else lay in all those drawers and cupboards? Was there a set of plug-in honeycomb coils, long and medium wave, for h.f., reaction and detector?

I remember finding such a set of coils in a box of my father's old junk; each coil carried a label showing the wavelength range covered when tuned by a 0·0005μF "condenser", and the legend "what are the wild waves saying" was printed across the top of the label.

No doubt, the shop had at one time had a battery charging installation like the one I saw advertised in a church bazaar recipe book, printed about fifty years ago. The advertisement invited customers to "see your accumulators charged in our modern battery charging station". 120 volt h.t. batteries could be bought for 1 shilling per week and the proud possessor of a "wet h.t." i.e. a bank of small accumulators, series connected, could have these recharged at a "very reasonable price".

When domestic electric installations became more common (there are limits to what can be done by gas) the h.t. battery was replaced by an "eliminator" which often had provision for trickle charging the accumulator. It was then but a short step to the "all-mains set" with its indirectly heated cathodes and 4 volt heaters. And now, with transistor radios, we are back to batteries.

LIGHT TO SOUND CONVERTER

By Gerry Brown

An experimental device providing an audio output, the frequency of which depends on the light falling on a light dependent resistor.

THIS Light to Sound Converter is intended as an experimental device and could have many novel applications. If fitted with a simple lens system it could provide an aid for the blind for sensing heights of liquids or changes in contrast or light levels. Alternatively it can be treated purely as a novel exercise in electronics or as a party game device which could be used for detection of objects or people whilst blindfolded.

Since the feature is experimental in its application no specific case design has been given. Suggestions for a case and simple optical accessories are given in the text.

PRINCIPLE OF OPERATION

The circuit of the Light to Sound Converter is shown in Fig. 1. Transistors TR1 and TR2, plus their associated components, form a simple multivibrator the output frequency of which is essentially determined by the values of C1, R2, R3, R4, C2, and PCC1; thus the frequency can be varied by the amount of light falling on the light dependent resistor (l.d r.) PCC1. Basic operation of the circuit can be best understood with PCC1 and R3 shorted-out, such that the junction of R2, R4 is taken to the positive supply rail. Immediately power is applied, one tran-

Approximate cost of components £1.70 inclusive

Components....

Resistors
- R1 2·2kΩ
- R2 4·7kΩ
- R3 22kΩ
- R4 4·7kΩ
- All ¼W ±10% carbon

Capacitors
- C1 0·047μF
- C2 0·047μF

Transistors
- TR1 2N706 silicon *npn*
- TR2 2N706 silicon *npn*

Miscellaneous
- PCC1 ORP12 light dependent resistor
- TL1 Earphone magnetic type 100–250Ω impedance
- B1 4·5V battery
- Veroboard 0·1in. matrix, 3¾in. x 1¼in., connecting wire, plastic or s.r.b.p. tube for light shield—approximately ¾in. diameter by 2½in. long.

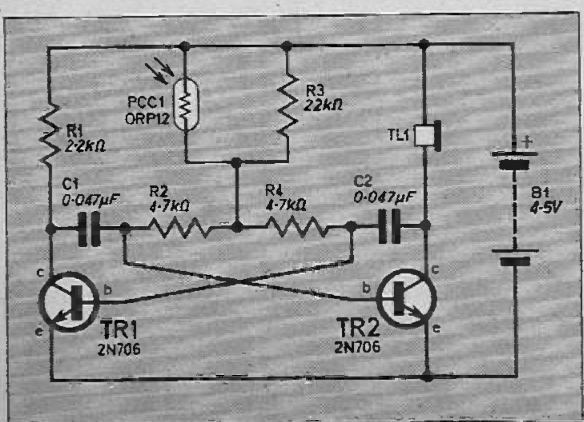
SEE SHOP TALK

sistor, or the other will conduct (in a circuit of this kind the initial process is an effectively random one). Assuming TR1 was the first to conduct, then C1, which would have charged almost simultaneously with application of power to the circuit, will begin to discharge through R2 at a rate equivalent to C1, R2. During this time TR2 will be turned off. When the junction of C1, R2 reaches approximately 0·6 volts, TR2 will conduct and C2, which charged when TR1 began conducting, will begin to discharge through R4. At this time the junction R4,C2 will be negative and hence TR1 will be cut-off, thus C1 will re-charge almost instantaneously via R1. Once the junction R4,C2 reaches 0·6V, TR1 will again conduct and the process repeats. The action of the circuit is somewhat like that of a rapid see-saw, indeed, some of the earlier versions of this circuit were actually referred to as such.

SENSITIVITY

Since with any photo-resistor there will be a light level above which there will be no further drop in its resistance (i.e. saturation) there will naturally be conditions where the aids' value could be questionable. On the other hand, in

Fig. 1. Circuit diagram of the Light to Sound Converter. The frequency of the multivibrator formed by TR1 and TR2 is varied by light falling on PCC1—the light dependent resistor.



totally dark surroundings PCC1 would have an extremely high resistance, so high that oscillator instability could occur resulting in a "chirping" or wavering in pitch. To overcome this disadvantage, R3 is included to provide some parallel limiting resistance; this addition only barely affects the overall sensitivity.

To maintain simplicity of the device, no special amplifier is employed and the earphone, which has the role of a miniature loudspeaker, is driven direct as the collector load of TR2.

CONSTRUCTION

In its prototype form, the converter was constructed on a piece of 0·01 inch Veroboard, as shown in Fig. 2. The transistors should be the final components to be soldered in position (using a heat shunt on each lead), thus preventing damage when fitting other items. Cutting breaks in the copper strips should be performed prior to fitting adjacent parts.

The earpiece TL1 can be mounted in position with impact adhesive, applied to both it and the circuit board. The same method can be used for the l.d.r. hood which will probably be employed initially. This tubular shield can be of any suitable material and should be painted matt black on the inside to prevent unwanted light reflection. Before the device is connected to a battery, it is wise to ensure that all the connections that have been made are correct.

A suitable case for the unit could be constructed from an old torch case with the photocell situated in place of the bulb and the earphone arranged so that the sound emits from a

LIGHT TO SOUND CONVERTER

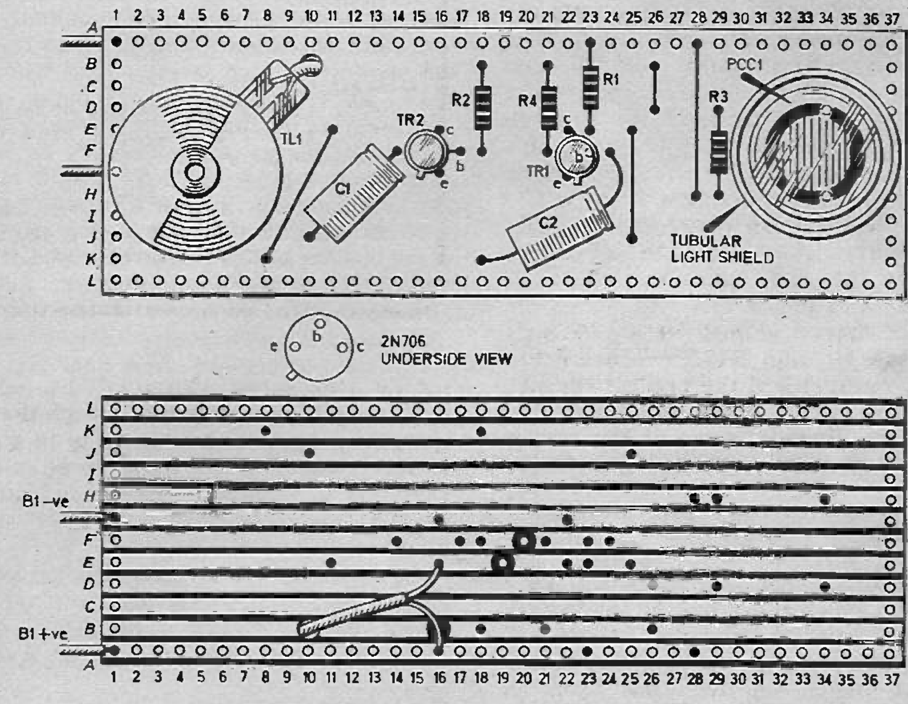


Fig. 2. Layout and wiring of the Veroboard, top and underside, showing the complete Light to Sound Converter less battery.

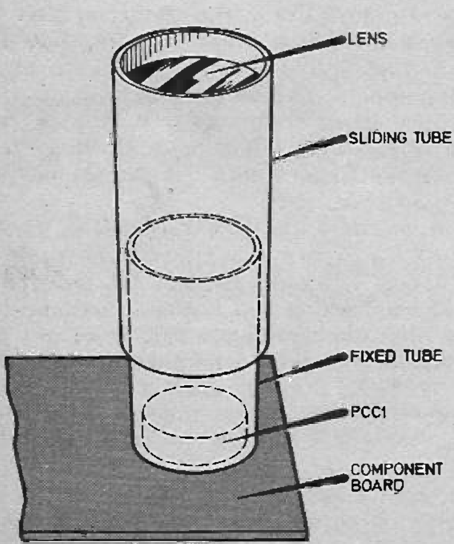
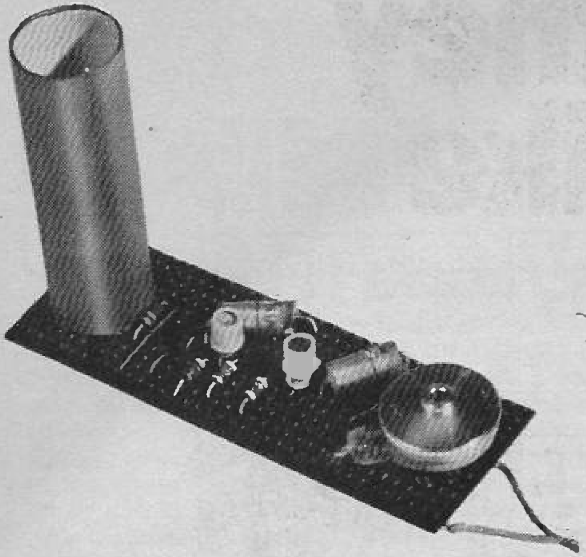


Fig. 3. A simple method of improving the sensitivity of the Light to Sound Converter by adding an optical system. The system shown allows the lens to be focussed by moving the sliding tube.



Photograph showing the prototype unit with a simple light shield.

grille at the other end of the "torch". If such a case is used three 1½ volt pen torch batteries wired in series can be used for the power supply and a small s.p.s.t. switch inserted in the positive lead to turn the unit on and off.

If the unit is to be used experimentally without a case the underside of the Veroboard should be protected in some way to prevent alteration of the output frequency by possible bridging of the copper strips with the hand. A layer of insulation tape covering the strips is suitable for this purpose.

OPTICS

In its prototype form the Light to Sound Converter carries no proper optical accessories and employs just a simple tubular light hood to limit slightly the l.d.r.'s angle of view. This scheme, nonetheless, proves to be extremely satisfactory for most general purposes and permits easy detection of small changes in the level of ambient lighting.

For specific tasks the device ideally requires the use of lenses. Such lenses might be obtained from an optician, one of the London-based optical manufacturers, or even the plastic lenses from an old pair of children's binoculars or a plastic magnifying glass.

Such a lens should be fitted in a sliding tube, as shown in Fig. 3, so that the distance between the lens and the l.d.r. is the image distance of the lens. A simple way of determining the approximate distance required is to focus the sun on a piece of card and measure the distance between the card and the lens; this distance can then be made the minimum distance between the lens and PCC1.

By sliding the lens in and out while pointing the unit at a distance light source a position can be found where the unit is most sensitive. Further experimentation with an optical system is left to the ingenuity of the constructor.

EXPERIMENTAL TEST

Ideally, the aid should be used with reflected light and not "look" at direct sunlight or electric lamps, resulting in saturation of the photo-sensor; this cannot damage the circuit but sensitivity will not be so good in this mode. To check correct operation of the device, place it with the l.d.r. away from a window and slowly wave a sheet of white paper in front, about 6 inches from the light shield. This ought to result in an increase in the pitch of the signal from the earphone, always assuming, of course, that this experiment is performed during daylight hours!

Choice of lenses must naturally be left to the constructor, but he/she may find it interesting to experiment with colour filters and polarising elements. Indeed, if either a dichroic (two-way) mirror or fibre optics can be obtained, they could be employed to permit simultaneous illumination and "viewing" of an object by the photo-sensor.

