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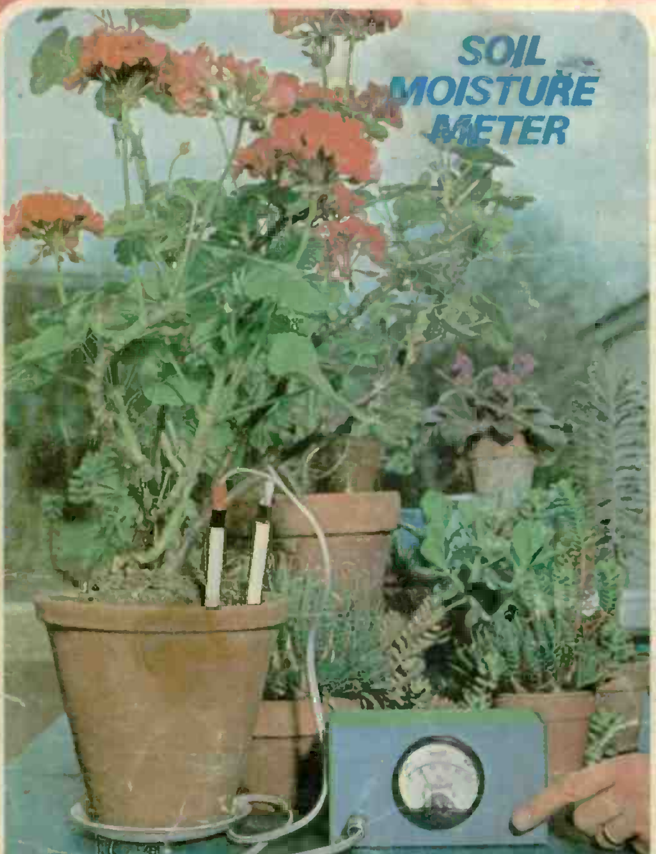

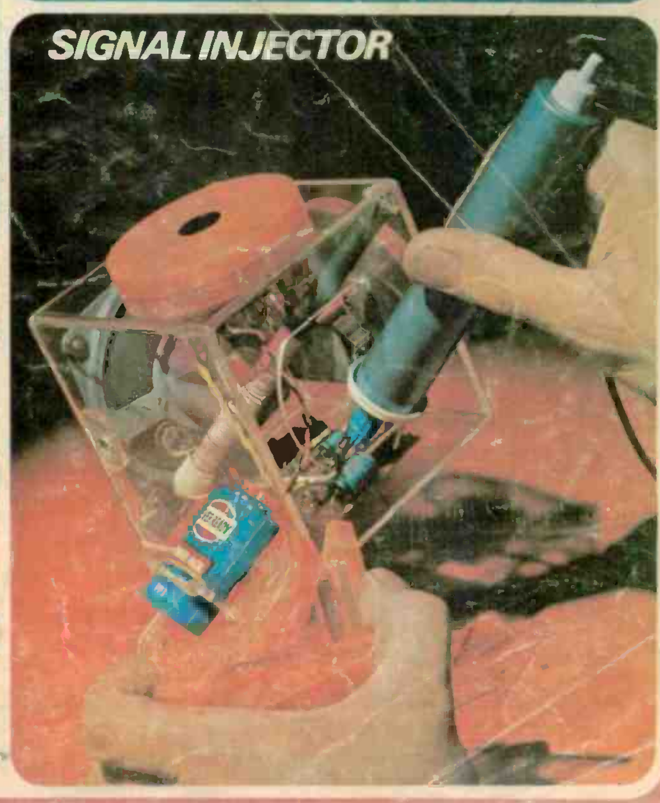

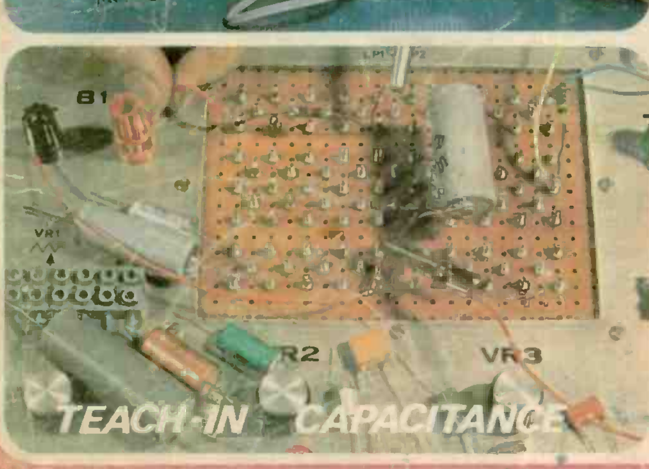

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Duo Type II
Size approx 17" x 10¾" x 6¾". Drive unit 13" x 8" with parasitic tweeter. Max. power 10 watts, 3 ohms. Simulated Teak cabinet.
£14 pair + £2 p&p.

Duo Type III. Size approx 23½" x 11½" x 9½". Drive unit 13½" x 8½" with H.F. speaker. Max. power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. **£32 pair** + £3 p&p.

SPECIFICATION R101

14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0·1%. *P.U.1* (for ceramic cartridges) 150mV into 3 Meg. *P.U.2* (for magnetic cartridges) 4mV @ 1kHz into 47K, equalised within ± 1dB R.I.A.A. *Radio* 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to −17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to −12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max) R101—P.U.1 and radio—65dB. P.U.2 −58dB. **R100** same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than −35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx 13¾" x 9" x 3¾".

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½	10%	3·3MΩ–10MΩ	E12	1·0p	0·8p
½	2%	10Ω–1M	E12	3·5p	3·0p
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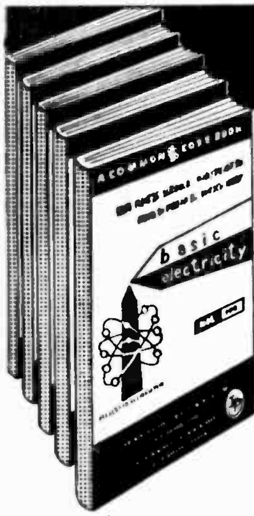

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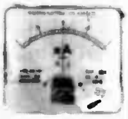

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100µA	£3·10	15V. A.C. ..	£2·80
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200µA	£3·00	8 Meter 1mA	£2·87
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500-0-500µA	£2·80	1 amp. A.C.*	£2·80
1mA	£2·80	5 amp. A.C.*	£2·80
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5mA	£2·80	20 amp. A.C.*	£2·80
10mA	£2·80	30 amp. A.C.*	£2·80

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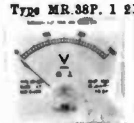

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		750mA	£1·60
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		10 amp. ..	£1·60
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50-0-50µA	£1·90	10V. D.C...	£1·60
100µA	£1·90	15V. D.C...	£1·60
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200µA	£1·75	100V. D.C.	£1·60
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500-0-500µA	£1·60	300V. D.C.	£1·60
1mA	£1·60	500V. D.C.	£1·60
1-0-1mA ..	£1·60	750V. D.C.	£1·60
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5mA	£1·60	50V. A.C...	£1·70
10mA	£1·60	150V. A.C.	£1·70
20mA	£1·60	300V. A.C.	£1·70
50mA	£1·60	500V. A.C.	£1·70
100mA	£1·60	8 Meter 1mA	£1·70
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10mA	£1·70	1 amp. A.C.*	£1·70
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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
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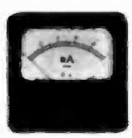
Type MR.65. 3½in. square fronts.



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		15 amp....	£1·90
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		50 amp....	£1·90
		5V. D.C. ..	£1·90
		10V. D.C. ..	£1·90
		20V. D.C. ..	£1·90
		50V. D.C. ..	£1·90
		150V. D.C.	£1·90
		300V. D.C.	£1·90
25µA	£3·50	30V. A.C.*	£1·95
50µA	£2·75	50V. A.C.*	£1·95
50-0-50µA	£2·35	150V. A.C.*	£1·95
100µA	£2·35	300V. A.C.*	£1·95
100-0-100µA	£2·25	500mA A.C.*	£1·95
500µA	£2·20	1 amp. A.C.*	£1·95
1mA	£1·90	5 amp. A.C.*	£1·95
1-0-1mA ..	£1·90	10 amp. A.C.*	£1·95
5mA	£1·90	20 amp. A.C.*	£1·95
10mA	£1·90	30 amp. A.C.*	£1·95
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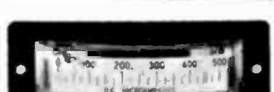
1mA	£4·40	300V d.c.	£4·40
50-0-50µA ...	£4·65		
1-0-1mA.....	£4·40	Dual range	
1A d.c.	£4·40	500mA/5A d.c.	£4·65
5A d.c.	£4·40	5V/50V d.c...	£4·65
10V d.c.	£4·40		



EDGWISE METERS

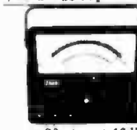
Type PE.70. 3 17/32in. × 1 15/32in. × 2½ in. deep.

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.

MULTIMETERS for EVERY purpose!

MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/.6/3/15/60/300/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30uA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm—20 to +63 db. £5·97½. P. & P. 15p.



MODEL PL436 20kΩ/Volt D.C. 8kΩ/Volt A.C. Mirror scale. ·6/3/12/30/120/600V D.C. 3/30/120/600V A.C. 50/600uA/60/600 mA. 10/100K/1 Meg/10 MegΩ. −20 to +46db. £6·97½ P & P 12½p.

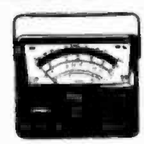
MODEL 5025 57 Ranges. Giant 5½in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: ·125, ·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 501A, 2·5, 5, 25, 50, 250 500mA, 5, 10 amp. Resistance: 2K, 10K 100K, 1MEG, 10 MEG. Decibels: −20 to +85 dB. £12·50. P. & P. 17½p.

TMK MODEL TW-20CB FEATURES RESETTABLE OVERLOAD BUTTON. Sensitivity: 20K Ω/Volt D.C. 5K Ω/Volt A.C. D.C. Volts: 0–0.5, 2.5, 10, 50, 250, 1,000V. A.C. Volts 0–2.5, 10, 50, 250, 1,000V. D.C Currents: 0–0.05, 0.5, 5, 50, 500mA. Resistance: 0–5K.50K, 0-500K. 5 MEGΩ. Decibels: −20 to +52 db. £11·50. P. & P: 17½p.

ROUND SCALE TYPE PENCIL TESTER MODEL TS.68

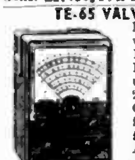
Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY £1·97 P. & P. 13p

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



Battery operated. 11 meg input, 26 ranges. Large 4½" mirror scale. Size 5¼" x 4½" x 2½". DC VOLTS 0 3–1200V. AC VOLTS 3–300V RMS. 8·0–800V P-P. DC CURRENT ·12–12MA Resistance up to 2000M ohm. Decibels −20 to +51 db Complete with leads/instructions. £17.50. P. & P. 20p.

TE-65 VALVE VOLTMETER



High quality instrument with 28 ranges. D.C.volts 1·5–1,500v. A.C. volts 1·5—1,500v. Resistance up to 1,000 megohms. 200/240v. A.C. operation. Complete with probe and instructions.
£17·50. P. & P. 30p. Additional probes available: R.F. £2·12½; H.V. £2·50.

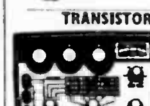
TE22 SINE SQUARE WAVE AUDIO GENERATORS

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 and leads. £17·50. Carr. 37½p.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V A.C.
Brand new with instruction. £17·50 P. & P. 37½p. S.A.E. for details.

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



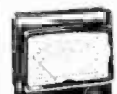
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 megΩ 6 Ranges ±1% L.1 µ H · 111 HENRYS 6 Ranges2 = %C. 10pF ± 1110mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000–1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100µA. Meter indication. Attractive 2 tone metal case. Size 7½ × 5 × 2in. £20. P. & P. 25p

MODEL LT.101 1000 O.P. V 0/10/50/250/1000 V. D.C. 0/10/50/250/1000 V. A.C. 0/1/100 M.A. 0/150 K ohms. £1·97. P. & P. 15p.

MODEL TE-200 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V. D.C. 0/10/50/250/1,000V. A.C. 0/50 µA/250 mA. 0/60K/6 megΩ. P. & P. 15p.

TMK MODEL MD.120 Mirror scale. 20k/Volt D.C. 10k Ω Volt A.C. 30/60/300/600/3,000 V. D.C. 6/120/1,200 V. A.C. Current 0-60uA/0 — 12/0 300mA. 0-60K/0·6 MegΩ. −20 to + 63 dB. £4·62½ P & P 15p

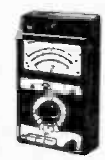
MODEL 500 30,000 O.P.V with overload protection mirror scale 0/·5/2·5/10/25 100/250/500/1,000v. D.C 0/2·5/10/25/100/250/500/1,000V. A.C. 0/50µA/5/50/500mA. 12 amp. D.C. 0/60/K/6 Meg./60 MegΩ. £8·87½. Post paid.



TMK LAB TESTER. 100,000 O.P.V. 6½in. Scale Buzzer Short Circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K /Volt A.C. D.C. Volts: ·5, 2·5, 10, 50, 250, 1,000 V. A.C. Volts: 3, 10, 50, 50, 250, 500, 1,000V. D.C. Current: 10, 100µA, 10, 100, 500mA, 2·5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100 MEGΩ. Decibels: −10 to +49 db. Plastic Case with Carrying Handle. Size 7½in. x 6½in. x 3½in. £18·90. P. & P. 25p.

U4312 MULTIMETER

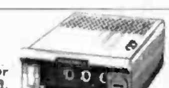
Extremely sturdy instrument for general electrical use. 667 o.p.v.
0/·3/1·5/7·5/30/60/150/300/600/900 VDC and 75mV.
0/·3/1·5/7·5/30/60/150/300 600/900VAC.
0/300uA/1·5/6/50/60/150/600MA/1·5/6 AMP. D.C.
0/1·5/6/15/60/150/600MA/1.5/6 AMP. AC.
0/200 Ω/3K/30K Ω.
Accuracy DC 1%. AC 1·5%. Knife, edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. £9·50 plus P. & P. 25p.



RUSSIAN 22 RANGE MULTIMETER

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 wA/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.

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: 5½in. 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	2S104	25p	BC119	30p	BFX29	25p	NKT229	30p
2G306	30p	2N3564	17p	2S301	50p	BC121	20p	BFX30	25p	NKT237	35p
2G308	30p	2N3565	15p	2S302	50p	BC122	20p	BFX37	30p	NKT238	25p
2G309	30p	2N3566	22p	2S303	60p	BC125	15p	BFX44	37p	NKT240	27p
2G371	15p	2N3568	25p	2S304	75p	BC126	25p	BFX68	67p	NKT241	27p
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2G381	22p	2N3570	125p	2S502	35p	BC135	12p	BFX85	30p	NKT243	62p
2N388A	49p	2N3572	97p	2S503	27p	BC136	15p	BFX86	25p	NKT244	17p
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	12p	2N3643	20p	40050	55p	BC152	17p	BFY21	42p	NKT276	20p
2N709	45p	2N3644	25p	40250	50p	BC153	20p	BFY24	45p	NKT278	25p
2N718	25p	2N3645	25p	40251	32p	BC154	20p	BFY29	40p	NKT281	27p
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2N727	25p	2N3693	15p	40311	35p	BC159	12p	BFY43	62p	NKT403	75p
2N914	17p	2N3694	18p	40312	47p	BC160	35p	BFY50	20p	NKT404	55p
2N916	17p	2N3702	10p	40314	37p	BC167	11p	BFY51	20p	NKT405	75p
2N918	30p	2N3703	10p	40315	37p	BC168B	12p	BFY52	20p	NKT406	62p
2N929	22p	2N3704	12p	40316	47p	BC168C	12p	BFY53	15p	NKT451	62p
2N930	20p	2N3705	10p	40317	37p	BC169B	14p	BFY56A	57p	NKT452	62p
2N937	52p	2N3706	10p	40319	55p	BC169C	15p	BFY76	42p	NKT453	47p
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2N1091	22p	2N3708	10p	40323	32p	BC171	15p	BFY90	65p	NKT717	42p
2N1131	25p	2N3709	10p	40324	47p	BC172	15p	BSX19	17p	NKT734	27p
2N1132	25p	2N3710	10p	40326	37p	BC175	22p	BSX20	15p	NKT736	35p
2N1302	17p	2N3711	10p	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	220p	40348	52p	BC182	12p	BSX28	32p	OC19	37p
2N1306	25p	2N3716	255p	40360	40p	BC182L	10p	BSX60	82p	OC20	85p
2N1307	25p	2N3773	240p	40361	40p	BC183	9p	BSX61	62p	OC22	50p
2N1308	25p	2N3791	275p	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	35p
2N1631	35p	2N3854	27p	40408	52p	BC187	27p	BSY25	15p	OC28	60p
2N1632	30p	2N3854A	27p	40409	55p	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	162p	2N3856A	35p	40468A	35p	BCY30	30p	BSY32	25p	OC42	40p
2N1711	24p	2N3858	25p	40528	72p	BCY31	40p	BSY36	25p	OC44	15p
2N1889	32p	2N3858A	30p	40600	57p	BCY32	60p	BSY37	25p	OC45	12p
2N1893	37p	2N3859	27p	40603	50p	BCY33	30p	BSY38	20p	OC46	15p
2N2147	72p	2N3859A	32p	AC107	30p	BCY34	35p	BSY39	22p	OC70	15p
2N2160	57p	2N3860	30p	AC126	20p	BCY38	45p	BSY43	50p	OC71	12p
2N2193	40p	2N3866	150p	AC127	24p	BCY39	60p	BSY51	30p	OC72	12p
2N2193A	42p	2N3877	40p	AC128	20p	BCY40	50p	BSY52	32p	OC73	30p
2N2194	27p	2N3877A	40p	AC151	18p	BCY41	15p	BSY53	32p	OC74	30p
2N2194A	30p	2N3900	37p	AC152	22p	BCY42	15p	BSY54	40p	OC75	25p
2N2217	25p	2N3900A	40p	AC154	22p	BCY43	15p	BSY56	90p	OC76	25p
2N2218	20p	2N3901	97p	AC176	20p	BCY54	32p	BSY79	45p	OC77	40p
2N2219	20p	2N3903	20p	AC187	25p	BCY58	22p	BSY90	57p	OC78	20p
2N2220	25p	2N3904	25p	AC188	22p	BCY59	22p	BSY95A	12p	OC81	20p
2N2221	25p	2N3905	30p	ACY17	27p	BCY60	97p	C424	15p	OC81D	20p
2N2222	20p	2N3906	25p	ACY18	24p	BCY70	15p	C450	15p	OC82	25p
2N2222A	25p	2N4058	12p	ACY19	24p	BCY71	20p	GET102	35p	OC82D	15p
2N2297	30p	2N4059	10p	ACY20	20p	BCY72	15p	GET113	25p	OC83	25p
2N2368	15p	2N4060	12p	ACY21	20p	BCY78	30p	GET114	20p	OC84	25p
2N2369	15p	2N4061	12p	ACY22	10p	BCY79	30p	GET118	20p	OC139	25p
2N2369A	15p	2N4062	12p	ACY28	17p	BCZ10	27p	GET120	25p	OC140	40p
2N2410	42p	2N4244	47p	ACY39	47p	BCZ11	40p	GET873	12p	OC170	25p
2N2483	27p	2N4248	15p	ACY40	14p	BD112	50p	GET880	45p	OC171	30p
2N2484	32p	2N4249	15p	ACY41	15p	BD116	112p	GET887	15p	OC200	40p
2N2539	22p	2N4250	18p	ACY44	25p	BD121	65p	GET889	22p	OC201	75p
2N2540	22p	2N4254	42p	AD140	47p	BD123	80p	GET890	22p	OC202	80p
2N2613	35p	2N4255	42p	AD149	47p	BD124	75p	GET896	22p	OC203	40p
2N2614	30p	2N4284	17p	AD150	62p	BD131	75p	GET897	22p	OC204	40p
2N2646	47p	2N4285	17p	AD161	35p	BD132	80p	GET898	22p	OC205	75p
2N2711	25p	2N4286	17p	AD162	35p	BDY10	125p	MAT100	25p	OC206	95p
2N2712	25p	2N4287	17p	AF109	45p	BDY20	105p	MAT101	25p	OC207	75p
2N2713	27p	2N4288	15p	AF114	25p	BDY61	125p	MAT120	25p	OCP71	42p
2N2714	30p	2N4289	12p	AF115	25p	BDY62	100p	MAT121	25p	ORP12	50p
2N2904	20p	2N4290	12p	AF116	25p	BF115	25p	MJ400	107p	ORP60	40p
2N2904A	25p	2N4291	15p	AF117	20p	BF117	47p	MJ420	80p	ORP61	42p
2N2905	25p	2N4292	15p	AF118	44p	BF152	28p	MJ421	80p	P346A	22p
2N2905A	25p	2N4294	17p	AF121	30p	BF164	20p	MJ430	102p	ST140	15p
2N2906	20p	2N4303	47p	AF124	22p	BF158	15p	MJ440	95p	ST141	20p
2N2906A	25p	2N4964	15p	AF125	19p	BF159	35p	MJ480	97p	TI834	62p
2N2907	22p	2N4965	18p	AF126	16p	BF163	35p	MJ481	125p	TI843	40p
2N2923	15p	2N5027	52p	AF127	16p	BF167	25p	MJ490	100p	TI844	12p
2N2924	15p	2N5028	57p	AF139	28p	BF173	33p	MJ491	127p	TI845	12p
2N2925	15p	2N5029	47p	AF178	42p	BF173	30p	MJE340	50p	TI846	12p
2N2926G	12p	2N5030	42p	AF179	45p	BF177	30p	MJE370	30p	TI847	12p
2N2926O	12p	2N5172	12p	AF180	50p	BF178	25p	MJE371	80p	TI848	12p
2N2926Y	12p	2N5174	52p	AF181	40p	BF179	30p	MJE520	75p	TI849	12p
2N3011	20p	2N5175	52p	AF186	39p	BF180	35p	MJE521	70p	TI850	12p
2N3014	25p	2N5176	45p	AF239	30p	BF181	35p	MPF102	42p	TI851	10p
2N3053	20p	2N5232A	30p	AF279	47p	BF182	30p	MPF103	35p	TI852	11p
2N3054	49p	2N5245	45p	AF280	47p	BF184	20p	MPF104	37p	TI853	22p
2N3055	72p	2N5246	42p	APZ11	32p	BF185	30p	MPF105	37p	XB112	12p
2N3133	25p	2N5249	67p	ASY26	25p	BF194	15p	MPS3638	32p	XC141	35p
2N3134	30p	2N5265	325p	ASY27	30p	BF195	15p	NKT124	42p	ZTX107	15p
2N3135	20p	2N5305	37p	ASY28	24p	BF196	15p	NKT125	27p	ZTX108	12p
2N3136	25p	2N5306	40p	ASY29	27p	BF197	15p	NKT126	27p	ZTX109	15p
2N3390	25p	2N5307	37p	ASY50	25p	BF198	15p	NKT128	27p	ZTX300	12p
2N3391	20p	2N5308	37p	ASY51	32p	BF200	35p	NKT135	27p	ZTX301	15p
2N3391A	30p	2N5309	62p	ASY54	25p	BF224	14p	NKT137	32p	ZTX302	20p
2N3392	17p	2N5310	42p	ASY67	45p	BF225	19p	NKT210	30p	ZTX303	20p
2N3393	15p	2N5354	27p	ASY86	32p	BF237	22p	NKT211	30p	ZTX304	25p
2N3394	15p	2N5355	27p	ASZ21	51p	BF238	22p	NKT212	30p	ZTX500	15p
2N3402	22p	2N5356	32p	AUY10	150p	BF244	32p	NKT213	30p	ZTX501	15p
2N3403	22p	2N5365	47p	BC107	10p	BFW61	47p	NKT214	20p	ZTX502	20p
2N3404	32p	2N5366	32p	BC108	10p	BFW87	25p	NKT215	22p	ZTX503	17p
2N3405	45p	2N5367	57p	BC109	10p	BFW88	23p	NKT216	35p	ZTX504	40p
2N3414	22p	2N5457	30p	BC113	10p	BFW89	20p	NKT217	40p	ZTX531	25p

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CA3039	82p
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CA3042	109p
CA3043	137p
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CA3045	122p
CA3046	81p
CA3047	137p
CA3048	204p
CA3049	160p
CA3050	125p
CA3051	134p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	108p

FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
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IC12	250p
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L923	40p
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SN7453	20p
SN7454	20p
SN7460	20p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
SN7493	87p
SN7495	87p
SN7496	87p
SN74107	52p
SN74153	140p
SN74154	220p
SN74160	180p
SN74161	260p
SN74164	220p
SN74165	225p
SN74192	175p
SN74193	175p
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TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
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TAA435	147p
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4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
4006 800PIV	12p	15p	27p
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50+ less 15% 100+ less 20%

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600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50+ less 15% 100+ less 20%

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3·3-33 V	2·4—100	3·9—100V
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6AK5	35p	50B5	50p	PC97	45p
6AK6	60p	50C5	50p	PC900	48p
6AL5	20p	80	55p	PCC84	40p
6AM6	30p	85A2	50p	PCC85	40p
6AQ5	38p	807	50p	PCC88	55p
6AS6	40p	1625	50p	PCC89	50p
6AT6	35p	5763	70p	PCC189	55p
6AU6	25p	6146	160p	PCF80	30p
6AV6	35p	AZ31	55p	PCF82	34p
6BA6	25p	CY31	35p	PCF84	60p
6BE6	30p	DAF91	30p	PCF86	60p
6BH6	75p	DAF96	45p	PCF800	80p
6BJ6	50p	DF91	22p	PCF801	50p
6BQ7A	40p	DF96	45p	PCF802	50p
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6BW6	85p	DK96	50p	PCF808	75p
6BW7	80p	DL92	35p	PCL82	35p
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6C4	33p	DL96	45p	PCL84	45p
6CD6	125p	DM70	45p	PCL85	45p
6CL6	50p	DY86	32p	PCL86	45p
6CW4	65p	DY87	33p	PFL200	65p
6F1	62p	E88CC	100p	PL36	55p
6F6G	35p	E180F	100p	PL81	50p
6F13	45p	EABC80	35p	PL82	45p
6F14	70p	EAF42	35p	PL83	45p
6F15	65p	EB91	20p	PL84	40p
6F18	50p	EBC41	55p	PL500	75p
6F23	85p	EBC81	30p	PL504	80p
6H6	17p	EBF80	40p	PY32	55p
6J4	50p	EBF83	40p	PY33	63p
6J5	25p	EBF89	32p	PY80	40p
6J5GT	30p	EBL21	60p	PY81	30p
6J6	20p	EC86	60p	PY82	35p
6J7	45p	EC88	60p	PY83	33p
6K8G	40p	ECC40	65p	PY88	40p
6L6GT	45p	ECC84	30p	PY800	40p
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6Q7	40p	ECC88	40p	U25	80p
6SA7	40p	ECF80	35p	U26	80p
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6SJ7	40p	ECF86	65p	U52	35p
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12AX7	30p	EF89	29p	UCL82	35p
12AV6	40p	EF91	30p	UCL83	60p
12BA6	40p	EF92	35p	UF41	60p
12BE6	40p	EF183	35p	UF80	35p
12BH7	45p	EF184	35p	UF85	40p
19AQ5	35p	EH90	40p	UF89	40p
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20F2	65p	EL33	£1·25	UL84	40p
20L1	£1·10	EL41	60p	UY41	48p
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AA119	7p	BAY31	7p	OA10	25p
AA129	10p	BAY38	15p	OA9	10p
AAZ13	10p	BY100	15p	OA47	10p
AAZ15	10p	BY103	22p	OA70	10p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	10p
BA110	25p	BY126	12p	OA81	8p
BA111	37p	BY127	15p	OA85	7p
BA112	70p	BY164	57p	OA90	8p
BA115	7p	BY210	35p	OA91	7p
BA141	32p	BYZ11	30p	OA95	7p
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Input 8-16 Ω Frequency 20-18,000 Hz stereo or mono switch, separate volume controls each earpiece, padded headband. £3·97, p/p 20p

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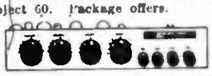

2 x Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. £16·75 Carr. 37½p. Or with PZ6 power supply £18·85 Carr. 37½p. 2 x Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. £20·25. Carr. 37½p.
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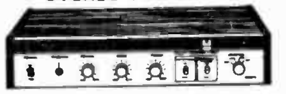
TELETON SAQ-206B STEREO AMPLIFIER



Latest exciting release. Brand new model. 6 + 6 watts rms. Inputs for mag, xtal, aux tape. Volume, bass, treble, sliding balance, scratch filter and loudness controls. List £32.50 OUR PRICE £19·95 Carr. 37p.

