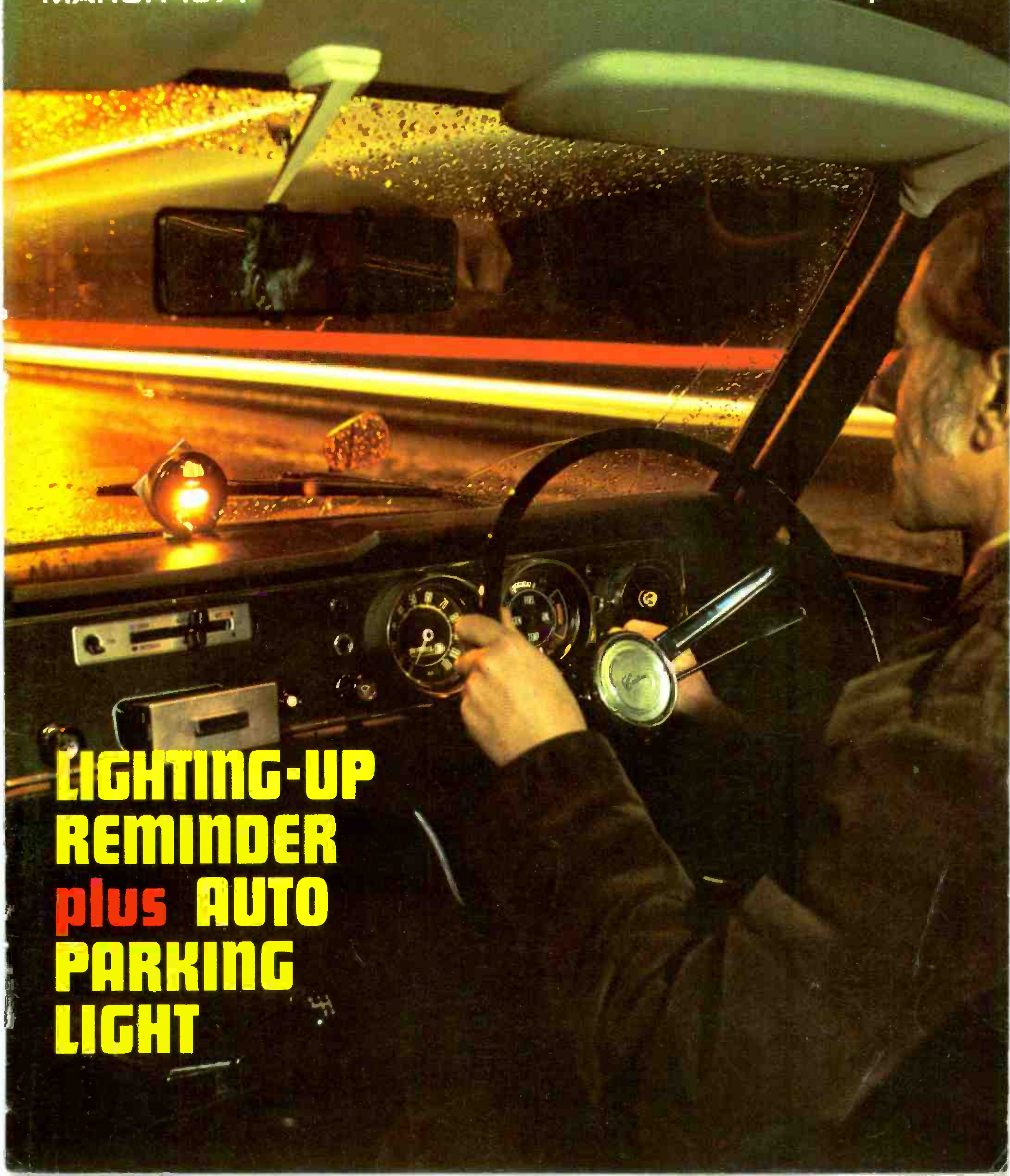
PRACTICAL

ELECTRONICS

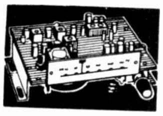
MARCH 1971

17½p (3/6)



LIGHTING-UP REMINDER plus AUTO PARKING LIGHT

★ TRANSISTORISED FM TUNER ★

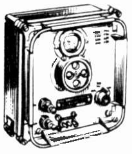


6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108 MHz. Ready built ready for use. Fantastic value for money. £6·37½. P. & P. 12½p. Stereo multiplex adaptors £4·97½.

AVO CT471A MULTIMETER

Battery operated, fully transistorised. Sensitivity 109m Ω/v. Measures AC/DC Voltages 12mV to 1,200v. AC/DC Current 12uA to 1.2 Amp. Resistance 12 ohm to 120 m Ω HF, VHF, UHF, Voltage with multiplier 4v to 400v up to 50 Mc/s, 40mV to 4V up to 1,000 Mc/s. Offered in perfect condition. £55 each. Carr. 50p.

CRYSTAL CALIBRATORS No. 10

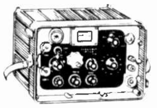


Small portable crystal controlled wavemeter. Size 7" × 7½" × 4". Frequency range 500 Kc/s. 10 Mc/s (up to 30 Mc/s on harmonics). Calibrated dial. Power requirements 300 V.D.C. 15mA and 12 V.D.C. 0.3A. Excellent condition. £3·47½. Carr. 37½p.

TAPE CASSETTES

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

AM/FM SIGNAL GENERATORS

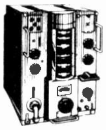


Oscillator Test No. 2. A high quality precision instrument made for the ministry by Airmec. Frequency coverage 20-80Mc/s. AM C.W./FM. Incorporates precision dial, level meter, precision attenuator 1μV-100mV. Operation from 12V d.c. or 0/110/200/250V a.c. Size 12 × 8½ × 9in. Supplied in brand new condition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

AVO CT.38 ELECTRONIC MULTIMETERS

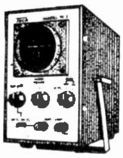
High quality 97 range instrument which measures a.c. and d.c. Voltage. Current, Resistance and Power Output Ranges d.c. volts 250mV-10,000V (10 meg Ω-110 meg Ω input). D.c. current 10μA-25A. Ohms. 0-1,000 meg Ω a.c. volt 100mV-250V (with R.F. measuring head up to 250MHz) a.c. current 10μA-25A. Power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

ADMIRALTY 62B RECEIVERS



High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 150-300 Kc/s; 560 Kc/s-1·5 Mc/s; 3·9-30·5 Kc/s. I.F. 500/KHz. Incorporates 2 R.F. and 3 I.F. stages, bandpass filter, noise limiter, crystal controlled B.F.O. calibrator I.F. output, etc. Built-in speaker, output for phones. Operation 150/230V a.c. Size 19½ × 13½ × 16in. Weight 114lb. Offered in good working condition. £22·50. Carr. £1·50. With circuit diagrams. Also available B41 L.F. version of above. 15KHz-700Hz. £17·50. Carr. £1·50.

TO-2 PORTABLE OSCILLOSCOPE



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.

TO-3 PORTABLE OSCILLOSCOPE

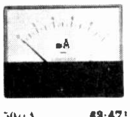
3in tube. Y amp. Sensitivity 0·1V p-p/CM. Bandwidth 1·5 cps-1·5MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9V p-p/CM. Bandwidth 1·5cps-800KHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10 cps-300KHz. Synchronization. Internal/external. Illuminated scale 140 × 215 × 330 mm. Weight 15½lb 220/240V.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

SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.
● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS



TYPE SW. 100
100 x 80 mm

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

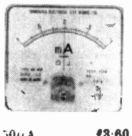
BAKELITE PANEL METERS

TYPE S-80
80 mm square fronts

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

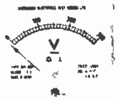
"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in 4¼in fronts.



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

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



50μA	£2·00	150mA	£1·37½
50-0-50μA	£1·87½	200mA	£1·37½
100μA	£1·87½	300mA	£1·37½
100-0-100μA	£1·75	500mA	£1·37½
200μA	£1·75	750mA	£1·37½
500μA	£1·50	1A	£1·37½
500-0-500μA	£1·37½	2A	£1·37½
1mA	£1·37½	5A	£1·37½
1-0-1mA	£1·37½	10A	£1·37½
2mA	£1·37½	3V d.c.	£1·37½
5mA	£1·37½	10V d.c.	£1·37½
10mA	£1·37½	15V d.c.	£1·37½
20mA	£1·37½	20V d.c.	£1·37½
50mA	£1·37½	100V d.c.	£1·37½
100mA	£1·37½	150V d.c.	£1·37½
		300V d.c.	£1·37½
		500V d.c.	£1·37½
		750V d.c.	£1·37½
		15V a.c.	£1·37½
		50V a.c.	£1·37½
		150V a.c.	£1·37½
		300V a.c.	£1·37½
		500V a.c.	£1·37½
		S Meter 1mA	£1·60
		VU meter	£2·10

Type MR.52P. 2½in square fronts.

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

Type MR.45P. 2in square fronts.

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

Type MR.65P. 3½in 3¼in fronts.

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

"SEW" BAKELITE PANEL METERS

Type MR.65 3½in square fronts.

25μA	£3·50	500mA	£1·75
50μA	£2·37½	1A	£1·75
50-0-50μA	£2·25	5A	£1·75
100μA	£2·25	15A	£1·75
100-0-100μA	£2·25	30A	£1·75
500μA	£2·10	50A	£1·75
1mA	£1·75	5V d.c.	£1·75
1-0-1mA	£1·75	10V d.c.	£1·75
5mA	£1·75	20V d.c.	£1·75
10mA	£1·75	50V d.c.	£1·75
50mA	£1·75	150V d.c.	£1·75
100mA	£1·75	300V d.c.	£1·75
		30V a.c.*	£1·75
		50V a.c.*	£1·75
		150V a.c.*	£1·75
		300V a.c.*	£1·75
		500mA a.c.*	£1·75
		1A a.c.*	£1·75
		5A a.c.*	£1·75
		10A a.c.*	£1·75
		20A a.c.*	£1·75
		30A a.c.*	£1·75
		50A a.c.*	£1·75
		VU meter	£3·10

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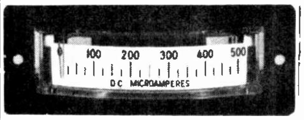

EDGWISE METERS

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

50μA	£3·00	500μA	£2·60
50-0-50μA	£2·87½	1mA	£2·37½
100μA	12·87½	300V a.c.	£2·37½
100-0-100μA	£2·75	VU meter	£3·25
200μA	£2·75		

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

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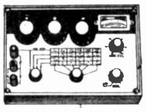
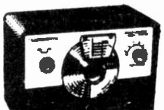


A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω-11·1 meg Ω 6 Ranges ±1%. L.1 μH - 111 HENRYS 6 Ranges -2%. C. 10pF ±1110 mFd. 6 Ranges ±2%. TURNS RATIO 1:1/1000-1:11100. 6 Ranges ±1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA. Meter indication.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

COSSOR 1049 DOUBLE BEAM OSCILLOSCOPES. D.c. coupled. Band width 1kc/s. Perfect order. £25. Carr. £1.50.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120kc/s-260 Mc/s on 6 bands. Directly calibrated variable R.F. attenuator. Operation 200/240V a.c. Brand new with instructions. £15. P. & P. 37½p. S.A.E. for details.



LELAND MODEL 27 BEAT FREQUENCY OSCILLATORS

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

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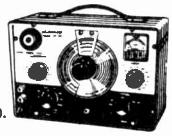
LAFAYETTE TE46 RESISTANCE CAPACITY ANALYSER



2pF-2,000 mfd 2 ohms-200 megohms. Also checks impedance, turns ratio, insulation, 200/250V a.c. **Brand New £17·50.** Carr. 37½.

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VM79. UHF MILLIVOLT METER. 100 Kc/s to 1,000 Mc/s. a.c. 10 mV to 3V. D.c. 10 mV to 3V. Current 0·01 μA to 0·3 mA. Resistance 1 ohm to 10 megohm. £125.

TT15. TRANSISTOR TESTER. Full range of facilities for testing PNP or NPN transistors in or out of circuit. £37·50. Carriage 50p per item.

MARCONI TF195M BEAT FREQUENCY OSCILLATORS. 0-40KHz. £20. Carr. £1·50.

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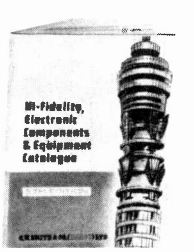

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2N918	37½p
2N929	22½p
2N930	27½p
2N1131	30p
2N1132	30p
2N1302	20p
2N1303	22½p
2N1304	25p
2N1305	25p
2N1306	25p
2N1307	25p
2N1308	30p
2N1309	25p
2N1613	22½p
2N1711	25p
2N1889	32½p
2N1893	50p
2N2147	75p
2N2160	62½p
2N2193	47½p
2N2217	27½p
2N2218	30p
2N2219	32½p
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2N2369A	20p
2N2484	20p
2N2613	35p
2N2646	52½p
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2N2923	17½p
2N2924	17½p
2N2925	17½p
2N2926G	12½p
2N2926Y	12½p
2N2926O	12½p
2N3053	25p
2N3054	50p
2N3055	75p
2N3391A	30p
2N3416	37½p
2N3570	12½p
2N3702	37½
2N3703	12½p
2N3704	17½p
2N3705	15p
2N3706	22½p
2N3707	15p
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2N4062	22½p
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2N4288	15p
2N4289	17½p
2N4290	15p
2N4291	15p
2N4292	15p
2N5354	27½p
2N5355	27½p
2S102	25p
2S103	37½p
2S104	37½p
40250	50p
40361	55p
40362	60p
AC107	37½p
AC126	25p
AC127	25p

AC128	25p
AC154	15p
AC176	25p
AC187	30p
AC188	30p
ACY17	30p
ACY18	25p
ACY19	25p
ACY20	22½p
ACY21	22½p
ACY22	17½p
ACY28	17½p
ACY40	15p
AD140	50p
AD149	50p
AD161	37½p
AD162	37½p
AF114	32½p
AF115	30p
AF116	32½p
AF117	25p
AF118	62½p
AF119	20p
AF124	25p
AF126	17½p
AF127	17½p
AF139	30p
AF178	47½p
AF180	52½p
AF181	42½p
AF186	40p
AF239	42½p
ASY26	25p
ASY27	32½p
ASY28	25p
ASZ17	42½p
AUY10	97½p
BAY31	7½p
BC107	12½p
BC108	12½p
BC109	12½p
BC113	25p
BC116	40p
BC125	55p
BC126	55p
BC147	17½p
BC148	12½p
BC149	20p
BC167	15p
BC172	17½p
BC177	37½p
BC186	37½p
BC182L	20p
BC184L	20p
BC212L	22½p
BCY30	25p
BCY31	30p
BCY32	50p
BCY33	20p
BCY34	25p
BCY38	30p
BCY42	15p
BCY43	20p
BCY71	30p
BCY72	17½p
BCZ11	37½p
BD121	65p
BD123	82½p
BD124	60p
BF115	25p
BF117	47½p
BF167	25p
BF173	30p
BF180	37½p
BF181	37½p
BF182	32½p
BF184	25p
BF185	25p
BF194	17½p
BF195	15p
BF200	37½p
BF224	30p
BF225	30p
BF244	47½p
BFX12	22½p
BFX13	22½p
BFX29	30p
BFX30	32½p
BFX44	37½p
BFX85	40p
BFX86	32½p
BFX87	32½p
BFX88	25p
BFY18	25p
BFY20	62½p
BFY50	22½p
BFY51	20p
BFY52	22½p
BFY90	67½p
BSX19	17½p
BSX20	17½p
BSX21	37½p
BSX76	15p
BSY26	17½p
BSY27	20p
BSY28	17½p

BSY38	20p
BSY39	22½p
BSY51	32½p
BSY56	90p
BSY95A	15p
BY100	17½p
BY124	15p
BY126	15p
BY127	20p
BYZ10	40p
BYZ11	35p
BYZ12	30p
BYZ13	25p
MJ480	97½p
MJ481	£1·25
MPF102	42½p
MPF103	35p
MPF104	37½p
MPF105	40p
NKT213	25p
NKT214	15p
NKT216	37½p
NKT217	40p
NKT224	22½p
NKT241	27½p
NKT261	20p
NKT271	25p
NKT272	25p
NKT274	20p
NKT275	25p
NKT278	25p
NKT281	27½p
NKT403	75p
NKT404	62½p
NKT405	75p
NKT773	25p
NKT10439	37½p
OA5	15p
OA10	25p
OA47	10p
OA70	10p
OA79	10p
OA81	10p
OA85	12½p
OA90	10p
OA91	7½p
OA95	7½p
OA200	7½p
OA202	10p
OA210	17½p
OC19	37½p
OC20	97½p
OC22	47½p
OC23	50p
OC24	50p
OC25	37½p
OC26	25p
OC28	62½p
OC29	62½p
OC35	50p
OC36	62½p
OC41	25p
OC42	30p
OC44	17½p
OC45	15p
OC46	27½p
OC70	12½p
OC71	15p
OC72	25p
OC73	30p
OC74	30p
OC75	25p
OC76	25p
OC77	40p
OC78	20p
OC81	25p
OC81D	20p
OC83	25p
OC84	25p
OC139	25p
OC140	37½p
OC169	20p
OC170	25p
OC171	30p
OC200	37½p
OC201	47½p
OC202	62½p
OC203	37½p
OC204	40p
OC205	62½p
OC207	75p
OCP71	97½p
ORP12	50p
ORP60	40p
P346A	25p
PL4001	14p
PL4002	15p
PL4003	16p
PL4004	17½p
PL4005	19p
PL4006	20p
PL4007	24p
T1843	40p
T1844	12½p
T1845	17½p
T1846	17½p

THYRISTORS

PIV	50	100	200	300	350	400
1A	25p	27½p	37½p	40p	—	47½p
3A	30p	37½p	40p	45p	—	50p
5A	—	55p	65p	—	—	75p
7A	—	55p	65p	70p	—	97½p
100A	—	—	—	—	£2·50	£2·75

VALVES

OA2	32½p
OB2	32½p
OZ4	30p
IL4	12½p
IR5	35p
IS5	25p
IT4	22½p
IU4	30p
IU5	47½p
2D21	32½p
3Q4	40p
3S4	35p
3V4	40p
5R4	55p
5U4	30p
5V4	40p
5Y3	30p
5Z4G	37½p
6/30L2	75p
6AC7	20p
6AG7	37½p
6AK5	30p
6AK6	57½p
6AL5	16p
6AM6	22½p
6AQ5	32½p
6AS6	30p
6AT6	25p
6AU6	25p
6AV6	32½p
6BA6	22½p
6BE6	25p
6BH6	42½p
6BJ6	42½p
6BQ7A	37½p
6BR7	85p
6BR8	65p
6BW6	80p
6BW7	67½p
6BZ6	32½p
6C4	30p
6CD6	£1·15
6CL6	50p
6CW4	62½p
6F1	62½p
6F6G	25p
6F13	35p
6F14	60p
6F15	55p
6F18	40p
6F23	77½p
6H6	15p
6J4	47½p
6J5	20p
6J5GT	30p
6J6	17½p
6J7	42½p
6K8G	30p
6L6GT	45p
6LD20	32½p
6Q7	37½p
6SA7	35p
6SG7	30p
6SJ7	35p
6SK7	30p
6SL7	30p
6SN7	27½p
6SQ7	40p
6U4	62½p
6V6G	25p
6V6GT	32½p
6X4	25p
6X5G	27½p
6X5GT	27½p
10C2	50p
10F1	90p
10P13	55p
10P14	£1
12AT6	25p
12AT7	20p
12AU7	25p
12AX7	30p
12AV6	30p
12BA6	32½p
12BE6	32½p
12BH7	32½p
19AQ5	32½p
20D1	45p
20F2	75p
20L1	£1
20P1	50p
20P3	60p
20P4	£1
20P5	£1
25L6	37½p

25Z4	30p
25Z5	42½p
25Z6	57½p
30C15	75p
30C17	80p
30C18	75p
30F5	85p
30FL1	77p
30FL12	92½p
30FL14	77½p
30L15	85p
30L17	85p
30P12	80p
30P19	75p
30PL1	77½p
30PL13	90p
30PL14	85p
35L6	47½p
35W4	25p
35Z4	25p
35Z5	35p
50B5	35p
50C5	35p
80	45p
85A2	37½p
807	47½p
1625	30p
5763	65p
6146	£1·50
AZ31	50p
CY31	35p
DAF91	27½p
DAF96	39p
DF91	22½p
DF96	39p
DK91	35p
DK92	45p
DK96	40p
DL92	35p
DL94	40p
DL96	37½p
DM70	32½p
DY86	32½p
DY87	35p
E88CC	62½p
E180F	75p
EABC80	32½p
EAF42	50p
EB91	16p
EBC41	52½p
EBC81	32½p
EBF80	40p
EBF83	42½p
EBF89	32½p
EBL21	60p
EC86	60p
EC88	60p
ECC40	55p
ECC84	30p
ECC85	27½p
ECC88	40p
ECF80	35p
ECF82	35p
ECF86	62½p
ECH21	57½p
ECH35	60p
ECH42	65p
ECH81	27½p
ECH83	42½p
ECL80	45p
ECL82	32½p
ECL83	62½p
ECL86	42½p
EF37A	40p
EF39	40p
EF40	50p
EF41	62½p
EF42	70p
EF80	25p
EF85	35p
EF86	32½p
EF89	27½p
EF91	22½p
EF92	37½p
EF183	32½p
EF184	35p
EH90	40p
EL34	52½p
EL33	£1·50
EL41	55p
EL42	57½p
EL81	50p
EL84	25p
EL85	41p
EL91	25p

EL95	35p
EM80	40p
EM81	42½p
EM84	37½p
EM85	55p
EM87	55p
EY51	40p
EY86	40p
EY87	42½p
EZ40	37½p
EZ41	45p
EZ80	27½p
EZ81	27½p
GZ32	47½p
GZ34	55p
KT66	£1·37½
KT88	£1·67½
MU14	40p
PABC80	40p
PC86	57½p
PC88	65p
PC97	42½p
PC900	47½p
PCC84	35p
PCC85	40p
PCC88	60p
PCC89	52½p
PCC189	55p
PCF80	32½p
PCF82	34p
PCF84	45p
PCF86	55p
PCF800	75p
PCF801	50p
PCF802	50p
PCF805	75p
PCF806	65p
PCF808	77½p
PCL82	39p
PCL83	65p
PCL84	44p
PCL85	47½p
PCL86	47½p
PFL200	55p
PL36	55p
PL81	47½p
PL82	45p
PL83	40p
PL84	35p
PL500	75p
PL504	80p
PY32	55p
PY33	62½p
PY80	32½p
PY81	30p
PY82	30p
PY83	37½p
PY88	40p
PY800	50p
PY801	50p
U25	75p
U26	75p
U50	30p
U52	30p
U191	70p
U281	40p
U282	40p
U301	57½p
U801	£1
UABC80	34p
UAF42	52½p
UBC41	47½p
UBC81	40p
UBF80	36p
UBF89	35p
UCC84	49p
UCC85	40p
UCF80	52½p
UCH21	55p
UCH42	65p
UCH81	32½p
UCL82	35p
UCL83	60p
UF41	50p
UF80	37½p
UF85	40p
UF89	35p
UL41	60p
UL84	32½p
UY41	40p
UY85	30p
VR105/30	27½p
VR150/30	25p

ZENER DIODES

400W (3·3 to 33V) .. 15p
1·5W (2·4 to 200V) .. 20p
10W (3·9 to 100V) .. 25p

INTEGRATED CIRCUITS

L900 49p; L914 49p; L923 62½p; IC-10 £2·50; SL403 £2·12½; MC1303 £2·62½; MC1304 £2·75; PA246 £2·62½; CA3005 £1·27½; CA3011 82½p; CA3052 £1·82½p; FCH131 50p; FCH161 50p; FJH141 50p; FJH171 50p; FJH181 50p; FJH221 50p; FJH231 50p; FJH241 50p; FJH251 50p; FJJ121 87½p; FJJ131 87½p; FJJ211 £1·25; FJY101 50p.