Whatever the ultimate sophistication of the aid, one is likely to achieve some degree of satisfaction from knowing that at least its primary application could be in helping others less fortunate than ourselves. In a world like ours this, surely, cannot be a bad thing! ▣

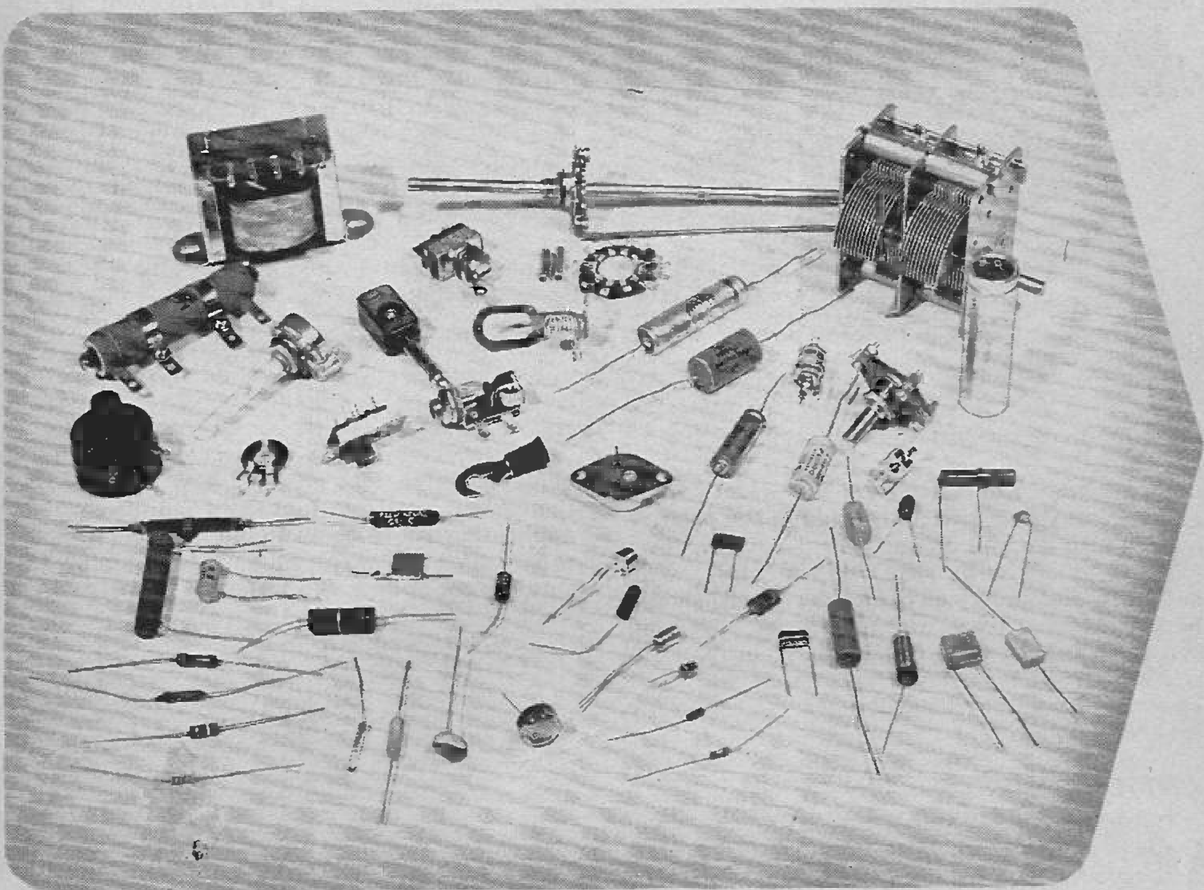
PLEASE
TAKE NOTE

We regret that the coil winding details of the Metal Locator, published last month, were omitted. The coil consists of 40 turns of 26 s.w.g. enamelled or cotton covered copper wire.

We apologise to readers and to Mr. Bollen for this omission.

In the Constructors Companion booklet given free with last months issue, the NKT 125 should not have been given as a substitute to the 2N 1091 on page 20.

what they look like



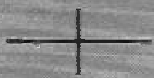
The first part of a series showing the various signs and designations used in electronics, explaining briefly what they represent and showing typical components.

The photograph above shows a range of components. **Top left:** transformer, various switches, connectors, lamp holder, reed relay and a reed switch and magnet. **Lower left:** range of resistors including a mains dropper, normal and preset potentiometers. **Lower centre:** thermistor, voltage dependent resistors, light dependent resistor, some transistors and two diodes. **Right:** selection of capacitors including variable and preset types.

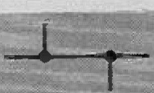
guide to circuit symbols

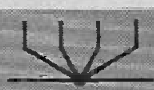
guide to circuit

Circuit Wiring

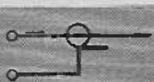

Two conductors crossing on a circuit diagram—no connection.

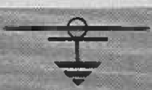

Junction or connection of two conductors on a circuit diagram.


Junction or connection of three adjacent connectors on a circuit diagram.


Common junction or connection of four conductors on a circuit diagram to a common point.

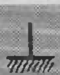

1
Continuous coaxial line.


Coaxial line split at one end into two terminals.

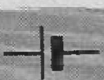

Earthed outer conductor of coaxial line.


Boundary line around part of a circuit diagram.

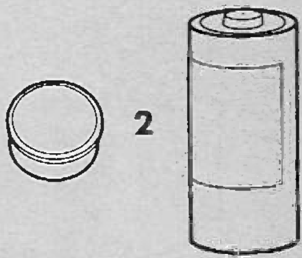

E
Earth connection.


CH
Connection to frame, chassis or case, not necessarily earthed.

Batteries


B
2
Primary or secondary cell. Long line represents positive terminal.


B
3
Battery of primary or secondary cells marked with voltage. Long line represents positive terminal.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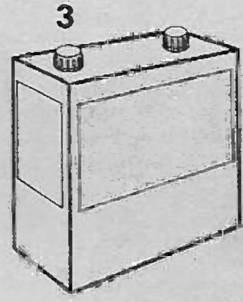
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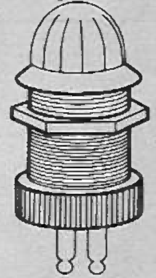
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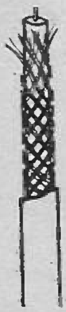
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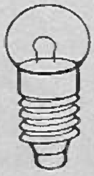
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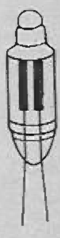
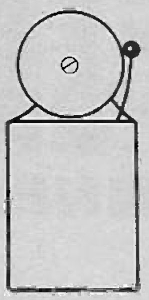

5

symbols . . . part 1



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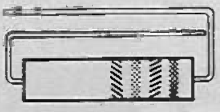

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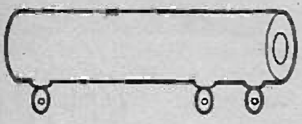

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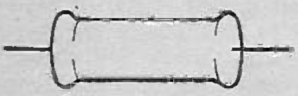

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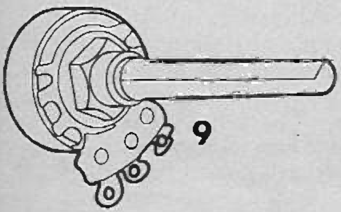

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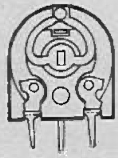
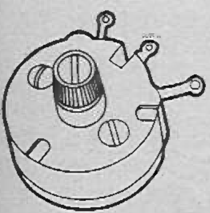
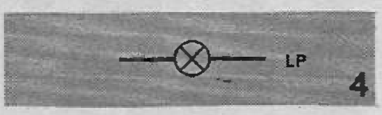


10

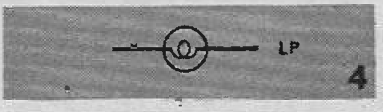


10

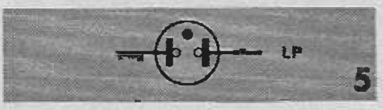
Indicating Devices



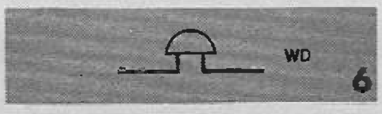
Signal or indicating lamp.



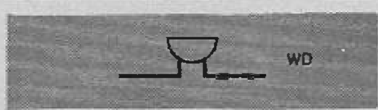
Filament illuminating lamp.



Neon lamp or indicator.

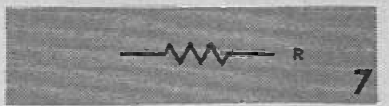


Electric bell.

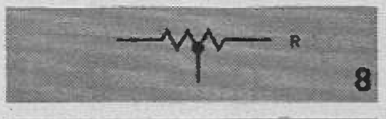


Electric buzzer.

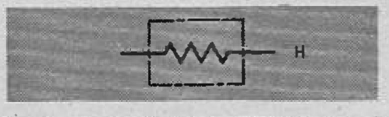
Resistive Devices



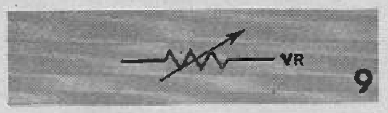
Fixed value resistor.



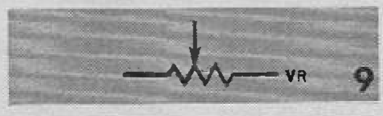
Fixed value resistor with tapping.



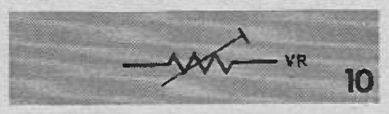
Resistive heating element.



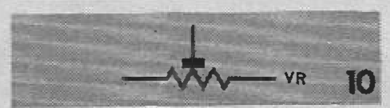
Variable resistor.



Potentiometer with control knob.



Variable resistor with preset adjustment.



Potentiometer with preset adjustment.

ELECTRONIC CIRCUITS–
.....IN THEORY and PRACTICE

TEACH-IN
...FOR BEGINNERS

By Mike Hughes M.A.

8 MULTIVIBRATORS

WHEN dealing with circuits, most books start with amplifiers; this pre-supposes you have something to amplify but if you haven't it can be frustrating making an amplifier you cannot check.

Because of this—and because we're all human and like to see things working right away—we will leave amplifiers to start with, and concentrate this month on a very important basic circuit having the grandious name "astable multivibrator".

It is such a frequently used circuit that one does not even have to read the Editor's mind to estimate that it will feature in several projects per annum. We are going to make it flash lights and produce an audible sound.

We'll keep to our word and not dive in at the deep end but will slowly develop the full circuit in easy stages. Follow the text and figures carefully.

BASE CURRENT

The circuit of Fig. 1 is similar to one shown last month. If we connect the free end of R1 to the positive rail we will pass base current, and provided it is great enough, the transistor will conduct "heavily" and the lamp will light.

Although the specification for the BC108 says it has an h_{FE} of 240, there is likely to be some variation between devices; as we want to ensure that the lamp comes on at its brightest we will assume that the gain of the device to hand is considerably less than this when it comes to calculating the value of R1.

We will assume, rather pessimistically, that the actual gain of our device is 120 (it does not matter if it happens to be higher). We will also overstate the current our bulb will draw, say 100mA. It can't be more than this because we would exceed I_{cmax} for the transistor.

Thus we can calculate the base current required.

$$I_b = \frac{I_c}{h_{FE}} = \frac{100}{120} = 0{\cdot}83\text{mA}$$

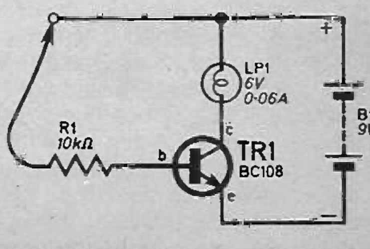
R1 is found by dividing the voltage drop of the transistor by the base current required.

Therefore

$$R1 = \frac{9 - 0{\cdot}5}{0{\cdot}00083} = 10{,}200 \text{ ohms.}$$

The nearest preferred value to this is 10 kilohm.

Fig. 1. Connecting the free end of R1 as shown causes TR1 to conduct sufficiently to light LP1 brightly.



CAPACITOR CHARGING/ DISCHARGING

Now look at Fig. 2(a). Strange as it may seem, D1 does not take an active part in our description because it is there only to protect the base emitter junction from high reverse voltages that we shall be applying (V_{eb} for the BC108 must not exceed 5V, remember?). You'll see how this comes about shortly.

Let's assume we connect the free end of C1 to the positive rail with the link to the negative rail disconnected and switch on. The capacitor can be considered as being "charged" because

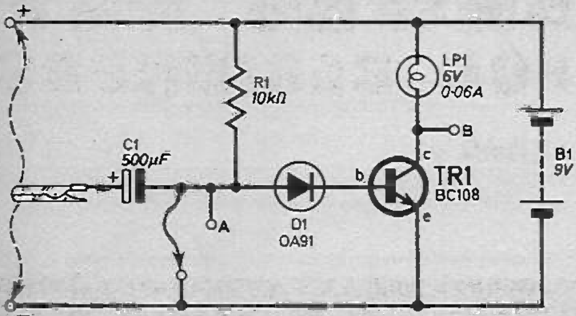


Fig. 2(a) (above). The circuit diagram to illustrate the switching action of a transistor.

Fig. 2(b) (top right). The circuit of Fig. 2(a) wired up on the Demo Deck.

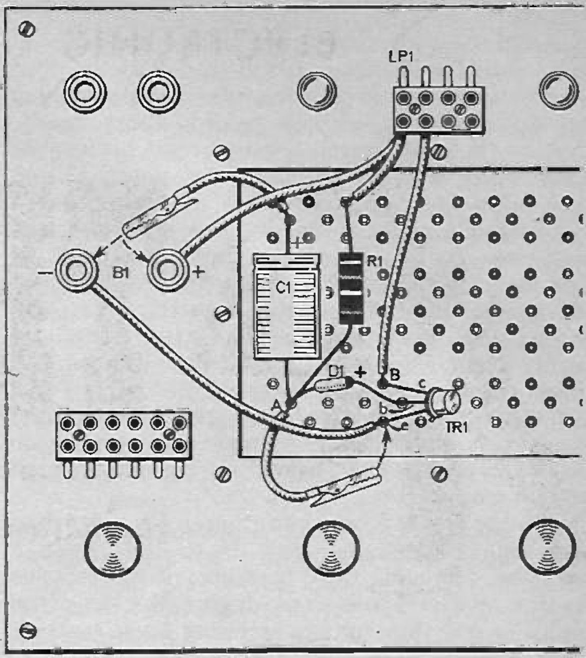
the positive plate immediately rises to +9V but the negative plate stays momentarily at zero.

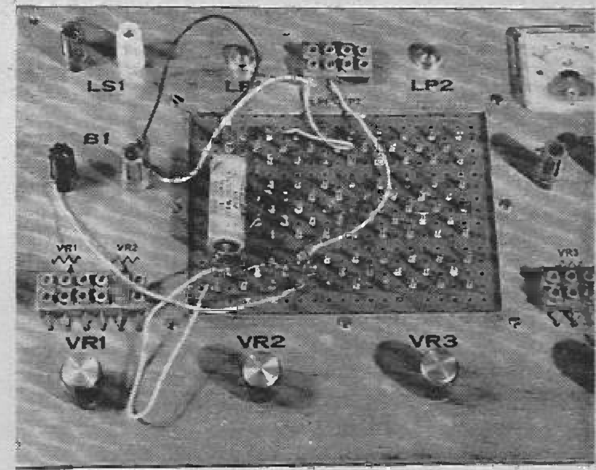
Forget the battery, transistor and diode for a moment and just consider C1 and R1. The 9V potential difference across the plates will cause a discharge current to pass through R1 and the potential of the negative plate will try to approach that of its counterpart.