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● SUGGESTED SYSTEM ●
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★ TRANSISTORISED FM TUNER

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

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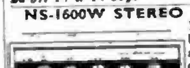
All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9v battery. Inputs 5MU/100MU. Output 50MW. £5·97. P. & P. 15p.

NS-1600W STEREO AMPLIFIER



Exceptional budget price amplifier. All silicon transistor. Handsome Walnut case. Switched input selector, separate balance, volume, treble, bass controls. Output 2 x 6W RMS. Inputs Mag. Tape. Xtal, Tuner, Tape Out. £14·75. Carr. 37p.

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Self contained, transistorised, battery operated. Simply plug in microphone, guitar, etc., and output into your amplifier. Volume control, depth of reverberation control. Beautiful walnut cabinet. 7½ x 3 x 4½in. £5·97, P. & P. 15p.

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Moving coil. Ideal for language teaching, communications. Headphone imp. 16 ohms. Microphone imp. 200 ohms. £4 62. P. & P. 15p.

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

Model S-100TR MULTI-METER/TRANSISTOR TESTER 100,000 o.p.v. MIRROR SCALE/OVER-LOAD PROTECTION

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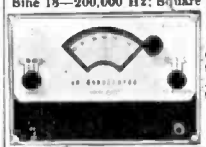
0/6/30/120/600 V. AC.
0/12/600uA/12/300MA/12 Amp. DC.
0/10K/1 MEG/100 MEG.
−20 to + 50 db. 0·01 — ·2 mfd.
Transistor tester measures Alpha, beta and Ico.
Complete with batteries, instructions and leads. £13·50. P/P 25p.

MCA. 220 AUTOMATIC VOLTAGE STABILISER

Input 88-125 VAC or 176-250VAC. Output 120VAC or 240VAC. 200VA rating. £11·97. Carr. 30p.

BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Sine 18—200,000 Hz; Square 18—50,000 Hz



Output max. + 10 dB (10 K ohms) Operation internal batteries Attractive 2-tone case 7½" × 5" × 2". Price £17·50. Carr. 17½p.

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TE-16A Transistorised Signal Generator. 5ranges 400kHz—30mHz. An inexpensive instrument for the handyman. Operates on 9v. battery. Wide easy to read scale. 800kHz modulation. 5¼ × 5¼ × 3¼in. Complete with instructions and leads. £7·97½. P. & P. 20p.

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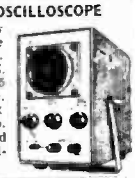

A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS–1 MHZ. Input imp. 2 meg Ω 25 P.F. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240 V a.c. Supplied brand new with handbook. £22.50. Carr. 50p.

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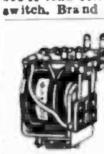
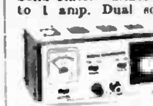
Variable range 0-111dB. Connections, Unbalanced T and Bridge T. Impedance 600 Ω range (0.1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (−3dB). Accuracy: 0.05dB. + Indication dB × 0.01. Maximum input less than 4W (50V). Built in 600 Ω load resistance with internal/external switch. Brand new. £27·50. P. & P. 25p.

230 VOLT A.C. 50 CYCLES RELAYS



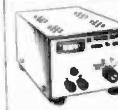
Brand new. 3 sets of changeover contacts at 5 amp rating. 50p each. P. & P. 10p (100 lots £40) Quantities available.

RP214 REGULATED POWER SUPPLY



Solid state. Variable output 0-24V DC up to 1 amp. Dual scale meter to monitor voltage and current. Input 220/240V AC. Size 185 x 85 x 105mm. £8·97 P. & P. 25p.

PS.1000B REGULATED POWER SUPPLY



Solid state. Output 6, 9 or 12 volt DC up to 3 amps. Meter to monitor current. Input 220/240v AC. Size 4" × 3½" × 6½". £11·97. P. & P. 25p.

UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 550kc/s-30mc/s. FET. S Meter, Variable BFO for SSB, Built-in Speaker, Bandspread, Sensitivity Control. 220/240v. A.C. or 12v. D.C. 12½" x 4½" x 7". Brand new with instructions. £25. Carr. 37½p.

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General coverage 150–400kc/s, 550 kc/s–30mc/s. FET front end. 2 mech. filters, product detector, variable B.F.O., noise limiter, S. Meter, Bandspread. RF Gain. 15" x 9½" x 8½". 18 lbs. 220/240v. A.C. or 12v. D.C Brand new with instructions. £45. Carr. 50p.

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Built in gearbox. All brand new and boxed. 60 RPM CW; 30 RPM CW; 2k/HR ACW; 2R/HR CW; 8R/DAY CW; 10 RPM CW; 20R/HR ACW.
50p each Post 12p.

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

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

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500 W.	£4·97½	P. & P. 32½p
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Transistorised Treasure Locator

This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, COINS, JEWELLERY, ARCHAEOLOGICAL PIECES ETC. ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards*, with the clear, easy to follow, step-by-step, fully illustrated instructions—Uses standard PP3 battery. No soldering necessary. Kit includes nuts, screws, wire, etc. **ONLY £2·37** + 27p p. & p. (Sectional handle as illustrated 75p extra). Parts available separately. Made up looks worth £15!

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SHORTWAVE TRANSISTOR RADIO

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Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins. — **Russia, Africa, USA, Switzerland, etc.** Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PP3 battery. Size only 3" x 4½" x 1½" Only £2·25 + 17p p. & p. Kit includes cabinet, screws, instructions, etc. (Parts available separately).

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Don't confuse with ordinary electronic organs that simply blow air over mouth-organ type reeds etc. Fully transistorised. **SELF CONTAINED LOUDSPEAKER.** *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night", play "Auld Lang Syne" etc. etc.* You have the thrill and excitement of building it together with the pleasure of playing a real, live, portable electronic organ. **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED.** No soldering necessary, Simple as ABC to make. *Anyone over nine years can build it easily in one short evening following the fully illustrated step-by-step, simple instructions.* **ONLY £2·75** + 23p p. & p. for kit, including case, nuts, screws, simple instructions, etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

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Find buried treasure with this READY BUILT & TESTED TREASURE LOCATOR MODULE

ONLY **£4·95**

FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, water, etc.—EASILY LOCATES COINS, GOLD, SILVER, JEWELLERY, HISTORICAL RELICS, BURIED PIPES, ETC. Signals exact location by "beep" pitch increasing as you near buried metallic objects. *So sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND!** GIVES CLEAR SIGNAL ON ONE COIN! £4·95 + 30p carr. etc. (High quality Danish Stethoscope head-phones £2·75 extra if required.) **EXAMINE AT HOME FOR 7 DAYS. YOUR MONEY REFUNDED IN FULL IF NOT 100% DELIGHTED.**

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON

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CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the RELAXATRON is basically a pink noise generator. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops!—a well known type of pink noise. IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX—then build this fantastic Relaxatron. Once used you will never want to be without it—TAKE IT ANYWHERE. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones. Components, nuts, screws, wire, etc. no soldering.
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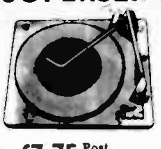

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13¼ × 11¼in. Above motor board 3¼in. below motor board 2¼in. with STEREO and MONO XTAL **£7·75** Post 25p.

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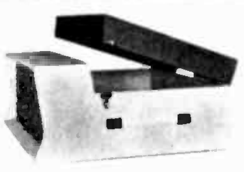

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£5·75 Post 25p

Comprising a fine example of a Wooler 10¼ × 6¼in. 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 3¼in. square has a special light-weight paper cone and magnet flux 10,000 lines.

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

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RA2W Ferrite Aerial	65p	Spare Cores	3p
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I.F. P50/2CC 470 kc/s.	33p	Printed Circuit, PCA1	50p
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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
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Ideal for Mike, Tape, P.U., Guitar. Can be used with Battery 9-12v or H.T. line 200-300v D.C. operation. Size 1¼" x 1¾" x 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

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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
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100/25V	10p	32+32/350V	25p		

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1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF. 15V. 10p.
500mF. 12V. 15p; 25V. 20p; 50V. 30p.
1000mF. 12V. 17p; 25V. 35p; 50V. 47p; 100V. 70p.
2000mF. 6V. 25p; 25V. 42p; 50V. 57p.
2500mF. 50V. 62p; 3000mF. 25V. 47p; 50V. 65p.
5000mF. 6V. 25p; 12V. 42p; 25V. 75p; 35V. 85p; 50V. 95p.

CERAMIC 1pF to 0·01 mF. 4p. Silver Mica 2 to 5000pF. 4p.
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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.
CHROME TELESCOPIC AERIAL, swivel base, 23in. 20p.
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
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WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt. 10 ohms to 100K, 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p.

SCOOP! METAL PLINTH AND PLASTIC COVER

Cut out ready for Garrard or B.S.R. Will play with cover in position. Latest design. Covered in black leatherette. Antimagnetic. 12¼ × 14¾ × 7¼in. **£5·50** Post 25p

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MINIATURE 200 v. 20mA., 6·3 v. 1 a. 2½ × 2½ × 2in.	75p
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GENERAL PURPOSE LOW VOLTAGE. Tapped Outputs at 2 amp. 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £2·25
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2 amp. 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £3·25
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CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v., 1½ amp., £1·50; 2 amp £1·50; 4 amp. £2·50.
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E.M.I. 13½ × 8in. LOUDSPEAKERS

With twin tweeters and crossover. 10 watt. State 3 or 8 or 15 ohm. (As illustrated) **£4** 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. **£2·25** Post 15p

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

10W MINI-MODULE LOUDSPEAKER KIT **£3·25** Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 8 ohm matching. TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9in. Modern design with fluted wood front. Highly recommended. **£5** Post 25p

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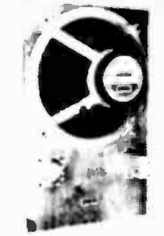

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LOUDSPEAKERS P.M. 3 OHMS. 6½in. £1.10; 8 × 5in. £1·25; 8in. £1.75; 10 × 6in. £1.90.
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GOODMAN'S OUTPUT TRANSFORMER 5 WATT MULTI-RATIO EL84 etc., 3, 8 and 15 ohms 80p. Post 20p.

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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 3¼ × 2¼ × 2¼in. (illustrated). **£1·25**

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120v. or 240v. A.C. 1,200 r.p.m. 4 pole 50mA. Spindle ⅛ × 3/20. Size 2¼ × 2¼ × 1¼in. Post 15p **85p**

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everyday electronics

PROJECTS...
THEORY......

BROADMINDED

A word of caution to newcomers. You'll have to be broadminded to read and enjoy this magazine.

Once upon a time the predominant reason for taking up "electronics" as a hobby was an interest in building radio receivers. But, as is now generally appreciated, radio is merely one special application or branch of this all-embracing technology.

The great expansion in uses of electronic circuits over the last two decades has been of untold benefit to the ordinary person. No longer is an interest in one particular specific application the requisite for involvement in the most exciting technology of the age. Electronics is wide open to *all* who want to use it.

AN ALL-PURPOSE TOOL

This is no exaggeration. The projects for the private constructor already published in these pages should have made this clear. And new readers can be assured that future designs will demonstrate even further how versatile and how useful is the electronic circuit—even in its simplest form.

Electronics is the all-purpose tool everyone can use to add to comfort or convenience at home, or to assist in the greater enjoyment of other spare time pursuits. Its practical applications know no bounds, and as a mind broadener, we reckon a lively interest in electronics has no equal.

COMMON GROUND

So it's not surprising that our pages have become a meeting place for a great variety of individuals, including, for example, photographers, motorists, gardeners, and pop musicians; not to mention those legions of handymen whose interests are less specific but who are always ready and eager to seize upon a likely project for use in or around the home. Where else are such diverse interests likely to find common ground?

So if you consider yourself to be broadminded, EVERYDAY ELECTRONICS should suit you. Join the growing band of electronics constructors who have fun building our designs and enjoy the benefits that electronic aids can provide.

Our April issue will be published on Friday, March 17

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.....EASY TO CONSTRUCT
.....SIMPLY EXPLAINED

VOL. I NO. 5

MARCH 1972

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Approximate cost of components

£

The approximate cost of components given, for constructional articles, in the box shown opposite is an estimated cost compiled from suppliers current catalogue and advertised prices. Parts for some projects may work out more expensive while others may be cheaper than our quoted price, depending on where the components are purchased.

We would like to point out that we, as publishers, cannot supply kits of parts or individual items for any of the published designs.

The circuit diagram of a timer which can be used in conjunction with an enlarger to provide stable exposure control is shown in Fig. 1. Stability is achieved by using a tantalum capacitor in the timing circuit and high stability resistors of the metal oxide type could also be used in the timer where extended range coupled with good stability is desired.

CIRCUIT DESCRIPTION

The delay is achieved by charging the tantalum capacitor C1 through resistor R_t. When the voltage across the capacitor exceeds the trigger voltage of the unijunction transistor TR1 the unijunction turns on and C1 discharges rapidly through R3 producing a short pulse of current. This pulse is amplified by TR2 and turns on the silicon controlled rectifier CSR1.

In the off state almost the total d.c. supply voltage is dropped across the relay coil and the relay is energised. Current may then flow through the load via relay contacts RLA2 while at the same time the other relay contact RLA1 latches the circuit d.c. supply. When CRS1 turns on it short circuits the relay which is de-energised and its contacts return to the normally open state switching off the load supply and also the timer supply.

A timing cycle is initiated by pressing the two-pole push-on/release-off switch. This allows the relay to latch its contacts, switching on the lamp, while at the same time the capacitor has any residual charge on it removed by shorting it to the ground line. When switch S2 is released the capacitor begins to charge and the timing cycle begins. Obviously variations of R_t will vary the rate at which C1 charges and hence vary the delay before the load is turned off.

Switch S3 is provided to allow manual override of the timer to allow focusing and exposure measurement to be carried out.

DARKROOM TIMER

A variable range timer designed for photographic work but suitable for any application needing a timed range from 0 to 4½ minutes

By Robert A. Shackleford.

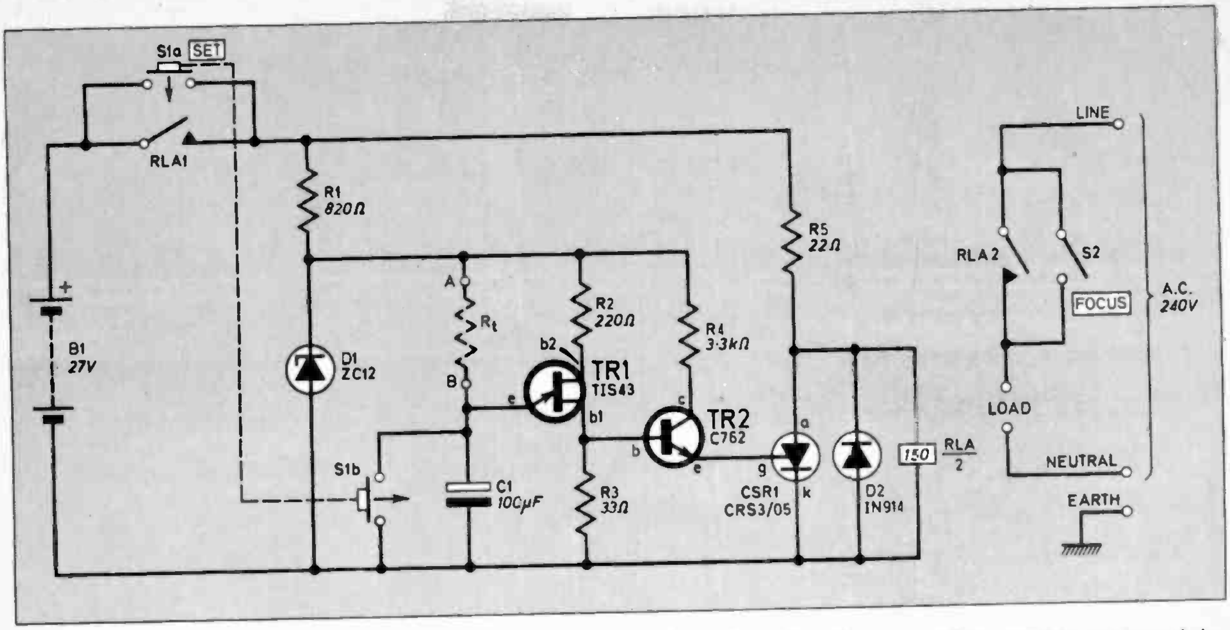


Fig. 1. The circuit diagram of the darkroom timer. Resistor R_t is the timing resistor and is replaced in the prototype by the circuit of Fig. 2.

Approximate cost of components

£ 4·50 excluding case

TIMING RANGES AND SWITCHING

To alter the time range a switch (S3) is used that brings into circuit various values of preset resistance Fig. 2. This switch and resistors take the place of R_t in Fig. 1. Connections to the circuit are made at points A and B (Fig. 1 and Fig. 2).

The time settings used on the prototype were preset values of 5, 10, 15, 20, 25, 30, 35 and 40 seconds corresponding to switch S3 positions 1, 2, 3, 4, 5, 6, 7, and 8 respectively. These times cover most of the timing requirements likely to be met in normal darkroom work. The switch circuit diagram is shown in Fig. 2, the switch being a 2-pole 9-way wafer type. Only 8 positions are used for the above times, the other being spare. The values of VR1 and VR4 are such as to give a delay of 5 seconds, VR2 is set to give a delay of 10 seconds, while VR3 is set to give a delay of 20 seconds. This then enables the required times to be obtained.

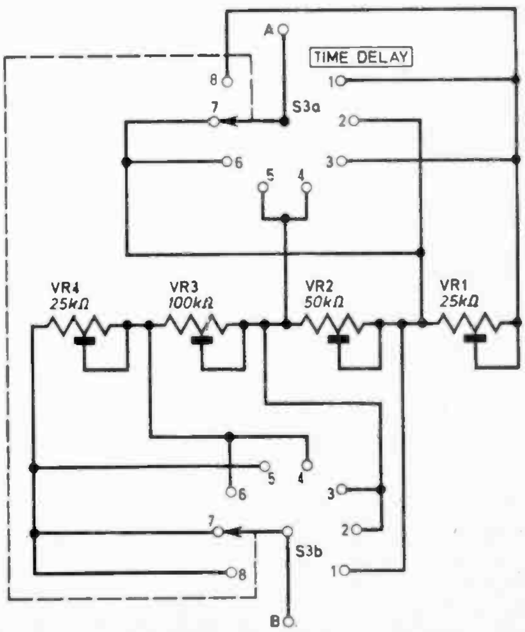
The timed ranges of the unit may be altered to suit individual requirements, or a variable resistor could be used for R_t or switched into the circuit by S3 in the ninth position should a continuously variable delay be required.

The capacitor C1 has a value of 100μF, and with a 1 Megohm resistor (R_t) this yields a delay of approximately 4½ minutes; this has been found to be about the upper limit of the timer.

CONSTRUCTION

The timer is constructed in a metal case the dimensions of which are given in the parts list. Two brackets are used to retain the batteries

Fig. 2. Switched timing resistor circuit.