SEND SAE FOR FULL LISTS!

DISCOUNTS
10% on 12+ any one type. 15% on 25+ any one type. Large quantity discounts on application
Postage—Semi Conductors 7½p; Valves 15p. Postage 10p. Over £3 post paid.

HI-FI EQUIPMENT
SAVE UP TO 33⅓% OR MORE
SEND S.A.E. FOR DISCOUNT PRICE LISTS AND PACKAGE OFFERS!

GARRARD

FULL CURRENT RANGE OFFERED, BRAND NEW AT FANTASTIC SAVINGS

2025T/C stereo	£9·87½	SL72B	£24·97½
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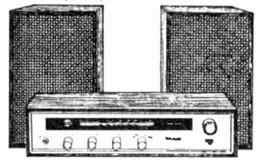
3000 stereo	£9·97½	SL75	£25·97½
SP25 MKIII	£11·75	SL75B	£27·97½
SL65B	£14·97½	SL95B	£37·50
		401	£27·50

Carriage 37½p extra each item.

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

TELETON SPECIAL OFFER!



CR10T AM/FM STEREO TUNER AMPLIFIER WITH MATCHING PAIR SA1003 SPEAKER SYSTEMS

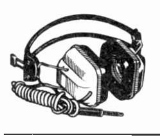
Output 4 watts per channel. Excellent reception AFC, built-in MPX. Cer/XTAL Input. Total List £50·25. OUR PRICE £29·95. Carr. 62½p.

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

TELETON SAQ203E STEREO AMPLIFIER

Solid state, 10W per channel music power. 6W r.m.s. Inputs for mag, ceramic, tuner, aux. SPECIAL PRICE, £20. Carr. 37½p.

ECHO HS-606 STEREO HEADPHONES



Wonderfully comfortable. Lightweight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25–17,000 cps. 8 ohm imp. £3·37½. P. & P. 12½p.

HOSIDEN DH04S 2-WAY STEREO HEADSETS

Each headphone contains a 2¼in woofer and a ⅞in tweeter. Built in individual level controls. 8 Ω imp. 25–18,000c/s. with cable and stereo plug. £5·97½. P. & P. 12½p.

AMERICAN TAPE

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

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

SPECIAL OFFERS!

Garrard SP25/III fitted Goldring G800 cartridge and wooden plinth and plastic cover. Ready wired. Total list price £35. OUR PRICE £22·50. Carr. 50p.
GOLDRING GL69/2 fitted Goldring G800 cartridge complete with de luxe base and cover. Total list price £50·80. OUR PRICE £39. Carr. 50p.

B.S.R. McDONALD

MP60 ..	£11·95	610......	£15·95
510......	£12·95	310......	£10·95

Carr. 37½p extra each item
Teak Base and Perspex Cover
For above BSR range £3·97½. Carr. 37½p.
TPD1 Series with plinth and cover and ready wired.

MP60....	£19·50	610......	£22·95
510......	£20·95		

Carr. 50p extra each item

GOODMANS SPECIAL OFFERS!

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

GOODMANS SPEAKERS!

Mezzo III teak. List £61·80 pr. OUR PRICE £46 pr. Carr. £1.
Magnum K, teak. List £80·20 pr. OUR PRICE £59·50 pr. Carr. £1.
Mambo teak. List £44·65 pr. OUR PRICE £32·50 pr. Carr. 50p.
Marimba teak. List £48·01 pr. OUR PRICE £35 pr. Carr. £1.
Magister teak. List £57 each. OUR PRICE £37·97½ each. Carr. £1.
Magister stand £2·97½ extra.

TE-1035 STEREO HEADPHONES

Low cost high performance stereo headphones. Foam rubber ear cups. Adjustable headband. 8 ohm impedance. 25–18,000Hz. With lead and stereo jack plug.
ONLY £1·97½. P. & P. 12½p.

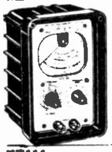
SINCLAIR EQUIPMENT

Project 60. Package offers. 2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply, £19. Carr. 37½p. Or with PZ6 power supply, £21. Carr. 37½p. 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply, £21·50. Carr. 37½p. Transformer for PZ8, £2·97½ extra. Add to any of the above £4·87½ for active filter unit and £16 for a pair of Q16 speakers. Project 60 FM Tuner £20·97½. Carr. 37½p.
All other Sinclair products in stock. 2,000 amplifier, £23. Carr. 37½p. 3000 Amplifier £36. Carr. 37½p. Neoteric amplifier £46, Carr. 37½p.

← See previous page ● G. W. SMITH & CO. (RADIO) LTD. ● See opposite page →

RUSSIAN C1-16 DOUBLE BEAM OSCILLOSCOPES

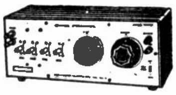
5MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated triggered sweep from 0·2μsec to 100msec/cm.
Supplied complete with all accessories and instructions. £87. Carr. paid.



MARCONI CT44/TF956 AF ABSORPTION WATTMETER

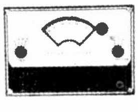
1 μ/watt to 6 watts.
£20. Carr. £1.

TE111. DECADE RESISTANCE ATTENUATOR



Variable range 0–111dB. Connections. Unbalanced T and Bridge T. Impedance 600Ω range (0·1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (–3dB). Accuracy: 0·05dB. + indication dB × 0·01. Maximum input less than 4W (50V). Built in 600Ω load resistance with internal/external switch. Brand new £27·50. P. & P. 25p.

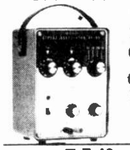
BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR



Sine 18–200,000Hz; Square 18–50,000Hz. Output max +10dB (10kΩ). Operation internal batteries.
Attractive two-tone case 7½in × 5in × 2in. Price £17·50. Carr. 17½p.

TE-16A Transistorised Signal Generator. 5 ranges 400 kHz–30 mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide, easy to read scale. 800 kHz modulation. 5¼ × 5¼ × 3½. Complete with instructions and leads. £7·97½. P. & P. 20p.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



New high quality portable instrument. Sine 1Hz to 100kHz. Square 20Hz to 20kHz. Output max. +10dB (10kΩ). Operation 220/240V a.c. Size 215mm × 150mm × 120mm. Price £27·50. Carr. 25p.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01 / ·003 / ·1 / ·3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. 4c/s.–1·2Mc/s. Decibels –40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V a.c. £17·50. Carr. 25p.

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. 220/240V a.c. operation. Complete with probe and instructions. £17·50. P. & P. 30p. Additional Probes available: R.F. £2.12½. H.V. £2.50.

AUTO TRANSFORMERS

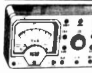
0/115/230v. Step up or step down. Fully shrouded.

150W.	£2·37½	P. & P. 17½p.
300W.	£3·25.	P. & P. 22½p.
500W.	£4·97½.	P. & P. 32½p.
1,000W.	£7·25.	P. & P. 37½p.
1,500W.	£8·97½.	P. & P. 42½p.

SOLID STATE VARIABLE A.C. VOLTAGE REGULATORS

Compact and panel mounting. Ideal for control of lamps, drills, electrical appliances, etc. Input 230/240V a.c. Output continuously variable from 20V to 230V. Model MR2305 5A 68 × 46 × 43mm, £8·37½. Model MR2310 10A 90 × 68 × 60mm, £11·97½. Postage 12½p.

MULTIMETERS for EVERY purpose!



TECH PT-34, 1,000 O.P.V. 0/10/50/250/500/1,000V a.c. and d.c. 0/1/100/500mA. d.c. 0/100K. £1·97½. P. & P. 12½p.

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. 0/50μA/250MA. 0/60K/6 meg. –20 to +62dB. £3·75. P. & P. 15p.

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

MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 meg. £5·50. P. & P. 15p.

TMK MODEL TW-50K. 46 ranges, mirror scale. 50K/Volt d.c. 5K/Volt a.c. D.c. volts: 0·125, 0·25, 1·25, 2·5, 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, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 10K, 100K, 1 meg., 10 meg. Decibels: –20 to +81·5dB. £8·87½. P. & P. 17½p.

TE-900 20,000Ω/VOLT GIANT MULTIMETER. Mirror scale and overload protection. 6in full view meter. 2 colour scale. 0/2·5 / 10 / 250 / 1,000 / 5,000V a.c. 0/25/12·5/10/50/250/1,000/5,000V d.c. 0/50μA/110/100/500mA/10A d.c. 02K/200K/20 meg. ohm. £15. P. & P. 25p.

MODEL 5025. 57 ranges, giant 5½in meter, polarity reverse switch. Sensitivity: 50K/Volt d.c. 5K/Volt a.c. D.c. Volts: 0·125, 0·25, 1·25, 2·5, 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, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 2K, 10K, 100K, 1 meg, 10 meg. Decibels: –20 to +85dB. £12·50. P. & P. 17½p.

HONOR TE.10A, 20kΩ/Volt 5/25/50/250/500/2,500V d.c. 10/50/100/500/1,000V a.c. 0/50μA/2·5mA 250mA d.c. 0/6K/6 meg. ohm. –20 to +22dB. 10–0, 100 mfd. 0-100-0·1 mfd. £3·47½. P. & P. 15p.

MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/0·6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA / 6mA / 60mA / 300mA/600mA. 0/8K/80K/800K/8 meg. –20 to +63dB. £5·97½. P. & P. 15p.

MODEL TE 80. 20,000 O.P.V. 0 / 10 / 50 / 100 / 500 / 1,000V. a.c. 0/5/25/50/250 / 500 / 1,000V d.c. 0·5μA. 5/50/500mA./0/6K/60/K/600K/6 Meg. £4·87½. P. & P. 15p.

MODEL TE-90. 50,000 O.P.V. Mirror scale, overload protection. 003/13/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V d.c. 0·03/6/60/600mA. d.c. 16K/160K/1·6/16 meg. –20 to +63dB. £7·50. P. & P. 15p.

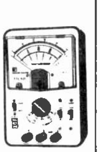
TMK MODEL TW-20CB. Features Resettable Overload Button. Sensitivity: 20KΩ/Volt d.c. 5KΩ/Volt a.c. D.c. volts: 0–0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 0–2·5, 10, 50, 250, 1,000V. D.c. currents: 0–0·05, 0·5, 5, 50, 500mA. Resistance: 0–5K, 50K, 0–500K, 5 meg. Decibels: –20 to +52dB. £11·50. P. & P. 17½p.

MODEL AS-100D. 100KΩ/Volt. 5in, mirror scale. Built-in meter protection 0/3/12/60/120/300/600/1,200V d.c. 0/6/30/120/300/600V a.c. 0/10μA/6/60/300mA/12A. 0/2K/200K/2M/200M. –20 to +17dB. £12·50. P. & P. 17½p.

TMK LAB TESTER. 100,000 O.P.V. 6½in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 500, 1,000V. D.c. current: 10, 100μA, 10, 100, 500mA, 2·5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: –10 to +49dB. Plastic case with carrying handle, size 7½in × 6¾in × 3½in. £18·90. P. & P. 25p.

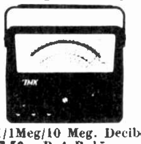
MODEL TE12. 20,000 O.P.V. 0/0·6/30/120/600/1,200 / 3,000 / 6,000V d.c. 1/6/30/120/600/1,200V a.c. 0 / 60μA / 6 / 60 / 600MA. 0 / 6K / 600K / 6meg./60. Megohm 50PF. 2 MFD £5·97½. P. & P. 17½p.

FTC-401 TRANSISTOR TESTER



Full capabilities for measuring A, B and ICO, npn or pnp. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6·97½. P. & P. 15p.

SKYWOOD SW-500

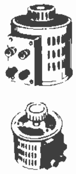


50 KΩ/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. AC Volts 3/30/300/600. DC Current 20uA/6/60/600mA. Resistance 10K/100K/1Meg/10 Meg. Decibels –20 to +57db £7·50. P. & P. 15p.

270° WIDE ANGLE 1mA METERS

MW1-6 60mm square £3·97½. MW1-8 80mm square £4·97½. P. & P. extra.

"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS



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5A	£9·75
8A	£14·50
10A	£18·50
12A	£21·00
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MODEL S-260 B Panel Mounting

1A	£5·50
2·5A	£6·62½

Please add postage

ALL MODELS INPUT 230 VOLTS, 50/60 CYCLES, OUTPUT VARIABLE 0-260 VOLTS
Special discounts for quantity

UNR-30 RECEIVER

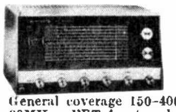
4 Bands covering 550KHz–30MHz. B.F.O. Built in Speaker 220/240V a.c. Brand new with instructions. £15·75. Carr. 37½p.

WS62 TRANSCEIVERS

Large quantity available for EXPORT! Excellent condition. Enquiries invited.

UR-1A SOLID STATE COMMUNICATION RECEIVER

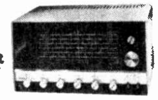
4 Bands covering 55KHz–30MHz. FET, S Meter, Variable BFO for SSB. Built in Speaker, Bandspread, Sensitivity Control. 220/240V a.c. or 12V d.c. 12½in × 4½in × 7in. Brand new with instructions. £25. Carr. 37½p.



LAFAYETTE HA-600 RECEIVER

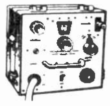
General coverage 150–400KHz, 550KHz–30MHz. FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter, Bandspread, RF Gain. 15in × 9¼in × 8¼in. 18lb. 220/240V a.c. or 12V d.c. Brand new with instructions. £45. Carr. 50p.

LAFAYETTE HA-800 SOLID STATE AMATEUR COMMUNICATION RECEIVER



3·5–4, 7–7·3, 14–14·35, 21–21·45, 28–29·7, 50–54MHz. Dual conversion, 2 mech. filters, product detector, variable BFO, S Meter, 100KHz calibrator. 220/240V a.c. or 12V d.c. 15in × 9¼in × 8¼in. 18lb. Brand new with instructions. £57·50. Carr. paid (100KHz Crystal £1·97½ extra).

CLASS D WAVEMETERS



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

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VOLTAGE STABILISER TRANSFORMERS 180–260V input. Output 230V. Available 150W or 225W. £12.50. Carr. 25p.

EDDYSTONE VHF RECEIVERS MODEL 770R. 19–165 Mc/s. Excellent condition. £150.

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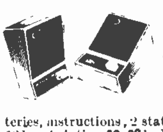

Transistorised Intercoms, ideal for home / office / workshop, etc. 2-way buzzer call system. For desk or wall mounting. Supplied complete with connecting wire, batteries, instructions, 2 station £2·97½. P. & P. 12½p. 4 station £6.62½. P. & P. 25p.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

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

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MOTORS

HYSTERESIS REVERSIBLE MOTOR
Incorporating two coils. Each coil when energised will produce opposite rotation of output shaft. 120V 60Hz 1/10 r.p.m. When run on 50Hz it will give a speed of 1/12 r.p.m. Price £1·25. P. & P. free.

LOW TORQUE HYSTERESIS MOTOR MA23

Extremely quiet running motor with high starting torque. Has many uses such as chart drives, discotheque colour wheels, etc. 1/20 r.p.m., 1/12 r.p.m., 1¼ r.p.m. 120V 50Hz, 1/12, ⅙, 1/18, 1/24, 1/240 r.p.m. 1/20, 1/60, ⅓, 1/16, 1/15, 1 r.p.m., 20 r.p.m. £1·50 post free.

HYSTERESIS CLUTCH MOTOR

With integral clutch allowing the motor to drop out of engagement with the gear train, thereby facilitating easy resetting when used in timers or in conjunction with a light spring. 6 oz torque at 240V 50Hz, 1/12 r.p.m., ⅛ r.p.m., ⅕ r.p.m., ⅓ r.p.m., ½ r.p.m., 15 r.p.m. 120V 50Hz, 1/12 r.p.m., 1/10 r.p.m., ⅛ r.p.m., 5/12 r.p.m., 4/11 r.p.m., 2 r.p.m. 120V 60Hz, ⅙ r.p.m., 1 r.p.m. 24V 50Hz, 1/20 r.p.m., 4 r.p.m. £1·25 each. P. & P. 25p.

D.C. MOTORS
Similar to above type MD 83. 28V 1/20 r.p.m., 1/60 r.p.m., 1 r.p.m. 12V 1/20 r.p.m. 24V 1/15 r.p.m. 30V 1/12 r.p.m. £1·50. P. & P. 25p.

SYNCHRONOUS MOTORS
200/250V 50Hz. New condition, ex-equipment. 8.7 1 r.p.h. and 1 r.p.m. Self starting, complete with gearing shaft ⅛in dia., ⅜in long. £1·50.

ELECTRIC CLOCK MOTOR
NEW 200–250V, 50Hz, 2W. Synchronous induction motor. 2 revs. per hour. O/P shaft, ⅛in dia. ⅜in long. Clockwise rotation. Three-holed mounting at 120° on 2in PCD. Price £1 post free.

SINGLE SPEED TAPE DECK

¼in tape, takes 7in spools, 1⅞in per sec. 3 motors, facility for remote control operation. Record/replay heads with separate erase head plus fast erase facility. Ex-equipment. Less spools. Price £5·98. P. & P. 75p.

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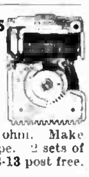
High quality solidly constructed solenoids. Actuated by 42V 45Ω coil. Overall length 3in × 1in square with a ⅛in travel of the ⅛in dia. shaft 43p. P. & P. 15p. 24V. 70 ohm. Armature ⅛in movement. Lug type fitting. L. 1⅛in × ⅞in × ⅞in. Price 23p. P. & P. 13p.

MINIATURE UNISELECTORS

3 bank, 12 way, 250 or 1400 ohm, 24V models available. Type 2200A. Supplied complete with plug-in base. Size 3in × 1in × 2in. A very neat precision component. Price £5·25. P. & P. 25p. 6 bank 25 way 50V 75 ohm. Make before break. Half Cycle type. 2 sets of wiper arms at 180°. Price £3·13 post free.

GOOD QUALITY INSTRUMENTS TAKEN IN PART EXCHANGE OR PURCHASED FOR CASH!

PORTABLE WHEATSTONE BRIDGE
Specification. Type: Moving Coil Galvanometer. Ranges: 1. 0·05 to 5 ohms. 2. 0·5 to 50 ohms. 3. 5 to 500 ohms. 4. 50 to 5,000 ohms. 5. 500 to 50,000 ohms. Scales: Switched. Slidewire: 0·5 to 50. Galvanometer Scale: 10–0–10. Case: Moulded plastic. Internal Source: 4V Dry battery. Dimensions: 200 × 110 × 65mm. Weight: 0·9kg. List price £25. Our price £9·99p.

AVOMETERS
These well-known portable test instruments have been overhauled and are offered complete with leads, crocodile clips and prods.

Model D	£14
Model 40, 47A, 48A	£16
Model 7	£17
Model 7X	£19·50
Model 8	£28
Model 8X	£33
Model HR	£20

Model 48A complete with voltage multiplier for 480V and 3600V. Current shunts for 120A and 480A. A.C. Current transformer for 20A and 60A. In special wooden box. 47A and 48A are Admiralty patterns of the model 40. £16·75. P. & P. 75p.

RESET TIMERS — ACRO TIMER BY HAYDON
Synchronous motor driven timer providing manual adjusted delay. Delay time is set on graduated dial. Press button closes contact and drives motor which drives an arm until it actuates the load switch. The cam then returns to initial position for repeat action. Various ranges available. 230V 50Hz Load contacts 15A 230V. £5.

HIGH SPEED IMPULSE COUNTERS

by Davis, Wynn & Andrews. 4in dial and pointer registers up to 100 and 4-digit counter both manually resettable. The drive to the counter is by air inverse escapement so that there is no loading of the pointer mechanism when digits are changed and adjustable pawls are unnecessary. Coil resistance 100 ohms for nominal volt operation, but the device works reliably from 20V at rates up to 10 impulses/sec. In circuit with a thyratron, or neostron, counting rates up to 100 impulses/sec are possible provided pulse width is restricted to keep mean current to 100mA. New, £6.38.

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Gear boxes give a drive ratio of 2·5 : 1 at right angles to the input. Driveable through the I/p shaft only. Dimensions 4in wide × 3¼in deep × 4¾in high. Robust construction in cast iron. Price £3·20. With pulley and ball race shaft mountings. Price £4·97. Carriage 75p.

WIDE RANGE OF PRECISION MULTI-TURN POTENTIOMETERS IN STOCK

TACHOMETERS

Portable and precision instruments by Smiths. Incorporating 4 mechanically selected ranges of 500, 1,000 5,000 and 50,000 r.p.m. Within 2% accuracy, supplied with accessories and carrying case. A neat and compact instrument. Bargain at £19·50. P. & P. 25p.

AVO TRANSISTOR ANALYSER CT 446
A portable direct-reading instrument capable of giving accurate transistor measurements in the grounded emitter configuration. Battery power unit 1·5V to 10·5V in 5 steps. Base current 0–1mA, 1-40 mA. Collector current 250 mA. Size: 15½ × 9½ × 5ins. Weight with batteries: 15 lb. Price £42·50. Carriage extra.

6 DIGIT ELECTRICAL IMPULSE COUNTER
New Type EM 101 24V Resettable	£5
New P.O. Type 5 digit 330 Ohms	£3·50
110V D.C. 4400 Ohms coil Ex-equip.	£2·98

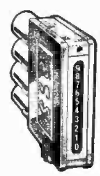
Packing and postage free.

VEEDER ROOT 6 DIGIT COUNTER
Suitable for counting all kinds of production runs, business machine operation. Mechanically driven. Reset type KA 1337, manual knob. Ex-equip. but new condition. Special price £1·25 plus 25p, P. & P.

3 DIGIT RESETTABLE COUNTER
Totalising 48V d.c. at 48mA: 10 impulses/sec. Length 4in × ⅞in × 1in. Price £4 post free.

6 DIGIT RESETTABLE COUNTER
Totalising 240V 50Hz. Viewing window 2in × ⅜in. Ex-equipment. Price £2·75. P. & P. 25p.

6 DIGIT TOTALISING NON-RESETTABLE COUNTER
Mechanical operation. Chromium finish. Length 1⅞in × ⅞in × ⅞in with viewing window ⅞in × 5/16in. Ex-equipment. Price 48p. P. & P. 13p.

BERKELEY DECIMAL COUNTING UNIT 0-9

Direct reading octal base plug in unit electronic counter. The number counts received is indicated by one of ten neon lamps behind acetate panel. The unit counts from 0–9 the tenth pulse resetting to zero and simultaneously generating an o/p signal. Circuits can be connected in cascade. Power supply 6·3V d.c. Cut on/Cut off 15V. Price £3·50 p. & p. free.

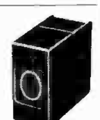
MINIATURE DIGITAL DISPLAY

Operates on a rear projection 6·3V. pilot lamp. Character size ⅝in high. 0–9 digits with degree. symbol, i.e. (4°). Dimensions 1in wide, 3⅞in deep, 1 5/16in high. List price 6 gns. Our price £2·73.

1in characters	£3.
4in characters	£9. Post free.

EAC DIGIVISOR Mk. II DIGITAL READ-OUT DISPLAY

Uses a sensitive moving coil movement to project digits 0–9 on to a viewing screen via an optical lens system. Image height ⅝in. Lamp 6·3V. Sensitivity 250 micro-amp. Dimensions L. 4 5/16in. W. 2⅝in. H. 1⅝in. Price £3·50. P. & P. 25p.

NEW SERIES M3 BY KGM DIGITAL INDICATORS

Provides selective display up to 10 character. Ideal where space is limited. Price £3.

BRAND NEW 4 Digit Countet with electrical reset
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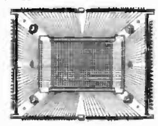
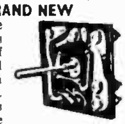
By Sangamo Weston, suitable for D.C. circuit. A high sensitivity relay more sensitive than the electromagnetic type. Single Coil Resistance 310 micro amps. 315Ω. List price £4·50. Our price £1·15.

NUMICATORS

Fig. size 16mm. Cold cathode gas filled in line 0–9 digital display tubes. Long life expectancy. Minimum striking voltage 180V. Side reading Type XN 7, XN 23 and XN 3 amber. Price £1·15. End reading GR 10 M/U clear £1·40 post free.