Now look at the circuit as a whole with a voltmeter connected between "ground" (the negative rail) and point A. Going through the same argument, the voltage we would see initially is zero but will rise in a positive direction as C1 discharges. When the potential reaches about +500mV the discharge will stop because TR1 starts to draw base current; this prevents the potential rising any further but I_b will flow through R1 and D1. This turns the transistor on and the lamp lights. You can see this effect on the Demo Deck.

TRANSISTOR SWITCH

To start the cycle make sure C1 is fully charged by shorting point A to ground; the lamp goes out immediately. When you remove the short circuit there will be a short delay (about 1 second) before the lamp comes on again—monitor point A while this is happening and you will see that the lamp lights just as the voltage reaches about 500mV. The delay is caused by the time it takes the potential dif-





Photograph of the Demo Deck wired up according to the circuit diagram of Fig. 2(a).

ference across the capacitor to decay from 9V to about 8·5V.

An important note to Demo Deck users: you can still use our simple circuit for a 10V range meter, (1 kilohm resistor in series with the Demo Deck meter) but its sensitivity is so poor (1,000 ohms per volt) that you will now start to read voltage levels rather less than those detailed above and its low internal resistance will start to affect the charge and discharge rates of the capacitors. Now is the time to start thinking about buying or making a 20,000 ohm per volt meter (see the *Simple Multimeter* article on page 414).

Discard the shorting link at point A and revert to a flying lead from the free end of C1. First touch the lead on to the positive rail then watch the meter with one eye, the bulb with your other and if you have a third eye or a helper, quickly transfer the flying lead to the negative rail and hold it there firmly. Notice that the meter tries to read backwards (indicating a negative voltage at point A) and the lamp goes out and stays out for about 4 seconds. Repeat the experiment several times remembering to return the flying lead back to the positive rail between times (ignore the slight flash from the bulb when you do this). You will notice that the lamp turns on after a definite delay and always when the potential at point A finds its way back to +500mV.

"What happened to this potential when the lamp was out?" Well, reverse the meter connections and see by repeating the experiment a few more times.

If your eye is quick, you should see that when you touch the flying lead on to the negative rail the potential falls to minus 8·5V relative to the negative rail, and during the time the lamp is out this voltage is rising back towards zero and ultimately back to +500mV.

Before we talk about what causes the longer delay time let's find out why the potential can go negative.

NEGATIVE POTENTIAL

At the start point of our cycle, point A was at +0·5V and the other side of the capacitor at +9V. When we move the flying lead to the negative rail we effectively change the potential on the positive plate by 9V in a negative going direction. You might think that this would virtually cause the capacitor to be discharged with only 0·5V being left across it. This is not true because no dicharge current has been seen to flow yet. Discharge current does, however, flow and the only way is through R1.

If the discharge current through R1 now increases suddenly (it flows from the positive plate of the capacitor through the battery and R1 and back to the capacitor) the potential difference across R1 must increase—but it was already 8·5V (point A was at +0·5V). The instantaneous change in current will cause the potential difference across R1 to increase by the same amount as the change in potential we applied to the positive plate. This means that the drop across R1 must increase from 8·5V to (8·5+9)V=17·5V.

As one end of R1 is well and truly fixed at the +9V battery potential it means that the other end must fall to (9−17·5)V=−8·5V. This is exactly what happens to point A and is why we have to protect the base/emitter junction of the transistor with D1.

With the positive plate at zero volts and point A at −8·5V the only discharge path is through R1. The potential at point A will rise slowly as it tries to reach +9V (see Fig. 3(a)) but this is

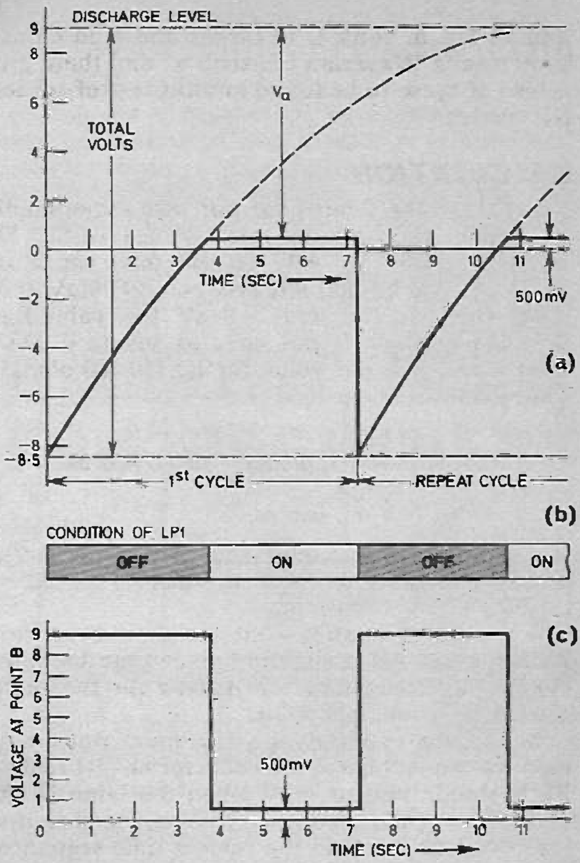


Fig. 3. (a) The graph obtained by plotting voltage at point A against time. (b) The state of LP1 with time. (c) The output voltage at point B of Fig. 2(a).

prevented by the transistor starting to draw base current (when the potential reaches 500V) so the graph suddenly levels off at +500mV.

The dotted part of the graph shows what would have happened had the transistor not been in circuit. Fig. 3(a) shows the graph for two consecutive cycles of our experiment.

CAPACITOR CHARGING TIME

The time it takes for a capacitor to discharge through a resistor is controlled by the value of the capacitor, the resistor and the voltage range through which it is discharging. We can even predict how long it will take to achieve partial discharge (as is the case for us). Let us say the capacitor wants to discharge completely through a voltage range of V_{total} (measured in volts), and we want to find how long it takes to discharge to a level of V_x volts from the final discharge level; the time taken is calculated from the following equation:

$$t = \log_e \frac{V_{total}}{V_x} \times C \times R$$

where t is the time measured in seconds, V_{total}

and V_a are in volts, C in farads and R in ohms. $\log_e$ means "Naperian Logarithm" and there are tables of these to be found in most sets of school log. tables.

CALCULATION

Let's use the figures for our own experiment to see how the formula works. V_{total} (see Fig. 3) is from $-8{\cdot}5$V to $+9$V so the total range is $17{\cdot}5$V. V_a will be that left between +500mV and +9V which, of course, is $+8{\cdot}5$V. Our value for C is 500µF which is the same as saying $0{\cdot}0005$ farads, and R is our value for R1 (10,000 ohms). Therefore,

$$t = \log_e\left[\frac{17{\cdot}5}{8{\cdot}5}\right] \times 0{\cdot}0005 \times 10{,}000 \text{ seconds}$$
$$= \log_e 2{\cdot}06 \times 5 \text{ seconds}$$

If you look up $\log_e 2{\cdot}06$ in your tables it is given as approximately $0{\cdot}72$. So the answer becomes $t=0{\cdot}72\times5=3{\cdot}6$ seconds.

Is this approximately what you got in practice? Probably you got a slightly longer time because electrolytic capacitors are usually on the high side of their nominal value.

Repeat the experiment a few more times but monitor the voltage at the collector of TR1 (point B). It should rise to +9V when the lamp is off and fall to nearly zero when it is on. Fig. 3 shows these voltage levels in the correct time sequence with what was happening at point A.

caused by the comparatively "heavy" currents we are switching. Now watch both bulbs and transfer the flying lead to ground.

As you would expect LP1 goes out; TR1 collector goes to +9V which makes LP2 go on (as it was already on there will be no change). Keep the lead firmly held on the ground line and keep watching. After about 4 seconds LP1 comes on again and TR1 collector falls to near zero. This forces TR2 out of conduction and LP2 now goes out. Keep watching. After another 4 seconds LP2 comes on again just as we have seen for the first stage. We are now back where we started and nothing else will happen unless you return the flying lead back to the 100 ohm resistor (ignore the odd flash while doing this but allow time to stabilise) and repeat the cycle.

Now connect the flying lead to the collector of TR2 and feedback the voltage changes of the second stage to control the first stage. The electronics now takes over from you and the lamps will continue their 4 second flashing cycles automatically!

You have made an "astable multivibrator"—one of a group of circuits called "oscillators". An oscillator produces changes of voltage levels (or controls current) in a regular repetitive manner for indefinite periods. You can monitor its "waveform" by looking at the voltage of one of the collectors. It is, of course a regular form of Fig. 3(c). Because of its rectangular shape we call it a "square wave".

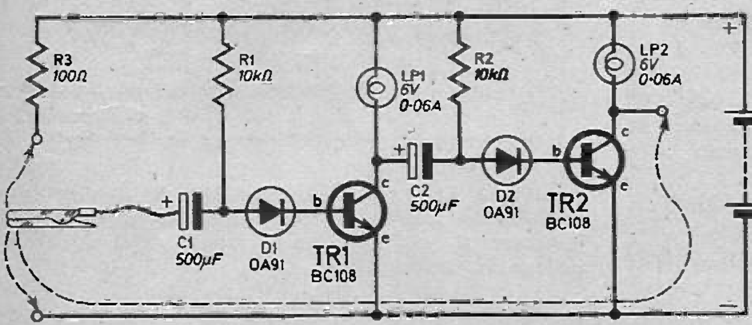


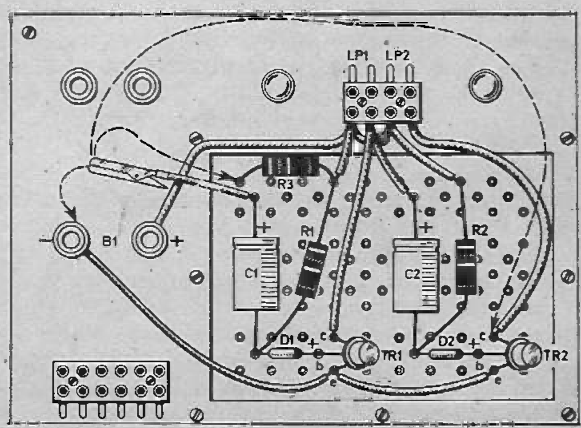
Fig. 4(a) (left). The basis of the astable multivibrator. When the positive end of C1 is connected to TR2 collector, the circuit operates automatically.

Fig. 4(b) (below). The circuit of Fig. 4(a) wired up on the Demo Deck.

THE ASTABLE MULTIVIBRATOR

Now build the circuit of Fig. 4(a) on the Demo Deck. You can see it is made up of two circuits each identical to that we have just analysed in depth. Instead of a flying lead at the capacitor of the second stage we will connect C2 direct to the collector of TR1. The voltage swings at its collector will do exactly the same as our flying lead would have done. We will, however, keep a flying lead on C1.

Connect this lead through a 100 ohm resistor to the postive rail, switch on and wait a few moments. After a short while both lamps will be alight. You need not worry about the 100 ohm resistor, it is there simply to prevent a side effect



From the point of "just" going to +9V for the first time to when it just goes to +9V the second time is called a "cycle".

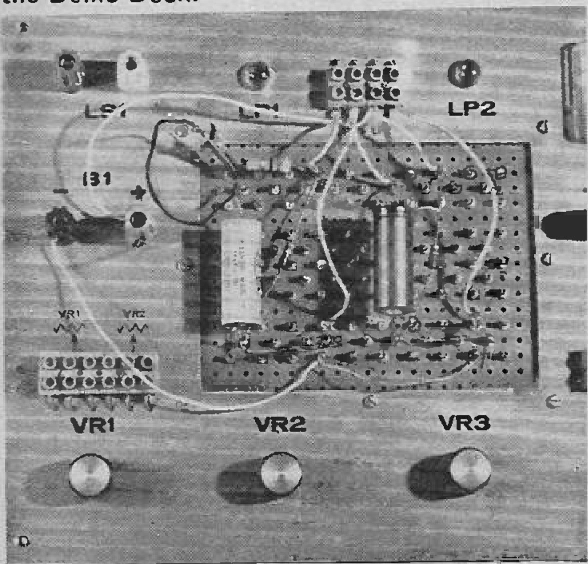
The dwell time at +9V is called the "off time" and the dwell at zero volts is the "on time". The total length of time of one cycle is called the "period".

The number, or fractions, of cycles that occur in a second is called the "frequency" and this is measured in "hertz" (abbreviation Hz).

In our case the period is 8 seconds so the frequency is $\frac{1}{8}$Hz or 0·125Hz.

For a square wave the ratio between on and off times is called the "mark to space ratio". In our case it is "one-to-one" or unity mark space ratio. You can change this ratio by altering the values of either R1 or R2. Try making each in turn 1 kilohm and then both 1 kilohm. Notice the change in mark/space ratio and also the frequency!

Photograph of the circuit of Fig. 4(a) wired up on the Demo Deck.



OUTPUT FREQUENCY

If you keep the circuit symmetrical so that R1 = R2 and C1 = C2, the formula for calculating the period is

$$t = 2 \times 0{\cdot}7 \times C1 \times R1 = 1{\cdot}4 \times C1 \times R1 \text{ seconds}$$

$$\text{hence, frequency} = 1/t = \frac{1}{1{\cdot}4 \times C1 \times R1} \text{ hertz} \quad (1)$$

The term R×C is frequently come across in electronics and is called the "time constant".

Using the above equation we can design our multivibrator to oscillate at any frequency from a fraction to tens of kilohertz (kHz). Musical pitches are determined by the frequency of sound vibrations and 700Hz is about that of "Top F" on a piano keyboard. Let's see if we can make this note electronically!