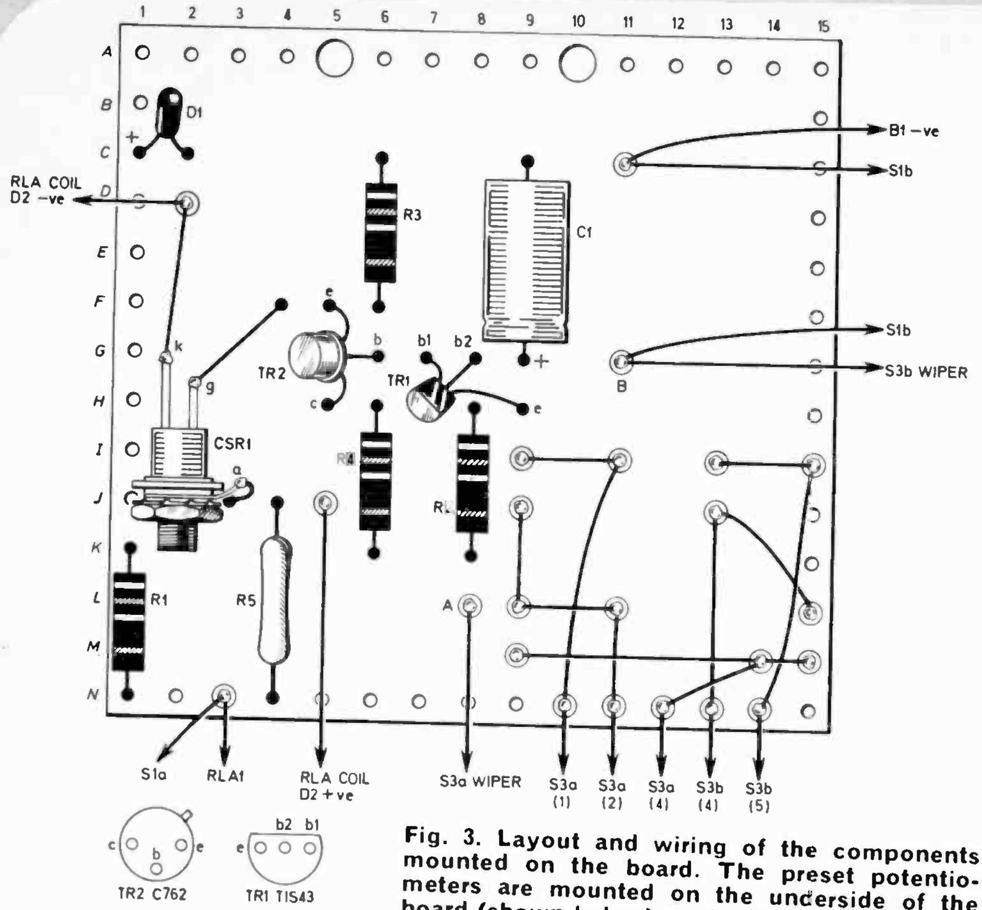
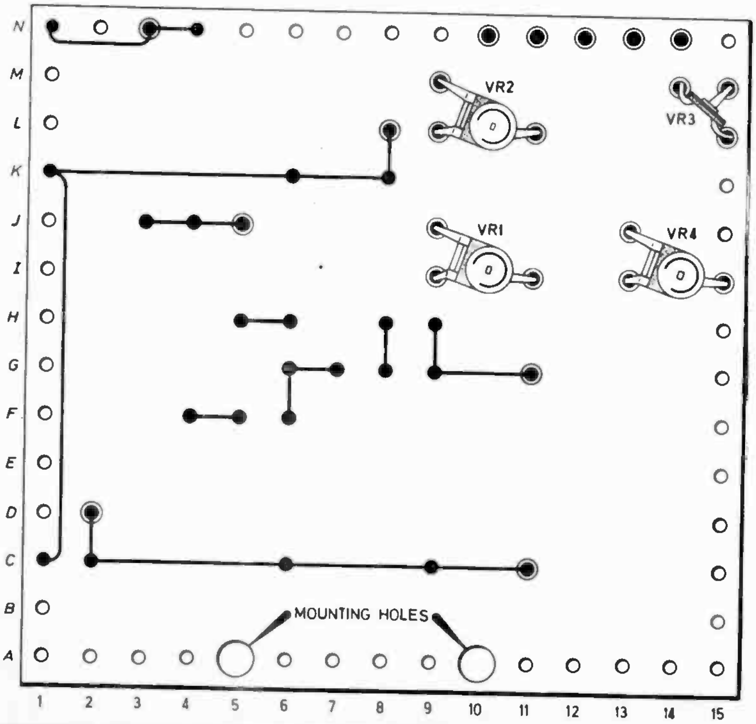
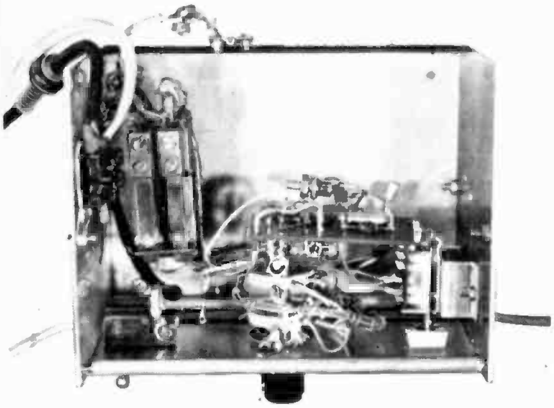


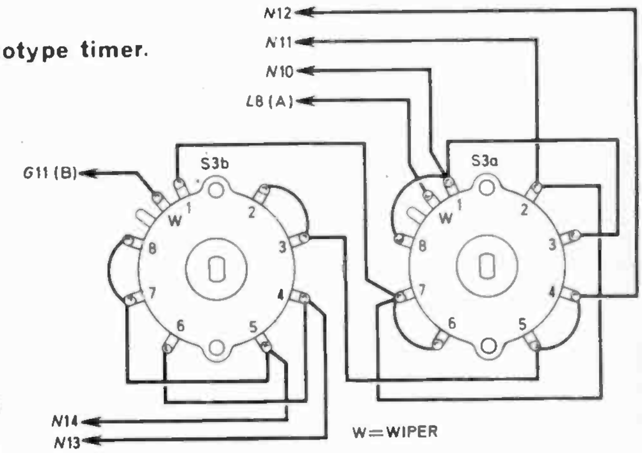
Fig. 3. Layout and wiring of the components mounted on the board. The preset potentiometers are mounted on the underside of the board (shown below) so that they can easily be adjusted.



DARKROOM TIMER

Inside view of the prototype timer.





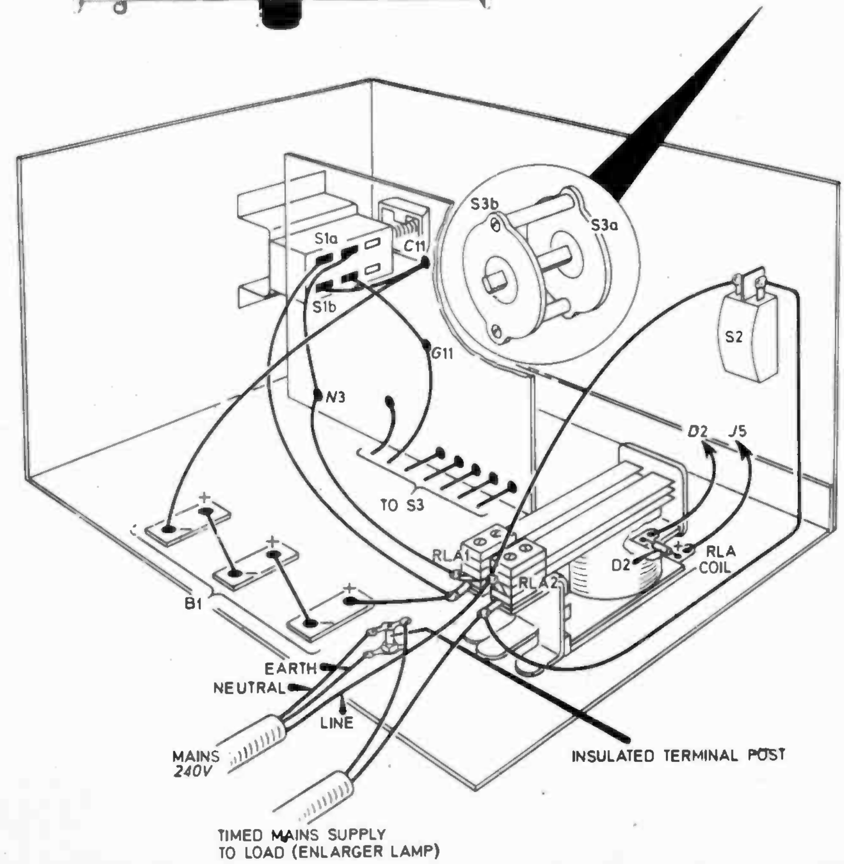


Fig. 4. Layout and wiring of the components mounted in the case; the board has been cut away to show S3 and S1. The board is held by a bracket fixed to S1. Switch S3 has also been shown separately, as it would appear when dismantled, for clarity. The batteries are not shown but their clips are wired up in the approximate positions of the batteries.

Components....

SEE **SHOP TALK**

Resistors
R1 820Ω
R2 220Ω
R3 33Ω
R4 3·3kΩ
R5 22Ω 5 watt wirewound
All ±5% ½ watt carbon except where stated.

Capacitors
C1 100μF tantalum 12V

Variable Resistors (R_t)
VR1 25kΩ skeleton preset
VR2 50kΩ skeleton preset
VR3 100kΩ skeleton preset
VR4 25kΩ skeleton preset

Semiconductors
D1 ZC12 or similar 12V, 250mW Zener diode
TR1 TIS43 unijunction, silicon *pnp*
TR2 C762 or 2N697 silicon *npn*
CSR1 CRS 3/05 or similar 50V, 3 amp controlled silicon rectifier (thyristor)
D2 IN914 (or any similar small diode)

Switches
S1 2 pole push-on, release-off pushbutton
S2 single pole single throw toggle
S3 2 pole 9 way wafer switch

Miscellaneous
RLA1 12V 150Ω relay having 2 normally open contacts (Keyswitch MK2 or similar)
B1 PP6 9V batteries—3 off wired in series.
Aluminium case 6½ in x 4 in x 4 in, plain perforated Veroboard 3·2 in x 3 in x 0·2 in matrix, Vero pins to suit board, battery connectors (3 off), insulated terminal post, earth tag, connecting wire, mains lead and plug, knob, 4BA fixings.

and provide a mount for S1. Switch S1 is also used to mount the circuit board and thus it determines the layout to a certain extent. The layout given need not be followed exactly and the bracket used to mount the switch and board may be modified to suit the parts used.

The circuitry itself is assembled on plain 0·2 inch matrix Veroboard, using Vero terminal pins and the switches and relay are mounted on the front panel and floor of the case respectively. The case is earthed to the main supply through a 3 core mains lead and plug.

Battery B1 is made of three PP6 9V types wired in series; the type and quantity of batteries are determined exclusively by the relay voltage and current requirements.

Mounting of the relay has been left to the individual, as there are so many on the market of different shapes and sizes and methods of fixing may vary. The only critical parameters are that it should have two normally open contacts and if the unit is to be used for controlling enlarger exposures, the contacts should be suitably rated to carry the lamp current.

Start construction by cutting the board to size and inserting the mounting pins in the positions shown. Connect the pins in the required manner using tinned copper wire and insulating sleeve where required (Fig. 3). Next mount all the components checking the polarity of the capacitors and diodes and the connections to CSR1 and transistors, which should be mounted after the other components and flying leads have been soldered in.

The tantalum capacitor C1 may be either the polarised or non-polarised type and may not be the same shape as that shown in Fig. 3. The correct polarity for polarised types is shown on C1 in Fig. 3.

Once the board is complete and has been checked for wiring errors and dry joints it may be mounted in the chassis, together with the remaining components, and connected up as shown in Fig. 4. Wires to components mounted on the front panel must be left long enough to facilitate removal of the panel for setting up.

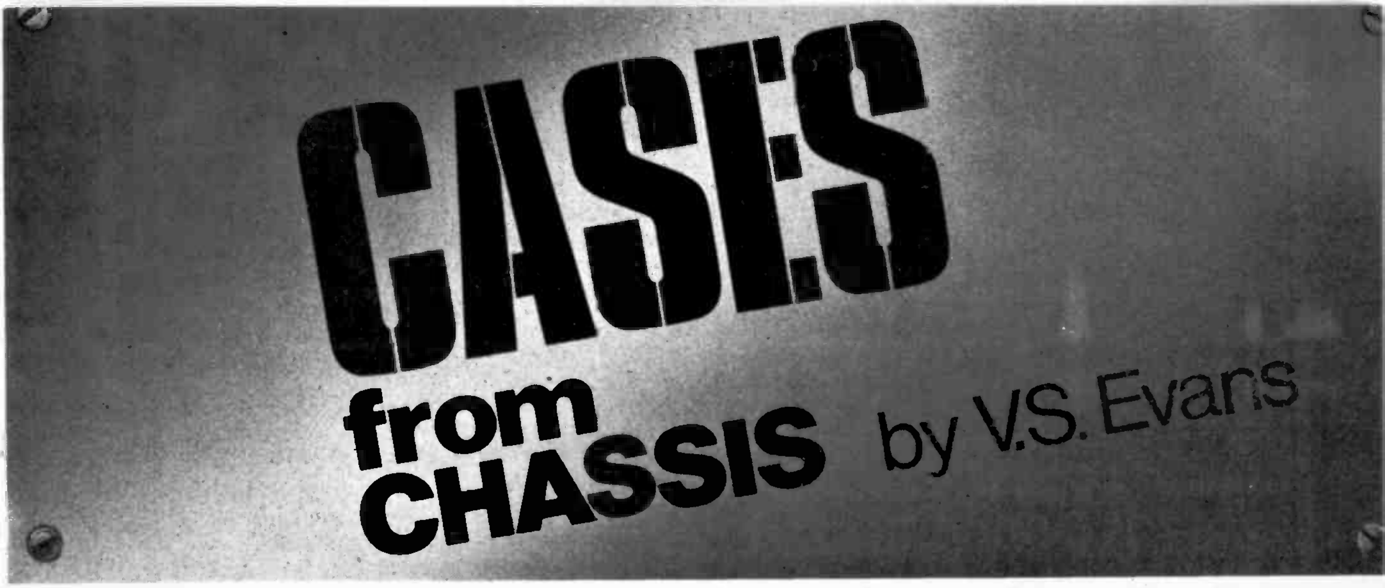
Take particular care when wiring the mains to the relay, S2, and the load and make sure that an earthing tag is fitted to the case and connected to the mains earth. The output to the load can be connected directly to the enlarger lamp or terminated in a suitable two-way mains line socket.

SETTING UP

To set the timer up it is only necessary to remove the front panel to gain access to the preset potentiometer. If a multimeter set to its ohms range is connected across one set of relay contacts (**without the unit connected to the mains supply**) or used on a d.c. volts range to monitor the voltage across the relay coil, then circuit operation will be easily visible, alternatively the unit may be connected to the mains supply and a mains lamp bulb used as the load.

The potentiometers should be set half-way around their tracks and with switch S3 set to the desired time, the circuit triggered by briefly pressing switch S2. The duration of the time delay may then be measured by measuring the time for which the meter pointer is deflected from its initial condition or the lamp is on. The potentiometers may then be adjusted as required and the process repeated until all the desired times are set up.

The front panel can then be designated with the time positions. Once this is complete the unit is ready for use and can be connected to the enlarger lamp and mains supply as required. ▣



CASES from CHASSIS

by V.S. Evans

An inexpensive case for your projects, using aluminium chassis

HAVING decided to build an electronic project—perhaps to your own design, or maybe partly so, early consideration should be given to the form of its eventual housing.

This may well be an important factor in deciding the size of the circuit board, control panel, or even method of construction and assembly.

HOME BUILT AND READY MADE CASES

Making a neat and presentable cabinet in wood or metal can be quite a problem, and usually requires the use of special tools and skills and takes some time and patience. The alternative is to use or adapt something already made up to the approximate size required.

Instrument cases and die cast boxes can of course be purchased, although a bit expensive, but are excellent for high class permanent projects.

ALUMINIUM CHASSIS

For less exacting or experimental projects use can be made of the considerably cheaper aluminium chassis available by fitting a panel of Paxolin, Formica or Perspex to the open side and using this as the front and control panel.

This panel is made to fit the aluminium chassis such that it rests on the corner flanges of the chassis, Fig. 1 which are slightly recessed, so that quite a neat job results. Small self-tapping metal screws are used to fix the panel to the flanges.

RE-USABLE

If the project is one of a temporary nature, or maybe a prototype which may well be dismantled and re-built, it is as well that the metal case itself (the chassis), is left untouched, i.e. no holes or metal cut-outs are made. This way your case will serve again and again and need

Fig. 1. Front panel is attached to the chassis by means of four self-tapping screws through the flanges

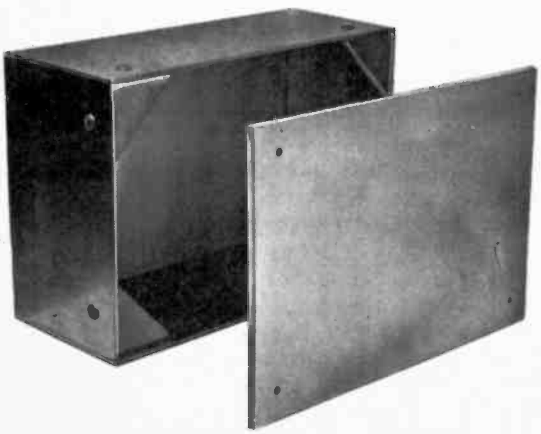
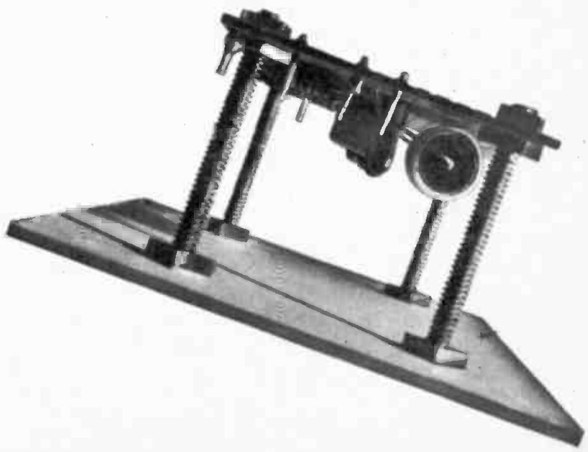
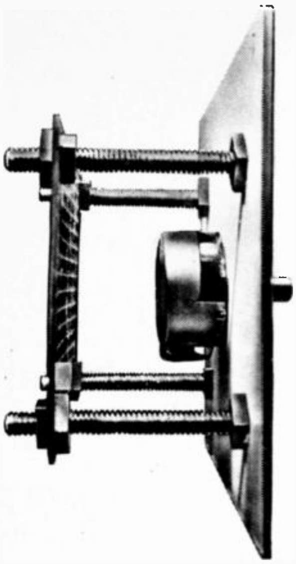


Fig. 2. The Circuit board is fixed to the front panel by four bolts and spacer nuts.





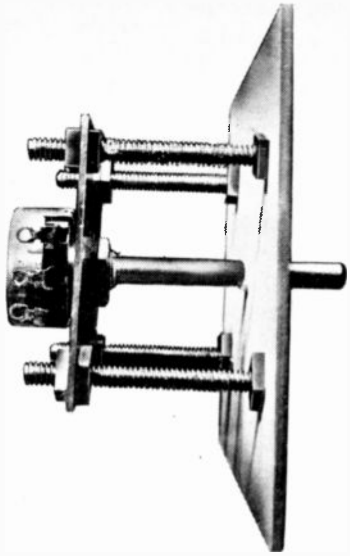


Fig. 3 (a) (left) Fixing the potentiometer to the front panel if there is not enough space on the component board.

Fig. 3 (b) (right). Alternative method for potentiometer fixing.

never be discarded as being full of unwanted holes.

COMPONENTS ATTACHED TO PANEL

To avoid "mutilating" the case, all controls and the component board etc. are mounted on, or attached to, the front panel. This leaves considerable scope for the constructors ingenuity. Fig. 2, shows how the circuit board can be attached to the back of the panel with 4 bolts of suitable length. Spacing sleeves or nuts being used to hold the board at a "distance." Remember to make allowance for corner flanges of the chassis when designing the dimensions of component board.

Controls such as variable potentiometers and variable capacitors can be mounted on the circuit board with their spindles protruding through holes drilled in the panel or they can be mounted directly onto the front panel as in Figs. 3(a) and (b).

Fig. 4. Using a metal angle strip to support heavy components such as mains transformers. This can be used in conjunction with circuit board fixing arrangement as shown in Fig. 2. or with angle brackets.

USING BRACKETS

An alternative method can be employed where the circuit board is attached vertically or horizontally to the panel with small angle brackets. This method would be used where the panel is carrying something bulky such as a meter or multiple wafer switch. Angle brackets may also be used to attach a metal heat sink carrying a power transistor, or, say a horizontal deck to support a mains transformer Fig. 4. If a small loudspeaker is involved this can also be mounted on the panel—the fret being simply a symmetrical pattern of holes drilled in the panel opposite the loudspeaker cone, Fig. 5.

By using a combination of these various ways to attach everything to the front panel, the case can be left virtually "untouched". Panels made from Formica offcuts are cheap, easily cut with a scriber and metal straight-edge, and can be regarded as expendable.

HOLES AND SLOTS

Although it is still necessary to cut holes and slots in the panel for mounting such things as meters, slide switches, etc., it is considerably easier with formica because in most instances the hole or slot can usually be deeply scribed with a scriber and then pushed out. It may then be necessary to "clean up" the hole with a small file. Small holes should be drilled in the usual way.

With Paxolin and Perspex it is slightly more difficult. The usual method for making a large circular hole is to drill around the circumference of the hole to be removed and then clean up with a file, this takes some time. There are special tools on the market for this—a tank cutter and a disc cutting saw. Both of these fit into drills but they tend to be costly.

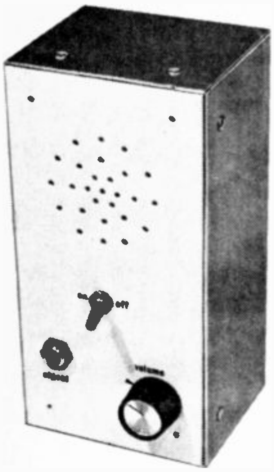


Fig. 5. A completed case of a small amplifier showing holes drilled for loudspeaker

FINISHING AND LETTERING

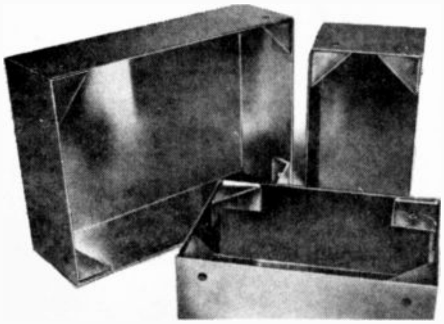
With Formica and Perspex panels there is no finishing required as these are available in a variety of colours with excellent finishes.

With Paxolin, however, its finish is smooth but it is only available in a brown colour which looks ugly. This can be sprayed to the colour of choice using any of the aerosol sprays on the market or even painting with a paintbrush will do. It is best to try the paint on an offcut first to make sure that the Paxolin is not affected by the paint.

As far as labelling the control panel, Letraset is by far the best method, adding a touch of professionalism. All three of the panel materials mentioned above readily accept Letraset.

To prevent the labels from being scratched off it is necessary to cover them with varnish, Letracote Gloss is ideal for this job as it protects the lettering and gives the panel a gloss finish. The whole panel can be sprayed or just the regions of lettering as preferred. ▣

Fig. 6. Various sizes and shapes of available chassis.



When the young Marconi demonstrated his wireless apparatus by sending a transmission over a distance of less than two miles on Salisbury Plain in 1896, there were many eminent scientists of the day who dismissed the novelty as a toy; and many who firmly believed that wireless waves would be diverted or distorted by hills. As for the possibility of transmitting across water—why, the very suggestion was ridiculous in the extreme. Everyone knew that the wireless waves needed a return path through the earth. Besides, water would absorb the wireless energy like blotting paper.

NO LIMIT

Marconi confounded these opinions on 11th May, 1897, when he carried out a successful transmission from Lavernock Point near Penarth to the island of Flat Holm in the Bristol Channel—a distance of three and a half miles. Though some doubters still stuck to their guns, this was hailed as a tremendous scientific achievement, and when a week later he succeeded in sending a message over a distance of nine miles across water, right across the Bristol Channel to Brean Down in Somerset, scientific enthusiasm was such that there were those who claimed that there was no limit to what could now be achieved with sufficiently high-power apparatus.

No limit, indeed. Within four years Marconi had sent his transmissions across the Atlantic from Poldhu in Cornwall to Signal Hill in Newfoundland; and to-day, no more than a lifespan since the time when the young man first arrived in England, ships at sea can communicate daily by Morse or speech with stations right across the world, and even modest 75-watt radiotelephone sets such as those used by Sir Francis Chichester, Robin Knox-Johnson, and Chay Blyth can carry their words across 5,000 miles of ocean. Moreover, during that lifespan, like strong branches from the main trunk of pure communication, have sprung electronic aids to navigation and safety in the shape of direction-finding, echo sounding and radar.

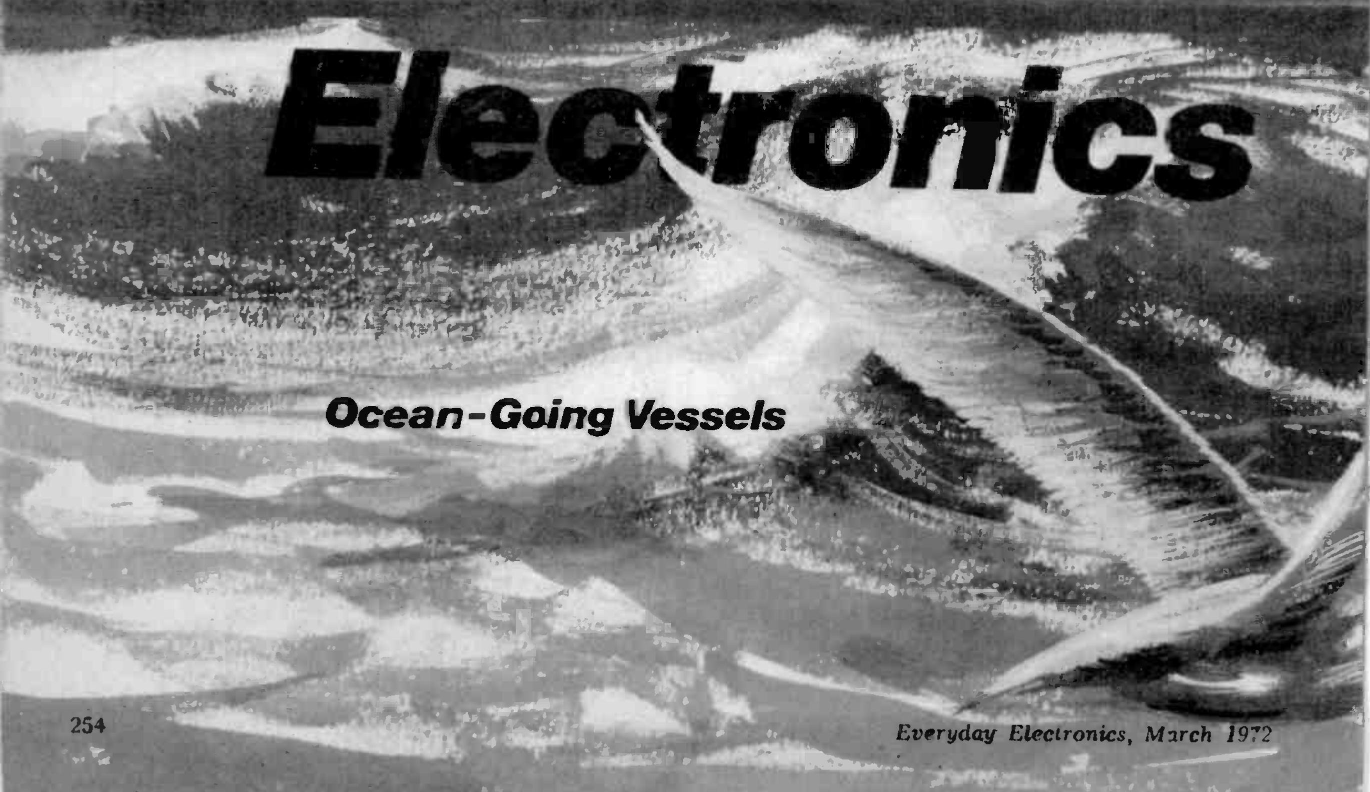
Electronics now contribute to efficient commercial ship operation as intercommunication systems, hyperbolic position-fixing systems, closed-circuit television, automatic steering equipment, data loggers, and automation systems using intricate computer techniques. One must, in fact, have the thought in mind that between the time that this article is written and the date of its appearance in print some new technique or application may be evolved and announced. Such is the rate of acceleration in the marine electronics industry.