MEMORY CORE STORES

42 × 52 2K bit ferrite core store complete with 84 OA10 load diodes. Ideal for building computer store or holding information in binary form. Price £2·75. P. & P. 38p.

MEMORY PLANES
Ferrite core memory planes with wired Ferrite cores. Used for building your own computer or as an interesting exhibit in the demonstration of a computer. Mounted on plastic material, frame 5 × 8in. Consisting of matrices 40 × 25 × 4 cores each one individually addressable and divided into 2 halves with independent sense and inhibit wires. £6·50. P. & P. 15p.

LINEAR THYRISTOR CONTROLLED LIGHT DIMMER—BRAND NEW

High grade full wave bridge circuit gives linear control of light brightness. Ideal for controlling room lighting and a.c./d.c. commutator motors fitted to portable electric hand drills. Fits standard 2in conduit box. 240V, 50Hz, 400W. Price £2·99. P. & P. 13p.

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L.F. Oscillator Furzehill G 420	£7·50

Valve Voltmeter Furzehill 378 B/2. 1mV–100V. 5 ranges. £8·50 post free.
Creed Morse Receivers Model 7B. £15. Carr. £3.
New Highgrade Moving Coil AC/DC Voltmeters. 2 ranges 0–150 and 0–300V. 200 Ohms/V. 5" meter mirror scale in teak case. £10·50 post free.

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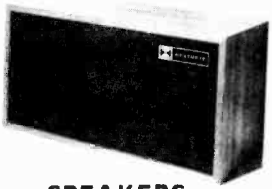
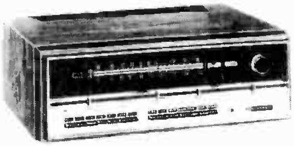
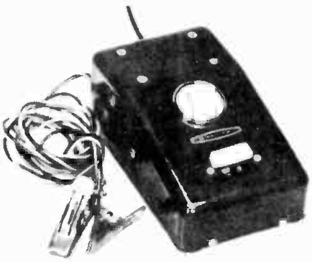


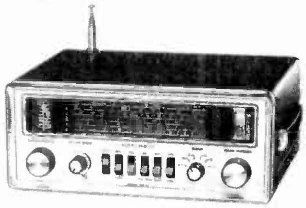
SPEAKERS

HI-FI & AUDIO

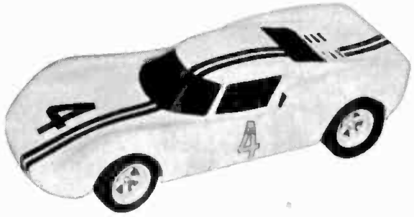




CONSUMER



SHORTWAVE



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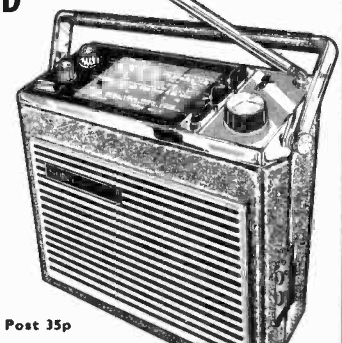
SONY TFM 8030L

BARGAIN SCOOP

HIGH PERFORMANCE 11 TRANSISTOR THREE WAVEBAND

PORTABLE BATTERY MAINS RADIO



This is a really top performance, top quality solid state receiver packed with SONY know-how and backed by the outstanding reliability for which SONY are renowned. Now this outstanding set is available from Lasky's at over 27% below the manufacturer's list price making it without a doubt the No. ONE SCOOP of 1971! Just look at these outstanding features. Covers MW, LW and FM (VHF). 11 transistor circuit for high sensitivity and stability. Powerful output to 5in PM Dynamic speaker with rich clear tone quality. AFC for drift free VHF reception. Pushbutton wavechange selectors and tone control. Choice of three power sources—9V battery, household mains or car battery with suitable adaptors. Dial light for use in the dark. External jacks for earphone, tape recording, external power input and car aerial. Ultra modern styling and superb finish with padded leatherette covered cabinet for superior sound damping with chrome trim, strong carrying handle.

The SONY TFM 8030L will enliven your leisure hours anywhere, anytime with exciting sound, news, sport music, etc. Technical specification: Freq. range. FM 87-108 MHz, LW150-Z85kHz, MW530-1,605 kHz. Circuit: 11 transistors, 7 diodes and 2 thermistors. Aerial System: Directional telescopic for FM, internal ferrite bar for LW/MW Power Output: 1.85W max. Speaker PM Dynamic-4Ωimp. Power Source: 9V power pack battery (Ever Ready PP9 or equiv.), AC mains with adaptor, Car battery with adaptor. Size: 9¾(W) × 8 5/16(H) × 3¾(D). Complete with earphone and battery.

Post 35p

MANUFACTURER'S LIST PRICE **£29·75**

LASKY'S SPECIAL OFFER PRICE **£21·50**

Optional Extras. SONY AC-90e AC adapter £4. DCC-126 stabilised car battery cord £6. Both post FREE if purchased with radio.

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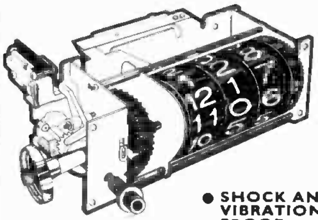
DIGITAL CLOCK SCOOP!



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- SHOCK AND VIBRATION PROOF
- BUILT IN ALARM BUZZER

This unique DIGITAL CLOCK is now available EXCLUSIVELY FROM LASKY'S in chassis form for you to mount in any housing that you choose. All settings are achieved by two dual-concentric controls at the front including: ON-OFF-AUTO and AUTO ALARM, "sleep" switch, 10-minute division "click" set alarm (up to 12-hour delay), time adjustment. Ultra simple mechanism and high quality manufacture guarantee reliable operation and long life.

The sleep switch will automatically turn off any appliance—radio, TV, light, etc., at any pre-set time up to 60 min. and in conjunction with the AUTO setting will switch on the appliance again next morning.

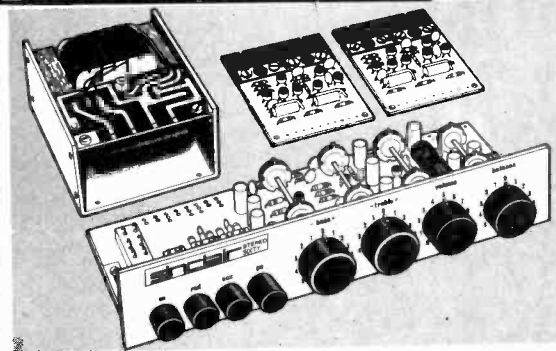
The clock measures 4¾W × 1¾H × 3¾D (overall from front of drum to back of switch). SPEC: 210/240V AC, 50Hz operation: switch rating 250V, 3A. Complete with instructions. **HUNDREDS OF APPLICATIONS.**

COMPLETE WITH KNOBS

LASKY'S PRICE **£6·95** **Post 18p**

SPECIAL QUOTATIONS FOR QUANTITIES

sinclair Project 60



Project 60 is a range of modules which connect together to form a complete stereo amplifier. The modules are: 1. Z-30 high gain power amp. 2. Stereo-60 pre-amp. control unit. 3. The PZ-5 unstabilised and PZ-6 stabilised power supplies. A complete system comprises two Z-30's, one Stereo-60 and a PZ-5 or PZ-6.

STEREO 60 SPECIFICATION

Input sensitivities: Radio up to 3mV, Magnetic Pick-up 3mV: correct to R.I.A.A. curve ±1dB: 20 to 25,000Hz. Ceramic Pick-up up to 3mV: Auxiliary up to 3mV ● Output: 1V ● Signal to noise: better than 70dB ● Front panel: brushed aluminium with black knobs and controls ● Size: 5¼ × 1¼ × 4in. **£9·97½** Post 17½p

Z-30 SPECIFICATION

●Power output: 15W R.M.S. into 5ohms using a 35V supply ● Frequency response: 30 to 300,000Hz ±1dB ● Distortion: 0·02% ● Signal to noise: better than 70dB ● Input sensitivity: 250mV into 100K ohms ● Loudspeaker imp: 3 to 15 ohms ● Power requirements: from 8 to 35V DC (The Z-30 will operate from batteries if required) ● Size: 3½ × 2¼ × ½in. **£4·47½** Post 17½p

PZ5 30V unstabilised—sufficient to drive two Z-30's and a Stereo 60 for domestic applications. **£4·97½** Post 12½p

PZ6 35V stabilised—ideal for driving two Z-30's and a Stereo 60 for low efficiency speakers. **£7·97½** Post 12½p

PACKAGE PRICE For Stereo 60 two Z-30's and one PZ-5. **£20** Post 50p

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A completely new design 20,000 O.P.V. pocket multimeter with mirror scale and built-in thermal protection. Exceptionally large easy to read meter with D'Arsonval movement. Colour coded scales. Single positive click-in, recessed selection switch for all ranges. Ohms zero adjustment. Range spec. a.c. volts: 0-6-30-300-1,200V at 10K/ohms/V. DC volts: 0-3-15-150-300-1.2KV at 20K/ohms/V. Resistance: 0-60K-6megs. DC current: 0-60μA—300 mA. Decibels: —20dB to + 17 dB. Extremely high standard of accuracy on all ranges. Uses one 1½V penlight battery. Strong impact resistant plastic cabinet —size only 4¾ x 3⅛ x 1¼in. Two colour buff/green finish. Complete with test leads and battery.

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AC187	30	BYZ12	30	OA10	25	2N388A	75
AC188	30	BYZ13	20	OA47	8	2N404	23
ACY17	29	BZY88 Series		OA70	8	2N696	15
ACY18	20	3.3V to 30V	15	OA73	8	2N697	17
ACY19	20			OA79	8	2N698	30
ACY20	19	D13T1	45	OA81	8	2N706	10
ACY21	19	MJE520	75	OA85	8	2N706A	12
ACY22	19	MJ480	97	OA90	8	2N708	16
ACY40	15	MJ481	1.25	OA91	8		
ACY41	15	MJ490	1.00	OA95	8	2N711	37
AD140	55	MJ491	1.35	OA200	10	2N711A	37
AD149	57	MPF102	43	OA202	10	2N911	50
AD161	37	MPF103	37	OC19	37	2N914	20
AD162	37	MPF104	37	OC20	97	2N918	42
AF114	25	MPF105	40	OC22	47	2N1090	30
AF115	25			OC23	60	2N1091	33
AF116	25	NKT124	30	OC24	60	2N1131	30
AF117	25	NKT125	40	OC25	37	2N1132	30
AF118	44	NKT126	37	OC26	33	2N1302	20
AF124	25	NKT128	25	OC28	60	2N1303	20
AF126	17	NKT135	26	OC29	75	2N1304	25
AF139	37	NKT137	32	OC35	50	2N1305	25
		NKT210	25	OC36	63	2N1306	30
AF186	40	NKT211	25	OC41	25	2N1307	30
AF239	37	NKT212	25	OC42	30	2N1308	34
ASY26	25	NKT213	25			2N1309	31
ASY27	30	NKT214	23	OC44	15	2N1507	23
ASY28	22	NKT215	21	OC45	15	2N1613	22
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BC149	15	NKT238	19	OC82D	15	2N2904	44
BC158	17	NKT239	23	OC83	23	2N2904A	49
BC169C	19	NKT240	20	OC84	25	2N2905	65
BC182	12	NKT241	21	OC139	25	2N2905A	75
BC182L	10	NKT242	15	OC140	35	2N2906	44
BC183	9	NKT243	56	OC170	25	2N2906A	54
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BC184	15	NKT244	17	OC200	37	colours	10
BC184L	15	NKT245	17	OC201	47	2N3053	25
BC212	17	NKT261	21	OC202	63	2N3054	63
BC212L	12	NKT262	19	OC203	37	2N3055	75
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BCY32	50	NKT274	18	OC207	75	2N3705	10
BCY33	20	NKT275	23	OCP71/M	47	2N3706	9
BCY34	25	NKT279A	12			2N3707	11
BCY38	30	NKT281	29	ORP12	50	2N3708	7
BCY70	19	NKT302	87	ORP60	60	2N3709	9
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BD123	1.10	NKT402	77	ST141	20	2N3820	60
BD124	1.03	NKT403	65	TD716	60	2N3826	30
BDY20	1.05	NKT404	60	TIP31A	62		
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BF173	30	NKT451	58	ZTX108	11	2N4062	20
BF178	52	NKT452	54	ZTX300	13	2N4284	15
BF180	37	NKT453	50	ZTX302	18	2N4287	15
BF181	37	NKT603F	30	ZTX303	18	2N4289	15
BF184	25	NKT613F	30	ZTX304	27	2N4871	40
BF185	25	NKT674F	30	ZTX314	11	3N84	1.30
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Mullard Miniature Electrolytic – C426 Series

Mfd.	Volt Wkg.	
2.5	16	8 Np
10	16	6 Np
20	16	6 Np
40	16	6 Np
80	16	6 Np
1.6	25	8 Np
6.4	25	6 Np
12.5	25	6 Np
25	25	6 Np
50	25	6 Np
80	25	6 Np
1	40	8 Np
4	40	6 Np
8	40	6 Np
16	40	6 Np
32	40	6 Np
50	40	6 Np

Mullard Metallised Polyester 250v

Mfd.		Mfd.	
.01	3 Np	.22	5 Np
.015	3 Np	.33	7 Np
.022	3 Np	.47	8 Np
.033	3 Np	.68	11 Np
.047	4 Np	1.0	14 Np
.068	4 Np	1.5	20 Np
.1	4 Np	2.2	24 Np
.15	5 Np		

Mullard Electrolytic – C437 Series

Mfd.	Volt.Wkg	
250	16	9 Np
400	16	12 Np
640	16	15 Np
1000	16	18 Np
160	25	9 Np
250	25	12 Np
400	25	15 Np
640	25	18 Np
100	40	9 Np
160	40	12 Np
250	40	15 Np
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3.75"	x 17"	x .15"	79 Np
3.75"	x 5"	x .15"	30 Np
3.75"	x 3.75"	x .15"	22 Np
2.5"	x 5"	x .1"	25 Np
2.5"	x 3.75"	x .1"	23 Np

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110 Semiconductor Projects (Marston) £1.25
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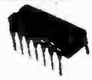

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SN7404N	Hex Inverter			
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SN7413N	Schmidt Trigger	45	40	35
SN7420N	Dual 4-input NAND gate			
SN7430N	8 input NAND gate	32	27	22
SN7440N	Dual 4-input NAND Buffer			
SN7442N	BCD to decimal decoder TTL output	£1.12	£1.00	88
SN7450N	Expandable Dual 2-wide 2-input AND-OR-INVERT gate			
SN7453N	Expandable 4-wide 2-input AND-OR-INVERT gate	32	27	22
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SN7472N	J-K Master-Slave Flip-flop			
SN7473N	Dual J-K Master-Slave Flip-flop	50	45	43
SN7474N	Dual D-type Edge-Triggered Flip-flop			
SN7475N	Quadruple Bistable Latch	65	60	55
SN7476N	Dual J-K Master-Slave Flip-flop with Preset & Clear	55	50	47
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LM741CN 95 Np (equiv SN72741P)

PC1006/1 Multimeter Sensitiser packaged circuit KIT includes all accessories £7.55

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	1–11	12–24	25
μL900	40 Np	35 Np	32 Np
μL914	40 Np	35 Np	32 Np
μL923	53 Np	50 Np	47 Np

Devices may be mixed to qualify for quantity price.

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PA234	1 Watt Amp	£1.00
PA237	2 Watt Amp	£1.87
PA246	5 Watt Amp	£2.63
PA424	Zero Volt Switch	£2.45

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MULLARD

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TAD110	AM/FM Receiver	£1.97

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Operate at 40kc/s. Can be used for remote control systems without cables or electronic links. Type 1404 transducers can transmit and receive. **FREE**: With each pair our complete transmitter and receiver circuit PRICE £5.90 Pair

(Sold only in pairs)

IOR

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DD175	4 pieces 100 PRV Rectifiers 500mA	50 Np
DD176	2 pieces 200 PRV Rectifiers 500mA	30 Np
DD177	2 pieces 400 PRV Rectifiers 500mA	50 Np
DD180	Bargain Transistor pack 2 AF – RF	57 Np
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TRIACS

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*These types have integral triggering.

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SC146D	10 Amp 400 PIV Plastic Flat-pack	£1.75
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ZENER DIODES

400mW 10% GLASS CASE TEXAS Mfr

1S2036	3.6 volt	1S2082	8.2 volt
1S2039	3.9 volt	1S2100	10 volt
1S2043	4.3 volt	1S2110	11 volt
1S2047	4.7 volt	1S2120	12 volt
1S2056	5.6 volt	1S2160	16 volt
1S2062	6.2 volt	1S2180	18 volt
1S2068	6.8 volt	1S2270	27 volt
1S2075	7.5 volt	1S2300	30 volt

Prices: 1-24 15Np 25-99 11Np 100+ 9Np

THYRISTORS

CR1/051C	1 Amp 50 PIV TO-5	40 Np
CR1/401C	1 Amp 400 PIV TO-5	50 Np
2N3525	5 Amp 400 PIV TO-66	£1.09
40739	10 Amp 400 PIV Stud Mtg.	£1.45

ENCAPSULATED BRIDGES

Type No	Current	Rms Volts	
W005	1 Amp	50	50Np
W06	1 Amp	600	65Np

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We're the Education Division of one of the world's largest Computer manufacturers (and who's better qualified to teach Computer Engineering than a Computer manufacturer?)

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Please give me further information

Name (Block Capitals)

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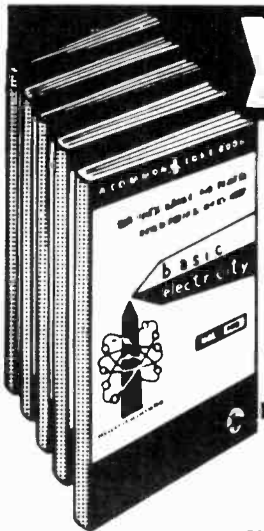

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'. . . *carefully written* . . .'
. . . I am very satisfied with these carefully written and well expressed manuals . . . *A.W., Shanklin.*

'. . . *valuable assistance* . . .'
. . . Your valuable assistance has enabled me to find a good position as a Radio and TV Engineer . . . *D.S., Bristol.*

'. . . *they are invaluable* . . .'
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To The SELRAY BOOK CO., 60 HAYES HILL, HAYES, BROMLEY, KENT BR2 7HP

Please send me WITHOUT OBLIGATION TO PURCHASE, one of the above sets on 7 DAYS FREE TRIAL, I will either return set, carriage paid, in good condition within 7 days or send the following amounts. BASIC ELECTRICITY £4·50. Cash Price on Down Payment of £1 followed by 4 fortnightly payments of £1 each (Total £5). BASIC ELECTRONICS £5·40. Cash Price or Down Payment of £1 followed by 5 fortnightly payments of £1 each (Total £6). This offer applies to UNITED KINGDOM ONLY. Overseas customers cash with order, prices as above.

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

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Prices include Postage and Packing.

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ELECTRIC CLOCK WITH 25 AMP SWITCH

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

FLUORESCENT CONTROL KITS

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

BLANKET SWITCH

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

BLANKET SIMMERSTAT

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

REED SWITCHES

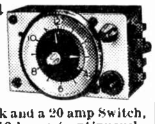
Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:
Miniature. 1in long × approximately ⅛in diameter. Will make and break up to ½A up to 300 volts. Price **13p** each, **£1·20** dozen.
Standard. 2in long × $\frac{3}{16}$in diameter. This will break currents of up to 1A, voltages up to 250 volts. Price **10p** each, **90p** per dozen.
Flat. Flat type, 2in long, just over $\frac{1}{16}$in thick, flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price **30p** each. **£3** per dozen.
Small ceramic magnets to operate these reed switches **9p** each. **90p** dozen.

HIGH CAPACITY ELECTROLYTICS

Brand new, not ex-equipment.
100 mfd. 25V, **6p** each **60p** doz.
200 mfd. 25V, **8p** each **75p** doz.
250 mfd. 50V, **16p** each **£1·65** doz.
400 mfd. 40V, **22p** each **£2·30** doz.
500 mfd. 12V, **10p** each **£1·05** doz.
500 mfd. 25V, **18p** each **£1·80** doz.
500 mfd. 50V, **23p** each **£2·40** doz.
500 mfd. 350V, **43p** each **£4·50** doz.
1000 mfd. 12V, **15p** each **£1·50** doz.
1000 mfd. 18V, **17p** each **£1·70** doz.
1000 mfd. 64V, **37p** each **£4** doz.
2000 mfd. 25V, **34p** each **£3·95** doz.
5000 mfd. 12V, **24p** each **£2·40** doz.
10,000 mfd. 6V, **29p** each **£3** doz.
10,000 mfd. 15V, **43p** each **£4·50** doz.
15,000 mfd. 10V, **53p** each **£5** doz.
60,000 mfd. 8V, **£1·10** each **£10** doz.
70,000 mfd. 13V, **£2** each **£20** doz.

3 AMP 12V BATTERY CHARGER KIT—comprising 230/40 mains transformer with 3 amp secondary and 3 amp rectifier **£1·15** + 23p post.
SONOTONE STEREO CARTRIDGE. Turnover type, ref. No. 19 T1. This fits most British pick-ups and is a really excellent reproducer. Limited quantity, **£1**.
5 AMP 3 PIN SOCKETS. These are always good stock, you never know when you will need some. Famous make, brown bakelite, standard size, 12 for **65p** plus 23p post.
DITTO WITH SWITCH. 12 for **£1** plus 23p post.
13 AMP SOCKETS, FLUSH MOUNTING. Bakelite, cream, less switch, 6 for **£1**.
2 AMP 3 PIN SWITCHED SOCKETS for surface mounting, brown bakelite. Made by famous maker, **13p** each or **£1·20** dozen.
100 ASSORTED SILICON RECTIFIERS G.P. AND SWITCHING DIODES. Small and very small sizes. A real snip for experimenters, **65p** per 100.
MAINS SUPPRESSION ADAPTOR for preventing mains interference caused by vacuum cleaners, razors, sewing machines, etc, rated at 4 amps, simply plug this into your 5 amp 3 pin socket, **30p each.**
A NEW SERVICE TO READERS
A bulletin of special snips and "too few to advertise" lines posted to subscribers each month. It will be called "Advance Advert News" and the Subscription is 60p per year, including our completed 1971 catalogue when this is published.

20 AMP ELECTRICAL PROGRAMMER



Learn in your sleep: Have Radio playing and kettle boiling as you awake—switch-on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an Electrical Programmer. Made by the famous Smiths Instrument Company. This is essentially a 230/240 volt mains operated Clock and a 20 amp Switch, the switch-off time of which can be delayed up to 12 hours (continuously variable not stepped). Similarly the switch-on time can be delayed. This is a beautiful unit, size 5¾×3¾×2¼in. deep. Metal encased, glass fronted with chrome surround. Offered at **£2·40** plus postage and insurance 23p.

40 WATT 12in. HI-FI SPEAKER

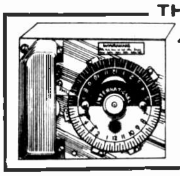
Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 40 watts R.M.S.—Cone moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms. Chassis diam. 12in.—12¾in. over mounting lugs. Overall height 5½in. A £10 speaker offered this month for **£7** plus 38p post and ins.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A one-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.*

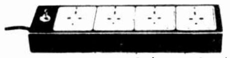
THIS MONTH'S SNIP

ELECTRIC TIME SWITCH



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

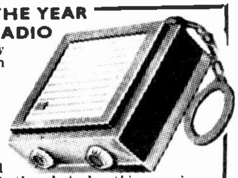
DISTRIBUTION PANELS



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

BARGAIN OF THE YEAR

MICROSONIC KEYCHAIN RADIO

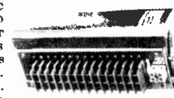


7 transistor Key chain Radio in very pretty case, size 2¾ × 2⅛ × 1⅛in—complete with soft leather zipped bag. Specification:—
Circuit: 7 transistor superheterodyne.
Frequency range: 530 to 1,600 Kc/s.
Sensitivity: 5 mv/m. Intermediate frequency: 465Kc/s or 455Kc/s. Power output: 40mW. Antenna: ferrite rod.
Loudspeaker: Permanent magnet type.
In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new. Price only **£1·25** plus 13p post and insurance, less batteries. 6 for **£7**. post free. Rechargeable batteries 43p pair. Charger 43p.