AUDIBLE OUTPUT

To hear the note we shall use a "loudspeaker". This consists of a coil of wire suspended between the poles of a very strong magnet and the coil has a fabric cone fixed to it. If we pass current through the coil it will move one way or the other and flex the cone at the same time. The latter sets up changes of air pressure which registers on our ears as sound.

We shall use the Demo Deck loudspeaker which has a coil resistance of 35 ohms but provided it is in the range 20 to 70 ohms any loudspeaker will do. Although there is more to it, we shall assume that the coil of the loudspeaker is, to all intents and purposes, a resistor when it comes to our calculations.

The oscillating current in the multivibrator flows between collector and emitter of either of the transistors. We will therefore replace one bulb with our loudspeaker. Unfortunately the resistance, being only 35 ohms, would allow too much collector current to flow and we would exceed I_{cmax} for the transistor; we must therefore put another resistor in series—see Fig. 5.

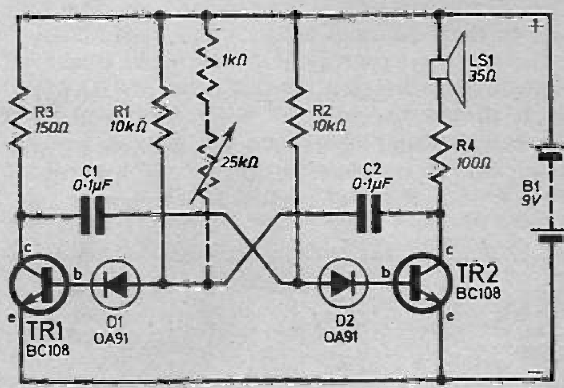
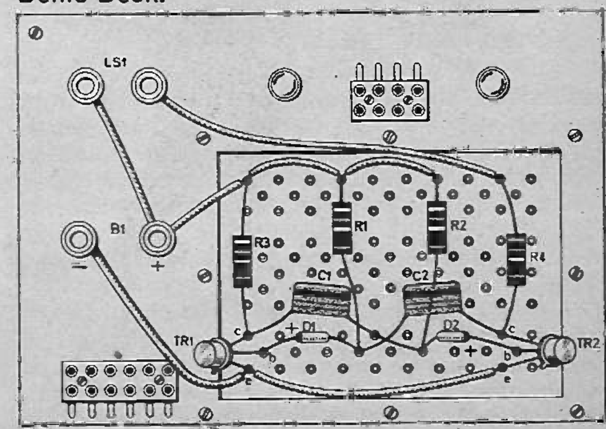


Fig. 5(a) (above). The astable multivibrator circuit for producing an audible output. To produce a variable tone, replace R1 by the dotted combination.

Fig. 5(b) (below). The above circuit wired on the Demo Deck.



The value of the resistor plus the loudspeaker should be high enough to prevent any current in excess of 100mA (i.e. the total collector load should not be less than 90 ohm). Let's play safe and make R4 100 ohms then even if you accidentally short circuit the loudspeaker no damage will be done.

Similarly we shall make the collector load to the other transistor (R3) 150 ohm—to keep the symmetry about right. Both of these resistors must have half-watt ratings.

SELECTION OF FREQUENCY

As these loads are almost the same as the bulbs (resistively speaking that is) we can leave R1 and R2 at 10 kilohm each. All we have to do now is calculate the values of C1 and C2 to give a frequency of 700Hz.

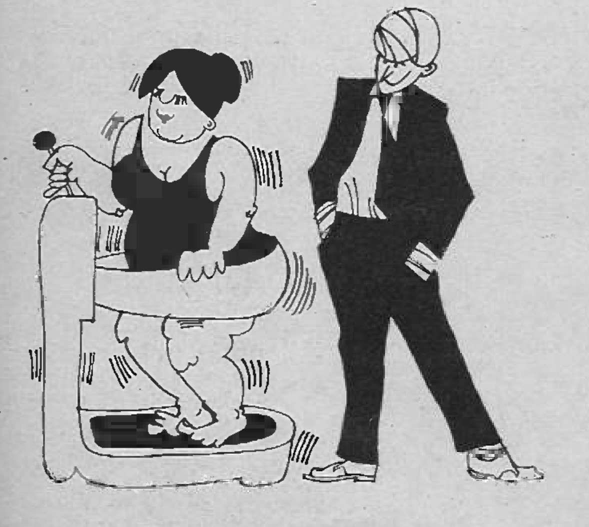
Using equation (1),

$$700 = \frac{1}{1{\cdot}4 \times R \times C} = \frac{1}{1{\cdot}4 \times 10{,}000 \times C}$$

$$\text{therefore } C = \frac{1}{14{,}000 \times 700} \text{ farads}$$

giving an aproximate value for C of $0{\cdot}0000001$ farads ($0{\cdot}1\mu F$).

So make C1 and C2, $0{\cdot}1\mu F$ each, connect up and switch on. If you have a piano, see how close you were to the right note. Don't expect perfection because you must remember resistors and capacitors have tolerances. If you want to you can make one half of the multivibrator variable by substituting R1 with a 1 kilohm resistor in series with VR3 of the Demo Deck (25 kilohm).



Next month: Alternating current. Components used in next months Teach In: Friedland Bell transformer, mains/8V; Resistors, 22 kilohm, 10 kilohm; Capacitors, $500\mu F$ elect. 12V, $0{\cdot}22\mu F$; Diodes, IN4004 (4 off).

SHOP TALK

By Mike Kenward

WORKING with electronic gadgets all the time it is not very often that we actually visit a shop to purchase a few odd items, normally we buy a stock from one of the manufacturers or distributors. However, we decided to go out with a list of about 30 items to cover two projects just to see what was involved.

After looking through our catalogues we decided that one supplier could provide all the parts required. The first thing that happened was that the shopkeeper took one look at the list (it was on E.E. headed notepaper by the way) and said we would have to leave it for at least an hour. Well, $1\frac{1}{2}$ hours later, he gave the list back with some components saying that he could not supply those marked.

We checked the items and asked why, for instance, he could not supply the relay asked for—after all it was in his latest advert in E.E.? Well, the advert went in about six weeks ago and since then he had sold out. How about the transistors and the integrated circuit and holder? Apparently he does not keep large quantities of these items and they were out of stock—waiting delivery from the distributors and no telling when that may be!

Fair enough there does not seem to be much he can do about those things. However, when we checked the parts back at the office we found that two of the items supplied from the list were completely wrong.

The motto from all this? We are sure most suppliers do their best to keep stocks of advertised components but the supply from manufacturers and distributors is far from speedy and regular, in some cases. This means that suppliers may have to wait anything up to a few months before they receive their orders and, if this happens to one it can happen to them all, so very often you will find one particular item is difficult to get anywhere.

This magazine can create a demand which the suppliers cannot cope with, for instance the SEW type meter used in the *Demo Deck*. Most suppliers would keep a few and perhaps sell one or two a week; however, we publish the *Demo Deck* design and suddenly they sell ten or more in a week. This happens all over the country and all the shops order more—perhaps a larger quantity than before—the distributors are hard pushed to cope with the demand and, in fact, in this case, the importers of the meter went completely out of stock and had to order more from Japan; hence a long delay for some readers. A similar thing happened with the loudspeaker and more had to be made to meet the orders.

Unfortunately there is little we can do about this situation and in some cases all we can say is, be patient or try to find an alternative.

We are sure most readers are sensible enough, unlike us, to check items bought before leaving the shop. We all make mistakes and the person who made up the order was probably in a hurry and put his hand in the wrong box. Incidentally, the shop was only too willing to change the incorrect items, and the advert for the relay did not appear the following month. Taking into account what we have just said let us now look at the more obvious supply difficulties that may be encountered when buying for this month's constructionals.

Light to Sound Converter

Judging by the response to the *Electrolaugh*, many readers will want to make up the *Light to Sound Converter* just to experiment with and, as far as we can see, there are not likely to be any supply problems.

Two points worth noting however; the earpiece used is a small magnetic type and these are generally available for about 50p. This earpiece could be replaced by a miniature loudspeaker provided its impedance is greater than about 75 ohms. The cost of such a speaker should be similar to that of the earpiece.

The simple light shield shown on the prototype unit is made of plastic tubing and some samples of this material and a price list have recently been sent to us from NCF Systems, 21A Bramble Street, Coventry, CV1 2HU. Telephone Coventry 26825. This firm will supply round or oval section white p.v.c. tube in one foot lengths; a list of various types of tube, together with prices is available from the above address, provided the request is accompanied by a s.a.e. The prices are reasonable; $\frac{5}{8}$ inch diameter round section costs 7p per foot, and end caps for this size, should they be required, are 3p each.

The p.v.c. tubing is easier to work than s.r.b.p. tube, has a better finish and appears to be much cheaper.

Simple Multimeter

The cost of the resistors used in the *Simple Multimeter* is determined mainly by the tolerance used. Most people will find that ± 2 per cent types are suitable and, unless a large scale higher sensitivity meter is used there is little point in employing ± 1 per cent resistsors.

There should not be any difficulty in component supply—unless the demand causes a lack of meters again. The case we have used is generally available but a shallower style will provide a more compact, better looking meter if you can find a suitable size. Plastic cases, provided they are fairly tough, are eminently suited for this purpose. We would advise you to buy a good pair of test probes to make the leads up, there are a number of types available.

Wash Wipe

As stated in the text of the *Wash Wipe* article the relay used is fairly critical and the one specified should be obtained if possible, as we know that this one will work well in the circuit shown; Henry's Radio can supply this relay. If you resort to a similar type make sure it will work from 6 to 12 volts and that the coil resistance is not less than 120 ohms nor greater than about 500 ohms the contacts used should be suitably rated. After some requests for 6V operation car devices we have specifically modified this circuit so that with a minor alteration it will work with a supply as low as 5 volts (with the specified relay).

All other components for this item are readily available.

Automatic wiper operation when washers are used. For all 6 and 12V cars fitted with washers and self-parking wipers.

WASH WIPE controller

By D.G. Howells

In these days of traffic jams, frequent road works and liberally salted roads, it has become essential to have some form of windscreen washing device to avoid developing an opaque film over the whole of the screen. Furthermore, it is important to be able to operate the washer and the wiper simultaneously, and without fumbling for badly located switches. Unfortunately, very few cars have a combined switch or stalk for both functions, and even fewer allow both functions to be performed by a single movement of such a stalk.

The device described in this article controls both wiper and washers simultaneously from one spring-loaded electric washer switch or manual washer pump. More important, when the switch or pump is released, the washer stops but the wiper continues for a pre-determined number of strokes (which can be preset by a suitably-located control). It is one of those accessories which, when fitted, makes you wonder how you ever managed without it!

OPERATION

The washer is operated directly by the hand-switch, in the case of electric types, or the hand pump. The wiper however, is controlled by a transistor circuit which is triggered on by the hand-switch or a microswitch operated by the pump but which will not switch off until a certain preset time period has elapsed. The wiper must be of the self-parking type, and can of course, be operated independently by means of the normal wiper switch. The circuit will work on both 6V and 12V cars with only one minor modification which is described later.

DELAY CIRCUIT

The circuit diagram shown in Fig. 1 (excluding

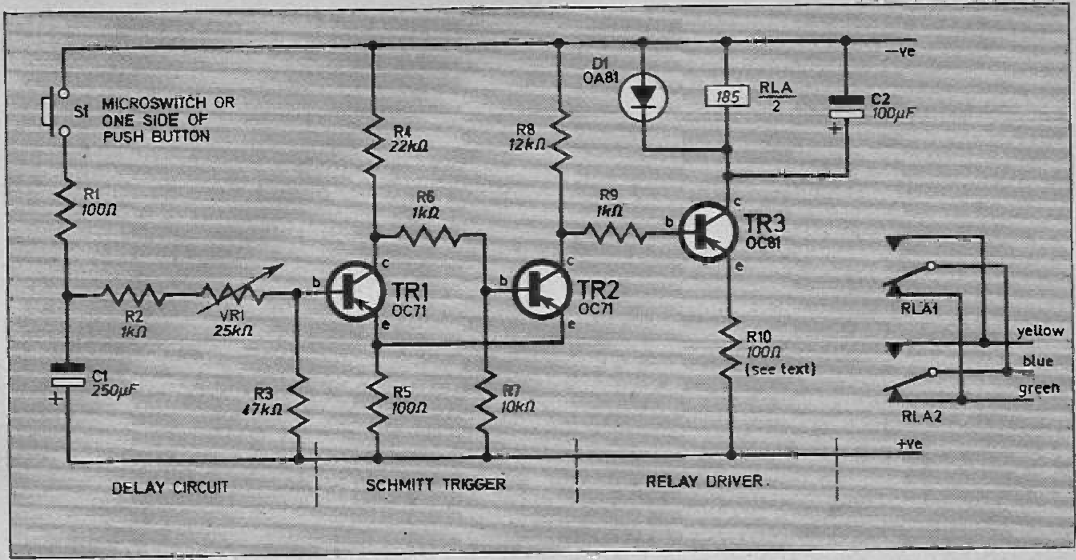


Fig. 1. Complete circuit diagram of the Wash Wipe Control. R10 is removed for 6V operation.

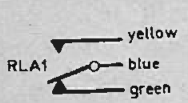


Fig. 2. Diagram showing how the relay contacts are shown in following Figs.

12 volt operation but can be modified for 6 volt operation if required. It can be considered as having three parts, as shown. The delay circuit feeds a Schmitt trigger which operates a relay driving transistor and hence the relay controlling the wipers.

When the washer switch or microswitch operated by the pump is closed, capacitor C1 charges rapidly via R1. Since the switch-on voltage of the Scmitt trigger is low, the trigger switches and the collector voltage of TR2 drops causing TR3 to switch on, thus operating the relay and hence the wipers.

When the hand-switch or pump is released, C1 can only discharge through R2, VR1, R3 and TR1 base, so that a short period, determined by the setting of VR1, elapses before the circuit reverts to its "normal" state. During this period TR3 is conductive, holding the relay on.