RADIO AND ELECTRONICS

Except for the periods immediately after the two world wars, it is during the past few years that this expansion of the use of electronics at sea has been most marked. This is pointed by the fact that in April, 1968, the title of the Radio Officers Union was officially changed to the Radio and Electronic Officers Union, while a number of companies now give extended training to their radio officers to bring them up to the rank of electronics officers. Indeed, even before the last war the responsibilities of the Merchant Navy radio officer—the traditional

Electronics

Ocean-Going Vessels



"sparks"—usually went well beyond the operation and maintenance of his communication station and included the maintenance—and sometimes the operation into the bargain—of echo sounders and direction-finders. Of course, in more recent times he has also become responsible for the maintenance of radar, intercommunication and sound distribution networks, closed-circuit TV for navigation or entertainment purposes, data logging equipment, communal aerial systems, etc.

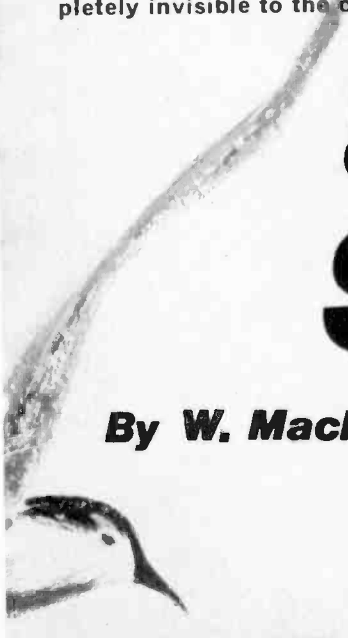
With the increasing use of automation at sea, and its dependence on electronics for much of its primary control and transmission of data and instructions, a ship's electronics installations are becoming much more complex from day to day and there is even talk—although it is still only talk—of the possibility of sending ships to sea without a crew at all. One wonders—is there indeed no limit?

But that is still in the future. At this moment the use of electronics on board ship is sufficiently considerable to be interesting. Ships' electronic installations naturally differ according to their needs which, of course, are dictated in part by international regulation and also by

The Lavernock and Brean Down experiments, May 1897, showing the method by which an increase in distance from three miles to eight miles was obtained. For these experiments kites covered with tin foil were used as aerials.

The control room and studio of the comprehensive television installation on board a cruise liner which distributes a choice of four programmes to more than 400 receivers in the ship's cabins and public rooms.

Navigational CCTV on a container ship in the Manchester Ship Canal clearly shows the forward tug which would otherwise be completely invisible to the officers on the bridge.



at Sea

By W. Machonachie

the type of service in which they are engaged. There is thus no "typical" merchant ship installation although regulations lay down the minimum equipment to be carried by four classes of merchant ship and also by fishing vessels.

SHIP CLASSIFICATION

The classification of ships as set out in the Merchant Shipping (Radio) Rules is, as might be expected in an official document, a little on the wordy side, but briefly summarised, Class I ships are those carrying more than 250 passengers on voyages of more than 16 hours duration. Class II covers passenger ships not in Class I and all cargo ships of 1600 tons or more. Cargo ships of 500 tons upwards but less than 1600 tons are Class III, and those of 300 tons and more but less than 500 tons constitute Class IV. The rules are not applied to sailing ships, pleasure yachts, or ships smaller than 300 tons, while fishing vessels have their own regulations.

Although there is therefore no typical merchant ship installation it is possible to define fairly accurately a typical installation for a type or class of ship. One of the most common ocean-going ships is the cargo liner, carrying general cargo on a regular service run—say from Southampton to Cape Town. She may carry up to twelve passengers, but is not classified as a passenger ship, and so far as her electronic equipment is concerned she can in broad terms be equated with the refrigerated meat or fruit carrier, or with the container ship, oil tanker, or bulk cargo carrier. All these ships run on international voyages and their electronics must cater primarily for the communication needs of their crews and owners and for the safe, economical and efficient running of the ships and their cargoes.

STATUTORY REQUIREMENTS

This type of ship—general cargo, tanker, bulk carrier, etc.—whether she be 1600 tons or 300,000 tons, must be equipped to a minimum standard before she is allowed to leave port. The mandatory requirement is for a wireless telegraphy installation capable of both main and emergency operation; an automatic alarm receiver, unless she carries enough radio officers to maintain a continuous human watch; a direction-finder; a portable transmitter/receiver for emergency use in a lifeboat. All this equipment must be of an officially approved nature, and her crew must include at least one qualified radio officer. Her wireless telegraphy installation has to comprise a main transmitter and separate receiver, both powered from ship's mains, as well as an emergency or reserve transmitter and a reserve receiver which derive their power from batteries so that they can be operative in the event of a failure of the mains supply.

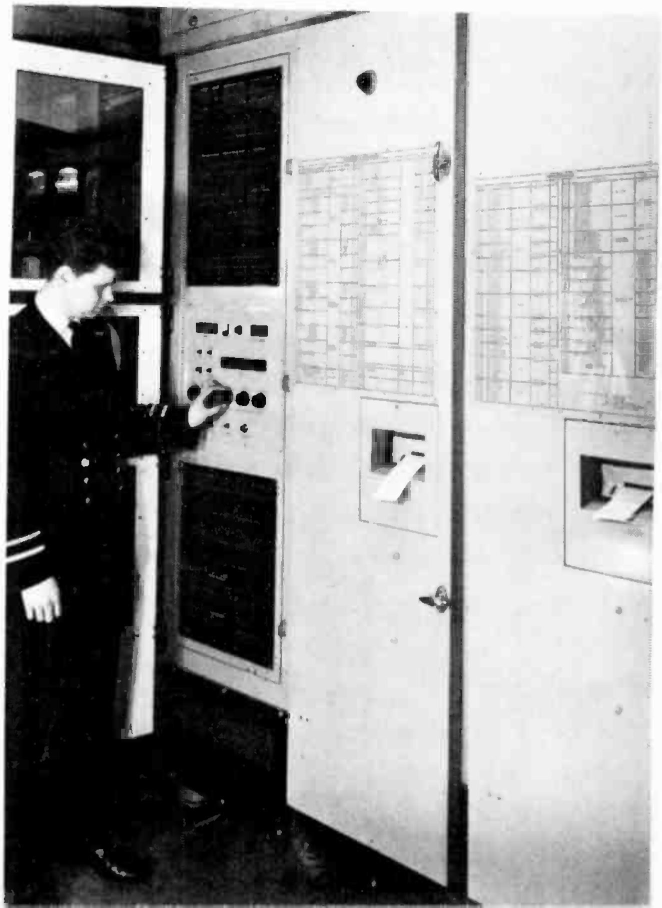
The installation must also include a watch-keeping receiver, fitted with a loudspeaker, and capable of reception in the 500kHz band, and an automatic keying device which can be made to operate either the main or the reserve transmitter in case of emergency and cause them to transmit the auto-alarm signal.

This the statutory minimum for Class II ships, which includes some of the largest vessels afloat today, may not seem to comprise a very sophisticated installation. There is, for instance, no compulsion to carry radar—at the present moment. In practice, however, only a very few ships nowadays carry no more than will satisfy the law.

NORMAL INSTALLATION

Walk aboard an ocean-going ship and you will almost certainly find at least one radar set on the bridge. Indeed, many now fit two radars, with interswitching arrangements so that units are in effect interchangeable if either set should suffer a breakdown.

In the wheelhouse you will also see an echo-sounder, or perhaps two—one recording and the other of the visual indicating type. Her direction-finder will probably be fully automatic, and both this and the radar will be coupled to the gyro-



The electronics officer of a cargo liner with the data logger which monitors 350 performance points in the main and auxiliary machinery, the refrigeration plant, and in the cold cargo space.

compass. Moreover, the direction-finder may now be linked with the auto-alarm receiver so that if an auto-alarm signal, preceding the distress call, is received while the radio officer is not on watch, the direction-finder will automatically take a bearing on the distress position.

Our Class II ship will almost certainly have a v.h.f. radiotelephone for short-range speech communication with port facilities such as pilots, tugs, and harbourmasters, and this may have remote control extension units in both wings of the bridge and also in the radio office. The wheelhouse will contain the master control panel of a crew-call and talk-back system providing internal two-way communication with working areas on and below decks and with loudhailing facilities as well, while an internal telephone network will also be provided.

Loudspeakers in crew quarters will be accessible to the crew-call system and will also be linked to a broadcast receiver and amplifier installation to enable personnel to listen to news and entertainment during their off-duty times. Outlet points from a communal aerial system will be fitted in crew's cabins so that they can use their own personal broadcast receivers if they wish. Broadcast radio entertainment is not all that ships' crews can enjoy at sea—television programmes, too, can be watched through the provision of multi-standard receivers which more and more ships are fitting as permanent installations in crew's and officer's mess-rooms.

The electronics officer of a transatlantic cargo liner using the facsimile weather chart receiver and recorder on the bridge.

CCTV AND ELECTRONIC MONITORING

On many large passenger liners today television is a "must" and an installation can be a very comprehensive one indeed, with hundreds of receivers or monitors in public rooms and cabins, offering a choice of four programmes or more. Such a system will be a combination of closed-circuit and off-air TV, taking the latter when within range of suitable shore transmissions and also generating its own on-board programmes with telecine, videotape, and from the ship's own studio and cameras.

Closed-circuit television has another marine application. If the ship is a large oil-tanker, bulk carrier or container vessel with the bridge aft and perhaps as much as 1,000 feet distant from the bows, she may well have a CCTV installation for navigational purposes. In such an installation the TV camera is mounted in the bows or up on the foremast and a monitor is fitted in the wheelhouse to give her officers a close-up view of objects immediately ahead which would otherwise be obscured from human-eye observation. Provided with a remote-controlled steerable camera and facilities for measuring the range and bearing of buoys, tugs, or other comparatively small objects close ahead of the ship, such a system can be invaluable when a very large vessel has to manoeuvre in restricted or busy waterways or has to negotiate canal locks and dock entrances.

Again, CCTV cameras are sometimes used to observe machinery operation in the engine room, where a different kind of electronic watchkeeper in the form of a data logger is often used to monitor hundreds of points of main engine and auxiliaries performance, such as oil pressures, fuel flow, temperatures of bearings and fluids, as well as temperatures and humidity levels in cargo holds and cold stores—in fact, any data which have to be checked regularly.

Data loggers or alarm monitoring systems of this kind are capable of producing a complete check on 400 parameters, with comparisons and off-limits alarm warnings, every three minutes, and will produce an instant readout on demand. The same round of tasks laboriously performed by human agency would keep several men fully occupied for a complete day's work.

SATELLITE AND HYPERBOLIC NAVIGATION SYSTEM

So far in use on only a very few ships is a system of navigation, or more properly position-finding, which derives information from four United States Navy satellites in polar orbit. These circle the earth every 108 minutes at an altitude of 600 miles, passing over the North and

South Poles, and broadcasting signals which announce their position every two minutes. The special shipborne observation equipment comprises a receiver, a data handler and a teleprinter. The system operates by measuring the Doppler effect variations in the broadcast frequency received from each satellite as it passes, but the shipboard installation is costly and cumbersome and the system is at present in use on only one or two high-prestige ships.

In much more common use are the Decca and Loran hyperbolic position-fixing systems which require only relatively simple and inexpensive receiving and metering equipment on board ships that wish to use them. Decca is very accurate but is relatively short-range and global coverage would therefore require a considerable number of shore station "chains." Loran, perhaps less accurate, will operate over greater distances from the shore transmitters, but so far serves only about one-fifth of the globe with more than 100 shore stations. The system of this type which appears to hold most promise is Omega, the v.l.f. hyperbolic system first developed for United States military use and since made available to commercial ships and aircraft. With four shore stations now in operation, transmitting on 10·2 kHz and 13·6kHz. Omega will later give complete global coverage with a total of eight shore stations.

WEATHER CHARTS

It goes without saying that knowledge of the weather conditions that lie ahead of a ship is of the greatest value, not only from the point of view of safety, but also because any delay in a voyage is nowadays a very expensive business. Weather forecasts and ice warnings have been a regular feature of international and maritime radio communications for many years—indeed, the *Titanic* received a number of warnings of ice before she struck the fatal berg.

Until a few years ago ships at sea had to rely on the reception of very lengthy coded morse broadcasts for their advance weather information. On board ship this involved the time-consuming and laborious task of decoding each transmission after the radio officer had copied it down, and then transferring the verbal information into symbols and figures on a chart, always with the possibility of error. Today some thirty weather facsimile transmitting stations have been established throughout the world by the World Meteorological Organisation, and these broadcast synoptic charts at regular scheduled times. These charts, compiled by the meteorologists and complete with all isobars and symbols, may be received in full facsimile by any suitably equipped ship, free of charge.

The suitable equipment consists only of a special receiver covering 51 spot frequencies and combined with a facsimile chart recorder which produces a permanent image of the chart printed in black or brown on white paper.

MANDATORY—THE MINIMUM

It will be seen that in the majority of well-run ships the mandatory requirement is regarded as the minimum, and any or all of the additional aids we have discussed may also be found in use on board ships for which they are suited.

Large passenger vessels may be expected to carry a wider range of equipment, sometimes with duplicated communications installations, while in such ships high-frequency long-range radiotelephony, nowadays using single-sideband, is the rule rather than the exception. Indeed, many cargo ships also make considerable use of high frequency radio telephone, and some passenger ships and tankers are now fitted with high-speed automatic transmission and reception with automatic error-correcting facilities and teleprinters linked into the shore Telex system.

So far this article has dealt only with the electronics usage of ocean-going ships. Electronics are just as useful to smaller vessels and fishing trawlers, and the types of equipment they employ and the ways in which they use them will be reviewed in a later article. ■

Acknowledgement

Photographs kindly provided by The Marconi International Marine Co., Ltd.

A typical communications console in the radio room of a modern passenger vessel. The two s.s.b. main transmitters are not visible in this picture.

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

TEACH-IN
...FOR BEGINNERS

By Mike Hughes M.A.

5 CAPACITANCE

THIS month we are going to introduce another very important electronic component, the "capacitor", but first of all let's look at the principle behind it. To do this we will revert to our simple water analogy.

CAPACITY AND CHARGE

There is no need to have a complete circuit to ensure water flow—we could, for example, have used a hose pipe connected to a source of pressure to fill a bucket. Taking this a little bit further if we used a pump that was only capable of producing a pressure equivalent to 30ft of water and we started to pump water into the bottom of a 40ft reservoir tank the initial rate of flow would be large and limited only by the resistance of the hose pipe. As the tank filled, the "back pressure" would cause the flow rate to fall and would stop altogether when the level of water in the tank reached 30ft.

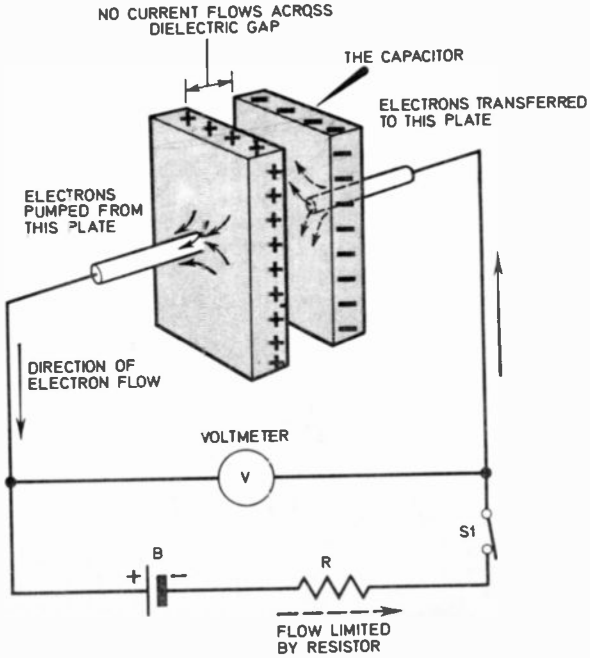
By closing the tap at the inlet of the tank we could take away the pump and hold the water in the tank as "stored energy". By opening the tap the water would flow out at a rate governed only by the resistance of the pipe and the water level in the tank. As the level falls the flow rate reduces until the tank is empty.

We have already defined the electronic analogues of pressure, resistance and flow rate, but we must now introduce a fourth parameter—the quantity of water stored in the tank. In electronic terms we call this the "charge". The water tank is equivalent to the capacitor which has the capacity to hold a given charge.

THE CAPACITOR

In its simplest form a capacitor is two plates of metal separated by a very small distance, see Fig. 1. Connecting a battery in series with a resistor across these plates will cause electrons to be pulled away from the plate connected to the positive terminal and "push"

Fig. 1. Schematic diagram of capacitor being charged.



them through the resistor to the other plate.

Initially the rate of flow will be limited only by the resistor but as the electrons leave one plate so it will start to show a positive potential with respect to the other. This potential difference will build up as time progresses and slow down the flow rate—just like the pump, hosepipe and tank. Eventually the potential across the capacitor will equal that of the battery and flow will stop.

By observing a voltmeter connected across the capacitor you could see this happening; this will be shown experimentally later. Opening the switch in Fig. 1 is just like turning off the tap and removing the pump. The charge of electrons will stay on the right hand plate and the potential difference will be maintained as shown on the meter. When we do this in practice you will see that the charge leaks away through the resistance of the voltmeter.

By connecting a resistor across the capacitor as in Fig. 2 we can deliberately make the electrons regain their original equilibrium. Initially the flow rate will be high but will get less and less until the capacitor is discharged and the current stops flowing. In principle that is all a capacitor does in any circuit.

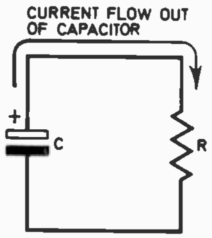


Fig. 2. Capacitor discharging through a resistor.

DEFINITIONS AND UNITS

Electronic charge is measured in units called coulombs. One coulomb is defined as the number of electrons that flow past a given point in a wire when a current of one ampere flows for one second.

Capacitance is measured in Farads. A capacitor has a capacitance of one Farad when, if it has been charged with one coulomb of electricity, produces a potential difference of one volt across the plates of the capacitor.

This can be represented mathematically by

$$C = \frac{Q}{V}$$

where C is the capacitance measured in Farads
Q is the charge on the plates
and V is the potential difference across the plates produced by the existence of Q.

To obtain a charge of one coulomb we would have to have a current of one ampere flowing for one second. This is a very high current in electronic terms and we only experience it in very high power circuits. Thus it should seem fairly logical that values of capacitance we encounter should be very much less than one Farad.

Usually we deal with millionths of Farads—microfarads (μF), thousandths of millionths—nanofarads (nF) and billionths—picofarads (pF).

CAPACITOR TYPES

Unlike resistors there is a much wider choice of differing styles of capacitor of both the fixed and variable type. Their circuit symbols are given in Fig. 3.

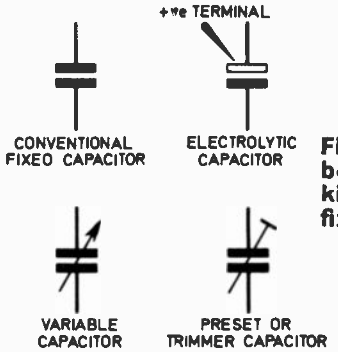


Fig. 3. Circuit symbols used for different kinds of capacitors fixed and variable.

It has always been a battle to obtain large values of capacitance in a small physical size because the phenomena that causes it is purely geometric—the area and separation of the two plates. If the distance between the plates is decreased, the capacitance increases, but by bringing the plates closer together (in most cases less than a thousandth of an inch) we have to introduce a spacer material—the "dielectric".

The dielectric itself can help increase capacitance but we immediately encounter another problem (except for very expensive dielectric materials), that these materials that enhance capacitance, very often exhibit poor insulation properties. If we used a very poor insulator as a dielectric any charge stored would leak away within the capacitor itself. We would say the capacitor was "leaky".

Some dielectrics will not withstand high voltages across them particularly when they are very thin.

ELECTROLYTIC

Some very effective dielectrics are in the form of a paste where the initial flow of current through the initially "leaky" capacitor produces an electro-chemical reaction that actually forms an insulator. Capacitors which use this form of dielectric are called "electrolytic", and they exhibit polarity properties (i.e. the capacitor can only be connected into circuit one way round). We usually turn to this type of capacitor when very high values of capacitance are required. They come in all shapes, sizes and working voltages.

Different types of capacitor are usually described by the type of dielectric and Fig. 4 shows some of the more important ones.

SILVER MICA AND POLYSTYRENE

Provided they are obtained from a respectable source, leakage is not usually a problem—this is well taken care of in manufacture. Nevertheless, the best type to use when this is the controlling parameter is the silver mica type. These are limited to low values of capacitance from 1pF up to 10,000pF; the higher values in the range tend to be rather expensive. They can operate up to about 300V but individual manufacturers types might differ widely.

Polystyrene capacitors have a similar range of capacity and are usually available at different voltage workings—typically from 30V to 500V. While they are not as effective as silver mica types in all applications, they are nevertheless very good insulation wise, and are a little cheaper.

CERAMIC AND POLYESTER

Ceramic dielectric devices also have a similar range of values and working voltages but sometimes are available with wider tolerances (this makes them cheaper) and some types are very sensitive to changes of temperature—this can be a useful or bad thing depending on the application.

Perhaps the most used by the amateur today is the polyester device. These start in value at about 0·01μF (10,000pF) and go up to 1μF with voltage ranges of from 50 to 300V. Overlapping this range and going up to about 5μF are polycarbonate types that are a little more expensive than polyester.

TANTALUM

For miniaturisation and high capacitance one can turn to solid Tantalum types. These are fairly new on the amateur scene and are inexpensive. These types have a very low leakage current—typically 0·02 microamp per microfarad volt. Available values range from 0·022μF to 270μF with working voltages generally from 100 to 60V respectively.

See Table 1 for a comparison of types.

Table 1: COMPARISON OF DIFFERENT CAPACITOR TYPES

Type	Capacitance Range	Working Voltage	Tolerance
Silver Mica	1—10,000pF	Typically 300V	±1, ±2%
Polystyrene	10—10,000pF	30—500V	±2, ±10%
Ceramic	50—10,000pF	30—500V	±20%
Polyester	0·01—1μF	50—300V	±20%
Polycarbonate	0·01—5μF	50—600V	±20%
Solid tantulum	0·02—270μF	6—100V	±20%
Electrolytic	1—20,000μF	10—600V	−25 to +100%

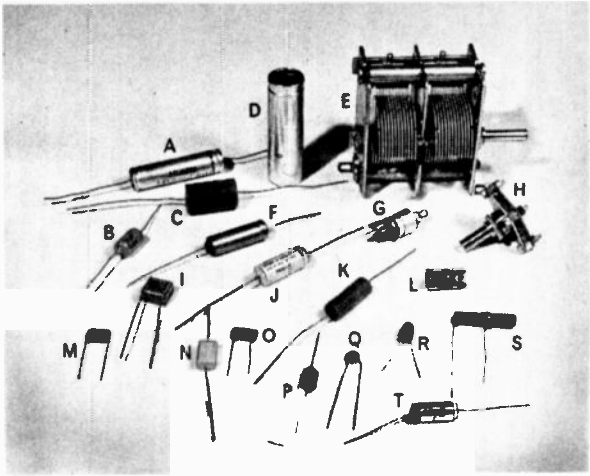


Fig. 4. Shown above is a variety of common capacitor types: A paper; B polyester; C tubular metallised polyester; D electrolytic can-type; E ganged variable; F electrolytic; G beehive trimmer (concentric); H variable; I metallised polyester; J paper dielectric; K tubular mixed dielectric; L trimmer (compression); M and N metallised polyester; O silver mica (printed circuit type), P silver mica; Q disc ceramic; R tantalum; S high voltage (pulse) ceramic; T polystyrene.