19-PIECE SOCKET SET

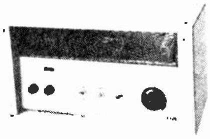
Complete with wall or bench rack. An ideal gift for the motorist. **80p** + 23p; post and insurance. Most useful sizes from ⅛in to ½in.

HONEYWELL PROGRAMMER



This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from Makers probably over £10 each. Special snip price **£5·75** plus 25p post and insurance. Don't miss this terrific bargain.

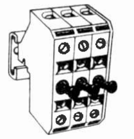
ERGOTROL UNITS



These units made by the Mullard Group are for operating and controlling d.c. Motors and equipment from A.C. mains.
Thyristors are used and these supply a variable d.c. resulting in motor speed control and operating efficiency far superior to most other methods.
These units are contained in wall mounting cabinets with front control panel on which are fuses—push buttons for on/off and the variable thyristor firing control.
4 models are available—all are brand new in makers cases:

Model 2410 for up to 5 amps	**£17·50**
Model 2411 for up to 10 amps	**£27·50**

MAINS CONNECTOR



A quick way to connect equipment to the mains safely and firmly; disconnection by plugs prevents accidental switching on; has sockets which allow insertion of meter without disconnection; cable inlets firmly hold one hair wire on up to four 7,029 cables. **65p** each.

DRILL CONTROLLER

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

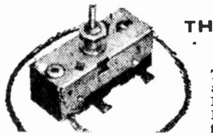
BALANCED ARMATURE UNIT

500 ohm, operates speaker or micro phone, so useful in intercom or simila circuits, **33p** each, **£3·50** doz.

PROTECT VALUABLE DEVICES

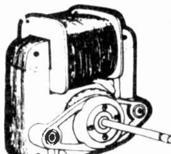
FROM THERMAL RUN-AWAY OR OVERHEATING: Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing.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

THERMOSTAT WITH PROBE



This has a sensor attached to a 15A switch by a 14in length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at **65p** each. Postage and insurance 14p.

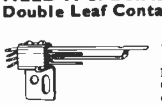
MAINS MOTOR



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

NEED A SPECIAL SWITCH?

Double Leaf Contact



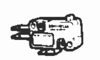
Very slight pressure closes both contacts, **6p** each, **60p** doz. Plastic push-rod suitable for operating, **5p** each. **45p** doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **18p** each. **£1·80** dozen, your assortment.

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

MICRO SWITCH



5 amp. changeover contacts, **9p** each, **90p** doz. 15 amp Model **10p** each or **£1·05** doz.

Where postage is not stated then orders over £5 are post free. Below £5 add 14p. Semiconductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

ELECTRONICS (CROYDON) LTD

Dept. PE, 266 London Road, Croydon CR0 2TH

Also 102/3 Tamworth Road, Croydon

COMPLETE STEREO SYSTEM

FOR ONLY £40·95

CARRIAGE £1·75

PREMIER STEREO SYSTEM "ONE" Consists of an all transistor stereo amplifier. Garrard 2025 T/C auto/manual record player unit fitted stereo/mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on/off, stereo/mono switch. Brushed aluminium front panel. Black metal case with teakwood ends: Size 12 × 5½ × 3½in. high (Amplifier available separately if required **£14·95**. Carr. 40p). **Now Available MATCHING F.M. TUNER £22·05.**

PREMIER STEREO SYSTEM "TWO"

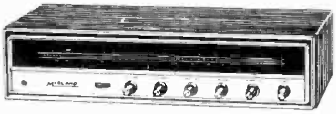
As system "ONE" above but with Garrard SP25.

PREMIER PRICE **£47** Carr. £1·75

MIDLAND AM/FM STEREO TUNER AMPLIFIERS

Two new all solid state receivers from Midland at economical prices. Beautifully styled in slimline cabinets.

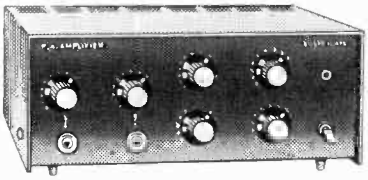
MODEL 19—520



MODEL 19—542

Specifications	*Model 19–520*	*Model 19–542*
Semi conductors	19 transistors, 12 diodes, 2 varistors	22 transistors, 12 diodes
Tuning range	FM 88–108 MHz FM Stereo Multiplex AM 535–1635 kHz	FM 88–108 mHz FM Stereo Multiplex AM 535–1605 kHz
Aerial	Internal AM and external FM	Internal AM and external FM
Frequency Response	50–17,000 Hz	35–20,000 Hz
Power Output	2½ watts rms per channel (8 watts music power)	4 watts rms per channel (18 watts music power)
Inputs	Ceramic phono	Magnetic/Ceramic phono and aux.
Speaker impedance	4–8 ohm	8 ohm
Controls	Power on/off, Volume, tone, balance, tuning, AFC. Stereo indicator	On/off, Volume, bass, treble, balance, tuning, AFC. Stereo indicator
Function	AM, FM, FM Stereo, Phono (Stereo indicator light)	AM, FM, FM Stereo, Ceramic, Magnetic. Aux.
Size	15" × 8 $\frac{1}{16}$ × 3½"	16½" × 9¼" × 3½"
PRICE	£30·45 Carr. & Ins. 50p	£44 Carr. & Ins. 50p

50 WATT PUBLIC ADDRESS AMPLIFIER MODEL PA-5000



A top quality amplifier giving 50 watts rms power output (80W peak). Incorporates 8 transistors and 4 silicon diodes (silicon output transistors). Inputs for 2 microphones each with individual volume controls, plus phono/aux input. Master volume control and Bass and Treble Controls. Well presented front panel for ease of operation, on/off power flick switch and pilot light. Output impedance 4/8/16 ohms Mike 1 and 2 sensitivity 2mV (50k Ω) Phono/Aux 300mV (100k Ω). Frequency response 50–20,000Hz. Fused output and thermal overload protection. A.C. Mains 220–250V. 50/60Hz. Size 13½in × 9in × 5in.

PREMIER PRICE **£39** P. & P. 50p

E.M.I. 13×8in. HI-FI SPEAKERS

Fitted two 2½in tweeters and crossover network. Available with 8 or 15 ohm impedance. Handling capacity 10W. Brand new.

£3·47 P. & P. 40p

VERITAS V–149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 × 3 × 2in. suitable for crystal microphone, low impedance microphone with transformer, radio, tape, etc. Max. input 1·5V, max. output 2·5V, gain 6dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case.

Mono Model **£3** Stereo Model **£3·47** P. & P. 12p

HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2½in. speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft. lead and stereo jack plug.

£2·47 P. & P. 25p

STEREO STETHOSCOPE SET Low imp. £1·25. P. & P. 10p

MONO STETHOSCOPE SET Low imp. 52p. P. & P. 10p

POCKET SIZE MULTI-TESTER With wide angle, jewelled meter movement, ceramic long-life, low-loss switching, tough impact resisting case. Sensitivity 20,000 ohms/volt D.C. 10,000 ohms/volt A.C.

19 Ranges: 0–5–25–50–250–500–2500 volts D.C. 0–10–50–100–500–1000 volts A.C. 0–50μA–2·5mA–250mA D.C. 0–6000 ohms–6 megohms. 10μ μf–0·001 mfd–1 mfd. —20 to +22dB. Complete battery, test lead and instructions.

£4·90 P. & P. 17p

SPECIAL OFFER!

Garrard SP25 Mk. II Single Record Player. Fitted Goldring G850 Magnetic Stereo Cartridge. Complete in Teak Plinth with Rigid Perspex Cover.

Total list Price over £24.

PREMIER PRICE **£18·90** P. & P. 50p

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED.

TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped—attractively boxed.

LP3	3"	250'	P.V.C.	28p
TT3	3"	450'	POLYESTER	37p
DT3	3½"	600'	POLYESTER	57p
SP5	5"	600'	P.V.C.	42p
LP5	5"	900'	P.V.C.	50p
DT5	5"	1200'	POLYESTER	75p
LP6	5¾"	1200'	P.V.C.	62p
DT6	5¾"	1800'	POLYESTER	£1·12
TT6	5¾"	2400'	POLYESTER	£1·87
SP7	7"	1200'	P.V.C.	62p
LP7	7"	1800'	P.V.C.	75p
DT7	7"	2400'	POLYESTER	£1·25
TT7	7"	3600'	POLYESTER	£2·50

TAPE SPOOLS 3" 5p, 5", 5¾", 7" 9p.

Post and Packing 3" 5p, 5", 5¾" 8p, 7" 10p. (3 reels and over Post Free.)

TAPE CASSETTES

C60 (60 min.) 37p 3 for £1·05

C90 (90 min.) 62p 3 for £1·80

C120 (120 min.) 87p 3 for £2·55

P. & P. 5p

All cassettes can be supplied with library cases at 3p extra each.

PREMIER RADIO

10 & 23, TOTTENHAM COURT ROAD, LONDON, W.1 TEL: 01-636 3451/2639

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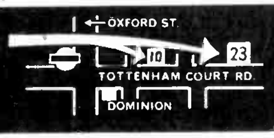
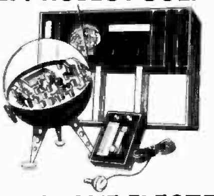


ROC ELECTRONICS

20 PROJECT SOLAR ELECTRONIC KIT Mod. R.128



This ultra modern Project Kit is shaped for the space age. Carried inside a transparent domed 4½in capsule the R.128 comes complete with a self-contained solar cell to power any one of 20 projects ranging from a one transistor radio to a morse set complete with key and morse training code. Supplied complete with easy to follow instructions and even the cement to assemble this unique electronic space capsule.

PRICE £4·50

EXCLUSIVE

2 OCTAVE ELECTRONIC ORGAN KIT Mod. R.129

Complete with a music book containing 10 easy to play songs the R.129 solid state organ kit covers 2 full octaves. Slotting into a fitted hardwood case the top panel carries the key assemblies and all the components including the loudspeaker. Like all Roc Electronic Kits every item is included down to the last nut and bolt so that the constructor can start assembly within minutes of opening the package.

PRICE £4·50

10 PROJECT INTEGRATED CIRCUIT KIT Model R.127

Using a robust Solid State Integrated circuit the R.127 kits will build any one of these projects: (1) Germanium Radio. (2) Test Oscillator. (3) Morse Telegraph Training Set. (4) I.C.I. Transistor Radio. (5) Germanium 1 Transistor Radio. (6) Record Player Amp. (7) Continuity Tester. (8) AF Signal Tracer. (9) Radio Transmitter. (10) Water Purity Tester.

PRICE £3·50

2 TRANSISTOR SOLAR RADIO KIT Model R.126

Like all Roc Electronic Kits the R.126 uses reliable no-solder connections to produce a complete 2 transistor radio in under 2 hours. As well as battery operation the kit is supplied complete with a solar cell to provide power from the Sun or any strong light source.

PRICE £2·50

EXCLUSIVE

CRYSTAL RADIO KIT Model R.125

This easy to build Radio is based on the same circuit developed by Marconi for the very first radio transmission but uses a modern ferrite aerial for maximum efficiency. A perfect introduction to Radio Theory.

PRICE £1·50

EXCLUSIVE

16 WATT STEREO AMPLIFIER Model R.138

As well as separate bass and treble controls the R.138 features switched main and remote speaker outputs so that the same stereo installation can be used to drive independent stereo speaker systems.

Fitted in a well finished walnut cabinet the brushed aluminium front panel and sensible control knobs set this amplifier in the professional class.

SPECIFICATION: Output: 16 Watts Total, 8 Watts per Channel. Frequency range: 30–20,000Hz. Inputs: Phono & Tuner. Outputs: Speakers Main, Speakers Remote, Tape Out, and Headphones. Controls: Bass, Treble, Volume, Balance (all ganged) Mode, Speakers Stereo/Mono and Power on/off.

EXCLUSIVE

PRICE £16·50

5 WATT 8 TRACK CARTRIDGE STEREO AMPLIFIER Model R.133

Just slot in one of the many 8 track cartridge tapes available for a continuous programme of your favourite music. A manual programme override switch enables you to switch from one track to the next at the push of a button at the same time a numbered indicator lights up to show which track is playing. Beautifully finished in an oiled walnut cabinet the R.133 is mechanically engineered to provide long and reliable service. SPECIFICATION—Tape speed: 9·5 cm/sec (3¾ i.p.s.). Wow & flutter: better than 0·3%. Frequency range: 40–12,000Hz. Cross talk: better than 45dB at 1,000Hz. Output: 5W total. 2·5W per channel. Amplifier outputs: 200mV.

EXCLUSIVE

PRICE £36·00

STEREO HEADPHONES Model R.328

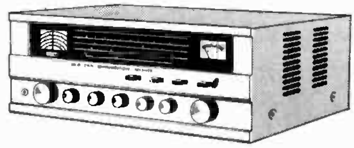
Built up to a standard not down to a price, the R.328 stereo headphones represent a breakthrough in value for money.

A valuable addition to any stereo installation they will provide many hours of listening pleasure.

SPECIFICATION:
Matching impedance: 8–16 ohms.
Frequency range: 30–15,000Hz.

PRICE £2·40

PROFESSIONAL SOLID STATE FOUR BAND COMMUNICATION RECEIVER Model R.135

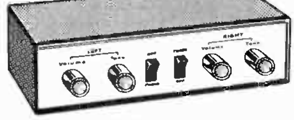


This is the communication receiver that you have long been waiting for. Fully transistorised and continuous coverage from 555kHz to 30MHz in four bands including illuminated electronic bandspread for 160–10 metres. Also incorporated is an internal speaker, automatic noise limiter, SSB/AM/CW Switch, AVC Switch, S Meter, Receive and Standby Switch, external socket for headphone or speaker, bandspread control, BFO control, on/off/AF gain, band selector, antenna trimmer and RF gain. The R.135 will run off of 240V a.c. dry batteries or any 12V d.c. negative ground source.

EXCLUSIVE

PRICE £45·00

10 WATT TRANSISTOR STEREO AMPLIFIER Model R.137

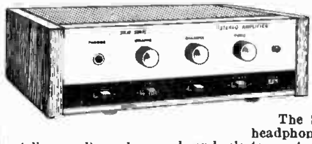


With separate tone and volume controls on each channel and inputs for both phono and tuner, this 10 transistor amplifier is the ideal start to an excellent budget system. Frequency response 70–20 KHz. Output impedance 8–16 ohm. Attractively styled with brushed aluminium front panel.

PRICE £9·50

EXCLUSIVE

10 WATT BUDGET STEREO ALL TRANSISTOR AMPLIFIER Model R.136



Ideal as a second stereo system or for the newcomer to Hi-Fi who wishes to upgrade existing equipment the R.136 sounds every bit as good as it looks. As well as inputs for crystal or ceramic cartridge the R.136 has a Stereo Tuner input which accepts the matching R.134 Stereo AM/FM Tuner.

The Satin Finish front panel carries a stereo headphone socket as well as volume, balance, tone (all ganged) speaker, mode and selector controls. Supplied complete with oiled walnut enclosure.

SPECIFICATION: Output: 10 watts total. 5 watts per channel. Frequency Range: 35–18,000Hz. Inputs: Phono and Tuner.

PRICE £13·00

EXCLUSIVE

AM/FM/MPX STEREO TUNER Model R.134

Perfect Matching Unit to the R.136 Amplifier. The R.134 Stereo Tuner is designed to give years of reliable performance. The Tuning Band covers AM & FM with a separate stereo beacon to indicate when stereo broadcasts are being received.

SPECIFICATION:
FM: frequency range: 88–108mHz. Usable sensitivity: 18μV. Stereo separation: 26dB at 1kHz. Image rejection: 55dB. AM: frequency range: 535–1,605kHz. Usable sensitivity: 280μV.

PRICE £21·00

EXCLUSIVE

STEREO FM/AM/MPX TUNER AMPLIFIER Model R.124

Another Roc Exclusive offering top value for money performance the R.124 is a Stereo Tuner/Amp with facilities only usually found in much more expensive units. Features like separate bass and treble controls, automatic frequency control switch and stereo headphone socket give the R.124 a price to specification ratio second to none.

Housed in a handsome walnut cabinet the classical low line styling of the R.124 will grace any home. SPECIFICATION: FM: Frequency Range: 88–108MHz. Usable sensitivity: 20μV. Stereo Separation: 26dB at 1kHz, 20dB minimum. Image Rejection: 55dB. AM: Frequency Range: 535–1605kHz. Usable Sensitivity: 300μV. Audio Section: Total Output Power: 4W. Phono Input: 200mV at 1MΩ. Tape Input: 100mV at 100KΩ.

PRICE £29·95

EXCLUSIVE

H.P. Terms available for personal callers on purchases over £30.

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PRACTICAL ELECTRONICS

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BUT, SERIOUSLY

Do some of us on occasion take this business a trifle too seriously? We feel this could be true, for now and again someone is heard to imply that so and so design is a flippant use of electronics.

Getting straight down to grass roots, let us consider any classic circuit arrangement; in fact suppose we take a well known building block such as the multivibrator, as a general illustration. This circuit has a habit of cropping up in the most unlikely guises, as we all know. It may appear in an item of test gear such as a c.r.o. trace doubler or a voltage to frequency converter, in a car lamp flasher, in the tone generator section of an organ, in a digital calculator, or in a "toss the coin" game, to name but a few. This ubiquity helps to demonstrate the point that an electronic circuit *as such* has no innate purpose apart from the purely electronic function it has been expressly designed to perform; and this alone is not enough. Outside purely academic circles, the circuit requires some gainful employment to justify its existence. Providing it is within the circuit's capabilities, the precise nature of the task it may be given is, in an electronic sense, irrelevant. It may be useful or it may be frivolous. There is no list of prescribed duties that circuits must restrict themselves to! They work for us as we decree.

Electronics is a very "human" technology, simply because it is easily adaptable to most of our whims and needs. And it plays, quite rightly, a major part in our amusement and entertainment, no less that in the "serious" activities of life.

To be fair we must not forget that to some individuals the study of electronic circuitry can be an end in itself. Academic minds so inclined can derive plenty of intellectual pleasure from the analysis of circuit behaviour without too much worrying about specific applications. But to most of us electronics surely means more than conducting a minute anatomical examination of a pretty trace on the c.r.t., or indulging in a prolonged immersion in mathematics, however good all this may be for the mind. When it comes to the crunch, electronics is a tool and the most proper and sensible thing is to apply it however and wherever we can, to serve us at both work and play.

If there are theoreticians who still shudder at some frivolous application of the technology, there is a homely example for them to ponder. Let them consider the television receiver—that embodiment of many elegant electronic techniques, a mass produced complex of circuitry that has been designed principally for our entertainment. Just dare suggest that this cathode ray companion and comforter for millions be redesignated something like a "communications monitor" and provide nothing but news and elevating cultural programmes, and the whole nation would go on strike! F.E.B.

THIS MONTH

CONSTRUCTIONAL PROJECTS

SPECIAL SERIES

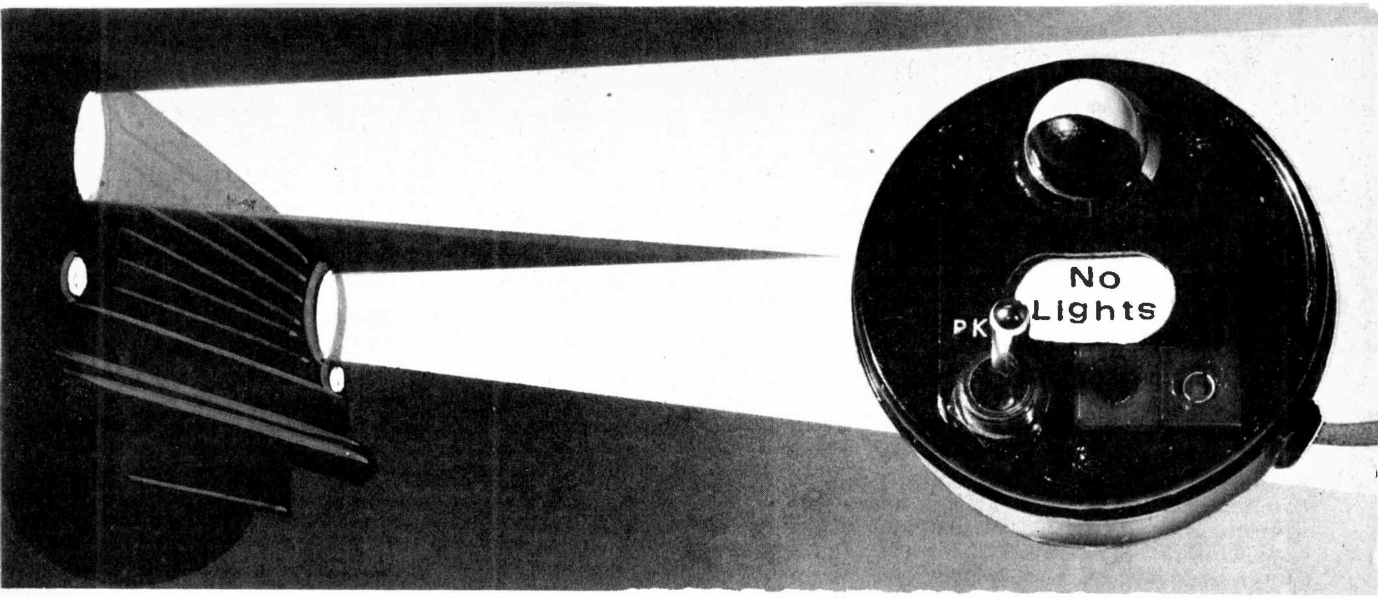
GENERAL FEATURES

BEGINNERS

NEWS AND COMMENT

Our April issue will be published on Friday, March 19

Practical Electronics, Fleetway House, Farringdon St., London, E.C.4. Phone: *Editorial* 01-634 4452; *Advertisements* 01-634 4202



MANY drivers are not regular users of parking lamps and tend to use side lights when parking in a strange situation. Because they would not use an automatic parking light very often, they do not consider it a worthwhile investment. The added facility of a lighting up reminder that this circuit offers will thus make the parking lamp worthwhile. The circuit is very simple and provides the following facilities:

(a) An automatic parking lamp that turns itself on and off at dusk and dawn.

(b) A warning system when the car is used with no lights in poor light or after lighting up time.

(c) A warning indication, while driving, as lighting up time approaches.

(d) Automatic cancellation of either system when the sidelights are switched on.

(e) No additional control switching when on route.

The complete unit can be attached to the car dash panel or to the windscreen where it is in view of the driver. Only three wires need to be connected to the car wiring which is not altered in any way. Both positive and negative earth 12 volt circuits are given, and for cars already fitted with an automatic parking light, only part of the circuit need be built. The unit utilises a standard parking lamp so if such a lamp is already used it can now be automated.

CIRCUIT

The fundamental circuit adapted for both positive and negative earth systems is shown in Figs. 1a and 1b; this illustrates the operation of the system using normal ignition and side light switching. With switch S1 in the "normal" position the circuit is operative when the ignition is on and the sidelights off. The circuit is then in the lighting up reminder state and LP2 will signal the approach of lighting up time when *en route*, or when about to move off without lights when they are required.

With S1 in the "park" position, the sidelights switched off and a parking lamp (LP1) plugged into SK1 and SK2, the circuit will function as an automatic parking light, the ignition switch and LP2 being out of circuit.