The value of VR1 determines the delay period of the circuit and this can either be pre-set or variable, in which case it can be located on the facia of the car to provide a control over the number of sweeps performed by the wiper. The time delay available is from approximately 1 second to 25 seconds; this could be increased by increasing the value of C1 or VR1 if required.

RELAY WIRING

Relay RLA1, used in the circuit is fairly critical and the recommended type should be used. This relay will work on a supply from 6 to 12 volts and resistor R10 is included in the circuit of the 12 volt system to limit the voltage applied. If this resistor is not fitted the relay may not turn off due to a small voltage across it.

The specified relay and circuit components will work on a supply as low as 5 volts provided R10 is left out and the emitter of TR3 connected to the positive supply. By altering the circuit in this way it can be used on cars with 6 volt electrical systems.

The contacts of the specified relay are rated at 2 amps and both sets are wired in parallel to

Fig. 3a. Wiring diagram of a single speed field coil wiper motor.

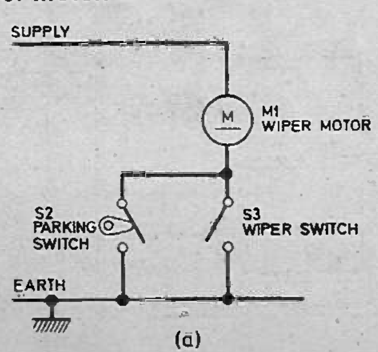
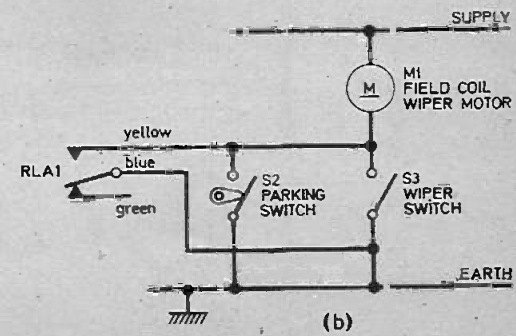


Fig. 3b. Method of connecting the controller to the circuit of 3a.



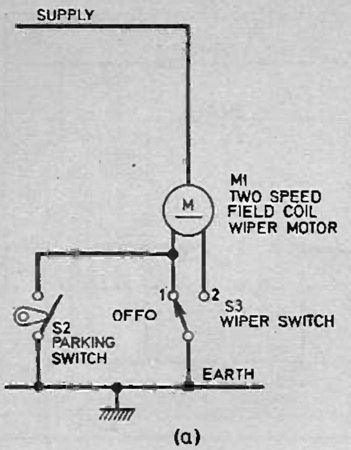


Fig. 4a. Wiring diagram of a 2 speed field coil wiper motor.

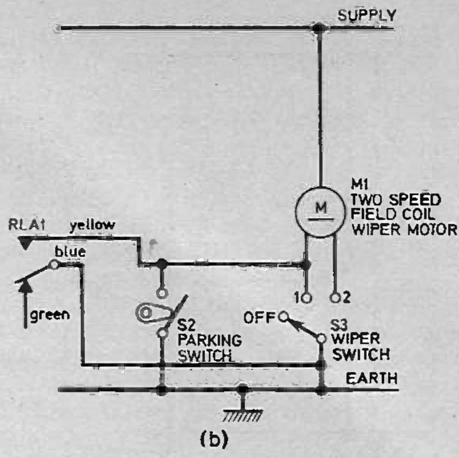


Fig. 4b. Method of connecting the controller to the circuit of Fig. 4a.

switch the wiper motor. Although some motors will draw more than 4 amps the relay is hardly ever used to break the connection as the self parking switch will carry the supply to the wipers until they are in the park position. Hence the contacts have been found to be adequate.

The circuit diagram of Fig. 1 shows both sets of contacts wired in parallel but to avoid unnecessary complication the following wiring diagrams will only show one set of contacts as in Fig. 2.

One point about the circuit is that it is switched on all the time the ignition is on, however current drain in the "standby" state is only 3mA and the life expectancy of the circuit in this state is extremely long. The supply must be taken from a point that is switched by the ignition switch.

WIPER MOTOR CIRCUIT

Not all self-parking wiper motors use the same circuit. Four common examples are shown in Fig. 3a, 4a, 5a and 6a. Fig. 3a shows a circuit commonly used with single speed field coil motors—most cars over 3 years old use such a system. The self-parking switch operates in parallel with the hand-switch. If this type of motor is fitted, the relay should be connected as shown in Fig. 3b.

The circuit of Fig. 4a is used with a two-speed field coil motor. The control is wired up in a similar manner to Fig. 3b but only one speed can be used. The wiring is shown in Fig. 4b.

More recent cars (generally less than three years old) are fitted with permanent magnet wiper motors that have to be shorted to stop them quickly, Fig. 5a shows a common wiring system of a single speed permanent magnet wiper motor and Fig. 5b shows how it is wired to the Wash Wipe control.

Two speed permanent magnet motors are normally wired up as shown in Fig. 6a, the method for connecting the relay to this system is shown in Fig. 6b—the control can only be used with the first switched speed in this case.

It is particularly important that the contacts

Fig. 5a. Circuit of a single speed permanent magnet wiper motor.

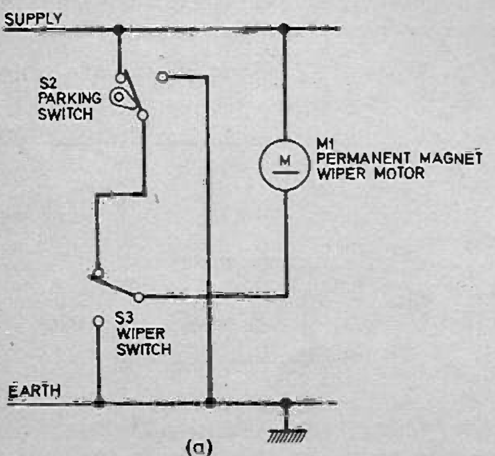
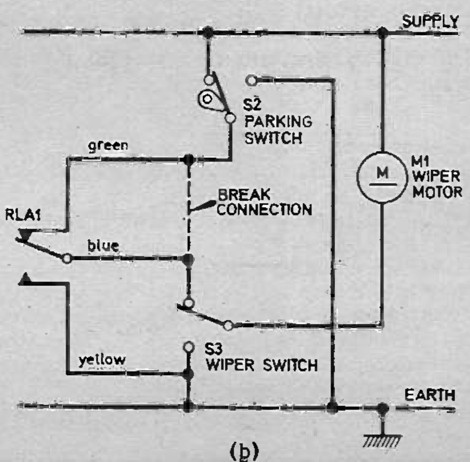


Fig. 5b. Method of connecting the controller to the circuit of Fig. 5a.



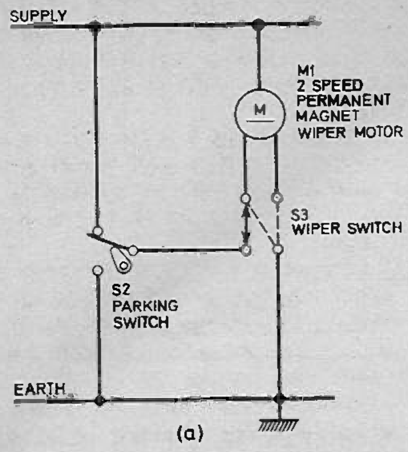


Fig. 6a. Circuit of a 2 speed permanent magnet wiper motor.

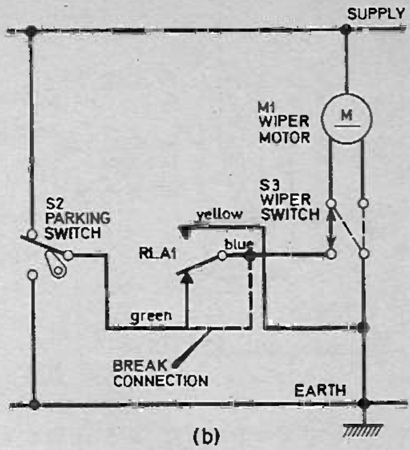


Fig. 6b. Method of connecting the controller to the circuit of Fig. 6a.

made to a permanent magnet wiper motor are correct, as the electrical system could be shorted out if the unit is fitted wrongly. Incidentally, it has been found that many garages and some manufacturers may give incorrect information concerning the type of motor fitted, this should be checked with the car manual and a wiring diagram if possible.

Components....

Resistors

R1	100Ω
R2	1kΩ
R3	47kΩ
R4	22kΩ
R5	100Ω
R6	1kΩ
R7	10kΩ
R8	12kΩ
R9	1kΩ
R10	100Ω

All ±10%, ¼W. carbon

SEE SHOP TALK

Capacitors

C1 250μF elect. 16V
C2 100μF elect. 16V

Semiconductors

TR1 OC71 germanium *pnp*
TR2 OC71 germanium *pnp*
TR3 OC81 germanium *pnp*
D1 OA81

Miscellaneous

S1 s.p.s.t. microswitch or d.p.s.t. press to make switch (see text)
VR1 25kΩ preset or log. variable potentiometer (see text)
RLA PC2 CBB/12, 6/12V operated, 185Ω coil relay with 2 sets of changeover contacts.
Connection blocks, 3 way 1 off and 6 way 1 off, Veroboard 0·15in matrix, 2¼in x 1⅝in, connecting wire, metal for case or bracket and microswitch mounting—if used, 6BA fixings, stiff wire to operate microswitch

It is not possible to use the accessory satisfactorily with wipers that are controlled by a switch with a park position and do not park fully automatically, nor can it be satisfactorily used with wipers that are not self-parking.

If the previously published Wiper Control has been fitted the green, blue and yellow wires on both these devices can be connected together i.e. green to green etc., and both units can be used independently or the washer will override the delayed timing of the Wiper Control if both are used together.

CONSTRUCTION

The delay circuit is wired on a piece of 0·15 inch matrix Veroboard approximately 2¼ inches by 1⅝ inches, as shown in Fig. 7. This can be mounted in a small aluminium box or on a bracket as shown, together with the relay and two connection blocks. All leads from the circuit board are taken to a plastic connecting strip. The leads should be of standard connecting wire, but of different colour combinations to assist identification. Leads from the relay to the connecting strip and from the strip to the wiper motor, should be of heavy gauge car connecting wire (green, blue and yellow wires).

The circuit panel should be made up first with all components and short (6 inch) flying leads attached—solder in the transistors last and use a heat shunt on each wire to protect the device from the heat of the soldering iron. Next, drill the bracket or box to hold the board and the two connecting strips, attach the flying leads to the board connecting strip and fix the board and strip in place using 6BA bolts with stand-off bushes under the board (Fig. 8).

Solder the connections to the relay RLA using heavy gauge car connecting wire, and affix the diode using a heat shunt and observing polarity. Glue the relay to the case or bracket and connect the green, blue and yellow wires to the relay connecting strip—fix this strip to the unit and

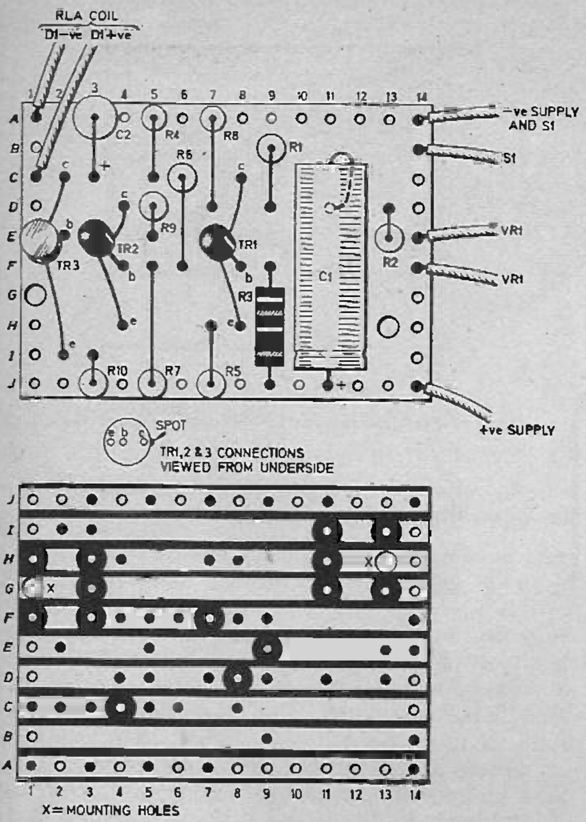


Fig. 7. Construction of the circuit board for the Wash Wipe Control.

all that remains to be done is to wire the unit to VR1, S1, the supply and the wiper motor circuit—again use heavy duty wire for the connections to the wiper motor.

When connecting the unit to an electric washer system the existing washer switch should be replaced by a double-pole, single throw type, one side of this switch is used to control the washers and the other side is used to control the Wash Wipe.

The layout shown in Fig. 7 is for a 12V system. For a 6V system omit R10 and solder the collector wire of TR3 into hole J2 instead of hole I2. Then wire up the unit in the same way as for a 12V system.

The circuit board is bolted or screwed down wherever space can be found behind or near the facia. Make sure, however, that hot or cold air from the heater or vents is not directed around the unit and do not mount the unit in the engine compartment—no temperature compensation components are included in the circuit.