TOLERANCE

A word about tolerance values. Like all components, capacitors have tolerances which usually vary from one type to another. Generally, silver mica types are within ±1 per cent and have their values printed on them. Polystyrene can range from ±2 to ±10 per cent and also have printed values; likewise with ceramics but the tolerance can be as high as ±20 per cent. Polyester types are usually ±20 per cent but values are frequently put on them in colour code form. The code is exactly the same as for resistors except that the values are in units of picofarads (pF), see Fig. 5. Polycarbonate types are similar but values are usually printed.

Electrolytics are usually used where tolerancing is not very important and one requires "at least" a certain value. They generally have tolerances of +100 to −25 per cent. Invariably they have values printed on them.

VARIABLE CAPACITORS

Variable capacitors are limited to comparatively low values—typically up to 500pF. Their most usual application is for tuning radios and this range of values is ideal. The most frequent type encountered uses an air dielectric and has a number of interleaved plates (to increase the total surface area). One set of plates is attached to a spindle and they can be moved relative to a fixed set. The shape of the vanes is designed so that in the radio tuning application the fre-

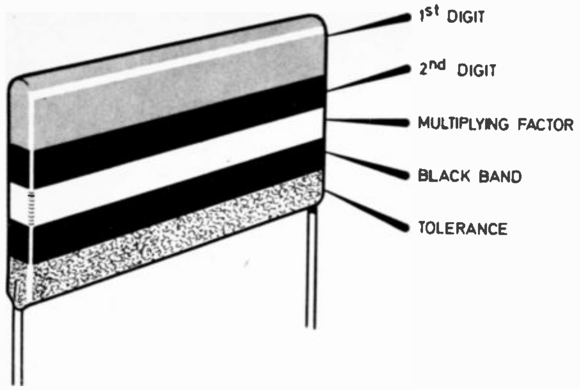


Fig. 5. An example of the capacitor colour code.

quency of the tuned signal varies in direct proportion to the degree of rotation.

As with resistors it is sometimes impossible to rely on manufacturing tolerances and preset trimmer types are required. These can be of the compressional type where the gap between two plates is adjusted with a screw, or the concentric type where one cylinder is made to slide over another thus varying the effective surface area of overlap. Values of trimmers are very low and rarely exceed 150pF.

EXPERIMENT 1

We shall now demonstrate the function of capacitors on the Demo Deck. For this we shall use one that will come in handy later. Ideally we specify an electrolytic with a high value, 500μF at 25V. Provided you have one in the range 250 to 1,000μF and its working voltage is in excess of 12V it will do.

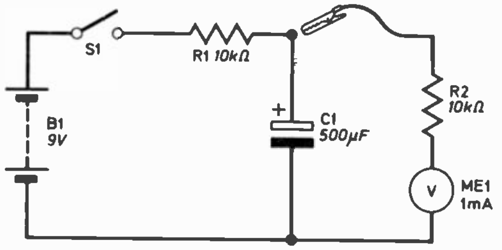
The circuit diagram and layout on the Demo Deck for this experiment is shown in Figs. 6(a) and (b).

First make a 10V range voltmeter by using a 10 kilohm resistor in series with the 1mA meter. Make two flying leads that have crocodile clips on their ends and attach the ends without clips to your voltmeter—make sure you know which one is going to the positive terminal. Now solder the capacitor across any pair of turret tags — identify the terminal of the capacitor (identified with a + sign or a red spot at this end). Solder a 10 kilohm resistor to the positive end of the capacitor and attach its free end to another tag. Now connect a flying lead to the negative end of the capacitor and take it to the negative terminal of the 9V battery.

Similarly connect a flying lead to the free end of the resistor but leave the other end of the lead free for the time being. Now use the crocodile clips to connect the voltmeter across the capacitor—positive lead to the positive end.

OBSERVATIONS

Initially nothing should show on the meter. Now connect the free wire from the resistor to the positive terminal of the battery. This connection acts as S1 in the circuit diagram. The



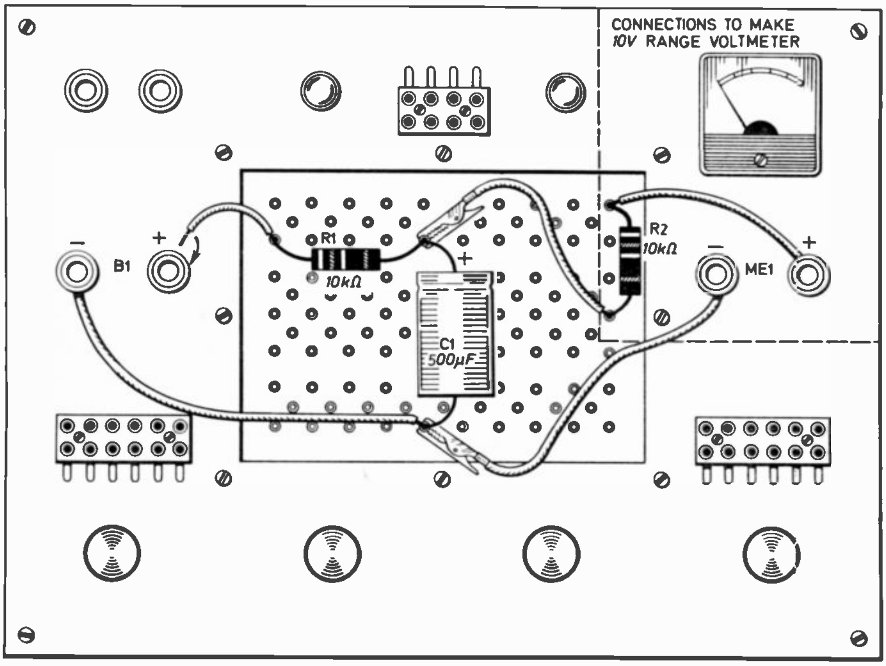
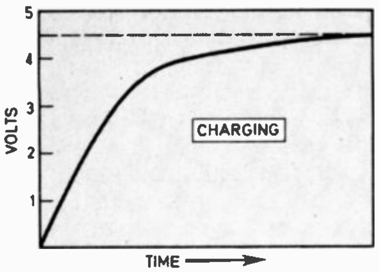


Fig. 6(a) (above). The circuit diagram for experiment 1.
Fig. 6(b) (left). The circuit wired up on the Demo Deck.



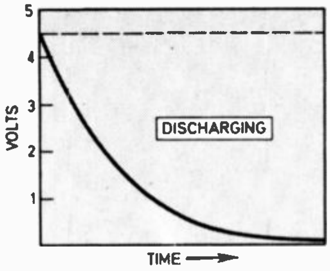


Fig. 7. Typical charge and discharge curves for a capacitor. Similar curves should be obtained from the results of experiment 1.

voltage across the capacitor will start to rise—fast at first, due to the high current flow—but the rate of rise will get less and less until the meter reads about 4·5V (0·45mA on the scale). The reason why the voltage does not rise above 4·5V is that the resistance of the meter (approximately 10 kilohm) forms a potential divider with the supply resistor. Now disconnect the lead from the positive battery terminal.

The voltage across the capacitor will fall caused by current flowing through the meter circuit—again fast at first and then the rate will tail off until no charge is left. Although it is difficult, try plotting a graph of voltage charged to (reading on meter), against time and then do the same for discharge. You should get curves rather like those shown in Fig. 7..

Although it requires buying another identical capacitor, you could do the same experiment with two 500µF capacitors in parallel. You will then notice an appreciable increase in the time of both charging and discharging.

SERIES AND PARALLEL COMBINATIONS

Putting capacitors in parallel increases the total capacitance

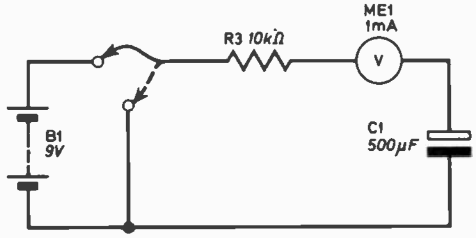
$$C_{total} = C_1 + C_2 + C_3 + \text{etc}$$

If you put the two capacitors in series you would find a decrease in the rate thus when series connected capacitance is reduced and is always less than either individual value—rather like resistors in parallel. The rule for capacitors in series is

$$\frac{1}{C_{total}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{etc}$$

EXPERIMENT 2

Use the Demo Deck to wire up the circuit of Fig. 8 but do not connect the positive terminal of the battery yet. We are going to charge the capacitor to 9V through a 10k ohm resistor and



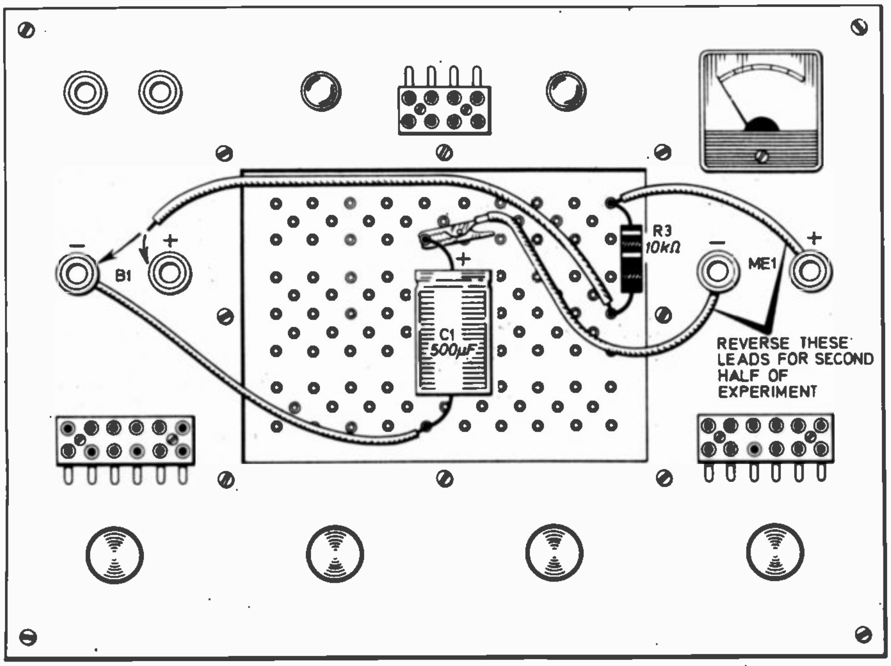


Fig. 8(a) (above). The circuit diagram for experiment 2.
Fig. 8(b) (left). The circuit wired up on the Demo Deck.

monitor the current on the 1mA meter in series.

Now connect the battery and watch the meter. Initially the charge current will be 0·9mA but this will gradually fall until full charge has been reached, i.e., the current becomes zero.

Now disconnect the positive lead from the battery and hold it on the negative terminal. Note that the meter tries to read backwards. Repeat the whole experiment, but when you get to the second half, reverse the connections to the meter. The negative current you saw can now be read from the meter scale. This is caused by the capacitor discharging back through the resistor.

Because the immediate "start" current was 0·9mA you can see that the only thing that limited the current in the first instance was the resistor. You could say that when the resistor is short circuited to the battery negative terminal, you were applying zero volts to the capacitor.

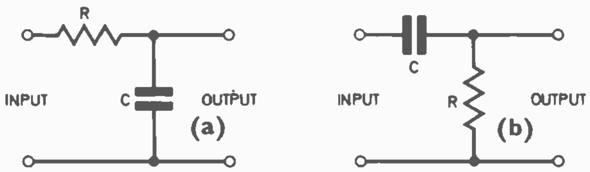


Fig. 9 (a) Integrator and (b) differentiator circuits.

The two experiments carried out demonstrate a pair of very important basic circuits which are usually seen in the form of Fig. 9. They are respectively called integrator and differentiator circuits.

Next month: Semiconductors and experiments with diodes.

Ruminations
By Sensor

Take a Card

A friend, who has just returned from the U.S.A., told me that the electronic construction hobby is highly organised over there. Apart from a large number of retailers specializing in the supply of components to the hobby market over the counter or by mail order, there have appeared, in drug stores, supermarkets and other unlikely places, complete kits of parts with full instructions for building electronic projects. The parts are mounted on a card covered by plastic; even the resin cored solder is supplied.

Where integrated circuits are used, the reductions in physical size and in the number of individual components required for a project have made it possible to supply everything required on a card no larger than *E.E.*

The advantages to the constructor are obvious and apply equally to other complete kits; all the parts are of the correct type and can be expected to work together without difficulty. There are no delivery problems and no frustrations due to unavailability of any component, it would seem to make things almost too easy. But what about all those components one already has? Are these doomed to lie on the workshop shelf until they become obsolete? And what of the pleasure one can gain by searching the advertisements in EVERYDAY ELECTRONICS looking for bargain price components? Personally, I would rather buy components as and when I need them and the phrase "any component sold separately" in a kit advertisement, gladdens my heart.

Take Another Card

I tend to lump together all "things sold on cards" as belonging to that class of cheap and nasty products that were once found in the cheaper stores, particularly at Christmas time. I think especially of one called, if memory serves me right, "The Young Carpenter", which contained a "tin" saw, a wooden hammer, trisquare and few other useless "tools". The saw buckled at the first attempt to cut anything, the wooden hammer head broke from its shaft, and the glasspaper disintegrated at the first rub. How much damage to a young child's confidence could be wrought by a toy like this? The young fingers, not very skilful to begin with, the eager desire to m a k e something, inexorably doomed to failure from the outset. It's enough to make anyone neurotic! I found my father's hacksaw and looked for something to saw; my mother's shopping basket lay near to hand and I carefully cut through the handle. There was no malice in the deed, I just wanted to saw something! It was very satisfying —but the aftermath was uncomfortable.

I am waiting for some manufacturer to bring out a range of educational toys and I suggest one might start with "The Young Roadmender". This would contain a pneumatic drill—realistic noise —really works—keeps children quiet for hours. For other people's children, of course.

ALTHOUGH only a simple instrument in the field of radio servicing, the pocket signal injector is a most valuable and handy tool for both the amateur and professional.

Because no mains power supply is required for its operation, and due to its small, compact size, this signal injector can be used almost anywhere—in the car, for example, where fault diagnosis can be carried out on the car radio which would normally be removed from the car necessitating, usually, in the car battery and speaker being removed also.

The signal injector is not, in general, able to pinpoint a malfunctioning component, but enables the stage containing the faulty component to be isolated enabling tests appropriate to this stage to be carried out.

CIRCUIT DESCRIPTION

The circuit diagram for the complete signal injector is shown in Fig. 1.

It can be seen that the collector of TR1 is capacitively coupled to the base of TR2 by capacitor C1, and TR2 collector is capacitively

Approximate cost of components
£ 0:80 excluding case

A useful pocket instrument for fault location on transistor radio receivers and audio equipment

SIGNAL INJECTOR

BY ALAN JARDINE

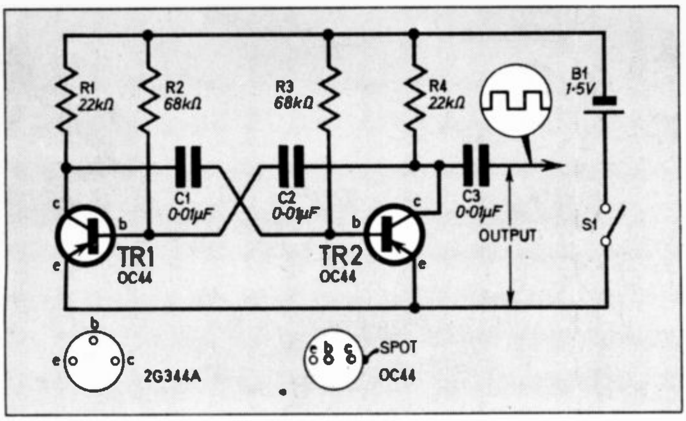


Fig. 1. The complete circuit diagram of the signal injector. Output is taken from the collector of TR2. and is a "square" wave of basic frequency 11kHz.

Components....

Resistors
R1 22kΩ
R2 68kΩ
R3 68kΩ
R4 22kΩ
All ¼ watt ± 10%

Capacitors
C1 0·01μF
C2 0·01μF
C3 0·01μF high voltage type (see text)

Transistors
TR1, TR2 OC44 or 2G344A germanium *pnp* (2 off)

Switch
S1 on/off push button

Miscellaneous
B1 1·5V battery type HP7
SK1 3 mm insulated socket
PL1 3 mm miniature plug
Veroboard, 4 x 25 holes 0·15 inch matrix
1 inch diameter tube about 5½ in long (it is advisable to obtain one with a clip-on lid);
1 crocodile clip; 1in nail; rubber grommet.

SEE SHOP TALK

coupled to the base of TR1 by capacitor C2.

This cross-coupling produces what is in effect an oscillator, due to the feedback action of the capacitors. This type of oscillator is called an astable (free-running) multivibrator.

Basically the multivibrator has two states, TR1 "on" (conducting)—TR2 "off" (non-conducting), and TR2 "on"—TR1 "off." The transistor states are activated by the capacitors C1 and C2; the length of time each is "on" and "off" is dependent on the values of C1, C2 and R2, R3.

OUTPUT WAVEFORM

The output voltage seen at the collector of TR2 is a square wave formed by the periods of TR2 being "on" and "off" as shown in Fig. 2.

The ratio of the time one transistor is "on" to the other is known as the mark/space ratio. In this case C1=C2 and R3=R2, each transistor is on for the same length of time and so it is 1.

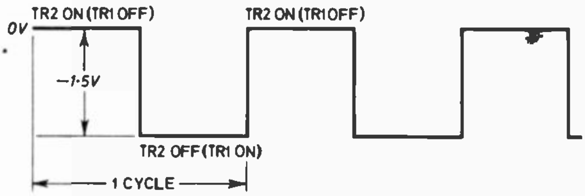


Fig. 2. The waveshape obtained at the output. This is made up from periods of TR2 conducting and non-conducting, the resultant effect being a square wave. A similar wave form is available at the collector of TR1.

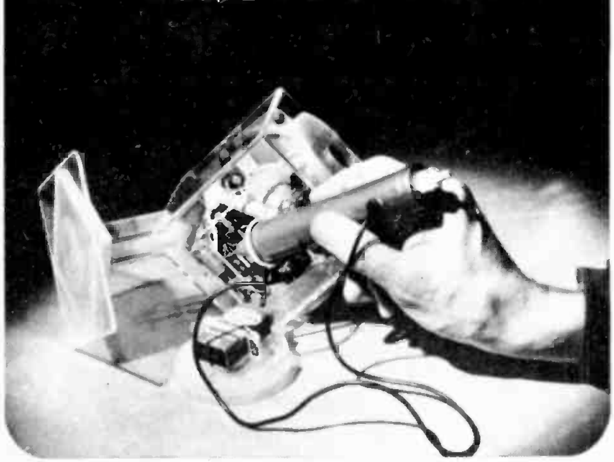
The frequency (in Hz) of the square wave at TR2 is given by: $f = 1 \div (1{\cdot}4C \times R)$ where C is in Farads, R in ohms. For the circuit of Fig. 1 the frequency is 1kHz.

This signal can be regarded as a sine wave of frequency 1kHz with harmonics up to 10MHz. Thus the signal can be injected into any stage of a radio set and will produce a continuous note if the set is in working order.

The capacitor C3, in the output stage, has no influence on the signal produced by the multivibrator—its function is to prevent any current flowing into the injector from the radio under test.

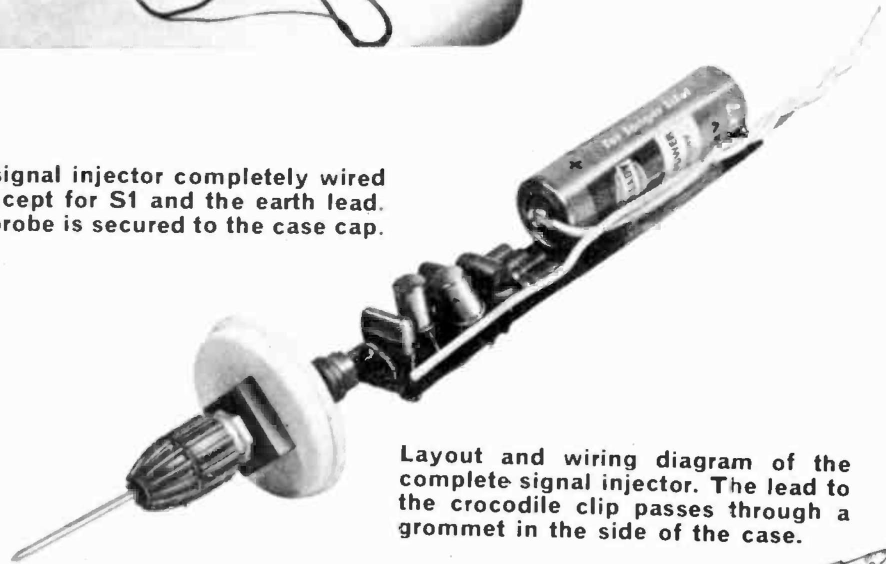
It must be stresed at this point that this signal injector is primarily designed for use on transistor radio sets. If it is going to be used on mains sets, capacitor C3 should be a high voltage type, at least 350 volts working and

SIGNAL INJECTOR

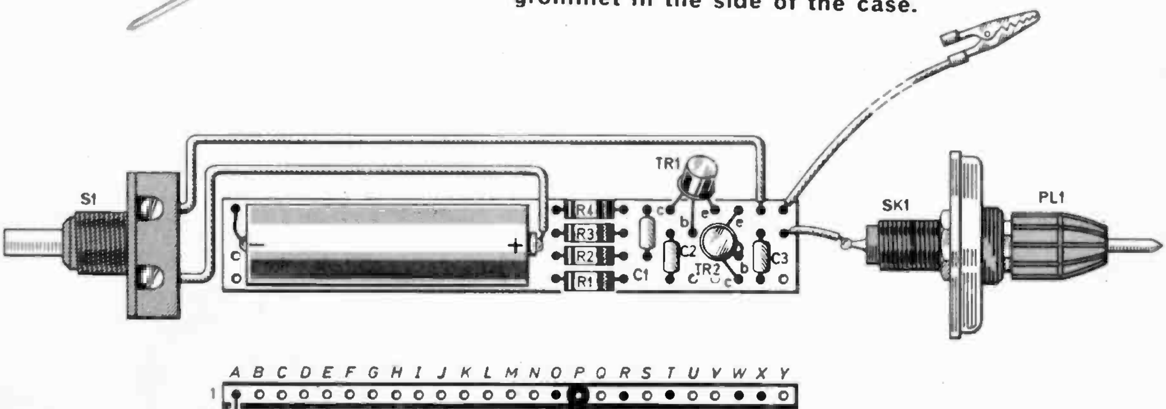


The photograph on the left shows the completed signal injector being used to test the Astron receiver. Complete test procedure for the Astron is given in the text of this article. The injector can also be used with other radios and audio equipment.

The signal injector completely wired up except for S1 and the earth lead. The probe is secured to the case cap.



Layout and wiring diagram of the complete signal injector. The lead to the crocodile clip passes through a grommet in the side of the case.



the metal case housing the unit must be adequately insulated. Several layers of insulating tape wrapped around the metal case should and must be used.

VEROBOARD LAYOUT

The resistors, capacitors and transistors are all mounted with the battery on a piece of 0·15 inch matrix Veroboard of dimensions $3\frac{3}{4}$in. × $\frac{5}{8}$in. (4×25 holes). The layout of the components is shown in Fig. 3(a).

The Veroboard length was chosen so that the battery can be attached to give a rigid, secure structure.

The underside of the board should be cut as shown in Fig. 3(b). Note the wiring across the copper strips at A1 to A4.

MOUNTING THE COMPONENTS

Once the Veroboard is cut we can mount the components, starting with the resistors R1, R2, R3 and R4 followed by the capacitors C1, C2 and C3.

A piece of tinned wire should now be soldered across the 4 strips of copper at A1 to A4 with one end protruding through the top of A4 for later connection to the battery.

Solder a 3 inch piece of insulated wire to the positive terminal of the battery and place the battery on the Veroboard in position shown. Secure in this position by wrapping some insulating tape around the battery and board.

Solder the bare lead from A4 to the battery base (negative terminal).

Next the flying leads to locations X4 and Y4 should be soldered. X4 lead should be about 5 inches long and Y4 should be about 2ft.

The probe flying lead should now be soldered in position indicated, Y2. This should be about 2 inches long and be of seven strand insulated wire.

All that remains to be done on the board now is to solder the transistors in position. Remember when soldering transistors, to use a heat shunt on the leads being soldered. A small pair of snipe nose pliers held across the lead being soldered will act as an efficient heat shunt. If no heat shunt is used permanent damage to the transistors may result.

Now take the leads from X4, Y4 and the positive battery terminal to the end of the board as shown. These may be held in position by means of a piece of insulating tape on the side of the battery.

Connect the push-button switch S1, as shown and ensure it is in the off position.

CASE

The case used in the prototype was an empty "Steradent" tube which is an aluminium tube with a plastic clip-on cap. A plastic clip-on cap should be used since it affords insulation of the probe from the case and no lead twisting results from the clip-on action.