LIGHT DEPENDENT RESISTOR

As daylight decreases, the l.d.r. (light dependent resistor—X1) resistance increases and since this forms a potential divider with R1 at the base of TR1, when the determined light level is reached, a switching function is triggered between transistors TR1 and TR2 so that TR2 conducts and consequently illuminates LP2 to show up the expression "no lights". The switching function is preferred to an emitter follower because there is no heat build-up across transistor TR2 while the input signal is developing. The life of the transistor is therefore prolonged. Resistor R3 is made up of two 22 ohm resistors in parallel.

The same circuit operation is carried out for both the parking lamp and internal warning system and the ignition/battery supplies are selected in conjunction with the appropriate lamp by the operation of the double pole changeover switch S1.

SYSTEM CANCELLATION

Both systems are cancelled when the normal sidelight switching operation is carried out following the internal warning, or where sidelights are required when parked. The circuit is completed via the filaments of the sidelights, rear light and number plate light; with the sidelight switch off, the small current required for the system flows through the paralleled filaments of the sidelights and associated lamps. When, however, these lamps are switched on, the circuit is shorted out and the no lights warning or the parking lamp, cease to operate.

If the car is garaged or parked within the law, the switch remains in the normal position and both systems are isolated. A check is readily available for both systems when light is shielded from X1. It is to be noted that LP2 will hunt if the l.d.r. picks up reflected light from the hand or any other adjacent surface capable of reflecting light on to the sensor.

OPERATIONAL LIGHT RANGE

The operational range of the system is good and operational levels of light may be selected by the insertion of light filters under the cover of the l.d.r. These may be in the form of ordinary thin paper and are far more economical than the inclusion of a variable resistance in the circuit.

With the engine running when *en route*, the internal lamp may flicker as the critical light period approaches. This is due to voltage variation of the car's supply (the charging system) but since the flicker is an added attraction factor, the necessity for voltage stabilisation is considered unnecessary and not in the interests of economy.

AUTOCHECKLIGHT

A LIGHTING-UP REMINDER AND AUTOMATIC PARKING LIGHT . . . BY G. W. JONES

COMPONENTS . . .

Resistors
R1 22kΩ
R2 1·2kΩ
R3 11Ω (2 × 22Ω in parallel)
All ¼W, ± 10% carbon

Transistors
TR1, 2 2N3704 (2 off)

Miscellaneous
X1 ORP12 light dependent resistor
LP1 12V, 2·2W external parking light
LP2 12V 2·2W bulb and holder
SK1, 2 Banana plugs and sockets (2 off)
S1 d.p.d.t. toggle switch
Veroboard 2in × 2in × 0·2in matrix (Electrovalue)
Case—see text
Three core cable for connection to car wiring
6B.A. fixings

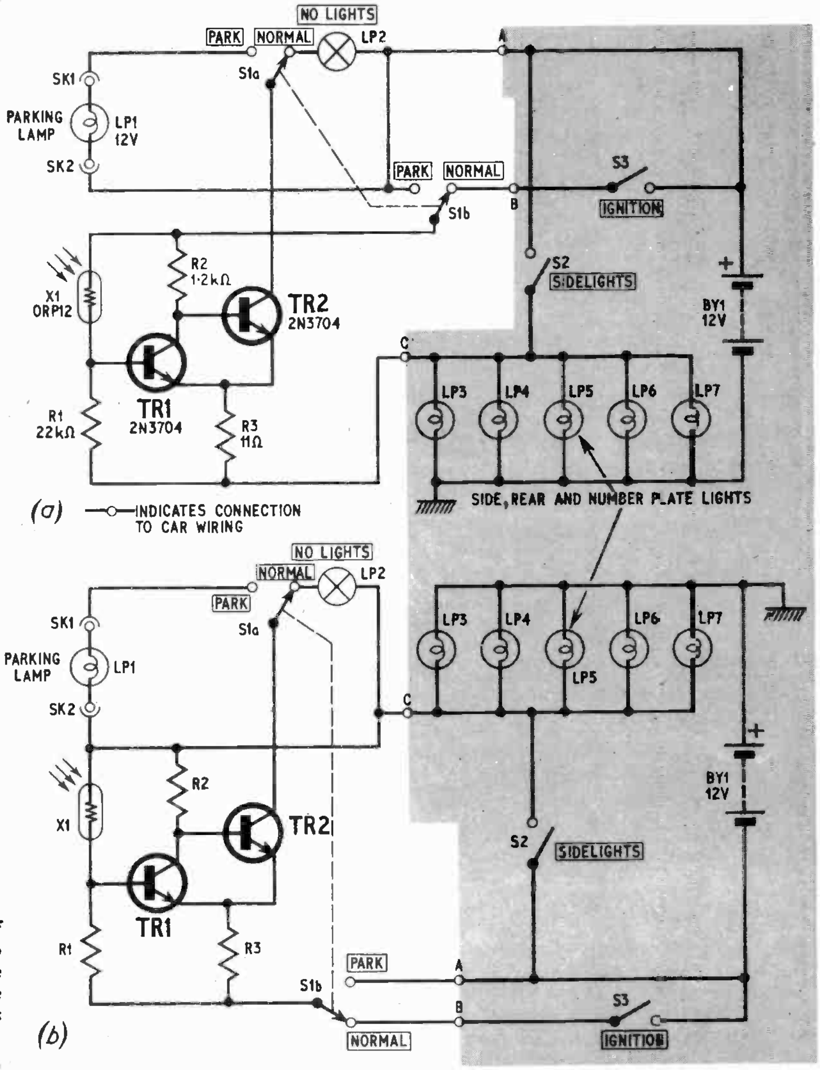


Fig. 1. Complete circuit diagram of the lighting up reminder plus auto parking light. (a) Design for negative earth system; (b) design for positive earth system. Tinted area represents car wiring.

CONSTRUCTION

The prototype unit was housed in a small tobacco tin, the lid of which was reinforced with aluminium. Holes can be cut in the lid and aluminium plate for X1 mounting, SK1 and SK2, S1 and the "no lights" indication. The legend "no lights" may be printed on tracing paper and inserted, between two protective celluloid layers, under the aluminium panel which is attached to the lid by three 6B.A. screws.

The mounting for X1 and LP2 holder were obtained from a single indication lamp dismantled for the purpose. SK1 and SK2 can be banana sockets or any

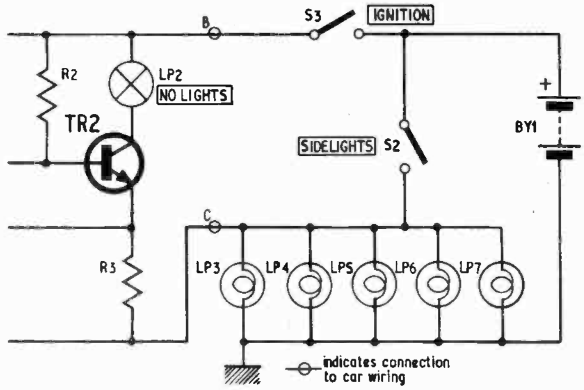


Fig. 3. Circuit diagram of the negative earth system for lighting up reminder only. Connections "B" and "C" are reversed for a positive earth system

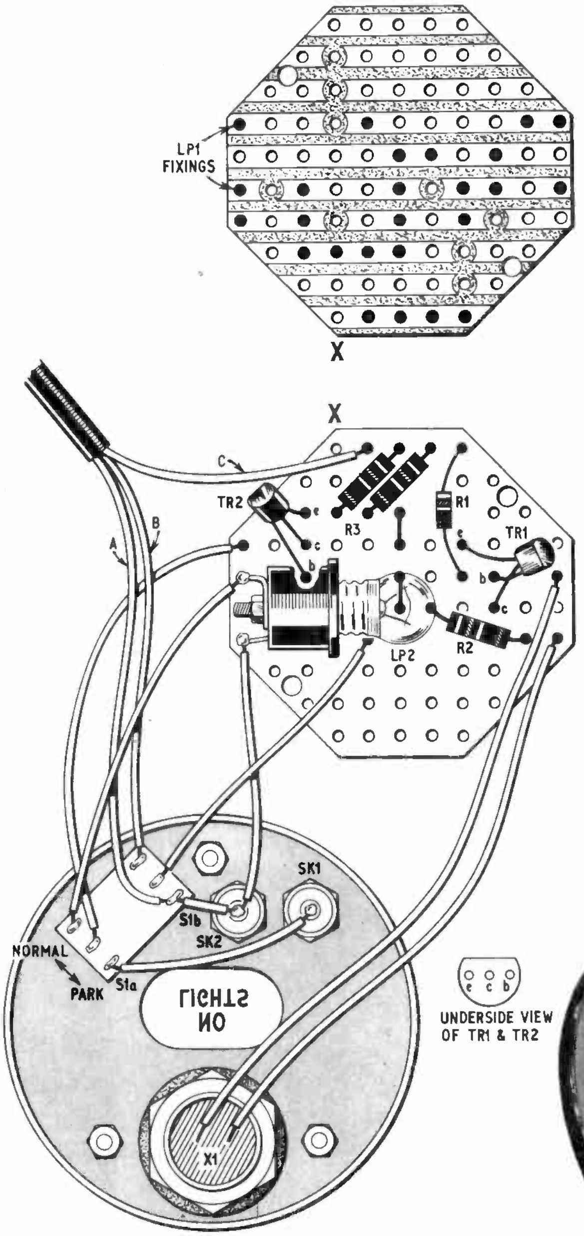


Fig. 2. Layout and wiring diagram of the prototype unit housed in a tobacco tin case. This is the negative earth system; for positive earth version the wire connected to S1b wiper is removed and reconnected to SK2, link between SK2 and S1b is removed. Wire "C" is taken to S1b wiper and a new wire—which now becomes "C"—is connected to SK2

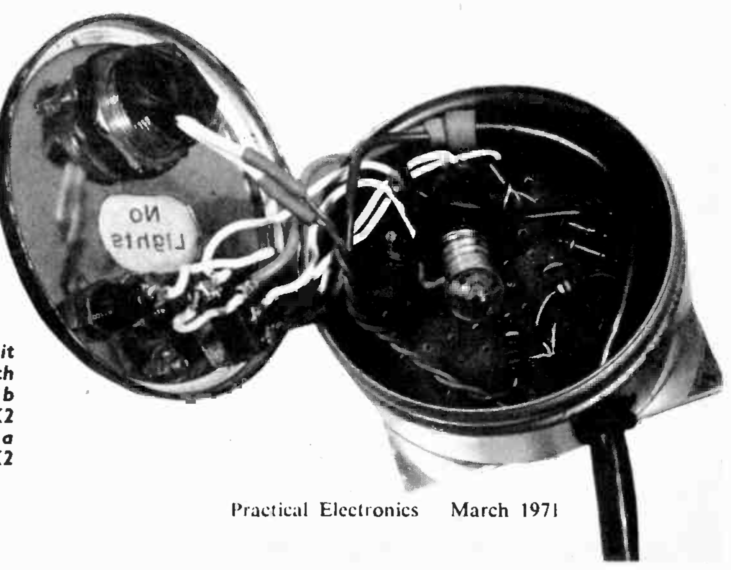
special socket to suit the parking light. The three core lead that connects the circuit to the car wiring can be taken out through a grommet hole in the side of the case.

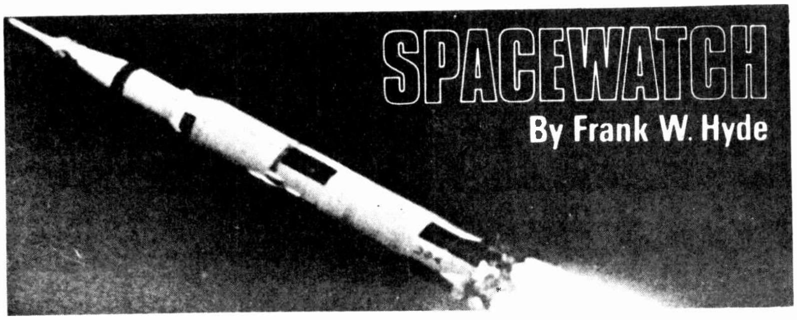
Components in the prototype were mounted on a piece of 0·2 inch matrix Veroboard, fixed inside the tin by two 6B.A. screws and spacers (see Fig. 2). The inside of the tin should be protected by insulation tape so that no connection is made between the circuit and earth on the car. It is, of course, possible to use any form of construction, since the layout of components is not critical—the unit could be built into the dashboard of many cars and LP2 could be housed in a warning light mounting chosen to correspond with the other panel warning lamps.

REMINDER ONLY

If it is required to provide a lighting up reminder only—without the facility of an automatic parking light—then S1, SK1 and SK2, and the connection to S2 (sidelights switch) on the car battery side may be omitted (see Fig. 3).

When the complete system is operated in the lighting up reminder mode, LP1 can be unplugged from SK1 and SK2 and hence the no lights warning may be cancelled by operation of S1 (change to "park" position) as well as by switching on the sidelights. ★





SOVIET ACHIEVEMENTS IN SPACE

After a period of apparent inactivity, the Soviet Union has in the past two years or so made some significant advances that have been spread over the whole area of space activities. The Russians have for a long time favoured the use of space platforms and automatic probes. They have covered the human element involved by longer periods under space conditions, and experimented with the transfer of astronauts from one vehicle to another.

The local earth-moon activities have formed a part of their programme but they have paid a good deal of attention to the special techniques required to explore the other planets. Already they have had two attempts to land robot craft on Venus and now a third attempt has been made.

The unfortunate loss of *Lunik 15* at the time of the *Apollo 11* mission was a particular disappointment, but served to indicate the difficulties that attend attempts to maintain communication, with vehicles that are at a low level in areas where there are mountains involved.

COLLECTING MOON SAMPLES

However the loss of control of *Lunik 15* was more than compensated by the successful mission of *Lunik 16*. This vehicle departed from the earth for the moon with the main task of collecting, automatically, samples of lunar soil, putting them into containers, and returning them to earth. The vehicle consisted of a descent platform carrying the return vehicle, which carried the drilling mechanism and control. Altogether something in excess of 100 grammes of lunar material was recovered.

The point of operation was in the Sea of Fertility, 56° 18′ W and 0° 41′ S, which is some 900km from the site of the *Apollo 11* landing. The material was friable surface substance of fine grain, for the first 15cm of the sample. The next section from 15cm to 33cm was of variable granular material with some larger inclusions of the order of 3mm in diameter. The last section from 33cm to 35cm was of large grain with some fragments of bedrock.

In appearance the material is a very dark grey almost black powdery substance. The mean specific gravity of the material was of the order of 1·2 and the variation in particle size ranged from 70μm at the surface to 120μm at the lowest depth. The composition appears to be basaltic with some feldspar and some metallic iron and vitreous particles. Some isotopes of short life were found and altogether about 70 chemical elements were present.

A comparison with the specimens brought back by *Apollo 12* shows very close agreement in the percentage of the various elements.

SOYUS 9

Andrian Nikolayev, who captained *Soyus 9*, has made some interesting comments on the 18-day flight. Month long flights are feasible but anything longer would require different techniques. There would be need for more efficient and extensive conditioning and also new medical procedures.

The post flight effects of this mission were very much more marked than those encountered with the shorter flights. Walking was found to be difficult over a period of days and there was frequent stumbling. They found it difficult to climb stairs, sometimes hard to stand upright.

A notable feature was the wasting of the lower limbs by as much as 4cm round the hips and 2cm round the shins. This appears to result from the loss of muscle tissue in the legs which are normally used to support the body at 1g. There was a loss of body weight of 5kg for the new astronaut Sevastianov and a little less for Nikolayev. However, they both recovered their normal weight in three weeks.

LUNOKHOD

The mobile moon vehicle *Lunokhod* was an exciting event and represented a new era in space technology. Although an instrument unit, previously landed by the United States, had been made to hop, *Lunokhod 1* is the first vehicle to be landed on the moon and become mobile under guidance from the earth direct. When the difficulties are properly realised, a task of this kind becomes a major point in history.

Because it is the first time that such a successful operation has been mounted, a whole new vista in the exploration of the moon becomes available. Provided that communications between the base station and the unit can be maintained, many new areas of the moon can be explored in detail.

At the moment this is feasible only in open areas because in hilly or mountainous regions loss of communication could be disastrous. This points to the likelihood that control from a space platform would be the ultimate aim. A very great advantage is that a mobile system remotely controlled would enable special regions to be explored which might be impossible for manned units.

MANNED FLIGHTS

It is significant that the Soviet space scientists do not regard the robot as the principal method. This is borne out by the fact that the internal environment of *Lunokhod 1* is similar to a life support system having a temperature between 16 and 18 degrees centigrade and a pressure of between 730 and 780mm Hg.

The present instrumentation could be built into a manned cabin without modification. From this it could well be surmised that a manned landing is still part of Soviet plans. Also there is a distinct suggestion that the Russians are looking further afield to Mars for automated surface units.

LUNAR EXPERIMENTS

Although not much appeared in the initial stages about the type of experiments being undertaken, the following were included in the mission.

(a) Determination of the composition of the surface of the moon using x-ray photometry.

(b) Measurement of extra-galactic x-radiation using an x-ray telescope to make long exposure studies of weak sources. These cannot be done effectively (where distant sources are concerned) with rockets and satellites.

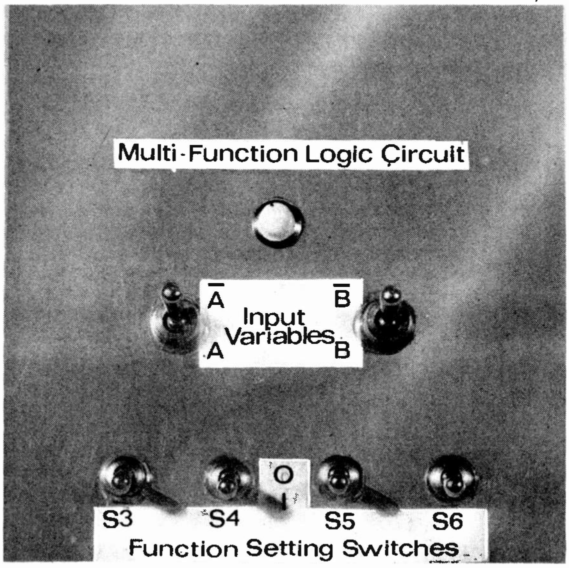
(c) Assessing the mechanical properties of the lunar soil by impressing a special stamp.

(d) The study of cosmic radiation from the sun.

(e) Experiments which involve the radiation from the moon itself.

(f) The very important cooperative effort of France and the Soviet Union in a laser experiment to determine accurately the earth–moon distance.

A special system of telemetric sensors is in use to measure the stresses acting on the chassis of the vehicle and a great deal of television recording is being made of the tracks that are made on the lunar surface.



MULTI-FUNCTION LOGIC CIRCUIT

By P. A. Davis, A.M.Inst.E.

A LOGIC function expresses the relationship between the input and output logic states of a circuit. The basic logic functions AND, OR and NOT are part of a series of functions.

With two input variables, A and B, four different input conditions can occur:

$$\bar{A}.\bar{B} \quad A.\bar{B} \quad \bar{A}.B \quad A.B$$

These four conditions could produce a 0 or 1 at the output, depending on the circuit logic, hence a total of 2^4 or 16 functions are possible.

For demonstration purposes, it is convenient to be able to produce any of these 16 functions without having to construct separate gates. The multi-function logic circuit makes it possible to establish any required function simply by selecting the appropriate combination with four switches.

FUNCTIONS OF BINARY VARIABLES

In the logic diagram of Fig. 1, each of the four switches S3, S4, S5, and S6 puts a 0 or 1 condition on its respective gate input, according to Table 1. This lists the function logic output corresponding to each of the 16 functions.

The switch settings are, in fact, those that would appear in a truth table of the desired function.

The A,B inputs are connected to decode each of the four possible input conditions and so select the appropriate gate as follows:

Input state	$\bar{A}.\bar{B}$	$A.\bar{B}$	$\bar{A}.B$	$A.B$
Gate selected	G1	G2	G3	G4

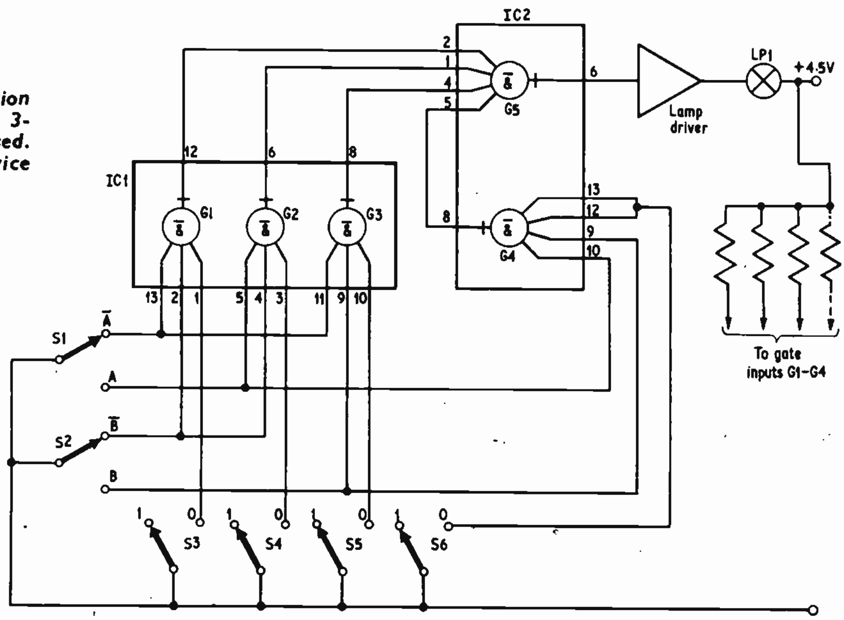
The G5 gate output will therefore assume a 0 or 1 condition depending both on the position of the function setting switches and on the particular combination of the A, B inputs.

A 1 condition will light the lamp via the lamp driver but a 0 condition will not.

CIRCUIT

The multi-function logic circuit makes use of two integrated circuits. These i.c.s are three and four input NAND gates; the SN7410N and SN7420N respectively.

Fig. 1. Logic diagram of multi-function unit. Here two i.c.s incorporating 3- and 4-input NAND gates are used. Gate input numbers refer to the device pin connections as seen in Fig. 2



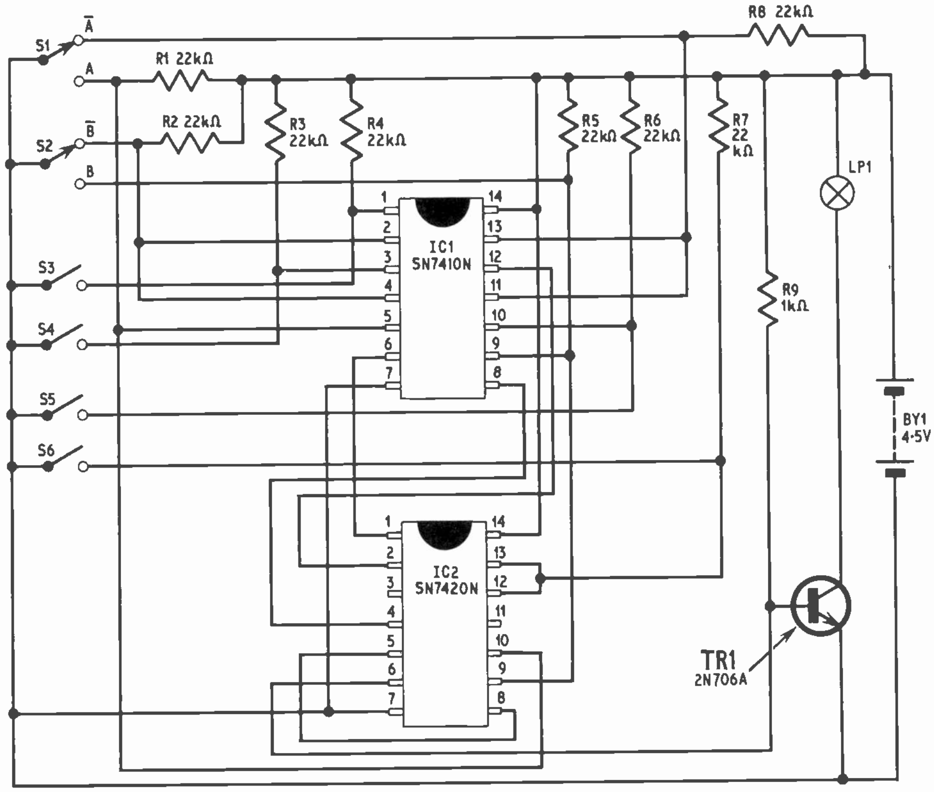


Fig. 2. Circuit diagram of unit. Note that all gate inputs have a positive bias

In the circuit diagram (Fig. 2), all the switched gate inputs are taken to the positive rail by way of resistors. This ensures that each input is held at logic 1 when its switch is opened.