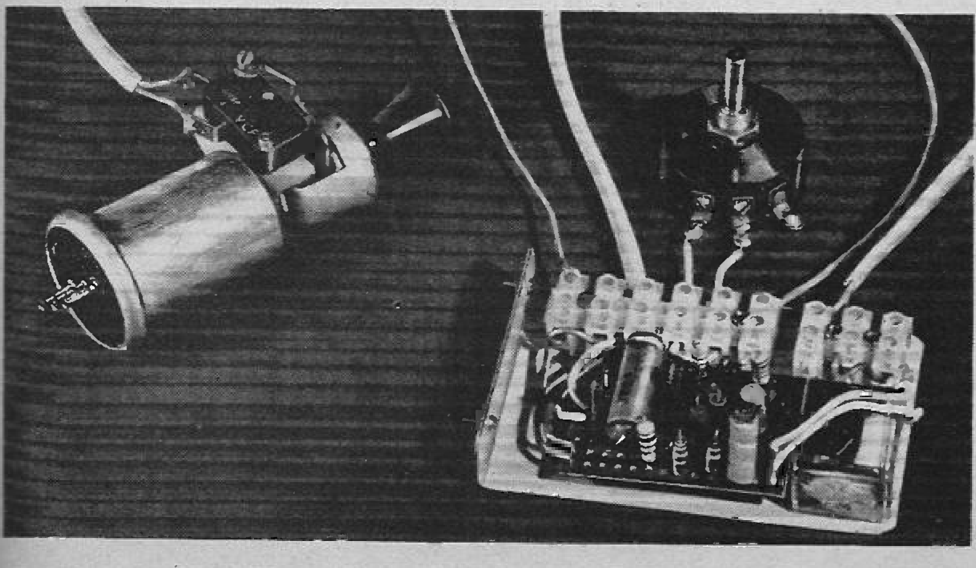
The hand-switch used for electric washers must be of the self-cancelling d.p.s.t. type (a spring loaded stalk-switch or push button can be bought at any good car accessory store),

If a manual pump system is used the micro-switch can be fitted under the dash panel and operated by a wire or lever that is depressed when the pump is fully depressed. An operating wire can be formed to a shape suitable for the particular system from a large paper clip.

The sweep control can be either a pre-set potentiometer fitted in the case or on the bracket or a variable control with knob, fitted in a convenient position on the dash panel. If a variable control is used a logarithmic type is recommended as this makes control easier over a short time period.

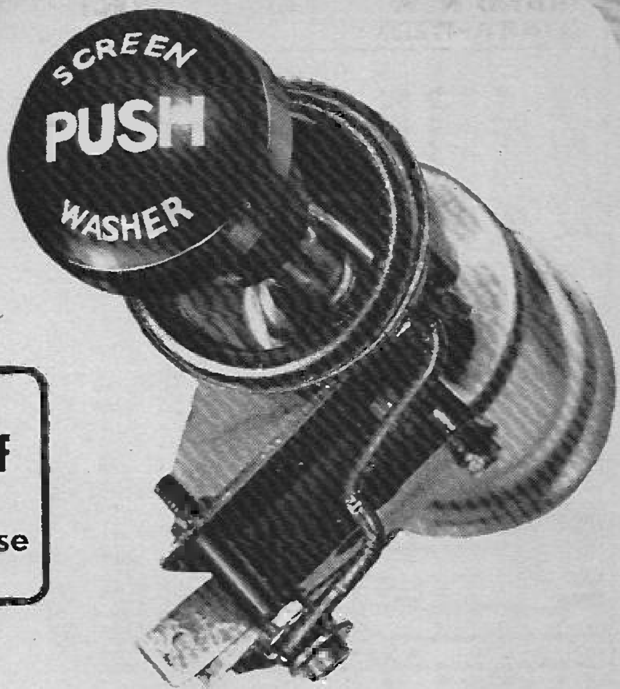
OPERATION

Because of the variation in the characteristics of different OC71 transistors, the overall time delay available may vary but should be able to provide more than enough sweeps after the washer jet has stopped. ▣



The complete unit ready for installing in the car.

WASH-WIPE Controller



Approximate cost of components £2.20 plus case

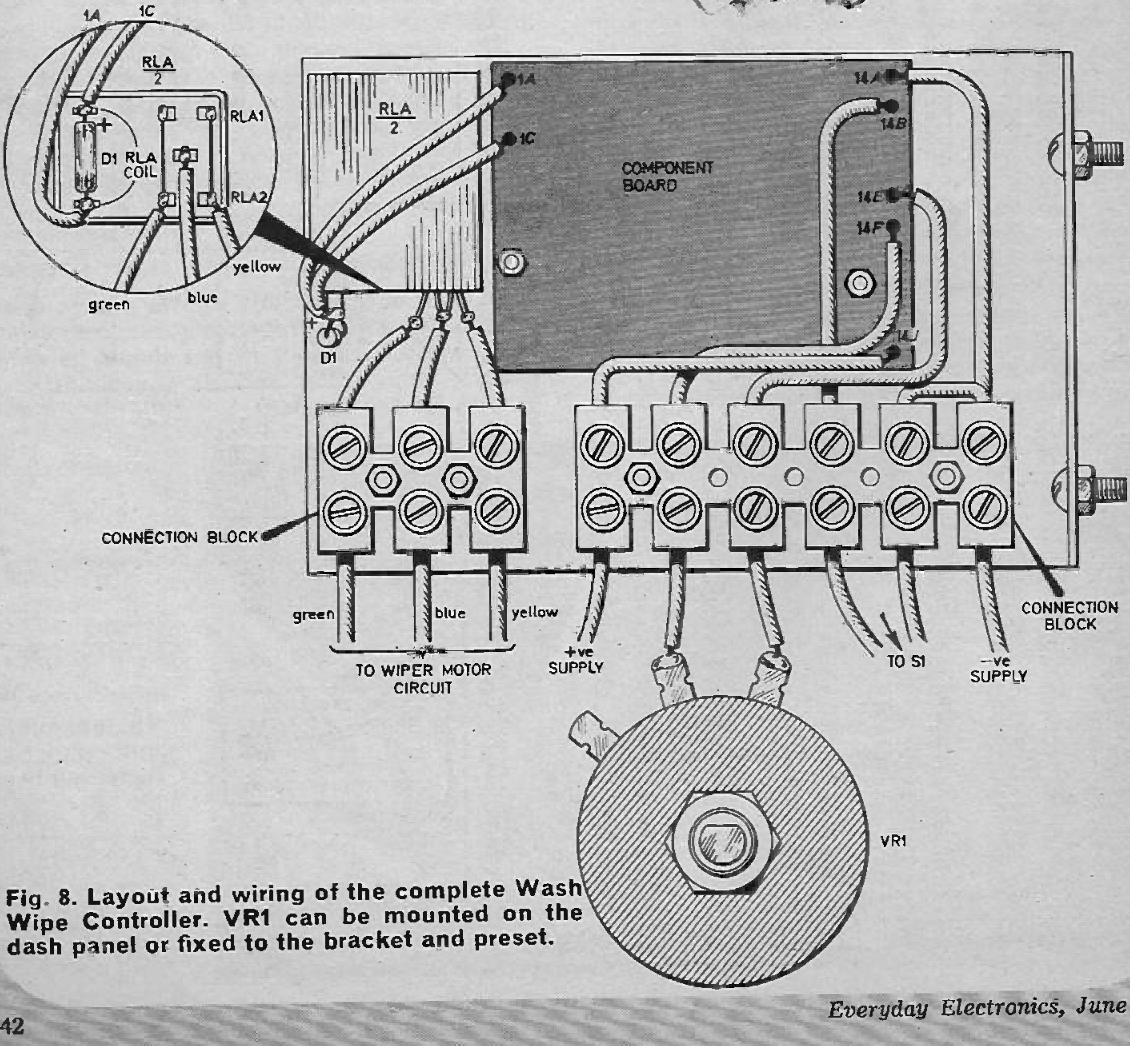


Fig. 8. Layout and wiring of the complete Wash Wipe Controller. VR1 can be mounted on the dash panel or fixed to the bracket and preset.

THEY MADE THEIR MARK

No2 VOLTA

By J. E. Gregory

Photograph: Science Museum London

Table I. THE VOLT (V)

The volt is the unit of electrical potential or "pressure". It can, perhaps, be most clearly understood by comparing it with water pressure. The higher a water tank is from a tap, the greater the water pressure at the tap. Similarly, with electricity the higher the voltage of a battery or generator, the higher the electric pressure at its output terminals. The unit was named after Volta in 1836 and was adopted very slowly until it received international recognition in 1881, when it was one of the first practical units to be approved by the International Electrotechnical Committee.

LAST month in the introduction to the series we saw that electric current as we now understand it was unknown and, that electrical experiments were based on the forces of attraction and repulsion. Then in 1798 Alessandro Volta, an Italian Physicist, after whom the Volt (see Table 1) is named, produced his galvanic battery. But first, like Volta, we must hear the legend of the "frogs thighs".

GALVANI'S DINNER

One evening in 1790 Aloisio Galvani, Professor of Medicine at Bologna was patiently waiting for his wife to finish preparing his favourite dinner, a delicacy of frogs thighs. To skin the frogs the good lady had borrowed one of her husbands instruments. As she was finishing the last thigh the scalpel fell from her hand on to the rear nerve of the frog's thigh and at the same time touched the plate. Immediately the skinned thigh stretched and jumped away, Senora Galvani repeated her actions several times before drawing her husbands attention to the mystery, he immediately "took charge" and exclaimed "I have discovered animal electricity the primary source of life". As news of this incident spread no frog was safe as experiments with them became the rage of Bologna.

Volta at that time, Professor of Physics at Pavia, did not believe in Galvani's animal electricity, he reasoned that the frogs legs played no part in the phenomenon other than providing moisture and that the electricity was produced by the steel of the scalpel and the tin plate set in a moist medium.

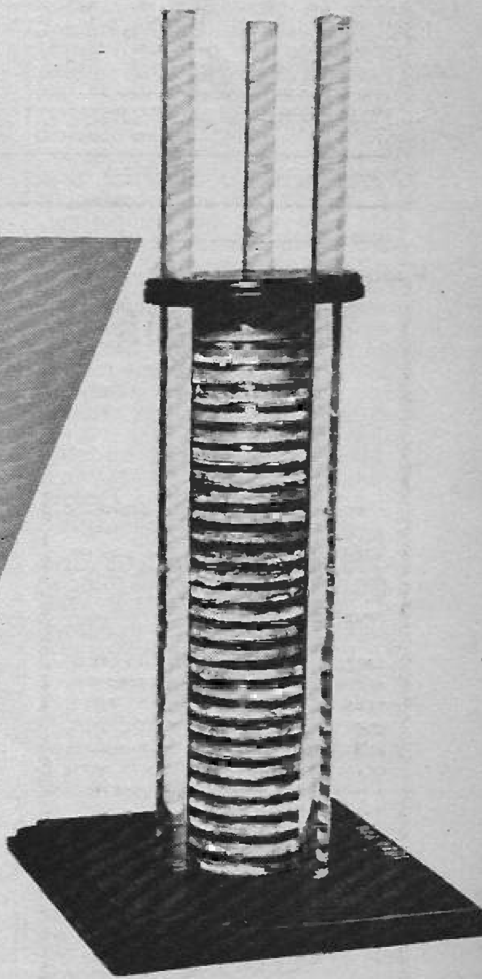
Volta pondered on his discovery and set about reproducing and multiplying the effect, he piled a large number of zinc and copper discs separated by moistened cardboard discs on top of one another so that the zinc of each pair was in direct contact with the copper of its neighbour. Volta found the pile gave a shock when opposite ends were touched simultaneously.

The modest Volta called his pile the Galvanic Battery after the old Professor. This pile which generated electricity without any external aid was the start of a new era in electrical science, and was the first electric battery in the modern sense.

Volta's fame grew and he constantly travelled throughout Europe demonstrating his electrical experiments. In 1801 Napoleon fresh from his conquests of the Austrian forces summoned him to Paris, so impressed was Napoleon that he had a special medal struck in Volta's honour. Other honours quickly followed. Senator of the Kingdom Lombady, the Copley medal of the Royal Society, and in 1815 the Emperor of Austria made him a director of the faculty of Padua.

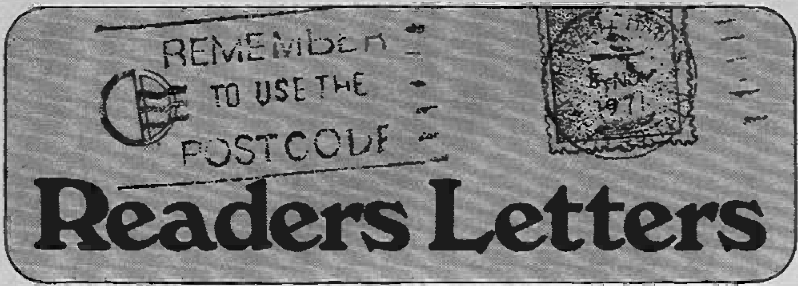
BRITISH ASSOCIATION

Before he died Volta made a journey to London to attend a British Association Meeting at which he presented a Voltaic pile to Michael Faraday, but more of him and the farad in a later article.



Volta's Pile.

Photograph Crown Copyright Science Museum London



Readers Letters

Electronic Lib

I am writing in response to your appeal to hear from some lady enthusiasts. I have been working in electronic factories for the past five years assembling printed circuit boards and doing point to point wiring, but in the last year or so I have become quite suddenly very interested in electronics (if you get my meaning). Since then I have been searching my local library for books on electronics that were not too advanced, and having got through the few that were there, I was just beginning to think that it was the end of the road in my quest to learn and understand electronics, when along came the first issue of EVERYDAY ELECTRONICS.

Here at last a magazine that was starting right at the beginning and, what was more important, one I could understand. So far I have had all issues and will continue to do so. I have not yet attempted any of the projects but I am hoping to do so in the near future, for having just taken advantage of your electronic tool-kit offer I am just about ready to venture into the very exciting world of electronics.

Many thanks for such an interesting and worthwhile magazine.

Miss J. Pledger
Basingstoke, Hants.

You have obviously got a great advantage over many "beginners" as, in the constructional techniques, you are a professional! We wish you success with future projects.

And Daughter

I have just managed to get hold of my April 1972 copy of your magazine (yes! in future it will be ordered) and read with interest a wife's view of her husband's hobby (*Wifely Woes*—June Burn). I will have to try and persuade my husband to present *his* side as I am the enthusiast in this family. I started evening classes for Radio and T.V. (Beginners) in September last year and found myself at sea among a lot of men who, though calling themselves beginners, obviously had a good background of knowledge which I lacked. I saw the first copy of your magazine and realised that this was just what I was looking for—instruction and constructional projects.