A small hole is drilled in the centre of the cap to suit a 3mm insulated socket (which forms part of the probe), and a nut and washer hold it securely in position.

Another hole is drilled in the opposite end of the tube to suit the switch S1.

The switch used, and obtainable from Woolworths, was found to be a little large to fit into the tube. It is necessary to file a little off each corner of the switch to enable an easy fit.

At the rear, and on the side of the tube, drill a small hole about $\frac{3}{16}$ inch diameter for the fly lead from Y4. A rubber grommet should be used in the hole for protection of this wire.

PROBE

The probe is very easily constructed. It consists of a 1 inch nail with its end filed to a smooth point and its head soldered to the inside of the 3mm plug. A length of insulated sleeving is then pushed over the stem of the nail, leaving about $\frac{1}{4}$ inch of tip exposed, and the plug cap screwed on. Push the plug into the socket on the lid of the tube—the probe is now complete and the fly lead from location Y2 on the Veroboard can now be soldered to the tag on the socket.

ASSEMBLY

First of all, check that the correct transistor lead connections have been made and that the battery is connected the right way round.

Thread the lead Y4 through the hole on the side of the case. Now lay a thin piece of foam rubber along the bottom of the Veroboard and lap it around the battery end (this may be held in position by a dab of glue and prevents possible shorting against the case) and slide the whole unit, switch end first, into the tube.

Screw the plastic fixing nut on the switch and clip on the lid. The grommet should now be placed in position and a crocodile clip attached to the end of the exterior lead.

The unit is ready for use.

TESTING

Testing the unit is a simple matter. Apply the probe to the aerial socket or aerial connection of a radio set that is known to be in working order, and attach the crocodile clip to the earth line in the radio and switch on.

With the volume knob turned up, a high pitched tone should be heard whatever the setting of the tuner dial.

If there is no sound, recheck the circuit and investigate for breaks in the circuit, short circuiting and dry joints.

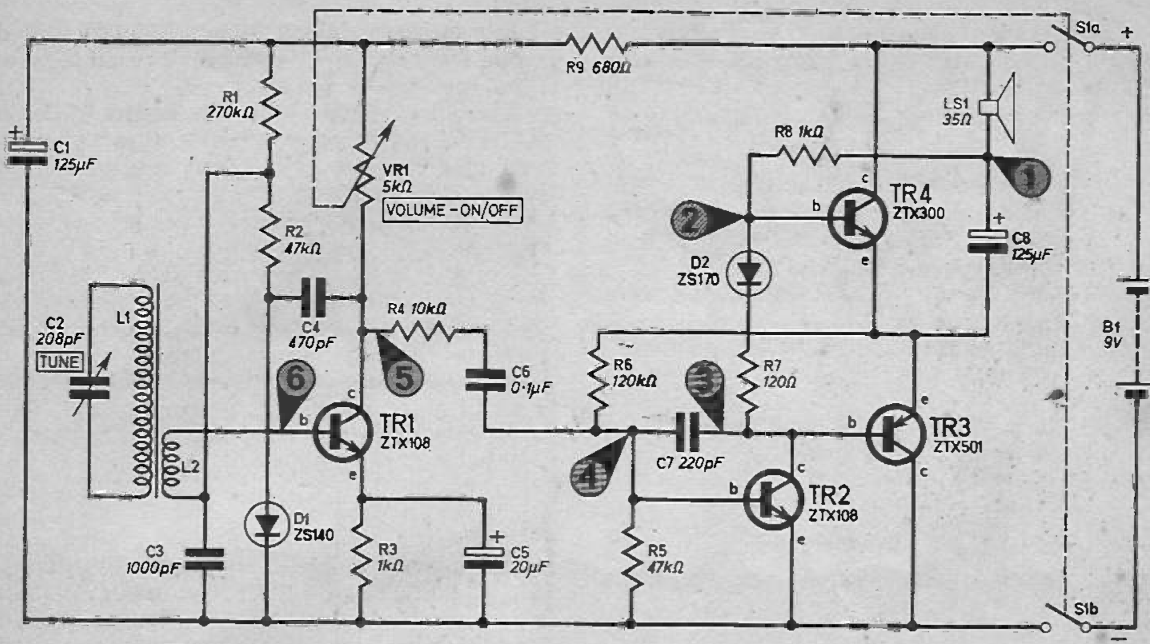


Fig. 4 The circuit diagram of the Astron receiver with the test points indicated for fault location and checks.

FAULT LOCATION

The completed signal injector may prove a very useful instrument for the constructors of the *Astron* receiver featured in the January edition of EVERYDAY ELECTRONICS as well as constructors of other projects or for use in fault locating on commercial transistor receivers.

The *Astron* circuit will be used to illustrate the use of this instrument, but it will be seen that the testing procedure can be adopted for use on other types of receivers, amplifiers, etc.

Basically what happens is that we work backwards through the circuitry from the loudspeaker listening to the volume and tone of the signal emerging from the loudspeaker.

When a point is reached which produces "no sound", then the fault lies between this point and the previous one. The absence of any sound indicates such things as a faulty component, dry joint, circuit break or wrong connection. When such a "noiseless" stage is reached, this region should be checked in detail.

For the *Astron*, signal injection should be at points 1 to 6 as indicated in Fig. 4.

Assuming that the radio is in perfect working order, the testing procedure should give results as listed below.

PROCEDURE

Turn the volume control full on and adjust the tuner so that no station is tuned—this results in a hiss from the loudspeaker. Attach the crocodile clip to the negative side of capacitor C1 and apply the probe to the points 1 to 6 in numerical order.

Point 1 A high-pitched sound of low volume will be heard over the loudspeaker. This indicates that the loudspeaker is functioning.

Point 2 A louder sound of the same pitch will result, indicating that the TR4 side of the output stage is functioning.

Point 3 The probe of this point produces higher pitched sound but with a reduction in volume as compared with test point 2. This indicates the functioning of the other half of the output stage—that containing TR3.

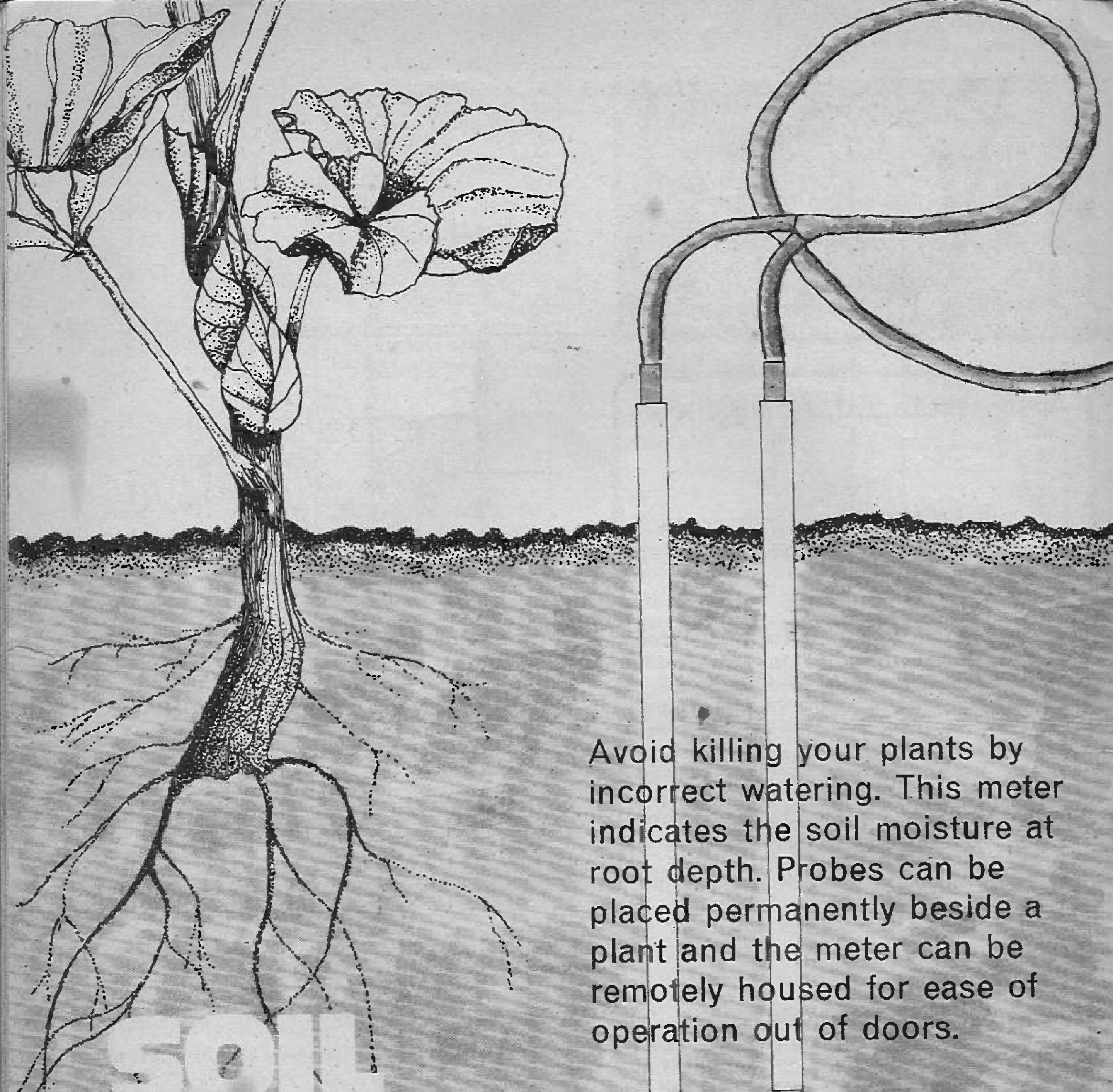
Point 4 This point is to test the driver stage containing TR2. A very loud sound is heard that has a lower pitch than point 3.

Point 5 A higher pitch sound than previous test point with the same volume level. Satisfactory signal indicates R4 and C6 free from fault.

Point 6 This position tests the performance of TR1. The sound produced by probing this point is very loud, with a lower pitch than previous test point.

It is important to test in the way described above, i.e., working back from the loudspeaker. Only if the stage previous to the one on test gives a satisfactory result can any conclusions be drawn about the one on test.

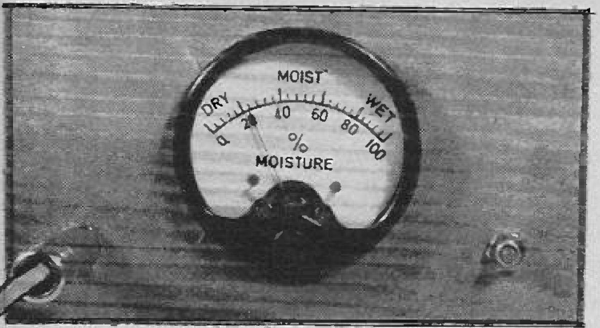
When a faulty stage is located, it should be examined in detail—it may be necessary to use other test equipment for this purpose. When rectified the above test procedure should be carried out again starting from test point 1. ■



SOIL MOISTURE METER

Avoid killing your plants by incorrect watering. This meter indicates the soil moisture at root depth. Probes can be placed permanently beside a plant and the meter can be remotely housed for ease of operation out of doors.

By D. Bollen



Approximate cost of components

£ 3·00 excluding case

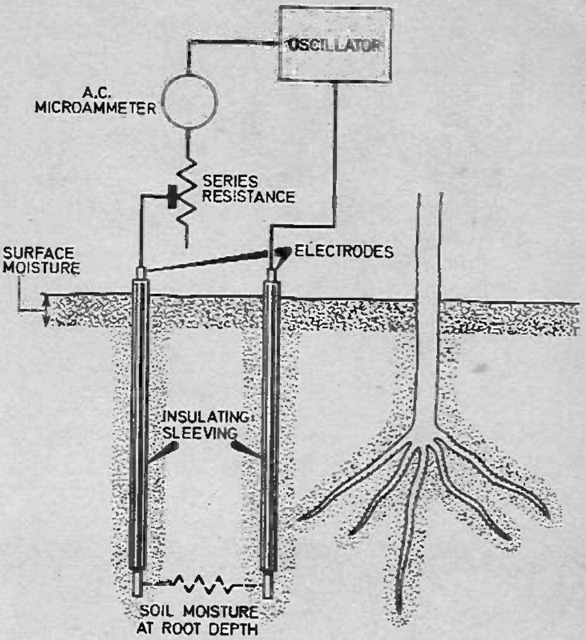


Fig. 1. Basic arrangement of the moisture meter.

On the face of it, watering the garden would seem to be a simple pastime, but it often does more harm than good. A light sprinkling during dry weather will, for example, merely attract rootlets to the surface and cause excessive transpiration, while water applied to apparently dry soil could percolate down to where roots are actually lying in sodden earth. Even more critical is the watering of plants in pots and seed boxes, because there is no large volume of earth to act as a moisture buffer.

Obviously, plants of different species have their own individual water requirements, and the only reliable way of ensuring that they are catered for is to measure soil moisture content at root depth.

MOISTURE MEASUREMENT

The electrical conductivity of a soil is approximately proportional to its moisture content, and the principle adopted here is to measure the a.c. current flowing between a pair of copper electrodes inserted in the ground. This gives a meter reading linearly calibrated in terms of percentage saturation which can be readily adapted to suit soils of widely differing porosity. It might be thought simpler to use d.c. current between the electrodes, but this would only result in electrode corrosion and errors due to polarisation of the electrodes.

The basic arrangement of the moisture meter is show in Fig. 1, with an oscillator supplying current to the electrodes via an a.c. microammeter and a series resistor. Insulated sleeving is fitted over the electrodes in such a way that only the ends are exposed to the soil, thus the depth at which readings are taken will depend on how far the electrodes are inserted.

Components....

SEE **SHOP TALK**

Resistors
R1 4·7kΩ
R2 68kΩ
R3 68kΩ
R4 4·7kΩ
All ±10% ½ watt carbon

Capacitors
C1 1μF polyester (250V d.c.)
C2 0·1μF polyester (250V d.c.)
C3 0·1μF polyester (250V d.c.)

Semiconductors
D1-D4 OA 200 (4 off)
TR1 BC 108 Silicon *npn*
TR2 BC 108 Silicon *npn*

Switch
S1 Single pole push to make

Meter
ME1 500 μA f.s.d. moving coil meter (100μA may be used—see text)

Miscellaneous
VR1 10kΩ vertical skeleton preset potentiometer
B1 PP3 9V battery
JK1 3·5 mm mono jack socket
PL1 3·5 mm mono jack plug
2¾ in x 2¼ in x 0·25 in matrix plain perforated circuit board, insulated sleeving, mounting pins to suit board, battery connectors, 24 in x $\frac{3}{16}$ in outside diameter copper tubing, case (approximately 4 in x 3 in x 3 in), connecting wire and probe leads.

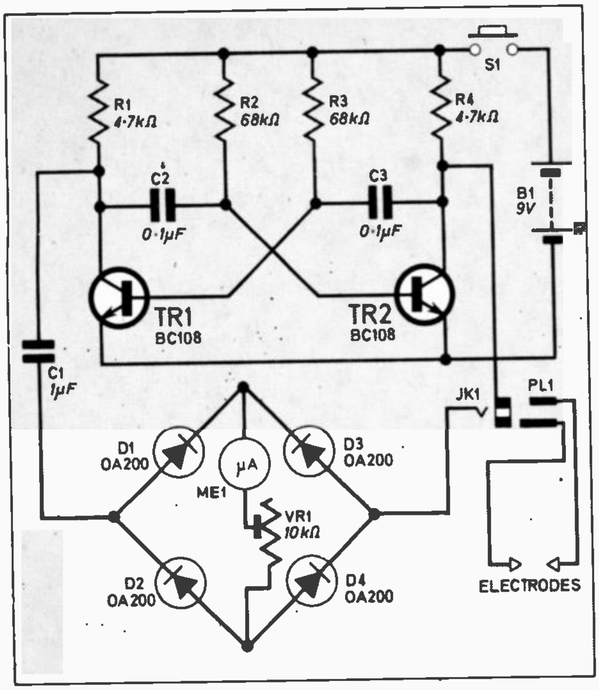


Fig. 2. Complete circuit diagram of the soil moisture meter.

CIRCUIT

The complete circuit of the moisture meter is given in Fig. 2. Transistors TR1 and TR2 are cross-coupled by capacitors C2 and C3 to form a multivibrator oscillator which provides a square-wave output of 8V amplitude at a frequency of about 100Hz. The output is taken through capacitor C1 which serves to prevent a flow of d.c. between the electrodes.

The multivibrator functions by the alternate switching of TR1 and TR2 actioned, at the selected frequency, by the charging of C2 and C3 through R2 and R3. Variation of these components will alter the frequency of the multivibrator.

The output is taken from across the collectors of the two transistors so that current is flowing through the probe circuit at all times. If the output was taken across one transistor only, then no current would flow when that transistor was fully conducting.

The a.c. microammeter in Fig. 2 consists of diodes D1 to D4, which form a bridge rectifier and meter ME1. The preset potentiometer VR1 functions as a series meter resistor and is also used for calibration. A.C. current passes from the collector of TR1, via C1, through the a.c. microammeter, and then by way of JK1 and PL1 to the electrodes, through the soil, and returns to the collector of TR2.

Switch S1 in Fig. 2 is a push button switch which energises the circuit only when a reading is being taken. The meter ME1 has a 500μA movement, but 100μA and 50μA movements may be used if their terminals are shunted by a resistor of 270 ohm or 120 ohm respectively. A convenient meter scale calibration would be 0-100, or 0-10, representing 0 to 100 per cent saturated—a method of altering the meter marking is given later in the article.

CONSTRUCTION

The moisture meter components can be housed in a small plastics food container or any other suitable small case, with ME1, S1, and SK1 fixed to the front. The remaining components are assembled on a piece of 0·25 inch matrix plain, perforated circuit board which is bolted to the meter terminals, see Fig. 3.

The photograph used in the heading of this article shows the meter face as marked in the prototype. To designate the meter as shown the movement must be taken from the case and the metal scale carefully removed from the movement. Unwanted markings already on the face can then be carefully removed using an abrasive cleaner or metal polish. Once this has been done new markings can be inked in and the meter reassembled, once again taking care not to damage the movement.

Commence construction by cutting the circuit board to size, and drill two holes to take the meter terminals. Insert all turret tags in the locations shown and then solder on link wires, resistors, VR1, capacitors, and leads, using insulated sleeving where necessary. When the circuit board has cooled, solder the diodes and transistors to the turret tags, using a heat shunt if you are not proficient at soldering the leads quickly.

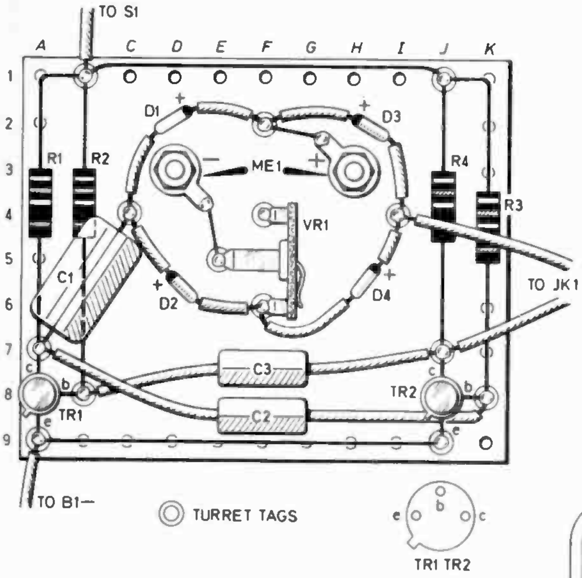
If the meter polarity is not the same as in Fig. 3, the connections to the solder tags should be reversed. Also, where a 100μA or 50μA meter movement is employed, the appropriate value of shunt resistor should be soldered across the meter tags, as mentioned earlier.

Having mounted the meter, push button switch and socket on the front panel, attach the circuit board to the meter and connect up the leads as shown in Fig 4. The battery can be taped to the inside of the box, or a special clip made to hold it in place.

To check that the circuit is functioning correctly, temporarily solder a 4·7 kilohm resistor across SK1, connect up the battery and press S1. Now adjust VR1 for a full-scale meter reading. If the meter does not respond at all when S1 is pressed, the circuit should be checked for wiring errors. Check the polarity of the diodes and the transistor connections in particular.

ELECTRODES

Take two pieces of 3/16 inch outside diameter copper tubing about 12 inches long (or longer if desired) and flatten one end of each with a



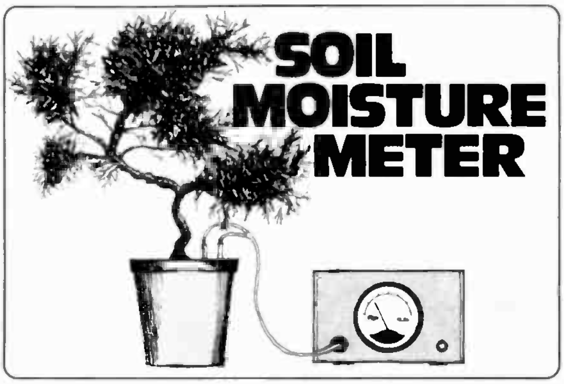
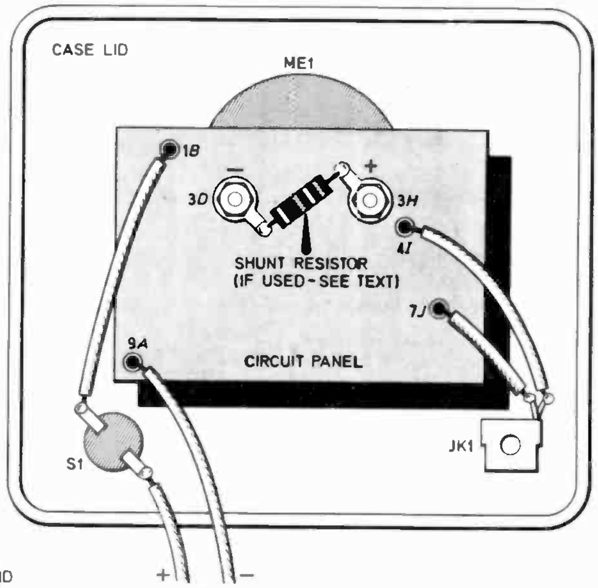
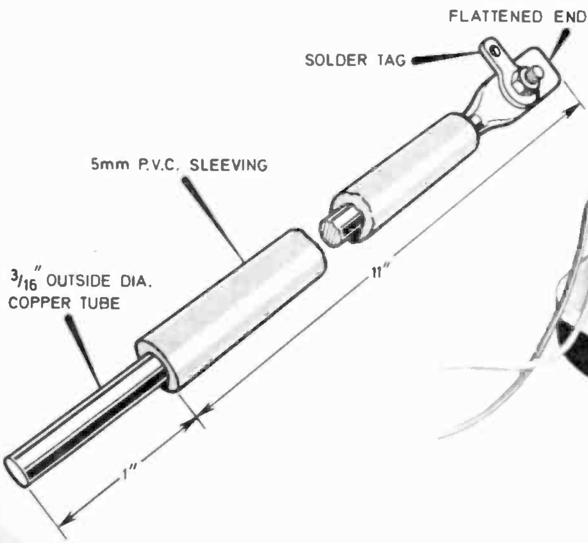


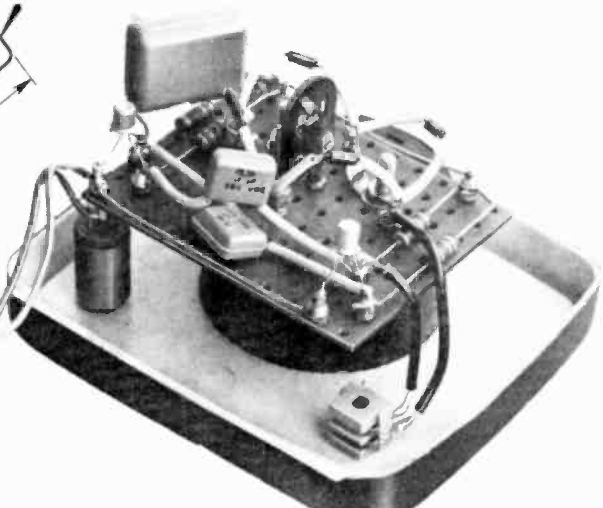
Fig. 3 (above). The layout and wiring of the complete circuit board. This board is mounted by the meter terminals.

Fig. 4 (right). Connections of the flying leads from the circuit board to the remaining components.

Fig. 5 (below). Construction of the moisture probe—two are required. These are connected by two core wire to JK1 via PL1.







hammer, see Fig. 5. Drill the flattened ends to take 6 B.A. screws. Push insulated sleeving over the electrodes leaving about 1 inch of the unflattened ends bare.

The moisture probes may be permanently installed or used at various locations with the meter. Having decided on the location of the electrodes, and the length of cable necessary (this should not exceed 20 yards) solder the ends of the cable to the electrode tags and fit PL1.