The unused input at gate G4 is connected to a used input rather than left floating.

Fig. 3 shows the i.c. gate configuration used.

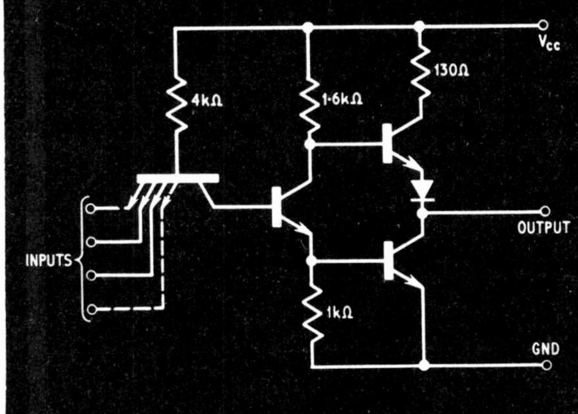
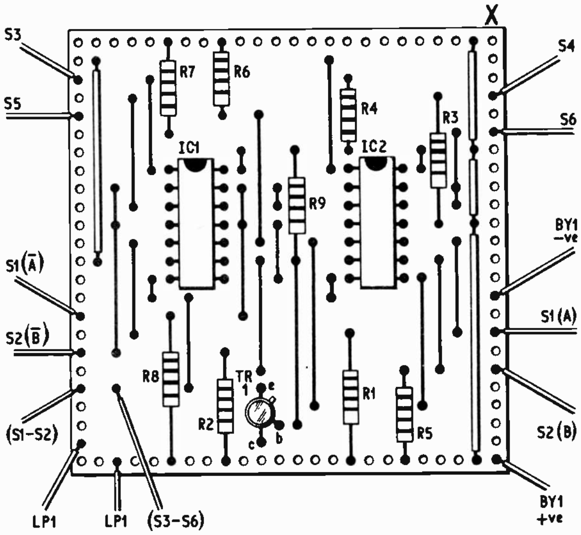


Fig. 3. Circuit diagram of the 3-input NAND gate employed in the SN7410N. For the SN7420N gates, an additional input, shown dashed, is used

Table 1. FUNCTIONS OF TWO BINARY VARIABLES

Function number	Function setting switches S3 S4 S5 S6	Logic function produced	Function name
1	0 0 0 1	$A.B$	AND
2	0 0 1 0	$\bar{A}.B$	
3	0 0 1 1	B	B
4	0 1 0 0	$A.\bar{B}$	
5	0 1 0 1	A	A
6	0 1 1 0	$\bar{A}.B + A.\bar{B}$	Exclusive OR
7	0 1 1 1	$A + B$	OR
8	1 0 0 0	$\bar{A}.\bar{B} = \overline{A + B}$	NOR
9	1 0 0 1	$A.B + \bar{A}.\bar{B}$	Logical Equivalence
10	1 0 1 0	$\bar{A}$	NOT A
11	1 0 1 1	$\bar{A} + B$	
12	1 1 0 0	$\bar{B}$	NOT B
13	1 1 0 1	$A + \bar{B}$	
14	1 1 1 0	$\bar{A} + \bar{B} = \overline{A.B}$	NAND
15	1 1 1 1	1	1
16	0 0 0 0	0	0



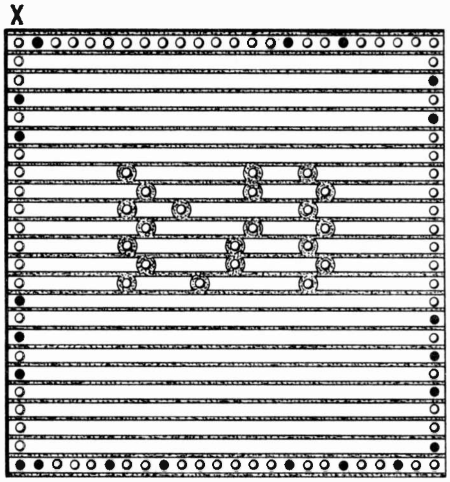


Fig. 4. Component layout and wiring for topside and underside of Veroboard

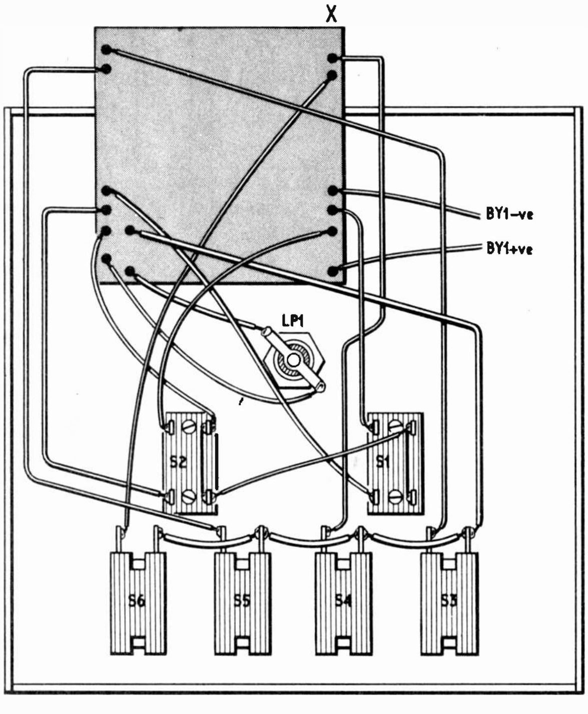


Fig. 5. Veroboard and control panel interwiring on an aluminium chassis plate

CONSTRUCTION

Apart from the chassis mounted switches and lamp, all of the components are mounted on a single piece of Veroboard as given in Fig. 4. To accommodate the dual-in-line i.c. packages, Veroboard of 0·1in matrix is used.

Wiring of the switches to the board is shown in Fig. 5. Positioning of these will depend very much on the preference of the user; whether a large or small display is required.

COMPONENTS . . .

Resistors
R1–R8 22kΩ (8 off)
R9 1kΩ
All 10%, ¼ watt carbon

Transistor
TR1 2N706A

Integrated Circuits
IC1 SN7410N
IC2 SN7420N

Switches
S1–S2 Single pole changeover (2 off)
S3–S6 Single pole on/off (4 off)

Lamp
LP1 Miniature indicator 6V 0·06A (Electroniques)

Miscellaneous
0·1in matrix Veroboard 2½in × 2½in, Vero pins (14 off), Aluminium chassis 8in × 6in × 1¼in

OPERATION

To operate the completed unit, first select the required function from Table 1. This function is then set using the switches S3, S4, S5, and S6.

Each input combination of A,B is then operated on by this function, and the result, a 1 or 0, will appear at the output of gate G5. If the output is 1 the lamp will light.

Say, for example, the OR function is required. Table 1 gives the function switch setting as 0111 (Function 7).

With these switches set accordingly, the switches S1 and S2 are set to A,B. It will be found that the lamp lights, hence, we can conclude that provided that A or B (or both) is present at the input, the lamp lights.

Apart from the convenience of the unit for demonstrating logic functions, it can be useful as part of a training programme — particularly if the function governing the input-output relationship has to be deduced from the unit's behaviour. ★

MARKET PLACE

Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned.

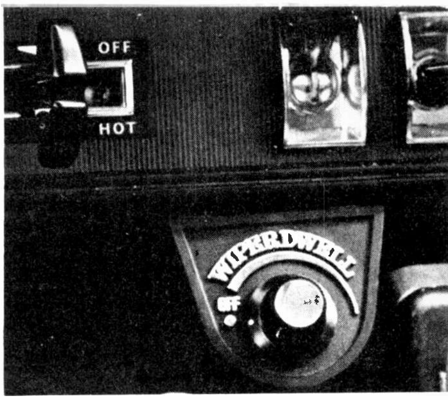
WIPER DELAY

There are many windscreen wiper control units on the market and, as our readers will have noted, the problem with many circuits is that they are unable to accommodate the various wiring configurations and wiper motor types in use on all modern cars.

Wiperdwell, a unit manufactured by **Automents Ltd.**, is one unit that can be used with all types of self-parking wiper motors and can easily be fitted by the average motorist in a very short time. The unit allows the selection, by a single control, of the most suitable wiping frequency for slight rain, fog and snow—a principle that works extremely well.

The unit can be fitted using a drill and screwdriver, comprehensive connection instructions are supplied and physical connection is made by way of "piggy back" connectors thus avoiding altering existing wiring and obviating soldering.

The Wiperdwell unit will not affect the normal operation of the wipers, can give up to 20 seconds between sweep delay, costs £4·75 and is supplied with a six month guarantee.



Wiperdwell windscreen wiper control from Automents

MINIATURE SWITCHES

Sub-miniature toggle-switches with a rating of 6A at 125V or 3A at 250V a.c. suitable for most of our constructional projects are now being marketed by **WEL Components Ltd.**

The switches have a breakdown voltage of 1,000V a.c. with insulation resistance of more than 100 megohms at 500V d.c. The switch contact resistance is typically less than 5 milli-ohms at 1A 2·4V d.c.

The switches are moulded in phenolic melamine with solder tag connections and are available in two types—Type TS106D is a single-pole double throw and costs approximately 37½p (7s 6d) each. Type TS206N is a double-pole double throw and costs approximately 47½p (9s 6d).

Addresses of nearest stockists can be obtained from WEL Components Ltd., 5 Loverock Road, Reading, Berkshire.

Another range of sub-miniature toggle and pushbutton switches suitable for many P.E. projects are those manufactured by **Birch Stolec Ltd.**

The switches include toggle, lever lock, rocker and momentary pushbutton types with one, two, three or four poles.

Contact ratings are: coin silver contacts, 5A resistive load at 115V a.c., or 2A at 250V a.c.; brass contacts with gold over nickel plate, 0·4V/A maximum at 20V maximum (a c. or d.c.); coin silver contacts with gold over nickel plate, 5A resistive load at 115V a.c. or 28V d.c., or 2A at 250V a.c., and 0·4V/A maximum (a.c. or d.c.).

Available with short or long toggles with nine different colour caps, the switches can also be supplied for printed circuit board or angled mounting.

Full details of these switches and addresses of nearest stockists can be obtained from Birch-Stolec Ltd., Ponswood Industrial Estate, Windmill Road, Hastings, Sussex.

Also, we have been informed that Gothic Electronic Components, Beacon House, Hampton Street, Birmingham 19, have been appointed stockists and distributors of the complete range of standard and miniature thumbwheel switches from Birch-Stolec.

REED RELAY

Two new miniature encapsulated reed relays supplied with either one normally open reed switch or one changeover contact are the most recent products from **Osmor Ltd.**

Ideal for printed circuit board mounting, the type ERA has maximum d.c. contact ratings of 10W 200V 0·5 d.c. and type ERC is rated at 4W 28V 0·1A d.c.

The relays are available for 6V, 12V and 24V operation, and are colour coded for easy identification. The coil is wound on a glass-filled nylon bobbin, and a magnetic screen is fitted as standard.

The complete relay is encapsulated in glass-filled nylon and measures only 22mm ($\frac{7}{8}$in) × 10·5mm ($\frac{1}{2}$in) diameter.

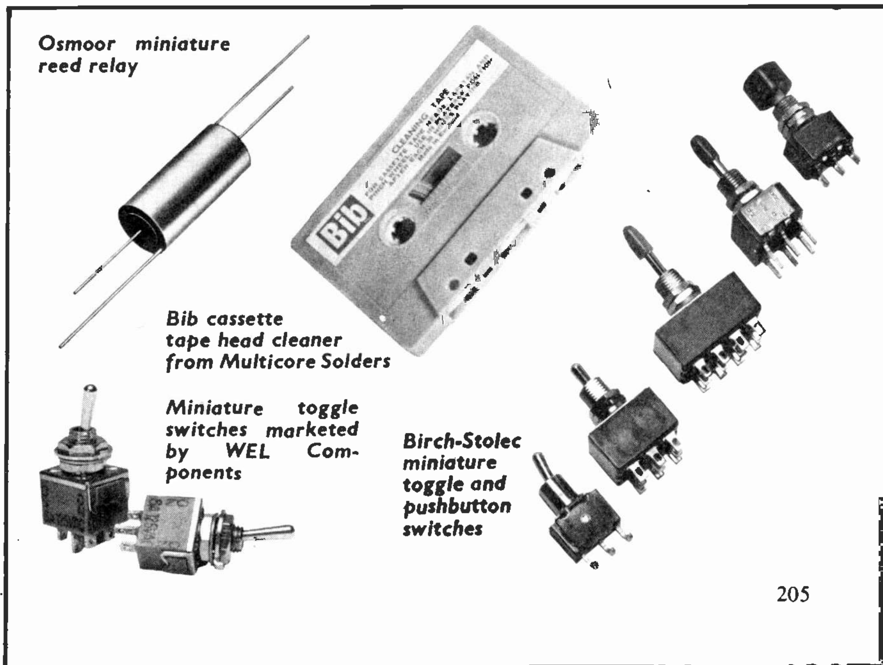
Price of the relays vary according to type and quantity; full details can be obtained from Osmor Ltd., 540 Purley Way, Croydon, Surrey, CR9 4DY, or at 53 London Road, Leicester, LE2 0PD.

TAPE HEAD CLEANING

Suitable for all compact casette type tape recorders and car player units, **Multicore Solders** have recently introduced a new tape head cleaning cassette tape.

It comprises a cassette tape container in which high quality cleaning tape is incorporated to clean tape heads, capstan and pinch wheel. Used in the same manner as a tape cassette by placing in the machine and operating in the play-back position, the whole operation takes approximately one minute.

Supplied in a plastics container the Bib Size 31 cassette tape head cleaner retails at 53p (10s. 7d.) and is available from most hi fi shops.

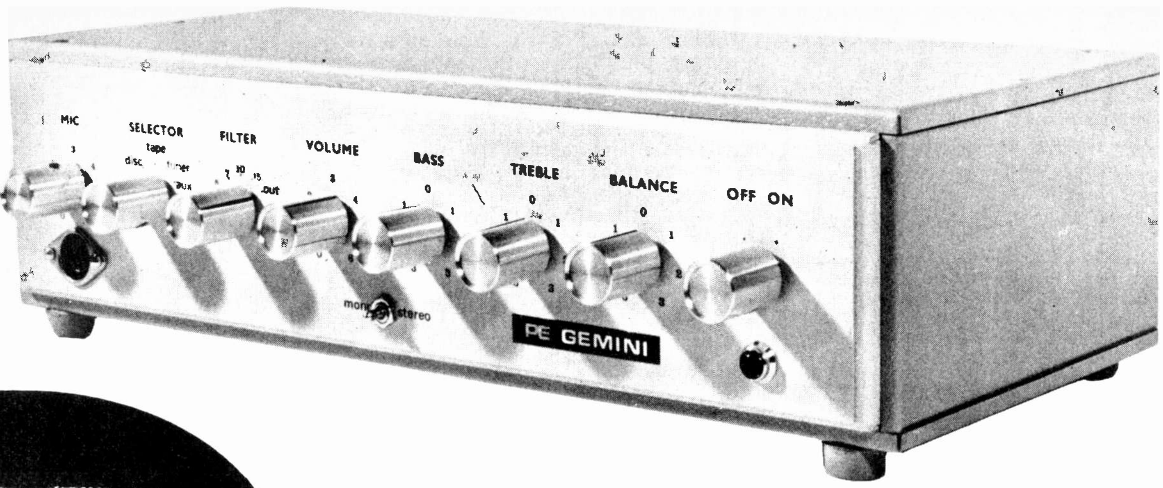


Osmoor miniature reed relay

Bib cassette tape head cleaner from Multicore Solders

Miniature toggle switches marketed by WEL Components

Birch-Stolec miniature toggle and pushbutton switches



PE GEMINI

DUAL PURPOSE STEREO AMPLIFIER

PART FIVE

By D. S. GIBBS and I. M. SHAW (FERRANTI LTD)

In this, the final part of the P.E. Gemini dual purpose stereo amplifier, we give final construction details of the pre-amplifier, a fault finding chart and hints on using the completed amplifier.

DRILLING

The pre-amplifier is housed in a Contil Mod-2 case size G and the dummy front panel (aluminium 12¾in × 2¾in × 18 s.w.g.) was actually cut from the unused main amplifier chassis. Full drilling dimensions for the box and panels are given in Figs. 36, 37, and 38.

Miniature toggle switches were used in the prototype for S1, S2, and S5 and the holes for these and the pilot light LP1 must be drilled to suit whatever components the constructor has available. The best arrangement is to drill the front panel and the dummy front panel whilst they are clamped together to ensure that any slight errors do not prevent the components from fitting through the holes. All the holes must be de-burred with a file or a large drill.

FRONT PANEL

To obtain a presentable finished article the dummy front panel can be rubbed with wire wool, using household soap and water, in one direction along the length of the panel. This process should be continued until all the scratches have been removed. A very good "brushed aluminium" finish can be obtained in this way; a satin finish can be obtained if the panel is coarse sand blasted by some local workshop or garage. Care must be taken not to introduce any fingerprints or grease before the panel is sprayed with Letracote gloss.

LABELLING

The front and rear panels can now be labelled using the same method as for the main amplifier cabinet, i.e. one light coat of Letracote gloss, apply the letters and then a further two coats of Letracote. As can be seen in the photographs, the prototype controls have numbers of relative magnitude arranged around them. The indication dots for these numbers can be marked first lightly in pencil with the help of the template, Fig. 39. The template is transferred to a thin piece of celluloid by drilling small holes in the required places. The celluloid template can then be placed over the dummy front panel and the dots marked in lightly in pencil. This method ensures that the dots exactly line up with the 30 degree switch positions and that the dots round the other controls are all at the same angles and radii.

ASSEMBLY

The front panel components are now mounted, not forgetting the dummy front panel which is held on by the control spindle nuts. Care must be taken not to mark the dummy front panel whilst tightening the various nuts and screws. The rear panel components, C52 (using a suitable capacitor clamp) and the assembled printed circuit board should be mounted on the appropriate parts of the case.

WIRING

The wiring should be executed with the case dismantled, i.e. opened out like an exploded diagram, to make the connections to the front and rear panels easier. Any systematic way of wiring the interconnections can be adopted but it is recommended that many

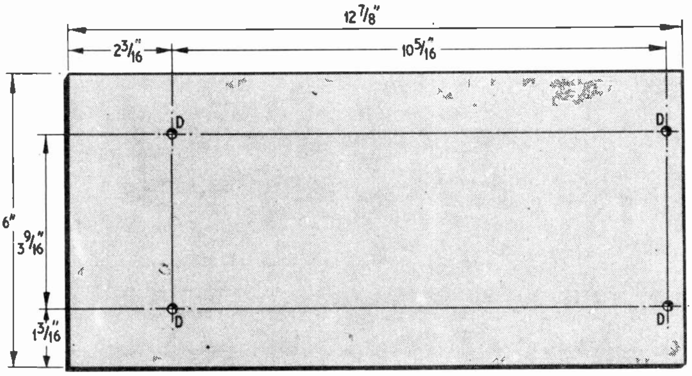


Fig. 36. Drilling details of the base of the pre-amplifier case. The small chassis supplied with the case is used to mount C52 and has one hole drilled in it ¾ inch down and 3⅛in across the panel. This hole can be seen as the earthing point in Fig. 42—top right hand diagram

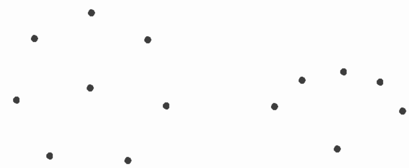


Fig. 39. Template for marking out indicator dots on the dummy front panel

DRILL SIZES for all metalwork

- A — $\frac{3}{16}$in
- B — No. 27
- C — $\frac{3}{8}$in
- D — No. 34
- E — $\frac{5}{8}$in
- F — $\frac{1}{2}$in
- G — $\frac{3}{4}$in

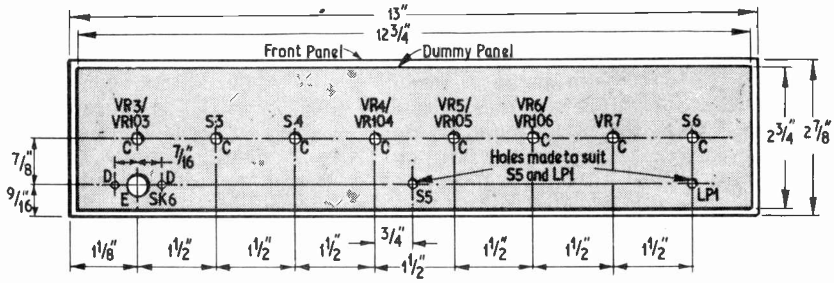


Fig. 37. Front panel drilling details. The dummy front panel should be clamped to this for drilling

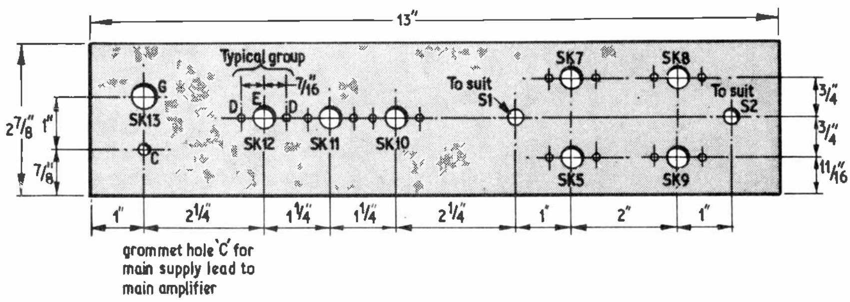


Fig. 38. Rear panel drilling details

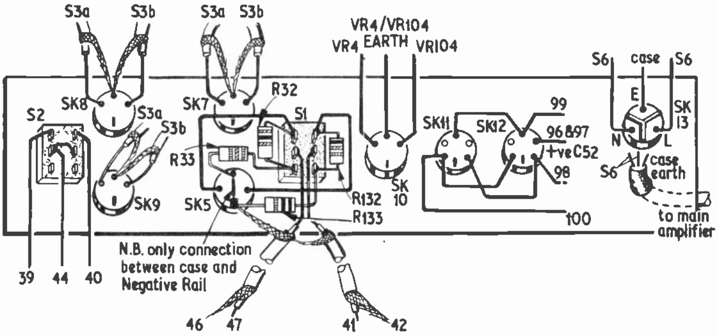


Fig. 40. Wiring of components mounted on the rear panel

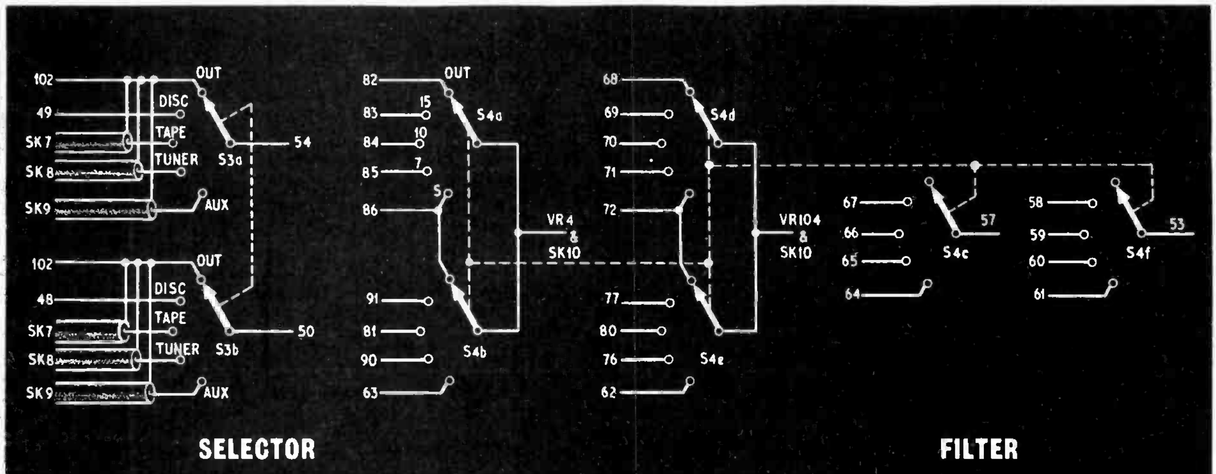
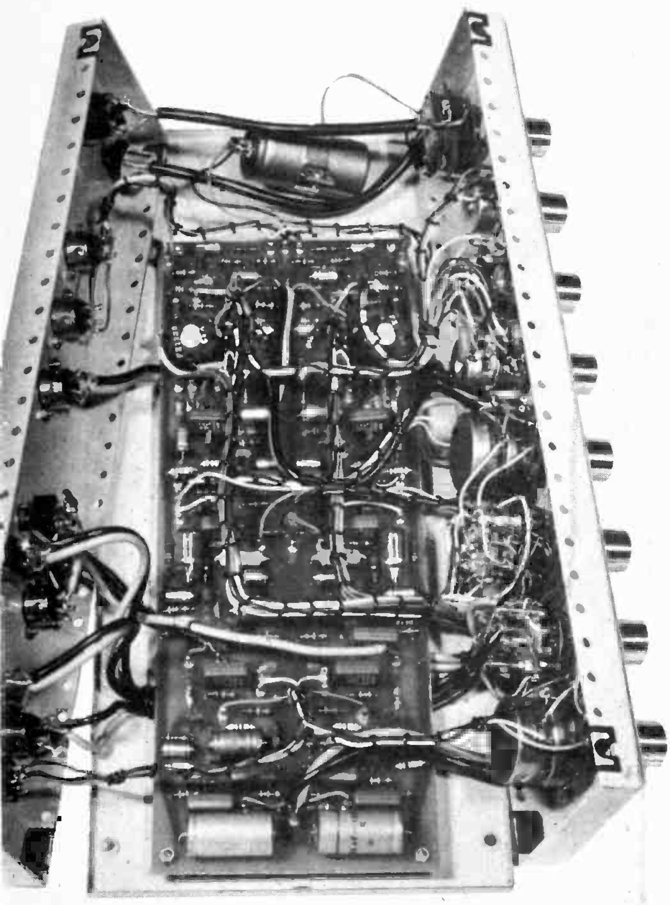


Fig. 41. Wiring details of the selector and filter switches (S3 and S4) mounted on the front panel. Note the use of screened lead

different colours are used for identification purposes. The components which are wired to the tone controls, C45, C46, C47, C145, C146, C147, must have sleeved wire ends and as short leads as practicable. The same applies to the four resistors in the area around S1, and SK5. The only internal screened cables necessary are the ones from the input sockets to S3, with the actual screens being connected to a stout tinned copper wire joining the "Out" positions of the selector switch. The sole connection between the case and the negative rail must be at SK5 as indicated, or complications may arise due to an earth loop being formed which could result in an incurable hum. The earth from the mains input cable is connected to a solder tag which is on the same bolt as C52 capacitor clip, but on the other side of the screening plate. This screen is fitted on final assembly in convenient holes between the mains switch and balance control such that it touches neither. As with the main amplifier the paint may have to be removed from around the screw holes to ensure that all the different sections of the box make electrical connection with each other. Finally, the feet can be fitted to the base of the case. Figs. 40, 41 and 42 give the wiring up details.