Last week I completed the *Snap Sequence Indicator* (even made a wooden box for it!) and it works—to the delight of my family and the incredulous amusement of our friendly neighbourhood electrician who helped me to get the components.

By the way, my enthusiastic assistant in this has not been my husband or son, but my ten year old daughter Lizzie.

Mrs. J. V. Devaney,
Lee, S.E.12.

These two letters show that the hobby is not one sided—we wish all ladies success.

15p Effort

I have purchased so far all four copies of your new magazine, and find them most interesting. I have completed the *Signal Injector* in one afternoon and it gives good service. I was very disappointed in your answer to Mr. M. D. McMahon's letter (April issue).

Your magazine *should include articles about servicing* and modification, improvements and additions to commercial or any available equipments. Also, you have not given an answer to the questions raised in the letter. As you stated, the servicing problem is a vast one, but you could give helpful advice or information to amateurs. The servicing trade is slow and expensive and other radio magazines have articles about maintenance.

Your categoric statement that "you" *cannot and will not include* such articles led me to the decision, that I *cannot and will not* be interested to have a subscription of your magazine unless you make an *effort for the 15p*.

The metrication is on the way for this country, and if you or readers like it or not, eventually you will have to learn it.

W. A. Alexander
Bristol.

More Metric

May I add my plea to that of M. D. McMahon's for metric sizes, most B.S. specifications have already been metricized and we shall all have to use metric in the near future; clearly the shorter the transition period the better, magazines such as yours could help in this respect.

Naturally no magazine cares to risk upsetting their readers but as I see it anyone unable to readily understand and appreciate anything so simple as metric measurements would not be able to understand the subject matter of your or any other book and would presumably not buy them in the first place.

F. Trusson
Essex.

May I just say how much I have enjoyed reading your magazine EVERYDAY ELECTRONICS right from the first issue. The magazine arrived on the bookstalls exactly at the right time for me. I started my first year at evening classes for O.N.C. last September, and as I do not work in the electrical field the practical aspect of E.E. is just what I require to put principles into practice.

I would like to compliment you on the excellent way in which the *Teach-In* feature is progressing, it has been a great help.

I would also like to second the suggestion made last month that S.I. units can be used throughout E.E. in future.

J. E. Farrer
London, E.6.

With regard to the comment made by M. D. McMahon in the April 1972 edition of EVERYDAY ELECTRONICS, I agree entirely about the use of metric measurement. At school, it is almost a crime to use inches and feet, or pounds and ounces, in the Maths or Physics lesson. Thus, I am completely lost when doing calculations using these units. Also throughout my components catalogues centimetres and millimetres are used for dimensions of components, this can be annoying when looking for the right size component.

I have successfully completed your *Signal Injector*. As relatively new to electronics, I hope to do either the *D.C. Power Supply* or the *Audio Tone Generator* next, depending on costs. The costs are my main problem, as a schoolboy it is not easy to find £5. I do appreciate when something, like the signal injector, comes up which is cheap and the case costs nothing, also I must commend you on an ability to create attractive and purposeful cases at reasonable costs.

The *Baby Alarm* which is

featured in the April edition; could it be used as a one way intercom? (i.e. is the sound produced by speaking into it audible in the loudspeaker?).

C. J. Radford
Bournemouth.

The Baby Alarm *would make a one way intercom but we will be publishing a proper intercom design in the future.*

Supply Abroad

When I saw your magazine advertised in our local paper I took interest in it and made my first electronic device — *Windscreen Wiper Control*. After a few failures it worked.

In your second issue I followed your *Demo Deck*. But trouble started: parts! It took me three weeks to buy a loudspeaker of 40Ω—4 inch diameter, as the one you mentioned is not obtainable in New Zealand. Also, then I was advised by several people experienced in "electronics" to change over to another magazine, preferably an Australian one, as the parts you quote for your circuits are very hard to get, very dear, or never heard of, or not used in New Zealand. But however, I carried on and made the *Demo Deck*.

In your January 1972 issue, my boys took a liking to the *Astron* m.w. receiver. So I went to the shops to find out the costs. First: the semiconductors: ZTX 100, 501 and 300—"never heard of", "not in our catalogues",—"oh, *that* magazine again." Everywhere the same: "Sorry Sir, cannot help you." The same with the loudspeaker! In the component parts: R9 not mentioned.

So you see, all in all, all very disheartening. And the transistors in the *Electro-Laugh* are, if obtainable, about $3·00 (N.Z.) each.

What am I to do? Give it up?—no—another magazine, but then what about my *Demo Deck*? One firm suggested to write to you and ask for different circuit diagrams, or the equivalent of transistors and loudspeakers as he says: "The *Teach-In* course is good and practicable."

Your February issue is not on sale yet. So you see, problems, problems.

So, can you help your New Zealand customers and is there any way to get your magazine sooner than three months after due dates? I am very much obliged for your help and remain.

F. Van Waelsden
Christchurch, N.Z.

We cannot give alternatives for you as we do not know what is available in New Zealand. We think it would be better if you bought your components from a supplier in this country and paid for them to be posted to you. As far as three months for an issue goes—if you take out a subscription it should be quicker.

Back Issues

After reading your *Readers Letters* I realise how many other people had the same feelings as I; namely that electronics would always be for the experts and beyond most of us, but as your magazine explains things, and sets out wiring diagrams etc, it is not now so mysterious. I have built myself a *Demo Deck* and find the practical experiments you present most helpful.

I had great success with the *Signal Injector*. This helped me to locate a fault in a transistor radio. One favour I would like to ask is it possible for me to obtain a copy of the first issue (November) I have the others but missed the first one. It is annoying to keep reading references to *Snap Sequence Indicator* and *Home Sentinel* and not know what they are.

Thank you for an interesting magazine.

R. Brown
Burton-on-the-Wold
Leicester.

Unfortunately we are no longer able to supply any back issues (see page 413). Thus it is now more important that all readers place a regular order or take out a subscription—details on page 412.

Red Flash

Despite the fact that I have been interested in electronics and radio in particular for over two years I am still not far out with the "beginner" class and find your articles interesting and helpful. Despite that it angers me to see such letters as H. A. Williams' letter of the April issue.

It seems to me that he is very narrow minded in his outlook since to me, electronics means electronics in its widest field, computers, radio, electronic music modules such as waa-waa and fuzz as well as the other circuits you print. To suggest that an electronics magazine should print circuits as flash every month and to have the insolence to suggest that such magazines should be printed to cover only one narrow subject makes me see red. Why not take it as it is and try all the circuits?

My interest is radio but I find your articles and circuits very interesting; thank you.

D. Burgess
Ross-shire.

Bee Counted

I was very pleased to see that in the May copy of E.E., you would be making a *Bee-Counter*. As a bee keeper I am very pleased to see that electronics can help me. I just hope I can build my *Bee-Counter* before they go out to pollenate.

Well, as a bee keeper E.E. is going to help me. So I wonder if you could now help me as a goat keeper as well. In the summer my goats always jump over the fence, as the grass on the other side is always greener.

So please can you work out a circuit for a transistor electric fence unit to keep my goats in.

D. A. Cullum
Cambridge.

No promises, but this could be a future project; farmers and smallholders please note.

Understandable

Well done. At last we can obtain a magazine, though a month behind out here, that every one can understand, I have worked with electronics for some time now, never have I come across such clear detailed circuitry, the projects quite compelling—who wants a rain detector in drought stricken N.S.W.!? They all work too, "Cam's Comic" readers note!

Shop Talk, very good idea all budding inventors should not miss that page, I would like to endorse the editorial in the Feb. issue you feel a bit of a charles when you build a good bit of working gear and can't put it right when it does go wrong!

Just one point I hope in a year's time I can pick up EVERYDAY ELECTRONICS and see fine projects for the not so experienced still predominate in the magazine, leaving doppler radar gear etc., to the other magazines.

M. T. Cole
New South Wales

Electronics Taped

I find your magazine very interesting and instructive. I am wondering if any readers would be interested in exchanging ideas and comments about electronics projects and electronics in general on tape.

If you would be interested in exchanging tapes please write to me, at the address given, and I will give you further details. Please enclose $2\frac{1}{2}$p stamp. If you prefer you can send a tape —two-track at $3\frac{3}{4}$ i.p.s. speed.

John Bradley
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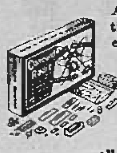

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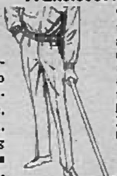

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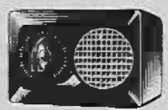

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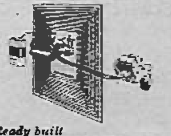

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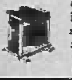

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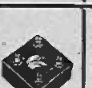

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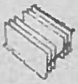

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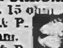

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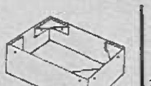

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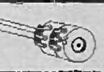

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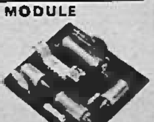

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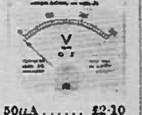
50–0–50µA	£3·10	300V. D.C.	£2·60
100µA	£3·10	1 amp. D.C.	£2·60
100–0–100µA	£3·00	5 amp. D.C.	£2·60
500µA	£2·75	300V. A.C.	£2·60
1mA	£2·60	VU Meter ..	£3·37
20V. D.C. ..	£2·60		

"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in. x 4¼in. fronts.

50µA	£3·60	50mA	£2·80
50–0–50µA	£3·10	100mA	£2·80
100µA	£3·10	500mA	£2·80
100–0–100µA	£3·00	1 amp.	£2·80
200µA	£3·00	5 amp.	£2·80
500µA	£2·90	15 amp.	£2·80
500–0–500µA	£2·80	30 amp.	£2·90
1mA	£2·80	20V. D.C. ..	£2·80
1–0–1mA ..	£2·80	50V. D.C. ..	£2·80
5mA	£2·80	150V. D.C.	£2·80
10mA	£2·80	300V. D.C.	£2·80
		15V. A.C. ..	£2·80
		300V. A.C.	£2·80
		S Meter 1mA	£2·87
		VU Meter ..	£3·60
		1 amp. A.C.*	£2·80
		5 amp. A.C.*	£2·80
		10 amp. A.C.*	£2·80
		20 amp. A.C.*	£2·80
		30 amp. A.C.*	£2·80

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



50µA	£2·10	200mA	£1·60
50–0–50µA	£1·90	300mA	£1·60
100µA	£1·90	500mA	£1·60
100–0–100µA	£1·75	750mA	£1·60
200µA	£1·75	1 amp.	£1·60
500µA	£1·65	2 amp.	£1·60
500–0–500µA	£1·60	5 amp.	£1·60
1mA	£1·60	10 amp. ..	£1·60
1–0–1mA ..	£1·60	3V. D.C. ..	£1·60
2mA	£1·60	10V. D.C. ..	£1·60
5mA	£1·60	15V. D.C. ..	£1·60
10mA	£1·60	20V. D.C. ..	£1·60
20mA	£1·60	100V. D.C.	£1·60
50mA	£1·60	150V. D.C.	£1·60
100mA	£1·60	300V. D.C.	£1·60
150mA	£1·60	500V. D.C.	£1·60
		750V. D.C.	£1·60
		15V. A.C. ..	£1·70
		50V. A.C. ..	£1·70
		150V. A.C.	£1·70
		300V. A.C.	£1·70
		500V. A.C.	£1·70
		S Meter 1mA	£1·70
		VU Meter ..	£2·10

Type MR.52P. 2¼in. square fronts.

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

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

50µA	£2·25	5 amp.	£1·70
50–0–50µA	£2·10	10V. D.C. ..	£1·50
100µA	£2·10	20V. D.C. ..	£1·50
100–0–100µA	£1·87	50V. D.C. ..	£1·50
200µA	£1·87	300V. D.C.	£1·50
500µA	£1·75	15V. A.C. ..	£1·80
500–0–500µA	£1·70	300V. A.C.	£1·80
1mA	£1·70	S Meter 1mA	£1·85
5mA	£1·70	VU Meter ..	£2·25
10mA	£1·70	1 amp. A.C.*	£1·70
50mA	£1·70	5 amp. A.C.*	£1·70
100mA	£1·70	10 amp. A.C.*	£1·70
500mA	£1·70	20 amp. A.C.*	£1·70
1 amp	£1·70	30 amp. A.C.*	£1·70

Type MR.65P. 3½in. x 3¼in. fronts.

50µA	£3·87	10V. D.C. ..	£2·20
50–0–50µA	£2·75	20V. D.C. ..	£2·20
100µA	£2·75	50V. D.C. ..	£2·20
100–0–100µA	£2·65	150V. D.C. ..	£2·20
200µA	£2·65	300V. D.C.	£2·20
500µA	£2·40	15V. A.C. ..	£2·30
500–0–500µA	£2·20	50V. A.C. ..	£2·30
1mA	£2·20	150V. A.C.	£2·30
5mA	£2·20	300V. A.C.	£2·30
10mA	£2·20	500V. A.C.	£2·30
50mA	£2·20	S Meter 1mA	£2·87
100mA	£2·20	VU Meter ..	£3·87
500mA	£2·20	50mA A.C.*	£2·20
1 amp.	£2·20	100mA A.C.*	£2·20
5 amp.	£2·20	200mA A.C.*	£2·20
10 amp.	£2·20	500mA A.C.*	£2·20
15 amp. ..	£2·20	1 amp. A.C.*	£2·20
20 amp. ..	£2·20	5 amp. A.C.*	£2·20
30 amp. ..	£2·30	10 amp. A.C.*	£2·20
50 amp. ..	£2·50	20 amp. A.C.*	£2·20
5V. D.C. ..	£2·20	30 amp. A.C.*	£2·20

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square fronts.