SETTING UP AND CALIBRATION

It is advisable to check that the probe cable does not introduce too much capacitance into circuit, especially when a long run is used. Support the electrodes off the ground on a piece of dry wood, connect PL1 to the meter and press S1. If there is a slight movement of the meter pointer away from zero this can be compensated for by adjustment of the meter zeroing screw.

Push the electrodes into the ground, about 3 inches apart, to the required depth, and then pour about two gallons of water onto the soil around the electrodes and leave for an hour or two, until the soil is saturated at root depth, then press S1 and adjust VR1 for a full scale (100 per cent) reading. If, after calibration, there is a prolonged dry spell, the meter reading will slowly decline and may eventually reach zero.

USING THE MOISTURE METER

Some plants will thrive best if their moisture level is maintained within limits, for example, house leeks 10-30 per cent, roses 30-70 per cent, and marrows 70-95 per cent. Cacti, on the other hand, will demand a seasonal watering programme varying from, say, 60-80 per cent in summer down to 5-10 per cent in winter.

There are many books available on gardening and the various moisture requirements of plants can be found from these books. If you require the probes to be permanently installed for monitoring of one plant a second set of probes could be constructed and used with the meter to check other plants both indoors and outdoors. A set of smaller probes may be useful when checking small pot plants.

Meter calibration can be checked from time to time when the soil becomes saturated after a heavy rainfall. ▣

MEMORY STORE

Retrieval By

Derek Burn

I SUPPOSE that it is true to say that I became involved in electronics by the back door. My only formal training had been a wireless mechanic's course in the RAF, and that was a very long time ago and almost forgotten. Then one day a new neighbour passed the house carrying under one arm a very large and impressive model boat and under the other an equally impressive box covered with an incredible array of knobs and dials. This fascinating sight could not be allowed to pass unremarked and I just had to find out more. I think perhaps a dormant interest had been aroused, for the immediate result of a most interesting conversation was that I gained a new friend and a new hobby.

The magnificent boat was of course radio-controlled, and it turned out that it was not working very well. Hoping that at least a part of my RAF course had stuck, I rashly offered to try to put things right. Fortunately it wasn't too difficult for these were the early days of radio control when valves and very simple circuits were the only hope for success.

We soon reached that triumphant stage when the gear would work correctly on about half of our visits to the local pond—and that was quite a fair performance in those days!

About this time, commercial equipment was beginning to appear featuring that new-fangled gadget, the transistor. Naturally we could not afford such luxuries, but at least we could try to learn something about the device and attempt to build our own gear. This was a very exciting period for radio control.

The transistor made it possible to devise very much more sophisticated circuitry which was small and light, and yet more reliable than the valve equipment that it replaced. Our visits to the pond became more frequent and much more successful.

As I learnt more about these transistors, I became fascinated by their possibilities, and my interests widened to cover any aspect of electronics that took my fancy. The main reason for this active interest was curiously my inherent laziness.

I had always been put off by the enormous amount of tin-bashing which seemed to be such an essential feature of the electronics of the valve era. The transistor changed all that. The chassis was now just a piece of printed circuit board, and I felt that I could now get stuck in!

Probably because I was never very successful with r.f. circuits (oscillators would never oscillate and amplifiers invariably did), the ham scene did not appeal to me. However, I discovered an unexpected talent for making multivibrators that worked, and so I was led inevitably into the field of digital circuits. As it happened, model radio control also moved in this direction with the introduction of the so-called digital proportional system, and so my interest in that aspect of electronics was maintained.

The scope of this type of circuitry is almost limitless, bounded only by one's imagination. Well, almost only, another factor being patience. After all, there is a limit to the number of bistables one is prepared to wire up!

Happily, just at this time, integrated circuits burst upon the amateur scene, and really complex circuits such as digital clocks became a reality. I can see no end to this type of electronics for many years to come, and I am happy that it should be so.

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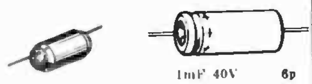
2N697	Sil. NPN	General	18p
2N1304	Ger. NPN	"	26p
2N1305	PNP	"	26p
2N2646	Sil. UJT	Oscillator, SCR driver	47p
2N2926	NPN	Small sig. amp	11p
2N3055	NPN	High power	60p
2N3702	PNP	Low power	13p
2N3704	NPN	Low power	13p
AC126	Ger. PNP	Small sig./driver	20p
AC128	PNP	Low power	20p
AD149	PNP	High power	58p
AC176	NPN	Low power	16p
*AD161	NPN	Med. power	33p
*AD162	PNP	Med. power	36p
BC108	Sil. NPN	Small signal	11p
BC109	NPN	Low noise	12p
BC168	NPN	Small signal	10p
BC169	NPN	Low noise	11p
BF194	NPN	RF amp.	14p
BFY51	NPN	Med. current	20p
OA90	Ger. diode	RF detector	6p
OA91	" "	General	5p
SD1		Silicon Rectifier 1 amp	10p
W02		Silicon bridge 1 amp	40p
*Matched pair AD161/AD162			60p

CAPACITORS

Non-polarised | Electrolytic



Electrolytic	
1mF 40V	6p
5mF 64V	6p
10mF 64V	6p
20mF 64V	6p
25mF 25V	6p
50mF 25V	6p
80mF 25V	6p
100mF 25V	7p
220mF 25V	10p
470mF 25V	12p
1000mF 25V	20p
2000mF 25V	30p
5000mF 25V	62p

Polystyrene

10pF	3p
22pF	3p
100pF	3p
220pF	3p
470pF	3p
1000pF	3p
2200pF	3p
4700pF	4p

Polyester M K T

0·01mF	5p
0·02mF	5p
0·047mF	6p
0·1mF	6p
0·22mF	6p
0.47mF	10p
1mF	14p

Many other higher and lower ratings will be found in the catalogue. Close tolerance and high stability types also.

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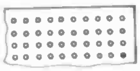

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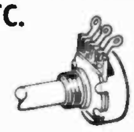

4·7Kohms, 10Kohms, 22 Kohms, 47, 100, 220, 470 Kohms; 1 Megohm, 2·2 Megohms.

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SHOP TALK

By Mike Kenward

We will try and clear up a few points that have come to light during the last month. First it would appear that in January issue two components were missed out of components lists. In the *Astron* R9 680ohms was left out ($\frac{1}{4}$W$\pm$10% carbon) and in *Electro Laugh* D1 1N914, diode was left out.

When constructing the *Electro Laugh* please note the link between P7 and Q7 is not very clear on Fig. 3 as C6 has printed rather darker than it should have.

In the *Astron* we have also managed to show two C5's on Fig. 3—the one on the left should be C6—and we have transposed the battery leads on Fig. 4. We have also made the same mistake with the battery leads in the *Rain Alarm*, February issue Fig. 4, sorry about these points.

Whilst talking about these projects there are some other points worth mentioning. The speaker used in the *Astron* is the same as that specified for the *Demo Deck*. Due to demand created by these articles the speaker is at present unobtainable, however, some firms have similar size speakers in stock and one of these could be used, provided that its impedance is not less than about 20 ohms. Speakers with much higher impedance than the 35 ohms specified will not provide such a high output power.

Some readers have enquired about the earpiece used in the *Electro Laugh*, it is a magnetic device and is generally available for around 60p. After some experimenting the unit was also found to work well into a small 75 ohm speaker and this makes a good alternative to the earpiece.

Component Wiring

Apparently new constructors are having difficulty in following our Veroboard layout and wiring diagrams. The main problem seems to be that readers are unsure about what is copper and what is board. In all our diagrams the black strips are the board and the white the copper. The small black dots are connections of the wires to the strips and the large black circular areas with white holes are the areas where the copper has been cut away with a drill or spot face cutter.

Another point that is worrying some constructors is the type of wire we use for making links on the board. In general the wire is 22 s.w.g. tinned copper wire but in some cases—where bare wire could touch other wires or components—single strand covered wire should be used.

We hope that has solved a few problems from previous months—now let us look at this month.

Moisture Meter

The 0·25 inch matrix perforated circuit board used in the *Moisture Meter* is the same as that used in the *Demo Deck*. To state the position about supply once again, it is made by R. S. Components but not available to readers from them. The board must be purchased through one of the normal components retail firms and a number of them either stock it or will get it for you; the same applies to the mounting pins used.

When it comes to covering the probes with insulating sleeving Home Radio sell some heat shrinkable sleeving which is easy to use and is eminently suitable for the job. The tubing is called Polyshrink and is available in a range of sizes to suit various diameters to be covered from $\frac{1}{8}$ inch to 3$\frac{1}{4}$ inches.

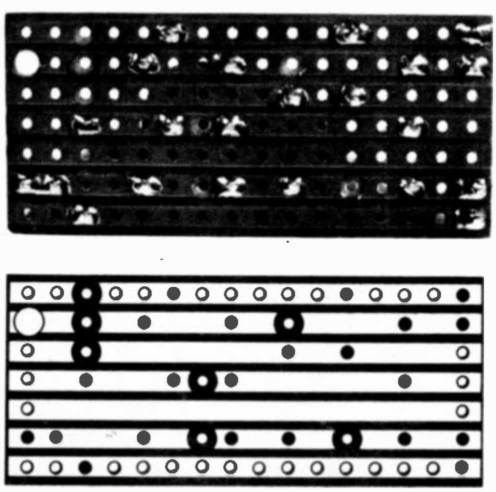
Darkroom Timer

The list of semiconductors used in the *Darkroom Timer* is varied but the Zener diode, silicon controlled rectifier and diode are all items that are readily available in a variety of type numbers. Indeed many suppliers no longer quote the type numbers but list such things as Zener diodes by the voltage and power rating as we have given in the components list. It is not necessary with this type of device to search for the correct type number provided the ratings we quote are the same.

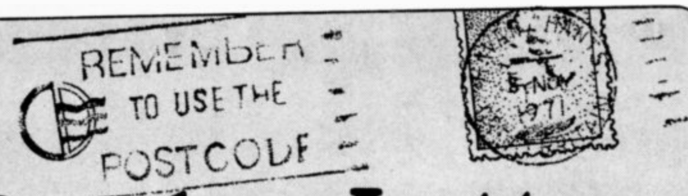
The wafer switch used is a 2 pole 9 way type and we have shown this as having two wafers, however, it is available in a number of types—all suitable—and some may only have one wafer or possibly two with 12 ways on each, it is only necessary to use 8 of the tags and a wiper.

Signal Injector

As far as we can see there are no buying problems concerning the *Signal Injector*—provided you take note of the advice given in the article concerning the tube used as a case.



Compare the photograph with the drawing and identify the strips of copper, soldered connections and breaks in the strips.



Readers Letters

Mystery!

Why is the subject of electronics surrounded by such an air of mysteriousness? I am new to electronics and have learned a lot from the first three issues of your magazine. If I want to develop a film there is no mystery. All I need is a developing tank, a bottle of developer and bottle of fixer. It's as easy as making a cup of tea. Your magazine is helping to destroy the mystique that has shrouded the subject for far too long. Carry on the good work.

Russ West
London.

Letraset

Thank you for your latest publication, EVERYDAY ELECTRONICS, a great alternative to *P.E.* which I have been taking for a number of years. I have just completed the record player featured on your first edition, with a few alterations in layout, to suit the plinth I made and I am delighted with results. I have one request to make, could you please inform me where I can purchase Letraset so often prescribed by your authors for projects but never a source of supply mentioned. I would be grateful if you would also let me know which sheet I would require for audio and if possible, price.

G. H. James
Scotland.

Letraset is available in a vast range of type faces from most large stationers. Each sheet contains a range of letters and numbers and hence any designation can be made up; the prices of the sheets vary.

Projects

Having just read my first copy of your magazine, EVERYDAY ELECTRONICS. I find this magazine most interesting as it deals with the practical aspects of electronics which are often complicated by theory in other periodicals.

I wonder if you have considered the use of electronics as used on small boats as most professionally manufactured electronic aids are very expensive. It would seem that there is a demand for practical advice as to the construction of instruments which would be of use to small boat owners.

B. L. Strang
Edinburgh.

The boat owner will not be overlooked in future issues.

It was quite by chance that I picked up a copy of the January 1972 issue of EVERYDAY ELECTRONICS and was so pleased that I have now ordered the first two copies and have placed a firm future order.

I am writing, because I expect that you are feeling your way as regards to the contents and level of your articles. There must be many like myself who reached a fair knowledge in the use of the valve and due to circumstances had to chop the hobby only to find now that there have been so many changes that it is most difficult to take up the hobby again.

Your *Teach-In* article is just right for us as is the m.w. reflex receiver. I am looking forward to making a start on the *Windscreen Wiper Control*, when I get the copy.

G. V. Pride
Dorset.

Device Function

May I offer the following comments concerning your new magazine, for which I have placed a regular order, in the hope that they may be of some assistance to you.

You appear to be aiming at simplicity and this is most important, but being specialists, I fear you may drift into the complication and jargon which so limits the field of other electronics magazines. You see I am sure there are a great number of do-it-yourself practical people who would like to widen their hobby scope, without having to do a great deal of research and study. They are the type of people who want to *use* the equipment in some useful way. After all, many people use motors, relays, solenoids etc., in gadgets and models, without knowing much about equipment designs—flux densities—back e.m.f., etc.

In a good deal of reading I have not come across a clear statement of what transistors and S.C.R.s do, without a long and difficult explanation of how (which incidentally seems to vary). Maybe as specialists you do not appreciate that the practical person is not interested in the how, he accepts a transistor as a "little thimble with three or more wires sticking out of it." What he wants to know is which wire to connect to what in order to make a timer work, a flash gun to flash, a bell to ring etc. In this respect, please keep printing a drawing of the base of the various transistors you use in your projects.

F. R. Holmes
Darlington.

We will keep printing those base drawings and, if you follow Teach-In *you will be able to learn, fairly simply, what the various devices actually do.*

Preferred

I am a beginner in electronics and therefore *E.E.* is of great interest to me. My only criticism is that in projects such as the *Electro Laugh* (which I shall make in the near future), which are built on Veroboard, you only show the holes round the edge. Construction would be greatly simplified if all the holes were shown, mistakes are hard to avoid as it is. I hope you can put this right soon.

In Mr. Sproxton's article *Component Buying & Supplying* he mentioned the notorious F. J. Camm who did not use preferred values for resistors and capacitors. Why have these? Why not have multiples of 1, 2, 3, 4, etc., instead of the E12 series, with the addition of multiples of 1·5, 2·5, 3·5, 4·5, etc., instead of E24 series? This does happen to some extent with electrolytic capacitors. Where do the preferred values derive from originally?

Colin Walls
Southend-on-Sea.

We have found from past experience that in most cases when all the holes—or a large number of them—are shown on Veroboard layouts that this tends to make them harder rather than easier to follow. It is a simple matter when constructing a unit to place a transparent ruler along each set of holes to make it easier to follow.

Preferred value resistors are necessary because manufacturers would turn out almost any value otherwise. We have the various series of values because they have been calculated so that any specified value can be made up from the fewest possible number of individual preferred values.

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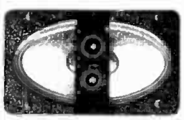

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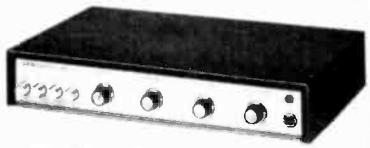

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SP5	5"	600'	P.V.C.	42p	SP7	7"	1200'	P.V.C.	62p
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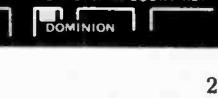

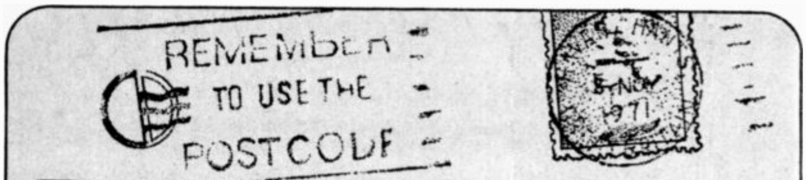

Readers Letters

The Bug

I don't know whether I should express my thanks for your new publication, or whether I would be perhaps better advised by my inner self to make this a letter of condemnation of you and your colleagues!

The reason for this indecision on my part, as you may have already guessed, is that I have been well and truly bitten by "the bug." Since I first picked up *E.E.* in my local newsagent just before Christmas my diet has been one entirely made up of resistors, capacitors, and other mysterious ingredients, some more indigestable than others! I have now devoured two issues of *E.E.* and two of big brother *P.E.* but my appetite shows no sign of abating.

Since cutting my teeth on Meccano many years ago I have always been a dabbler, and have run the whole gambit of the more "fiddling" pastimes—model-making, marquetry, fretwork, paper-folding, printing, in fact any hobby that can be enjoyed in a reasonably small space. But until now the radio/electronics world had remained totally incomprehensible, then along comes *E.E.* and suddenly I begin to get a glimmer of light through the haze and glimpse a whole new area of pleasant and useful activity. Or to come back to earth and use my wife's expression "I see we have a new collection of gadgets cluttering up the kitchen!"

Anyhow, for better or worse, the die has been cast and I am anxious to try out my new soldering iron, and actually construct something. Trouble is, for a couple of reasons, progress is not what I had hoped it might be, and I have yet to hear the first cries of my first-born electronic creation, and am still being denied the heart-warming patter of tiny oscillators!

You see, first of all as a complete absolute beginner, there are many things not covered by "first-step" *Teach-In* type articles. What is needed is a couple of really basic articles which assume no pre-knowledge at all. For example, what sort of wire do I use for connecting components; How does one *actually* mount components on to various types of perforated board; what is used for connecting links (in illustrations e.g. January cover—Laugh Simulator—it looks like bare wire of paper clip proportions). It is the same with books borrowed from library—components are explained in great detail, but the ordinary bricks and mortar are largely ignored.

J. G. Richards
Sale.

The bare wire used for connecting components on a circuit board is normally 22 s.w.g. tinned copper wire — as used for the soldering exercises in Teach-In *part 1. Where necessary single strand covered wire may also be used. The* Using Printed Wiring Board *article in our first issue deals with the component mounting question and* Shop Talk *this month refers to Veroboard.*

Laugh

I am a very keen reader of your magazine and although electronics in todays form is fairly new to me I have tried several of your projects (with great success) and find them very well explained and easy to construct. I must however tell you about one of them in the January edition, the *Electro Laugh.* I set to work and constructed this project only to find that it would not work. After checking my wiring several times I was about to give up when I discovered (by referring to the circuit diagram) that you have made a mistake. I refer to Fig. 4. This shows the copper strip on the Veroboard as being cut at point Q24 when in fact it should not be cut at all. After soldering a piece of wire across this cut I found that the laugh simulator worked quite well.

Brian Wadsworth
Staffs.

This point may help some readers who are having similar troubles. There is actually no mistake in the Electro Laugh *wiring, this difficulty has arisen because a link shown under C6 in Fig. 3 has become obscured. Reference is made to this project in* Shop Talk *this month.*

Connections

I am writing to you, concerning the *Astron M.W. Receiver*. I followed the instructions very carefully not forgetting to solder the transistors as requested, on completion I switched on expectingly, but alas, there was no sound apart from the faintest crackling when I switched on. Determined not to be dismayed I checked and re-checked the circuit, till it came to my notice that D1 and D2 in Fig. 1 did not show the same polarities as in Fig. 3. Where upon I reversed the polarities of D1 and D2 to correspond with Fig. 1 but still the result was the same, next I noticed that TR1 and TR2 in Fig. 3 were facing in opposite directions yet they are both *n.p.n.* and have the same value, could you please advise.

M. Torpey
Wood Green.

The diode connections are correct in both Figs. 1 and 3, the positive sign on the diodes corresponds to the arrow head in the circuit symbol.

It would seem that you have been misled by the perspective view of the transistors in Fig. 3. Both TR1 and TR2 face the same way, the leads have been shown bent in different directions for clarity. When wiring in transistors refer to the base diagram (shown between the two parts of Fig. 3 in this case) and the lead markings on the wiring diagram.

Some points concerning construction of the Astron *are also given in* Shop Talk *this month.*

Further Control

I have experienced a similar difficulty with the *Windscreen Wiper Control* as mentioned by Mr. Bacon in your January issue, the maximum delay being seven seconds.

I adjusted R2 to the point of cut-off, disconnected the negative end and found the sum of R2 plus R3 was 200 kilohms. As no adjustment of values at this point could be helpful, I reconnected R2, disconnected C2 and found the control operated normally.

As C2, on test, was satisfactory, I reconnected it with a 125 ohm resistor in series and this achieved the desired result, the delay being variable from five to thirty seconds with R2 operational over the full range.

J. Roscoe
Cheshire.

From this letter it would seem that the problem can be caused by leakage through C2. Readers can either fit a resistor in series or try another capacitor for C2.

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2N706A	12p
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2N930	20p
2N987	40p
2N1131	25p
2N1132	25p
2N1302	18p

Type	Price
2N1303	18p
2N1304	22p
2N1305	22p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1613	20p
2N2147	75p
2N2160	60p
2N2217	25p
2N2218	20p
2N2218A	25p
2N2219	20p
2N2219A	25p
2N2220	25p
2N2221	20p
2N2221A	25p
2N2222	20p
2N2222A	25p
2N2369	15p
2N2369A	15p
2N2646	40p
2N2904	20p
2N2904A	25p
2N2905	25p
2N2905A	25p
2N2906	20p
2N2906A	25p
2N2907	23p
2N2907A	25p
2N2925	15p
2N2926	10p
2N3011	20p
2N3053	20p
2N3054	50p
2N3055	75p
2N3525	£1·00
2N3614	55p
2N3702	10p
2N3703	10p
2N3704	12p
2N3705	10p
2N3707	12p
2N3708	10p
2N3714	£2·00
2N3715	£2·20
2N3716	£2·85
2N3771	£2·00
2N3772	£2·05
2N3773	£2·85
2N3791	£2·75
2N3819	35p
2N3820	55p
2N3823	50p
2N3824	95p
2N3903	20p
2N3906	25p
2N4058	12p
2N4061	12p
2N4062	12p
2N4289	12p
2N4290	12p
2N4871	35p
2N5457	30p
2N5458	35p
2N5459	40p
40250	50p
40360	40p
40361	40p
40362	50p
40430	£1·00
40543	65p
40594	£1·05
40595	£1·05
40636	£1·10

Full transistor list available— send for your free copy today!

HENRY'S LOW COST INTEGRATED CIRCUITS

BRAND NEW FULL SPECIFICATION TTL74 SERIES BRANDED FAIRCHILD, I.T.T. AND TEXAS

DEVICES MAY BE MIXED TO QUALIFY FOR QUANTITY PRICES

No.	Description	1-11	12-24	25-99	100+	250+
7400	Quadruple 2-input NAND gates	20p	18p	14p	14p	12p
7401	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7402	Quad 2-input NOR gates	20p	18p	16p	14p	12p
7403	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7404	Hextuple inverters	20p	18p	16p	14p	12p
7405	Hex inverters with open collector outputs	20p	18p	16p	14p	12p
7410	Triple 3-input NAND gates	20p	18p	16p	14p	12p
7413	Dual 4-input Schmitt triggers	30p	27p	25p	22p	20p
7420	Dual 4-input NAND gates	20p	18p	16p	14p	12p
7430	Single 8-input NAND gates	20p	18p	16p	14p	12p
7440	Dual 4-input NAND buffer gates	20p	18p	16p	14p	12p
7441	BCD-Decimal decoder/Nixie driver	75p	72p	70p	60p	55p
7442	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7443	Excess 3-Decimal decoder TTL outputs	£1·00	95p	90p	80p	70p
7447	BCD-Decimal 7 seg. decoder/indicator driver	£1·75	£1·60	£1·45	£1·30	£1·15
7448	BCD-Decimal 7 seg. decoder/driver TTL O/P	£1·75	£1·60	£1·45	£1·30	£1·15
7450	Expand dual 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7451	Dual 2-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7453	Quad 2-input expand AND-OR-INVERT gates	20p	18p	16p	14p	12p
7454	4-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7460	Dual 4-input expanders	20p	18p	16p	14p	12p
7470	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7472	Single J-K flip flop (gated inputs)	30p	27p	25p	22p	20p
7473	Dual J-K flip flop	40p	37p	35p	33p	30p
7474	Dual D flip flop	40p	37p	35p	33p	30p
7475	Quadruple bistable latch	45p	42p	40p	38p	35p
7476	Dual J-K flip-flops with Preset and Clear	40p	37p	34p	31p	28p
7480	Gated Full Adder	80p	72p	67p	59p	55p
7481	16-bit read/write memory	£1·25	£1·15	£1·10	£1·00	90p
7482	2-bit binary Full Adder	87p	80p	70p	65p	60p
7483	4-bit binary Full Adder	£1·00	90p	85p	80p	73p
7484	16-bit RAN with gated write inputs	90p	85p	80p	75p	71p
7486	Quadruple 2-input Exclusive OR gates	45p	41p	38p	35p	33p
7490	BCD decade counter	75p	70p	65p	60p	55p
7491	8-bit shift register	£1·00	95p	90p	80p	70p
7492	Divide twelve counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	75p	70p	65p	60p	55p
7494	Dual entry 4-bit shift register	80p	75p	70p	65p	60p
7495	4-bit up-down shift register	80p	75p	70p	65p	60p
7496	5-bit parallel/serial in/out shift register	£1·00	97p	95p	90p	83p
74100	8-bit bistable latch	£2·50	£2·30	£2·00	£1·75	£1·50
74118	Hextuple Set-Reset latches	£1·00	95p	90p	80p	70p
74121	Monostable multivibrators	60p	55p	50p	46p	41p
74141	BCD-Decimal decoder/Nixie driver	£1·00	95p	90p	80p	70p
74145	BCD-Decimal decoder (1-4-line) TTL O/P	£1·50	£1·40	£1·30	£1·10	£1·00
74150	16-bit data selector/multiplexer	£3·25	£3·20	£2·95	£2·15	£2·05
74151	8-bit data selector/multiplexer	£1·10	95p	90p	80p	70p
74153	Dual 4-line to 1-line data selector multiplexer	£1·35	£1·27	£1·20	£1·15	£1·10
74154	16-bit decoder/demultiplexer	£2·00	£1·75	£1·55	£1·30	£1·06
74155	Dual 2-line to 4-line decoder/demultiplexer	£1·55	£1·47	£1·35	£1·10	£1·06
74156	Dual 2-line to 4-line decoder/demultiplexer	£1·55	£1·47	£1·35	£1·10	£1·06
74190	Sync decade up-down counter, 1-line mode	£1·95	£1·85	£1·75	£1·60	£1·50
74191	Sync 4-bit up-down counter, 1-line mode	£1·95	£1·85	£1·75	£1·60	£1·50
74192	Sync decade up-down counter, 2-line mode	£2·00	£1·90	£1·80	£1·65	£1·55
74193	Sync 4-bit up-down counter, 2-line mode	£2·00	£1·90	£1·80	£1·60	£1·40
74196	Asynchronous presettable decade counter	£1·50	£1·40	£1·30	£1·10	£1·00
74197	Asynchronous presettable 4-bit binary counter	£1·50	£1·40	£1·30	£1·10	£1·00

Complete data on the above in booklet 20 pages, Ref. 29, issue 2 at 15p post paid.