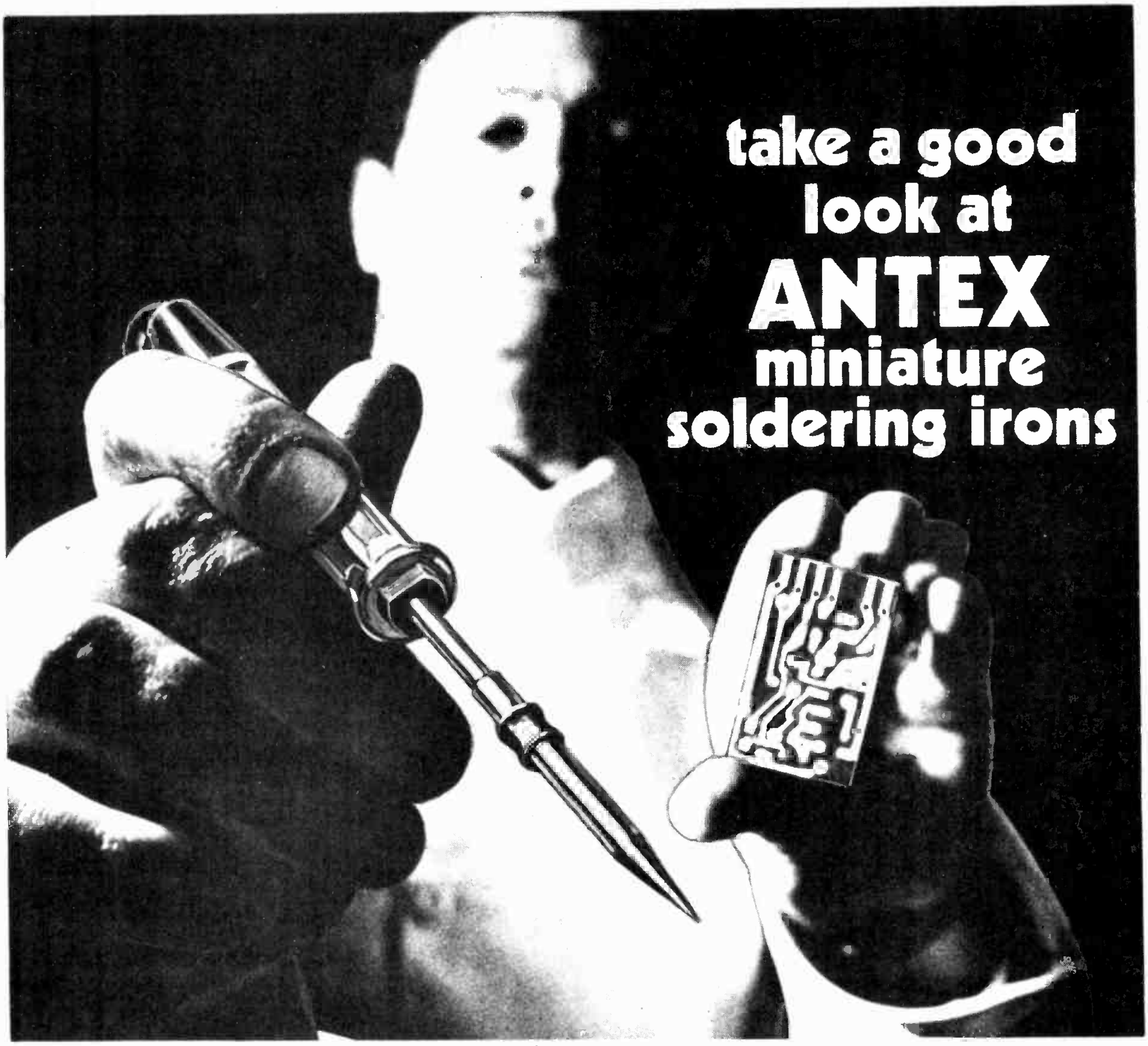


INTER UNIT CONNECTIONS

The cable which supplies power to the pre-amplifiers and audio to the main amplifier must be made a suitable length to suit the particular installation. Any multi-core (at least three core) screened cable can be used since the output impedance of the pre-amplifier is quite low. We have not given any pin connection numbers for this cable because we have noticed that in some cases the numbers on plugs and sockets do not always correspond with each other. All that is required is that the channels do not inadvertently get reversed and that the earth and supply rails have a continuous path from the main amplifier. This cable must be in place before power is applied to the main amplifier or the charging current taken by C6 and C106, if this plug is inserted after the power has been applied, may damage the driver and output transistors.

FAULT FINDING

This is a complex amplifier and it is possible that the constructor will have some problems to iron out before it works perfectly. Most faults will be due to: wires left unconnected or connected to the wrong place, components inserted at the wrong place on the printed circuit board, transistors or diodes inserted the wrong way round (easily done with the Ferranti devices), or surplus solder bridging the gap between two printed circuit tracks.


take a good
look at
ANTEX
miniature
soldering irons

Photograph of the front panel showing control designations

Faulty components are rare, especially if one uses new components of good quality, and if it is found that one of the transistors or diodes is defective after testing the amplifier, make sure that it was not destroyed by a wiring error before replacing it. To avoid expensive accidents great care should be taken to check all the wiring thoroughly before connecting the amplifier to the mains—it will be too late afterwards.

Given time and patience, most faults can be tracked down with a multimeter. An instrument of at least 20,000 ohms per volt is recommended. An oscilloscope and an audio oscillator can save a lot of time and trouble, particularly with faults such as distortion and oscillation. And if it is required to test the amplifier through it's full specification, a wave analyser and a squarewave generator will also be required.

To assist in getting the amplifier to work correctly, a table giving the normal voltages at various points in the circuit, is given on page 212, together with a list of fault symptoms and their most likely causes. This will help to track down most faults with the minimum of trouble, but we can not claim to have thought of everything.

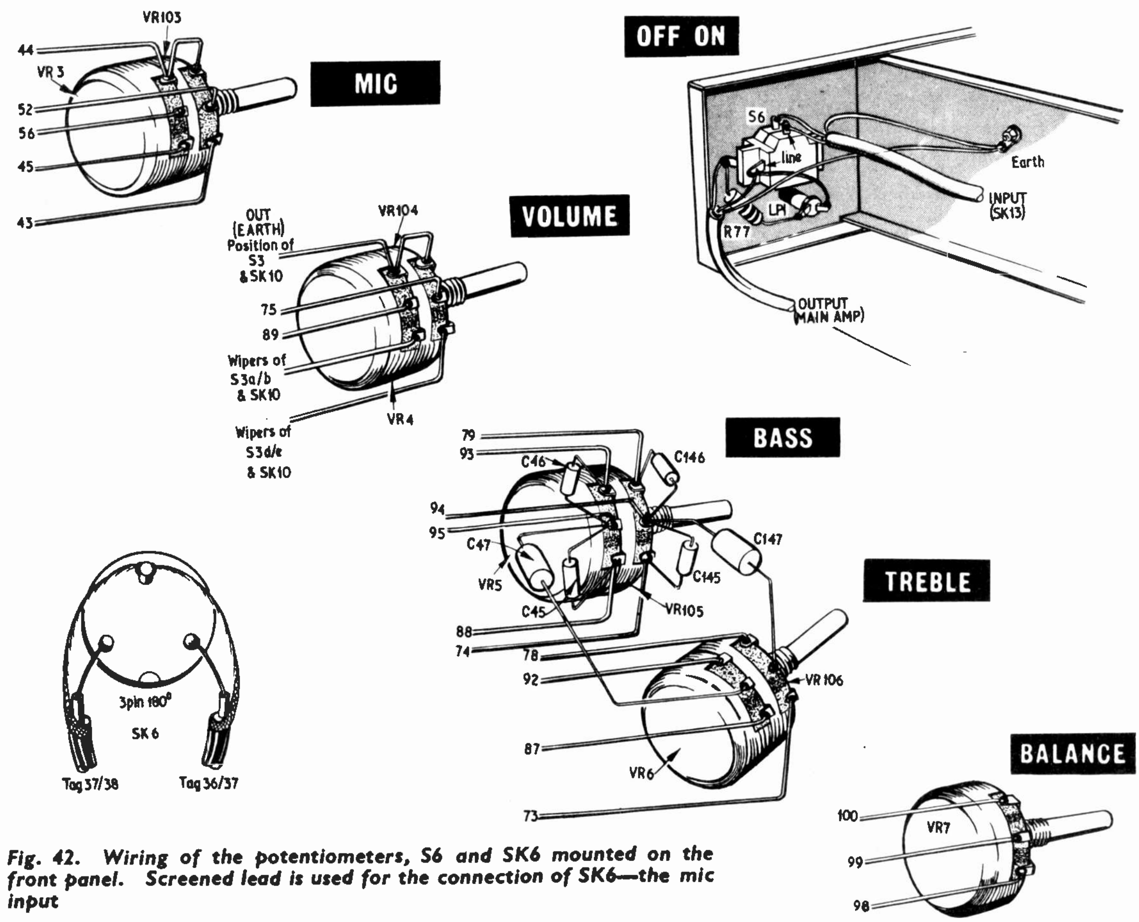


Fig. 42. Wiring of the potentiometers, S6 and SK6 mounted on the front panel. Screened lead is used for the connection of SK6—the mic input

CONNECTING UP

The amplifier is working perfectly, a record deck or f.m. tuner is connected to it; on switching on there is a loud hum on both channels. This happens to nearly every audio enthusiast sooner or later and the usual cause is an earth loop. This arises when both the amplifier and the piece of equipment to which it is connected are earthed separately to the mains. A small a.c. voltage is induced into the earth leads of both units and when they are connected together a 50Hz current flows in the outer braid of the coax cable between them, causing an objectionable hum. The cure is simply to disconnect *one* of the earths, preferably not the amplifier, and so break the loop. The record player deck or f.m. tuner, etc. will then be earthed via the amplifier. Another source of hum arises if the earth connection between the amplifier and the ancillary equipment gets broken whilst still leaving the signal lead (coax inner) connected. This causes a really colossal hum, often accompanied by a chorus of radio stations.

The prototype amplifier did not show any sign of radio breakthrough but if it is to be operated near a transmitter and breakthrough is experienced, connect a capacitor of 100 to 1,000pF directly between each input and earth, alternatively a ferrite bead may be placed on each of the input leads (directly at the input sockets in both cases). Radio breakthrough can also be a symptom of h.f. oscillation in the circuit.

Supposing the amplifier is working perfectly, but there is only an output from one channel. The first thing to do is to check the wiring of the input plug, especially if using a ready made lead. The P.E. Gemini is wired as Fig. 43a which is the DIN standard for amplifiers but many of the ready made leads, intended for tape recorders, etc. are wired as Fig. 43b.

Low impedance signal sources, such as a tape recorder, f.m. tuner or low impedance dynamic microphone, can be connected up with ordinary twin screened (stereo) cable, but low capacitance screened cable should be used for high impedance sources, particularly magnetic pickups. The popular stereo cable has a capacitance of 100pF or more per foot, and only 4 to 5 feet is required to produce a resonance at 10kHz with a normal 500mH magnetic pickup. Twin lighting flex is quite suitable for connecting up the loudspeakers.

PE GEMINI CHECK CHART

POWER SUPPLY

Normal Voltages (no load)

Across secondary	45–55V (50Hz)
Across C3	65–75V
Across output terminals	55V
Across D1 and C2	10V
Between 0V rail and TR1 base	9·3V
Across R4	0·7V
Across R5	1·4V

Fault symptoms and possible causes

Output voltage zero

(1) Fuse blown. Check for cause before replacing.
(2) Bad contact in mains plug and socket.
(3) C1 short circuit, or short circuit present across output.
(4) R6 omitted or open circuit.
(5) D2, D3, D4, or D5 open circuit.

Output voltage low

(1) D1 or C2 wrong way round.
(2) TR1, TR2 or TR3 open circuit or wrongly connected.
(3) R1 or R2 wrong value.
(4) Wrong transformer taps connected.

Output voltage high

(1) D1 omitted or open circuit.
(2) TR1, TR2 or TR3 short circuit or wrongly connected.
(3) R1, R2, or R6 wrong value.

IMPORTANT: The power supply should be tested and adjusted to the correct voltage before the ht+ leads to the amplifier are connected.

MAIN AMPLIFIER

Normal Voltages

(Referred to common rail unless otherwise specified.)

H.T. rail	55V d.c.
Output terminal	27·5V
Emitter of TR4	26·7V
Junction of R9 and R10	26·2V
Base of TR5	0·7V
Collector of TR5	0·5V
Base of TR6	1·3V
Collector of TR6	27V
Across TR7 coll/emitter	1–1·5V
Junction of R15 and R16	47V
Across R25 and R26	0·7V

Fault symptoms and possible causes

Voltage at output terminal high

(1) TR10 or TR12 short circuit or wrongly connected.
(2) TR4, TR5, TR6, TR11 or TR13 o/c.
(3) R9, R10 wrong value or R10 o/c.
(4) C8 s/c or leaky.

Voltage at output terminal low

(1) TR4, TR5, TR6, TR11 or TR13 s/c or wrongly connected.
(2) TR10 or TR12 open circuit.
(3) R9, R10 wrong value or R9 open circuit.
(4) C6, C7 leaky or short circuit.

Bias current too low

(1) TR7 short circuit.
(2) R18 or R19 wrong value.

Bias current too high

(1) TR7 o/c or wrongly connected.
(2) R18 or R19 wrong value.

PREAMPLIFIER

Normal Voltages

(Referred to common rail unless otherwise specified)

H.T. rail	40V
Across C16	37·5V
TR14 and TR16 emitters	18V
TR15 and TR17 collectors	18V
TR15 and TR17 emitters	28·5V
TR18 emitter	6·8V
TR19 emitter	24V
TR20 emitter	9V
TR21 emitter	20V

Fault symptoms and possible causes

No output for all inputs

(1) No h.t., check wiring and C52.
(2) TR18, 19, 20, or 21 s/c or o/c.
(3) Wiring error after S3.

Weak distorted output for all inputs

(1) H.T. voltage excessively low.
(2) TR18, TR19, TR20, or TR21 inserted wrong way round.
(3) C33, C48, or C50 leaky or s/c.
(4) Incorrect resistor value.

No output or weak distorted output on disc

(1) TR14, TR15 o/c, s/c, or connected wrong way round.
(2) C17, C18, or C23 leaky.
(3) Incorrect resistor value.

No output or weak distorted output on Mic

(1) TR16, TR17 o/c, s/c, or connected wrong way round.
(2) C25, C27, or C29 leaky.
(3) Incorrect resistor value.

Add 100 for right-hand channel component numbers   o/c = open circuit   s/c = short circuit

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2N697	22p	2N2925	22p	40362	68p	BC149	15p	BFX88	26p
2N706	12p	2N2926	11p	AC107	46p	BC153	35p	BFY50	23p
2N930	29p	2N3053	27p	AC126	20p	BC154	38p	BFY51	20p
2N1131	36p	2N3325	54p	AC127	20p	BC157	19p	BFY52	23p
2N1132	40p	2N3702	13p	AC128	20p	BC158	17p	BSX20	16p
2N1302	19p	2N3703	13p	AC153K	25p	BC159	18p	C407	17p
2N1303	19p	2N3704	13p	AC176	27p	BC167	13p	MC140	25p
2N1304	23p	2N3705	13p	ACY20	20p	BC168	11p	MP86531	35p
2N1305	23p	2N3706	13p	ACY22	16p	BC169	13p	MP86534	30p
2N1306	33p	2N3707	13p	AD140	56p	BC177	17p	NKT211	25p
2N1307	33p	2N3708	13p	AD142	71p	BC178	15p	NKT212	25p
2N1308	36p	2N3709	13p	AD149	60p	BC179	17p	NKT214	23p
2N1309	36p	2N3710	13p	AD161	40p	BC182L	13p	NKT274	18p
2N1613	23p	2N3711	13p	AD162	40p	BC183L	11p	NKT403	65p
2N1711	26p	2N3794	15p	AF114	30p	BC184L	13p	NKT405	79p
2N1893	54p	2N3904	35p	AF115	30p	BC212L	25p	OC71	29p
2N2147	95p	2N3906	35p	AF117	28p	BC213L	25p	OC81	25p
2N2218	33p	2N4058	20p	AF124	30p	BC214L	25p	OC81D	25p
2N2218A	43p	2N4059	20p	AF127	28p	BCY70	19p	ZTX300	17p
2N2219	38p	2N4060	20p	AF139	48p	BCY71	33p	ZTX301	17p
2N2219A	53p	2N4061	20p	AF239	49p	BCY72	15p	ZTX302	22p
2N2270	62p	2N4062	20p	ASY26	27p	BF115	38p	ZTX303	22p
2N2369A	19p	2N4124	18p	ASY28	27p	BF167	43p	ZTX304	33p
2N2483	35p	2N4126	27p	BC107	14p	BF173	50p	ZTX500	25p
2N2484	42p	2N4284	15p	BC108	12p	BF194	17p	ZTX501	25p
2N2904	38p	2N4286	15p	BC109	14p	BF195	18p	ZTX502	30p
2N2904A	42p	2N4289	15p	BC125	55p	BFX29	31p	ZTX503	25p
2N2905	44p	2N4291	15p	BC126	55p	BFX84	25p	ZTX504	60p
2N2905A	47p	2N4292	15p	BC147	15p	BFX85	34p		

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82Ω–220kΩ	E12	7p	6p	6p
C	⅛W	5%	4·7Ω–330kΩ	E24	1p	0·8p	0·7p
C	¼W	10%	4·7Ω–10MΩ	E12	1p	0·8p	0·7p
C	½W	5%	4·7Ω–10MΩ	E24	1·2p	1p	0·9p
C	1W	10%	4·7Ω–10MΩ	E12	2·5p	2·5p	1·9p
MO	½W	2%	10Ω–1MΩ	E24	4p	3·5p	3p
WW	1W	10% ± 1/20Ω	0·22Ω–3·9Ω	E12	7p	7p	6p
WW	3W	5%	12Ω–10kΩ	E12	7p	7p	6p
WW	7W	5%	12Ω–10kΩ	E12	9p	9p	8p

CODES: C = carbon film high stability low noise. MO = metal oxide Electrosil TR5 ultra low noise. WW = wire wound Plessey.

VALUES: E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

Prices are in pence each for same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1p on total resistor order.)

INTEGRATED CIRCUIT AMPLIFIERS

SINCLAIR IC.10 complete with instruction book giving amplifier circuit details and range of applications. **£2·95** nett. Components pack for stereo inc. mains transformer, controls, etc., **£4·75** nett.

PLESSEY SL403A. Only **£2·75** each nett. 3W into 7·5Ω for 18V supply. Application data **10p**: free with two or more.

WAVECHANGE SWITCHES LONG SPINDLES

1P 12W; 2P 6W; 3P 4W; 4P 3W .. .. **24p each**

SLIDER SWITCHES D.P.D.T. .. .. .. **15p each**

NEON INDICATOR LAMPS all 200/250V

Square bezel, red only **19p**
Round chrome bezel red, amber, clear .. .. **23p each**
Toggle switches, 250V a.c. 1·5A. Chrome dolly and chrome milled nut S.P.S.T. **19p**; S.P.D.T. **22p**; D.P.D.T. **28p**; S.P.D.T. centre off **25p**.

S-DeC's put an end to "birdsnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC (70 points) only **£1**. Compact T-DeC, increase 1 capacity, may be temperature-cycled. T-DeC (208 points) only **£2·50**. Full range stocked.

MULLARD POLYESTER C280 series

250V 20%: 0·01, 0·022, 0·033, 0·047, **3p** ea.; 0·068, 0·1, 0·15, **4p** ea.; 0·22, **5p**. 10%: 0·33, **7p**; 0·47, **8p**; 0·68, **11p**; 1μF, **13p**; 1·5μF, **21p**; 2·2μF, **24p**.

MULLARD SUB-MIN ELECTROLYTIC

C426 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, 8/4, 8/40, 10/2·5, 10/16, 10/64, 12·5/25, 16/40, 20/16, 20/64, 25/6·4, 25/25, 32/4, 32/10, 32/40, 32/64, 40/16, 40/2·5, 50/6·4, 50/25, 50/40, 64/4, 64/10, 80/2·5, 80/16, 80/25, 100/6·4, 125/4, 125/10, 125/16, 160/2·5, 200/6·4, 200/10, 250/4, 320/2·5, 320/6·4, 400/4, 500/2·5.