25µA	£3·50	1 amp.	£1·95
50µA	£2·75	2 amp.	£1·95
50–0–50µA	£2·35	5 amp.	£1·95
100µA	£2·35	15 amp.	£1·95
100–0–100µA	£2·25	30 amp.	£1·95
500µA	£2·20	50 amp.	£1·95
1mA	£1·95	5V. D.C. ..	£1·95
1–0–1mA ..	£1·95	10V. D.C. ..	£1·95
5mA	£1·95	20V. D.C. ..	£1·95
10mA	£1·95	50V. D.C. ..	£1·95
50mA	£1·95	150V. D.C.	£1·95
100mA	£1·95	300V. D.C.	£1·95
500mA	£1·95	30V. A.C.*	£1·95
		50V. A.C.*	£1·95
		150V. A.C.*	£1·95
		300V. A.C.*	£1·95
		500mA A.C.*	£1·95
		1 amp. A.C.*	£1·95
		5 amp. A.C.*	£1·95
		10 amp. A.C.*	£1·95
		20 amp. A.C.*	£1·95
		30 amp. A.C.*	£1·95
		50 amp. A.C.*	£1·95
		VU Meter ..	£3·10

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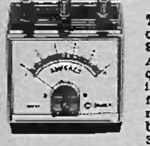
SEW EDUCATIONAL METERS



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

50µA	£5·00	20V d.c.	£4·40
100µA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c. ...	£4·40
50-0-50µA ..	£4·65		
1-0-1mA....	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c. ..	£4·65
10V d.c. ...	£4·40		

EDGWISE METERS

Type PE.70. 3 17/32in. x 1 15/32in. x 2¼ in. deep.

50µA	£3·10	500µA	£2·75
50–0–50µA	£3·00	1mA	£2·45
100µA	£3·00	300V. A.C.	£2·45
100–0–100µA	£2·90	VU Meter ..	£3·40
200µA	£2·90		

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

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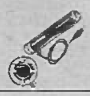
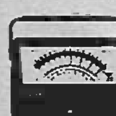
ROUND SCALE TYPE PENCIL TESTER MODEL TS.68

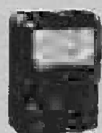


Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY £1·97 P. & P. 13p

SKYWOOD SW-500
50K Ω/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. DC Current 20uA/6/600mA Resistance 10K/100K/1 Meg/10 Meg. Decibels — 20 to +57 db. £7·50. P. & P. 15p.



370 WTR MULTI-METER
Features A.C. current ranges. 20,000 o.p.v.
0/·5/2·5/10/50/250/500 1000 V DC.
0/2·5/10/50/250/500/1000 V AC.
0/50uA/1/10/100MA/1/10 Amp DC.
0/100MA/1/10 Amp AC
0/5K/50K/500K/5MEG/50MEG.
-20 + 62 db.
£15, P. & P. 25p.



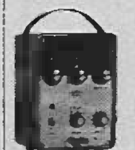
TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual an d leads. £17·50. Carr. 37½p

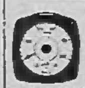
TE-20D RF SIGNAL GENERATOR

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. 37½p. Size 140 x 215 x 170 mm.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



New high quality portable instrument. Sine 1 Hz to 100 KHz. Square 20 Hz to 20 KHz. Output max + 10 dB (10 K ohms). Operation 220/240v. A.C. Size 215mm x 150mm x 120mm.
Price £27·50. Carr. 25p.



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MW1-6 60mm square	£3·97½
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P. & P. extra

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A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 megΩ 6 Ranges ±1% L.1 µ H - 111 HENRYS 6 Ranges2=%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 7⅜ x 5 x 2in. £20. P. & P. 25p

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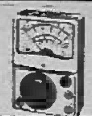
Built in gearbox. All brand new and boxed 60 RPM CW: 30 RPH CW; 2R/HR ACW; 2R/HR CW; 8R/DAY CW; 10 RPM CW; 50p each. Post 12p.

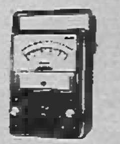


HIOKI MODEL 720X
20,000 O.P.V.
Overload protection.
5/25/100/500/1000 VDC.
10/50/250/1000 VAC.
50 uA/250 mA. 20K/2 meg ohm. −5 to + 62db.
£4·97. P. & P. 15p.

Model S-100TR MULTI-METER TRANSISTOR TESTER 100,000 o.p.v. MIRROR SCALE OVER-LOAD PROTECTION
0/·12—·6/3/12/30/120/600 V DC.
0/6/30/120/600 V. AC.
0/12/600uA/12/300MA/12 Amp. DC.
0/10K/1 MEG/100 MEG.
−20 to + 50 db.
0·01— ·2 mfu.
Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. £13·50, P.P. 25p.

MODEL 500 30,000 O.P.V. with overload protection mirror scale 0/·5/2·5/10/25/100/250/500/1,000 V. D.C. 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 Meg Ω. £8·87½. Post paid.

HT100B4 MULTI-METER
Features A.C. current ranges. 100,000 o.p.v. Mirror Scale. Overload protection.
0/·5/2·5/10/50/250/500/1000 V DC.
0/2·5/10/50/250/100 V AC.
0/10/250µA/2·5/25/250 mA/10 Amp. DC.
10 Amp. AC.
0/20K/200K/2MEG/20 MEG.
−20 + 62db.
£12·50. P. & P. 25p.



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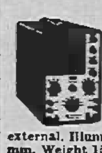
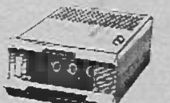
Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1000v D.C. 2·5/10/50/250/500/1000v A.C. DC Current 100 uA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3M Ω. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE £5·97 P. & P. 25p.

TO-3 PORTABLE OSCILLOSCOPE



3in. tube. Y amp. Sensitivity 0-1v p-p/CM. Bandwidth 1·5 cps–1·5 MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9v. p-p/CM. Bandwidth 1.5 cps -800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps–300 KHz. Synchronization. Internal/external. Illuminated scale 140 x 215 x 330 mm. Weight 15½ lb. 220/240V. A.C. Supplied brand new with handbook. £40·00. Carr. 50p

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0·2, ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100v. D.C. Input: Fully floating (3 poles). Input power: 110-230v. A.C. 50/60 cycles. Overall size: 5¼in. x 2 13/16in. x 8 3/16in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. £49·97½. Carr. 50p.

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2G303 20p	2N3440 97p	28104 25p	BC119 30p	BFX29 25p	NKT229 30p
2G306 42p	2N3564 17p	28301 50p	BC121 20p	BFX30 25p	NKT237 35p
2G308 30p	2N3565 15p	28302 50p	BC122 20p	BFX37 30p	NKT238 25p
2G309 30p	2N3566 22p	28303 80p	BC125 15p	BFX44 37p	NKT240 27p
2G371 15p	2N3568 25p	28304 75p	BC126 20p	BFX68 67p	NKT241 27p
2G374 20p	2N3569 25p	28501 32p	BC134 12p	BFX84 25p	NKT242 20p
2G381 22p	2N3570 125p	28502 35p	BC135 12p	BFX85 30p	NKT243 62p
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2N404 20p	2N3605 27p	3N83 40p	BC137 15p	BFX87 25p	NKT245 20p
2N696 15p	2N3606 27p	3N128 70p	BC138 20p	BFX88 20p	NKT261 20p
2N697 15p	2N3607 22p	3N140 77p	BC140 35p	BFX89 62p	NKT262 30p
2N698 25p	2N3638 18p	3N141 72p	BC141 35p	BFX93A 70p	NKT264 20p
2N699 30p	2N3638A 20p	3N142 55p	BC147 10p	BFY11 42p	NKT271 20p
2N706 10p	2N3641 18p	3N143 67p	BC148 10p	BFY18 25p	NKT262 20p
2N706A 12p	2N3642 18p	3N152 87p	BC149 12p	BFY19 25p	NKT274 20p
2N708 15p	2N3643 20p	40050 55p	BC152 17p	BFY21 42p	NKT275 20p
2N709 62p	2N3644 25p	40250 50p	BC153 20p	BFY24 45p	NKT278 25p
2N718 25p	2N3645 25p	40251 32p	BC154 20p	BFY29 40p	NKT281 27p
2N718A 30p	2N3691 15p	40309 32p	BC157 15p	BFY30 40p	NKT401 87p
2N726 30p	2N3692 18p	40310 45p	BC158 11p	BFY41 50p	NKT402 90p
2N727 30p	2N3693 15p	40311 35p	BC159 12p	BFY43 62p	MKT403 75p
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2N918 30p	2N3703 10p	40315 37p	BC168B 10p	BFY52 20p	NKT406 62p
2N929 22p	2N3704 11p	40316 47p	BC168C 11p	BFY53 15p	NKT451 62p
2N930 20p	2N3705 10p	40317 37p	BC169B 11p	BFY56A 57p	NKT452 62p
2N987 40p	2N3706 9p	40319 55p	BC169C 12p	BFY76 42p	NKT453 47p
2N1090 22p	2N3707 11p	40320 47p	BC170 12p	BFY77 57p	NKT713 20p
2N1091 22p	2N3708 7p	40323 32p	BC171 15p	BFY90 65p	NKT717 42p
2N1131 25p	2N3709 9p	40324 47p	BC172 15p	BSX19 17p	NKT734 27p
2N1132 25p	2N3710 9p	40326 37p	BC175 22p	BSX20 15p	NKT736 35p
2N1302 17p	2N3711 12p	40329 30p	BC177 20p	BSX21 20p	NKT773 25p
2N1303 17p	2N3713 187p	40344 27p	BC178 20p	BSX26 45p	NKT781 30p
2N1304 22p	2N3714 200p	40347 57p	BC179 20p	BSX27 47p	OC16 50p
2N1305 22p	2N3715 123p	40348 52p	BC182 10p	BSX28 32p	OC19 37p
2N1306 25p	2N3716 130p	40360 40p	BC182L 10p	BSX60 82p	OC20 75p
2N1307 25p	2N3773 240p	40361 40p	BC183 9p	BSX61 62p	OC22 50p
2N1308 25p	2N3791 206p	40362 50p	BC183L 9p	BSX76 15p	OC23 60p
2N1309 25p	2N3819 34p	40370 32p	BC184 11p	BSX77 20p	OC24 60p
2N1507 17p	2N3820 55p	40406 57p	BC184L 11p	BSX78 25p	OC25 40p
2N1613 20p	2N3823 50p	40407 40p	BC186 25p	BSY24 15p	OC26 25p
2N1631 35p	2N3854 27p	40408 52p	BC187 27p	BSY25 15p	OC28 60p
2N1632 30p	2N3854A 27p	40409 56p	BC212L 12p	BSY26 17p	OC29 60p
2N1637 30p	2N3855 27p	40410 62p	BC213L 12p	BSY27 15p	OC35 50p
2N1638 27p	2N3855A 30p	40412 50p	BC214L 15p	BSY28 17p	OC36 60p
2N1639 27p	2N3856 30p	40467A 57p	BCY10 27p	BSY29 17p	OC41 22p
2N1701 160p	2N3856A 35p	40468A 35p	BCY30 27p	BSY32 25p	OC42 25p
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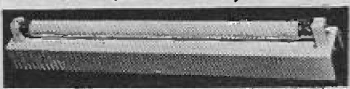

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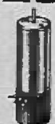

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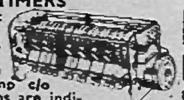

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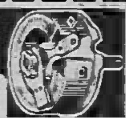

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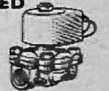

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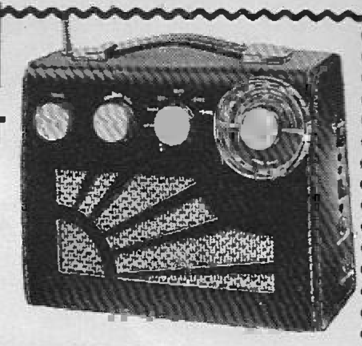

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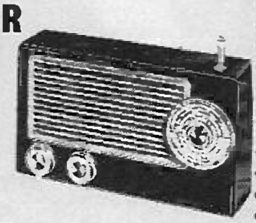

6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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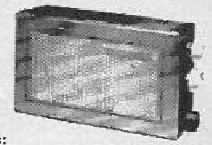

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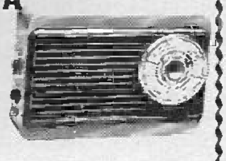

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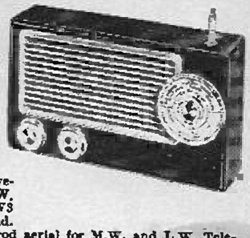

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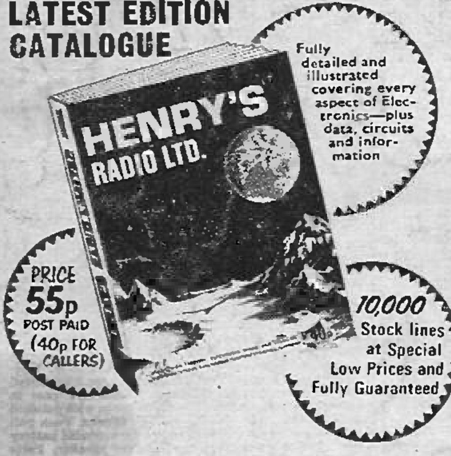

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SEE EARLIER PAGE FOR TRANSISTORS & DIODES, etc. FREE LIST No. 36 ON REQUEST

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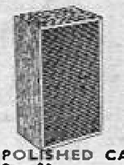

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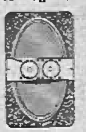

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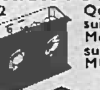
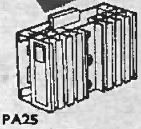
MPA12



Quality transformerless low noise amplifiers suitable for all Audio, PA and Hi-Fi use. Modern compact designs. PA25 and PA50 supplied with plug harness for use with MU442 Power Supply.



PA25

MPA12/3 18v. 0·8A. 12W. 3-4 ohm. £4·50
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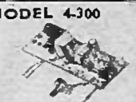

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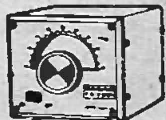

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Mains unit (optional) Model PS900 £2·47. Post 20p
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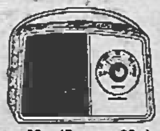

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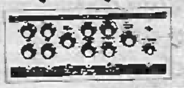

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