Texas I.C. Handbook. Complete information on 100 types. **40p.** Post 10p.

Integrated circuit sockets 14 pin D.I.L. **25p**; 16 pin D.I.L. **30p**.

INTEGRATED CIRCUITS

Type	Price
MFC4000P	55p
MFC4010P	60p
1C12	£2·50
PA246	£1·50
TAD100	£1·50
TAD110	£1·50
MC724P	50p
702C (TO5)	75p
709C (TO5)	45p
709C (D.I.L.)	45p
723C(TO5)	£1·00
741C(TO5)	80p
MC1303P	£2·00
MC1304P	£2·25
SL403D	£1·50
741C(DIL)	75p
914(TO5)	40p
923(TO5)	40p
TOSHIBA 20 watt amp.	£4·47
TOSHIBA Pre amp	£1·50

PLESSEY INTEGRATED CIRCUIT 3 Watt Amplifier SL403D

Complete with 8-page booklet, circuits and data

£1·50 ea.

ZENER DIODES

	1–24	25 +	100 +	500 +	1000 +
400m/w BZY 88 series*	12p	10p	8p	7p	6p
1½ watt ZL series	25p	23p	20p	17p	15p
3 watt 3TZ series	30p	27p	25p	22p	20p
10 watt ZS series +	40p	37p	35p	30p	25p

All types are 5%. Wire Ended + these Stud. in voltages 3·3-100 volt in all standard values. *3·3-33 volt.

TRIACS

Stud with accessories

Type	P.I. volts	Current	1-11
SC35A	100	3 amps	80p
SC35B	200	3 amps	85p
SC35D	400	3 amps	90p
SC40A	100	6 amps	90p
SC40B	200	6 amps	£1·05
SC40D	400	6 amps	£1·00
SC45A	100	10 amps	£1·05
SC45B	200	10 amps	£1·15
SC45D	400	10 amps	£1·25
SC50A	100	15 amps	£1·35
SC50B	200	15 amps	£1·45
SC50D	400	15 amps	£1·75
SC40E	500	6 amps	£1·25
SC46E	500	10 amps	£1·45
SC50E	500	15 amps	£1·95
DIAC SD2			25p

SILICON RECTIFIERS

1 AMP MINIATURE PLASTIC WIRE ENDED

Type	P.I.V.	1-49	50+	100+	500+	1000+
1N4001	50	6p	5p	4½p	4p	3½p
1N4002	100	7p	6p	5p	4½p	4p
1N4003	200	8p	7p	6p	5p	4½p
1N4004	400	8p	7p	6p	5p	4½p
1N4005	600	10p	9p	8p	7p	6p
1N4006	800	12p	10p	9p	8p	7p
1N4007	1000	15p	12p	10p	9p	8p

BRIDGE RECTIFIERS

Miniature Potted Silicon ½" × ½" × ½"

Type	P.I.V.	Current	1–12	Type	P.I.V.	Current	1–11
1002	100	2a	55p	4004	400	4a	75p
2002	200	2a	65p	6004	600	4a	80p
4002	400	2a	75p	1006	100	6a	70p
6002	600	2a	80p	2006	200	6a	75p
1004	100	4a	65p	4006	400	6a	£1·00
2004	200	4a	70p	6006	600	6a	£1·10

QUANTITY OFFERS! FROM STOCK

AF117 Mullard **20p**
25 + 17p
100 + 15p
500 + 12p
1000 + 10p

2N2646 Motorola **40p**
25 + 35p
100 + 32p
500 + 28p
1000 + 25p

OC170 Mullard **25p**
25 + 20p
100 + 18p
500 + 15p
1000 + 13p

BY127 Mullard **15p**
25 + 12p
100 + 10p
500 + 9p
1000 + 8p

OC35 Mullard **50p**
25 + 45p
100 + 40p
500 + 35p
1000 + 30p

2N2926 Green **10p**
25 + 9p
100 + 8p
500 + 6p
1000 + 5p

BC107 All Makes **10p**
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

2N3055 Fairchild **75p**
25 + 65p
100 + 50p
500 + 40p
1000 + 35p

BYZ13 Mullard **25p**
25 + 20p
100 + 17p
500 + 15p
1000 + 12p

OA202 **10p**
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

OC28 Mullard **60p**
25 + 55p
100 + 50p
500 + 45p
1000 + 40p

2N3819 Texas **35p**
25 + 30p
100 + 25p
500 + 20p
1000 + 17p

BC108 and 9 All Makes **10p**
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

AD161 AD162 35p each
25 + 32p
100 + 28p
500 + 25p
1000 + 22p

OUR RANGE IS ALWAYS EXPANDING — Enquiries invited for new types arriving daily

ADDITIONAL DISCOUNTS — 10% 12+ : 15% 25+ : 20% 100+ — DELIVERY IS FROM STOCK

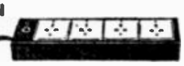
HENRY'S RADIO LTD. SEMI-CONDUCTOR DEPARTMENT 303 EDGWARE RD., LONDON, W2. TEL: 01-723 1008/9 CALLERS 356 EDGWARE ROAD W2.

NEW LIST · NEW PRICES 1971 TRANSISTOR LIST 1500+ SEND FOR YOUR FREE COPY TODAY...

DISCOUNTS 10% 12+ 15% 25+ 20% 100+ } ANY ONE TYPE POSTAGE 7p. ALL ORDERS

We respectfully ask customers to include a minimum £1.00 per order, it helps to plan ahead & saves postage as well.

DISTRIBUTION PANELS

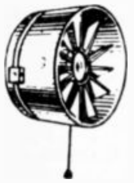


Just what you need for work bench or lab.
4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work. £2 less plug. £2·25 with fitted 13 amp plug; £2·40 with fitted 15 amp plug, plus 28p P. & I.

RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1 each or £11 per dozen, specify 5, 10 or 15 amp—*simply fit in place of switch.*

EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5½" casing with 5½" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets. £2 plus 36p post and ins.

MAINS MOTOR

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

TELEPHONE DIAL

Ex-G.P.O. Perfect working order.
50p each.

TELEPHONE HAND SET

Ex-G.P.O. Perfect order.
50p each + 20p p. & p.

SELECTOR SWITCHES

Ex-G.P.O. All in good working order.

3 pole	£1·25	5 pole	£1·75
4 pole	£1·50	6 pole	£2·00

plus 20p p. & p.

KITS FOR PREVIOUS PROJECTS

Kits of parts available as follows:—

HOME SENTINEL INTRUDER ALARM
Electronic Components with case £3·75

SNAP INDICATOR
All components but not case or battery 75p.

WINDSCREEN WIPER CONTROL
Components including metal for chassis £2.

RECORD PLAYER
All components, but not case, loudspeaker, record deck or pick-up £5·50

DEMO DECK
Components as list £6·75 POST PAID

FUZZ BOX
Electronic parts including box £1·85.

PHOTOGRAPHIC COLOUR TEMPERATURE METER
Electronic components less case £2·65.

ASTRON RADIO
All electronic parts less case £3

REMOTE TEMPERATURE COMPARATOR
All electronic parts less case £4·25.

ELECTRO LAUGH
Parts less case £2

TRANSISTOR MICROPHONE
All parts £1·70

AUTO ALERT
All electronic parts and metal bracket £2·50.

RAIN WARNING ALARM
All electronic parts and chassis £1·80

WA-WA PEDAL
All electronic parts £2·90.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only 22p, plus 18p postage.

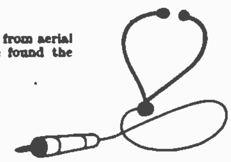
MICRO SWITCH

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

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the Wireless World about a year ago. We can supply kit of parts for improved and even more efficient version (P.W. June), price £4·95. When ordering please state whether for positive or negative systems. Plus 30p post.

RADIO STETHOSCOPE



Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2—twin stethoset instead of earpiece 75p extra post and ins. 20p.

STANDARD WAFER SWITCHES

Standard size 1½" wafer—silver-plated 5-amp contact, standard ¼" spindle 2" long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10way	12way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

TANGENTIAL HEATER UNIT

This heater unit is the very latest type, most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only need control switch. £2·50, 3kW Model as above except 2 kilowatts £2·50. Don't miss this. Control Switch 25p. P. & P. 40p.

THIS MONTH'S SNIP

MULLARD AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up .9 volt battery operated. Size 2" long × 1½" wide × 1" high.
SPECIAL SNIP PRICE 80p each. 10 for £5.

POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit house wiring, car electrics. Test polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), 30p or 2 for 50p. Post paid.

SOIL MOISTURE METER

DARKROOM TIMER

SIGNAL INJECTOR

and other featured projects. To receive these kits quickly send quoted approx. price and any change due will be refunded.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over £5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only £1 post paid.
DON'T MISS THIS TERRIFIC BARGAIN.

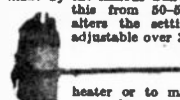
BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3¾" x 6¼" x 2" with leads and prods. Price £1·75 plus 20p postage.

THERMOSTATS

Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30–80°F. 40p. Calibrated dial 20p extra. Suitable box for wall mounting 25p.

Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting to this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flame-stat or fire alarm. 43p plus 12½p post and insurance.



Type "D" We call this the Ice-stat as it cuts in and out at around freezing point, 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing. If a length of our blanket wire (16 yd 50p) is wound round the pipes, 40p.

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature, 50p.

Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 90p.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. £2·95 plus 20p post and insurance.

DRILL CONTROLLER

NEW IKW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1·50 plus 13p post and insurance. Made up model also available. £2·25 plus 13p post and p.

HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack £5·50.

AUTO—ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in. or fully retractable. Suitable for 12v. positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £5·75 plus 25p post and ins.

AUTO-LITE

as circuit in Practical Wireless Kit of parts £1·20 post paid.

TOGGLE SWITCH

3 amp. 250v. with fixing ring 7½p each, 75p doz.

CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. 38p each or 10 for £3·42.

ROCKER SWITCH

13 amp self-fixing into an oblong hole. size approximately 1" × ¾" 6p each. 10 for 54p.

MAINS RELAY BARGAIN

Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V A.C. Good British Make. Ex-unused equipment. Size approx. 1½" × 1". Open construction

Single pole	25p each	10 for £2·25
Treble pole	35p each	10 for £3·15

BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits, 33p each, £3·50 doz.

2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3·75. Post and ins. 38p.

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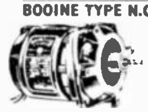

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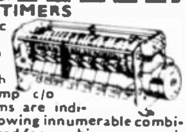

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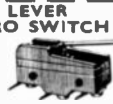

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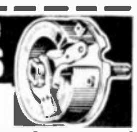

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2N2906A	27½p	2N5354	27½p	BC118	10p	BFY26	20p	NKT212	30p	P346A	22½p
2N2907	30p	2N5355	27½p	BC121	20p	BFY29	50p	NKT213	30p	TIS34	62½p
2N2923	15p	2N5356	32½p	BC122	20p	BFY30	50p	NKT214	22½p	TIS43	27p
2N2924	15p	2N5365	47½p	BC125	20p	BFY41	50p	NKT215	22½p	TIS44	10p
2N2925	15p	2N5366	32½p	BC126	20p	BFY43	62½p	NKT216	37½p	TIS45	10p
2N2926		2N5367	57½p	BC140	37½p	BFY50	23p	NKT217	42½p	TIS46	11p
Green	14p	2N5457	37½p	BC147	10p	BFY51	20p	NKT219	30p	TIS47	11p
Yellow	12½p	2S005	75p	BC148	10p	BFY52	23p	NKT223	27½p	TIS48	12½p
Orange	12½p	2S020	£2·00	BC149	12p	BFY53	17½p	NKT224	25p	TIS49	12½p
2N3011	30p	2S102	50p	BC152	17½p	BFY56A	57½p	NKT225	22½p	TIS50	17½p
2N3014	32½p	2S103	25p	BC157	20p	BFY75	30p	NKT229	30p	TIS51	12½p
2N3053	18p	2S104	25p	BC158	11p	BFY76	42½p	NKT237	35p	TIS52	12½p
2N3054	46p	2S501	82½p	BC159	12p	BFY77	57½p	NKT238	25p	TIS53	22½p
2N3055	62p	2S502	35p	BC160	62½p	BFY90	67½p	NKT240	27½p	TIS60	22½p
2N3133	30p	2S503	27½p	BC167	11p	BFW58	27½p	NKT241	27½p	TIS61	25p
2N3134	30p	3N83	40p	BC168B	10p	BFW59	25p	NKT242	20p	TIS62	27½p
2N3135	25p	3N128	70p	BC168C	11p	BFW60	25p	NKT243	62½p	TIP29A	50p
2N3136	25p	3N140	77½p	BC169B	11p	BPX25	£1·85	NKT244	17½p	TIP30A	60p
2N3390	25p	3N141	72½p	BC169C	12p	BPX29	£1·80	NKT245	20p	TIP31A	62½p
2N3391	20p	3N142	55p	BC170	12½p	BPY10	£1·45	NKT261	20p	TIP32A	75p
2N3391A	30p	3N143	67½p	BC171	15p	BRY39	37½p	NKT262	30p	TIP33A	
2N3392	17½p	3N152	87½p	BC172	15p	BSX19	17½p	NKT264	20p		£1·02½p
2N3393	15p	R.C.A.		BC175	22½p	BSX20	17½p	NKT271	20p	TIP34A	£2·05
2N3394	15p	40050	55p	BC182	10p	BSX21	37½p	NKT272	20p	TIP35A	£2·90
2N3402	22½p	40251	32½p	BC183	09p	BSX26	45p	NKT274	20p	TIP36A	£3·68
2N3403	22½p	40309	32½p	BC184	11p	BSX27	47½p	NKT275	20p		

Post & Packing 13p per order. Europe 25p. Commonwealth (Air) 65p (MIN.)
Matching charge (audio transistors only) 15p extra per pair.
Prices subject to alteration without prior notice.

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	1-11 £p	12-24 £p		1-11 £p	12-24 £p		1-11 £p	12-24 £p
SN7400	0·20	0·18	SN7433	0·80	0·75	SN7472	0·32	0·30
SN7401	0·20	0·18	SN7437	0·64	0·06	SN7473	0·43	0·41
SN7402	0·20	0·18	SN7438	0·64	0·60	SN7474	0·43	0·41
SN7403	0·20	0·18	SN7440	0·23	0·21	SN7475	0·45	0·44
SN7405	0·20	0·18	SN7441AN	0·87	0·83	SN7476	0·45	0·44
SN7406	0·80	0·75	SN7442	0·85	0·81	SN7480	0·70	0·65
SN7407	0·80	0·75	SN7443	2·86	2·70	SN7481	1·40	1·38
SN7408	0·20	0·18	SN7444	2·86	2·70	SN7482	0·87	0·82
SN7409	0·20	0·18	SN7445	2·50	2·40	SN7483	0·87	0·82
SN7410	0·20	0·18	SN7446	1·00	0·95	SN7484	2·00	1·85
SN7411	0·23	0·21	SN7447	1·00	0·95	SN7485	3·62	3·40
SN7412	0·48	0·46	SN7448	1·00	0·95	SN7486	0·33	0·30
SN7413	0·40	0·38	SN7449	1·00	0·95	SN7490	0·87	0·84
SN7420	0·20	0·18	SN7450	0·20	0·18	SN7491AN	1·21	1·10
SN7423	0·51	0·47	SN7451	0·20	0·18	SN7492	0·87	0·84
SN7427	0·48	0·45	SN7453	0·20	0·18	SN7493	0·87	0·84
SN7428	0·80	0·75	SN7454	0·20	0·18	SN7494	0·87	0·84
SN7430	0·23	0·15	SN7460	0·20	0·18	SN7495	0·87	0·84
SN7432	0·48	0·42	SN7470	0·40	0·38	SN7496	0·87	0·84

MULLARD SUB-MIN ELECTROLYTIC

C425 range axial lead — 6p each

Values: (μF/V): 0·64/64; 1/40; 1·6/25; 2·5/16; 2·5/64; 4/10; 4/40; 5/64; 6·4/6·4; 6·4/25; 8/40; 10/16; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 32/64; 40/16; 50/6·4; 50/25; 50/40; 64/10; 80/2·5; 80/16; 80/25; 100/6·4; 125/10; 125/16; 200/6·4; 200/10; 320/6·4.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	6p	9p	10p	11p	12p	15p	20p	—
3A	15p	—	—	22½p	—	30p	—	—
6A	—	—	25p	30p	32½p	35p	—	—
10A	—	52½p	57½p	65p	77½p	86½p	97½p	£1·25
15A	—	57½p	62½p	77½p	90p	97½p	£1·20	£1·57½
35A	—	80p	90p	£1·00	£1·25	£1·50	£2·50	—

1 amp and 3 amp are plastic encapsulation.

DIODES & RECTIFIERS

IN34A	10p	AA119	7p	BAX16	12½p	FST3/4	22½p
IN914	7p	AA129	15p	BAY18	17½p	OA5	17p
IN916	7p	AAZ13	12p	BAY31	7p	OA10	20p
IN4007	20p	AAZ15	18p	BAY38	25p	OA9	10p
IS44	7p	AAZ17	10p	BY100	15p	OA47	8p
IS113	15p	BA100	15p	BY103	22p	OA70	7p
IS120	12p	BA102	25p	BY122	47½p	OA73	10p
IS121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8p
IS131	10p	BA115	7p	BY127	17p	OA85	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
IS920	7p	BA142	17p	BYX10	22p	OA91	7p
IS922	8p	BA144	12p	BYZ10	35p	OA95	7p
IS923	12p	BA145	17p	BYZ11	32p	OA200	7p
IS940	5p	BA154	12p	BYZ12	30p	OA202	10p
		BAX13	5p	BYZ13	25p	TIV307	50p

"SCORPIO" CAP DISCHARGE IGNITION SYSTEM
(As printed in P.E. Nov. '71). Complete kit £10·00
P. & P. 50p.

BRIDGE RECTIFIERS

A.	PIV		A.	PIV	
1	100	37p	4	50	60p
1.4	140	57p	4	100	70p
2	50	32p	4	400	80p
2	200	41p	6	50	62p
2	400	46p	6	200	80p
			6	400	£1·10

THYRISTORS (SCR)

PIV	50	100	200	300	400
1A	25p	27½p	37½p	40p	47½p
4A	47½p	55p	57½p	—	77½p
7A	—	87½p	92½p	—	£1·12½p

TIC47 0.6 amp. 200 PIV 55p.
Also 12 amp. 100 PIV 75p
2N3525 at £1.12½p

VEROBOARD

	0·15 Matrix	0·1 Matrix
2½ × 3¾in	17½p	20p
2½ × 5in	21p	24p
3¾ × 3¾in	21p	24p
3¾ × 5in	27½p	27½p
5 × 17in (Plain)	85p	—

Vero Pins (Bag of 36) 20p
Vero Cutter 45p
Pin Insertion Tools (·1 and ·15 matrix) at 55p.

HEAT SINKS

4·8 × 4 × 1in Finned for Two TO-3 Trans., 48p. 4.8 × 2 × 1in Finned for One TO-3 Trans., 33p. For SO-1, 2½p. For TO-5, 5p Finned. For TO-18, 5p Finned.

RESISTORS

Carbon Film

⅛ watt 5%, 1p.	¼W, 1W & 2W E24 Series.
¼ watt 5%, 1p.	
½ watt 5%, 1½p.	
½ w 2% M/O 4p.	
1 watt 10%, 2½p.	¼W & ½W E12 Series.
2 watt 10%, 6p.	

MULLARD C280 M/FOIL CAPACITORS

0·01, 0·022, 0·033, 0·047 .. 3p each
0·068, 0·10 .. .. 4p each
0.15, 0·22, 0·33 .. .. 5p each
0·47 .. .. .. 9p
0·68 .. .. .. 11p
1μF 14p
1·5μF 21p
2·2μF 25p

WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only). 7p
5 watts 5% (up to 8·2kΩ only), 9p
10 watt 5% (up to 25kΩ only), 10p

POTENTIOMETERS

Carbon:
Log. and Lin., less switch, 16p.
Log. and Lin., with switch, 25p.
Wire-wound Pots (3W), 38p.
Twin Ganged Stereo Pots, Log. and Lin., 40p.

PRESETS (CARBON)

0·1 Watt	6p	VERTICAL
0·2 Watt	6p	OR
0·3 Watt	7½p	HORIZONTAL

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R53 (STC) £1·27½ — VA3705 95p
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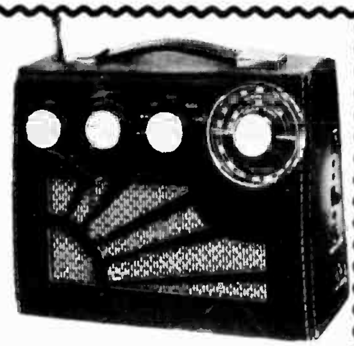
10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND. VHF AND LOCAL STATIONS AND AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated 7 section Telescopic Aerial, can be angled and rotated for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" × 2½" Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" × 7" × 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

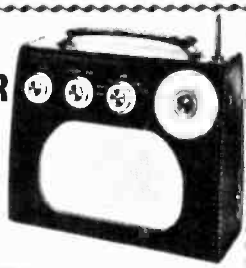
Total building cost **£8·50**

P. P. & Ins. 50p

(Overseas P. & P. £1)



ROAMER EIGHT Mk I



NOW WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mW transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 8" × 2½" Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost **£6·98** P. P. & Ins. 41p.
(Overseas P. & P. £1)

Exclusive to readers of "EVERYDAY ELECTRONICS"

"EVERYDAY SEVEN"

MEDIUM and LONG WAVE PORTABLE. Specially designed circuit for easy construction incorporating 7 transistors and 2 diodes, air spaced tuning capacitor, push pull output using 600 mw transistors, heavy duty loudspeaker for quality sound and room filling volume, internal Ferrite Rod aerial, Volume/on/off control, tuning control and wave change switch. Handsome, strongly made wooden case, size 11½" × 7½" × 3½" with carrying handle and black knobs with spun silver inserts. The ideal radio for those who are comparatively inexperienced in electronic construction. Easy build plans are supplied free with parts or available separately for 25p.

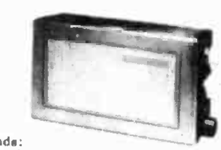
Total building costs **£4·98** P. P. & Ins. 41p
(Overseas Post £1)

ROAMER SIX

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.

Total building costs **£3·98** P. P. & Ins. 26p
(Overseas P. & P. £1)

POCKET FIVE

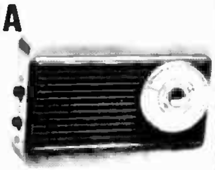


3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5½ × 1½ × 3½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2·23** P. P. & Ins. 21p
(Overseas P. & P. 63p)

TRANSONA FIVE

5 TRANSISTORS AND 2 DIODES

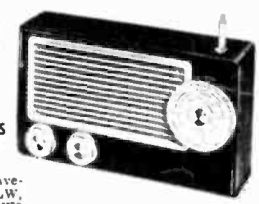


3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6½ × 4½ × 1½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2·50** P. P. & Ins. 22p
(Overseas P. & P. 63p)

TRANS EIGHT

8 TRANSISTORS and 3 DIODES



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2½in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£4·48** P. P. & Ins. 31p
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All parts including Case and Plans **£5·50** P. P. & Ins. 31p
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TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for ....

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