LARGE CAPACITORS

High ripple current types: 1000/25 **28p**; 1000/50 **41p**; 1000/100 **82p**; 2000/25 **37p**; 2000/50 **57p**; 2500/64 **84p**; 2500/70 **97p**; 5000/25 **62p**; 5000/50 **£1·10**; 5000/100 **£2·91**; 10000/15 **85p**; 10000/25 **£1·23**.

MEDIUM RANGE ELECTROLYTICS

Axial leads: 50/50 **9p**; 100/25 **9p**; 100/50 **12p**; 250/25 **12p**; 330/25 **12p**; 250/50 **19p**; 500/25 **19p**; 500/50 **22p**; 1000/25 **20p**; 1000/50 **30p**; 2000/25 **30p**.

SMALL ELECTROLYTICS

Axial leads: 4·7/10, 4·7/25, 5/50, **5p** ea. 10/10, 10/25, 10/50, 33/10, 50/10, **5p** ea. 25/25, 25/50, 47/25, 100/10, 220/10, **6p** ea.

ENAMELLED COPPER WIRE even No. SWG.

only: 2 oz. reels: 16–22 SWG **23p**; 24–30 SWG **27p**; 32, 34 SWG, **29p**; 36, 38 SWG, **34p**; 4 oz. reels 16–22 SWG only **41p**.

PEAK SOUND PRODUCTS ENGLEFIELD AMPLIFIER

12 + 12 watts RMS per channel

Stereo amplifier in modular kit form (including cabinet) 12 watts per channel **£38·45**. Cabinet kit only **£6**. These prices nett.

BAXANDALL SPEAKER SYSTEM

Designed by Peter Baxandall. Superb reproduction for its size. Handles 10 watts with ease. Uses ELAC 15Ω 59RM109 speaker unit. Kit **£13·90** nett; built **£19·40** nett.

MAINLINE AMPLIFIER KITS

RCA/SGS designed main amplifier kits. Input sensitivity 500–700mV for full output into 8Ω.

Power	Kit price including components	Suitable unreg. power supply kit
12W	£8·40 nett	£4·60
25W	£9·50 nett	N/A
40W	£10·50 nett	£5·75
70W	£12·60 nett	£6·94

30 WATT BAILEY AMPLIFIER KIT

Sensitivity 1·2V for full output into 8Ω. Transistors and PCB for one channel **£7·30**. Transistors and PCBs for two channels **£14·60**. Capacitors and resistors (metal oxide) **£2** per channel.
Complete unregulated power supply kit **£4·76**.

ZENER DIODES

5% full range E24 values: 400mW: 2·7V to 30V **19p** ea. 1W: 6·8V to 82V **33p** ea. 1·5W: 4·7V to 75V **60p** ea. Clip to increase 1·5W rating to 3 watts (type 266F) **4p**.

CARBON TRACK POTENTIOMETERS, long spindles.

Double wiper ensures minimum noise level.

Single gang linear	220Ω to 2·2MΩ	12p
Single gang log	4·7KΩ to 2·2MΩ	12p
Dual gang linear	4·7KΩ to 2·2MΩ	42p
Dual gang log	4·7MΩ to 2·2MΩ	42p
Log/antilog	10K, 47K, 1MΩ only	42p
Dual antilog	10K only	42p

Any type with ½A D.P. mains switch, extra **12p**. Please note: only decades of 10, 22 and 47 are available within ranges quoted.

CARBON SKELETON PRE-SETS

Small high quality, type PR, linear only 100Ω, 220Ω, 470Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10MΩ. Vertical or horizontal mounting **5p** each.

TYGON SPEAKER MATERIAL

Seven designs, 36in × 27in sheets, **£1·57**. Pattern books, send S.A.E. plus 3p in stamps.

COMPONENT DISCOUNTS

10% on orders for components for £5 or more. 15% on orders for components for £15 or more (No discount on nett items).

POSTAGE AND PACKING

Free on orders over **£2**. Please add 10p if under. Overseas orders welcome: carriage charged at cost.

IMPORTANT—Please ensure that cheques dated on and after February 15th are drawn in decimal currency. Otherwise they cannot be accepted.

ELECTROVALUE

Dept. PE371, 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY
Hours: 9—5.30; Sat. 1 p.m. Tel.: Egham 5533 (STD 0784-3). Telex 264475

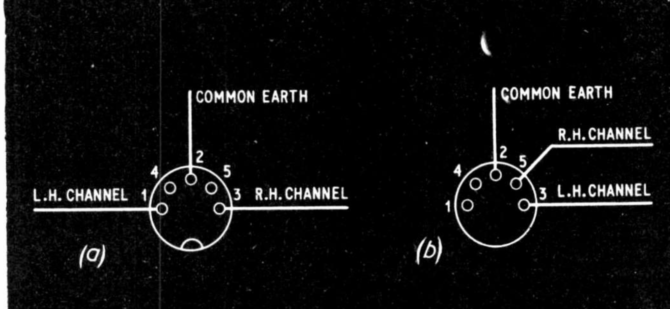


Fig. 43. (a) Input wiring of the P.E. Gemini; (b) wiring of some ready-made leads

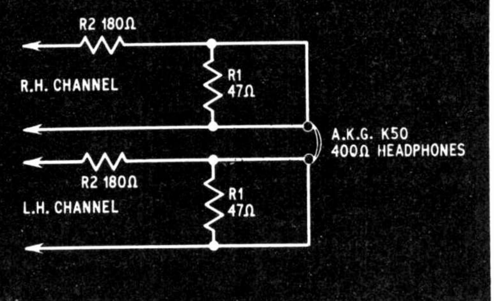


Fig. 44. Attenuator circuit for use with AKG K50 headphones

TAPE INPUT

The tape input of the P.E. Gemini preamplifier has a flat frequency response and a sensitivity of 100mV at 50 kilohms, suitable for connection to the equalised output of a tape recorder or tape unit. The input is like this to accommodate the wide choice of speeds and equalisation standards (DIN, CCIR, and NAB at 15, 7½, 3¾, 1⅞ i.p.s.) many extra components and some complicated wiring and switching would be needed. If the low level output of your tape recorder is not equalised you will have to construct an "add on" equalisation stage to give an output of 100mV.

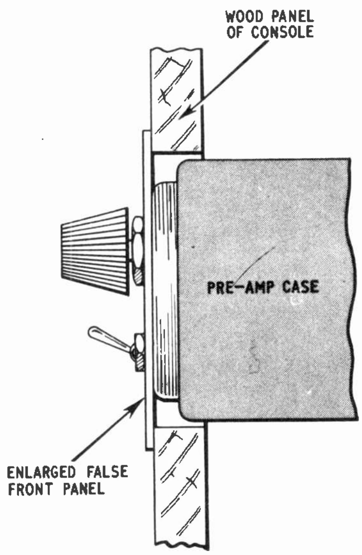


Fig. 45. Method of mounting the pre-amplifier in a console

HEADPHONE OUTPUT

The headphone output from the main amplifier is connected directly to the loudspeaker outputs and in most cases it will be necessary for the constructor to add an attenuator to reduce the volume to a comfortable level. Because of the wide variation in headphone impedances (4 to 600 ohms) and sensitivity between different types, the constructor will have to determine the correct values experimentally; Fig. 44 shows the circuit used, the values given being suitable for AKG K50 headphones of 400 ohms impedance. Resistor R1 should not be greater than the impedance of the earpiece and (R1 + R2) should not be less than 15 ohms, and preferably greater than 100 ohms if the attenuator is permanently wired to the amplifier. Some headphones have a built in attenuator and these can be connected directly to the headphone output socket.

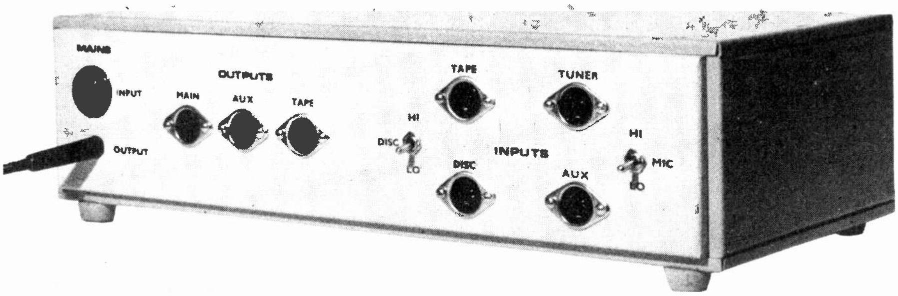
CASES

The Contil Mod 2 cases, used for both units, were chosen because they are relatively cheap, easily obtainable, and have an attractive if somewhat functional appearance. There is no reason why the constructor should not design his own case to match other equipment, provided that the case is well screened and the layout given is closely adhered to.

The preamplifier may be mounted in a console by increasing the size of the front panel so that it covers the hole required, as shown in Fig. 45. The front panel can be secured by screws from the front or clamps behind the panel. ★

ACKNOWLEDGEMENTS

The authors wish to thank Ferranti Ltd. for permission to publish this article and also L. Morral, R. J. Grundy and M. A. Rambaut for help given at various stages of the construction of the P.E. Gemini Amplifier.



Note: In Fig. 14 the arrow from tag 24 should go to FS2 not FS1. Main amplifier components list—R12 and R112 should be 1·2kΩ not 1kΩ.

DIGI-CLOCK

By R. W. Coles

Part 4

As mentioned in the first part of this article, "Contil" Mod-2 case type "C" is used to house the Digi-Clock, and this makes construction much simpler than if a "one-off" case design were to be employed.

The front and back panels of these cases are formed from p.v.c. covered aluminium, which makes the necessary hole cutting quite easy. The only tools absolutely necessary are a hand drill and a good file, but a clean and neat finish can be more easily achieved with a nibbling tool such as the "Monodex" sheet metal cutter.

CONSTRUCTION ON CHASSIS

The chassis supplied with the case is also made of aluminium and is used as a base-plate for all the main components, including the three circuit boards which are spaced from it only by three 6BA nuts. The chassis is earthed and acts as a low impedance "ground plane" for the logic circuitry, thus increasing the noise immunity of the system.

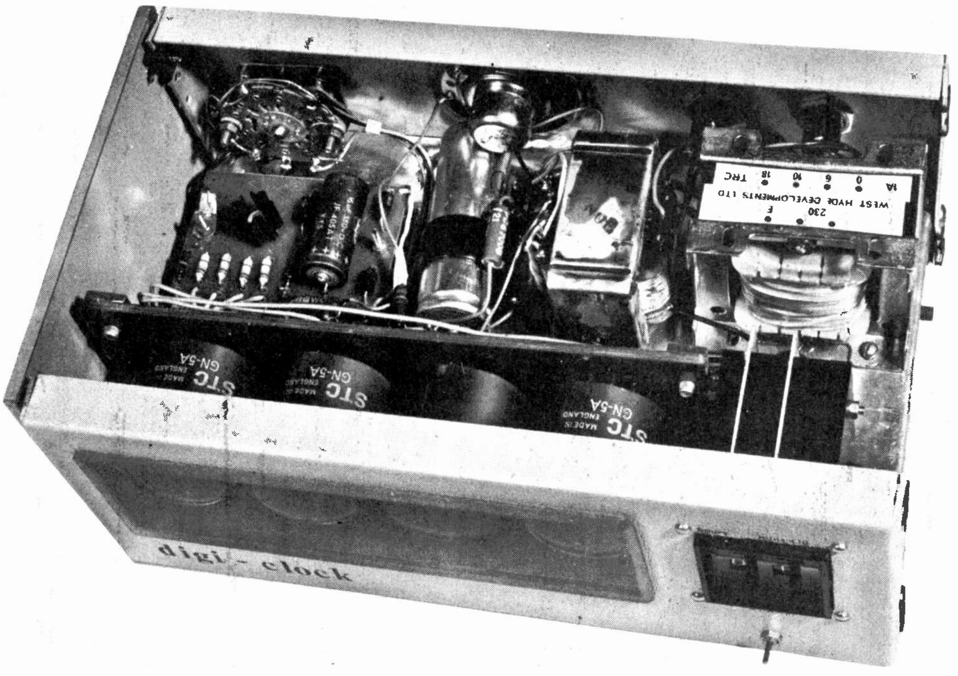
The series pass transistor TR2 employed by the 5V regulator uses the chassis as a heat sink; it is vital that this transistor is isolated from the aluminium by an insulating mica washer of the type normally supplied with this type of device.

Drilling dimensions for the chassis and front and back panels are given in the diagrams, and it is important to remember that some of the chassis holes are required to match other holes drilled by the constructor in the circuit boards and the display panel bracket. It is preferable to match these chassis holes to the latter, rather than drill all the holes straight from the diagrams.

The mounting bracket for the "Nixie" tubes is made from ⅛in s.r.b.p. sheet, and as can be seen from the diagram, the tubes are inserted directly into holes drilled in this bracket, no bases being employed.

With the dimensions given, the tubes are a tight fit in their mountings, and no extra fixative was used in the prototype. A dab of contact adhesive could be used if necessary, and still allow the tubes to be removed should this ever be desirable. Valve bases type B12A are available for the GN5A although the numeral spacing would have to be altered if these are used, since the tubes would not be so close together.

The decimal point indicator is mounted in a ⅜in coil former or some other suitable tube, cut to the dimensions shown, and fastened to the display panel with contact adhesive. When being installed, the neon is simply pushed through from the rear of the bracket, its insulated leads providing all the tension necessary to retain it in the tube.



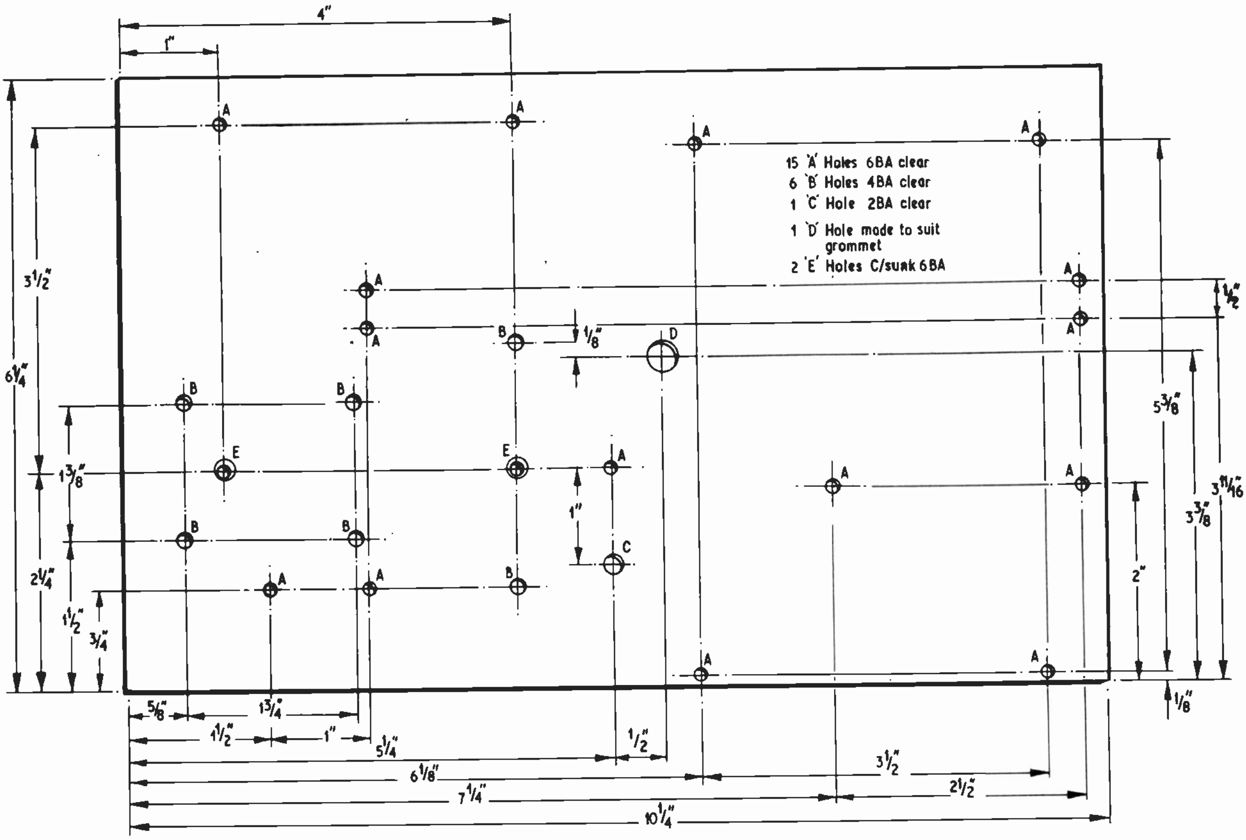


Fig. 17. Chassis drilling details assuming components used are as specified in the components list. Modifications may be necessary for variations of component type. Clearance above chassis 2¾in

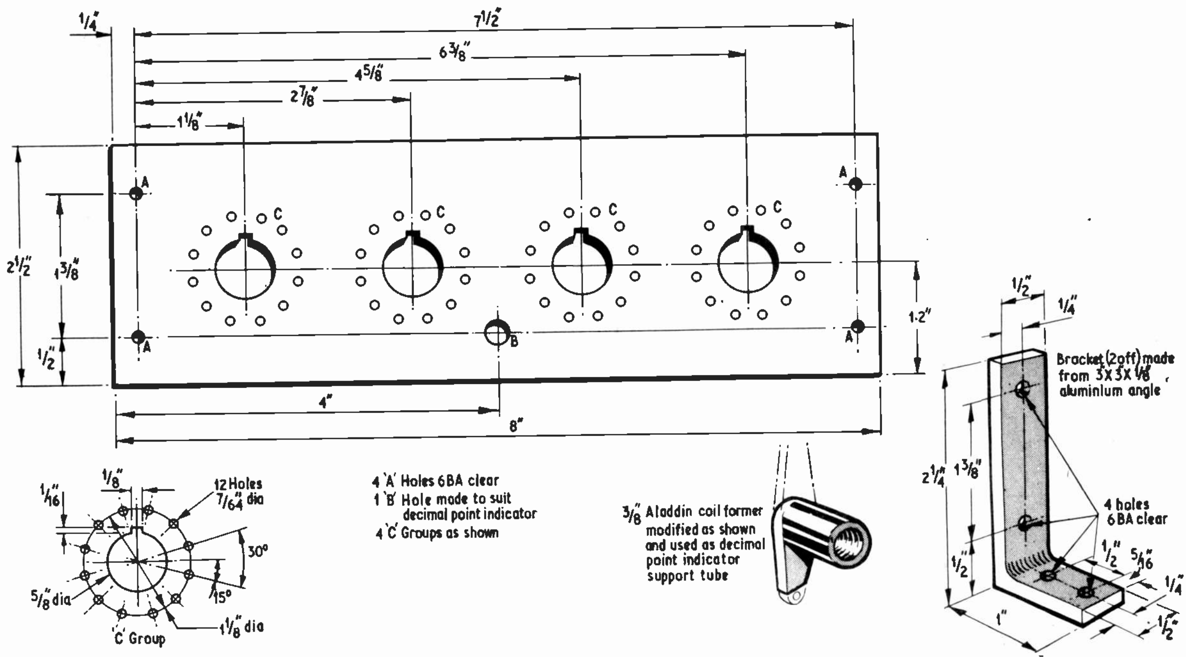


Fig. 18. Display panel drilling for "Nixie" tubes

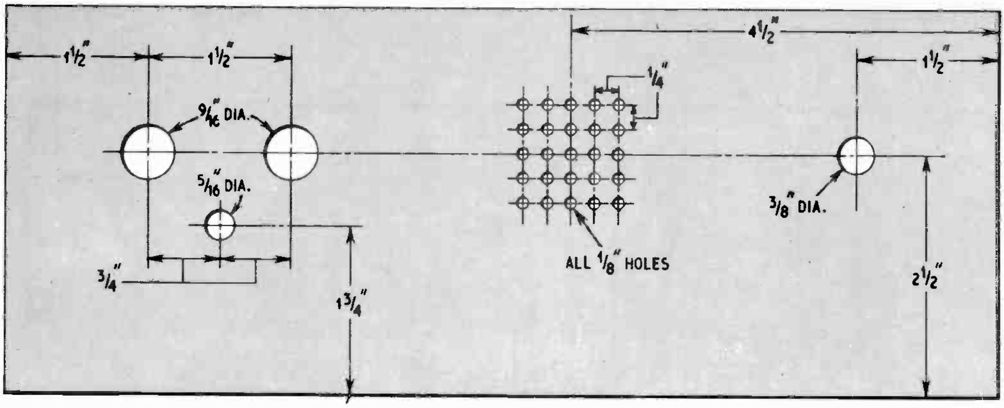


Fig. 19. Back panel drilling details for components specified

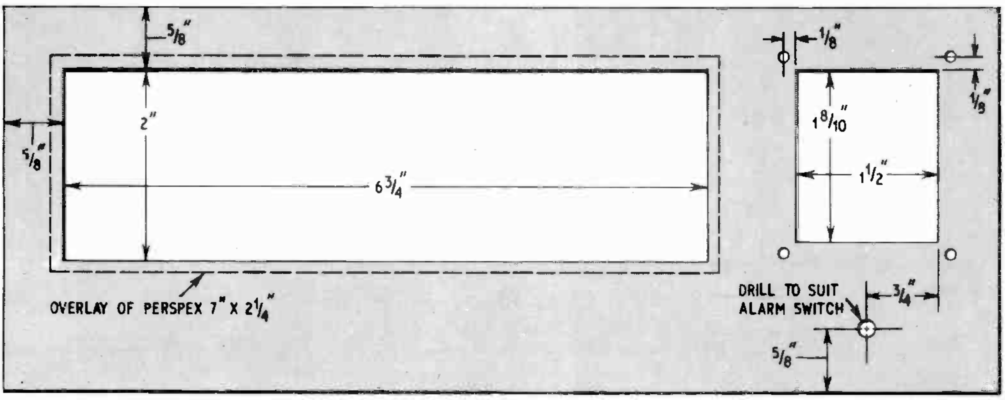


Fig. 20. Front panel drilling details for components specified

Table 1: CONNECTIONS TO MAIN CLOCK BOARD "A"

(a) Plain side terminations

IC Number	Hole Number	Board "A" Outlet	Wire Colour	Destination
—Resistor R1—		1	green	T2, 6·3V
1	6E	2	black	S1a wiper
6	2E	3	red	S1c wiper
6	6A	4	orange	S1b wiper
13	4F	5	red	Board B5
13	3C	6	orange	Board B4
13	3B	7	pink	Board B3
9	2H	8	violet	Board B1
12	3E	9	green	Board B9
9	2F	10	blue	Board B13
ALL	Ground Rail	11	black	chassis
ALL	$+V_{cc}$ rail	12	red	Board B12
12	3B	13	brown	Board B10
9	3G	14	yellow	Board B2
11	7H	15	(optional hours × 10 zero line to V1 pin 10)	
11	7G	16	yellow	V1 pin 1
13	6H	17	grey	V3 pin 10
13	6G	18	pink	V3 pin 1
13	3A	19	white	V3 pin 2
13	6A	20	violet	V3 pin 3
13	7E	21	yellow	V3 pin 4
13	6F	22	green	V3 pin 5

(b) Copper side terminations

IC Number	Hole Number	Board "A" Outlet	Wire Colour	Destination
—	—	23	—	—
—	—	24	—	—
14	6H	25	pink	V4 pin 10
14	6G	26	green	V4 pin 1
14	2A	27	red	V4 pin 2
14	6A	28	brown	V4 pin 3
14	6E	29	black	V4 pin 4
14	6F	30	white	V4 pin 5
14	6C	31	yellow	V4 pin 6
14	6B	32	orange	V4 pin 7
14	2H	33	grey	V4 pin 8
14	2G	34	violet	V4 pin 9
12	6H	34	orange	V2 pin 1
12	7G	36	green	V2 pin 2
12	2A	37	grey	V2 pin 3
12	7A	38	brown	V2 pin 4
12	7E	39	pink	V2 pin 5
12	7F	40	yellow	V2 pin 6
12	7C	41	red	V2 pin 7
12	7B	42	black	V2 pin 8
12	2H	43	white	V2 pin 9
12	2G	44	violet	V2 pin 10

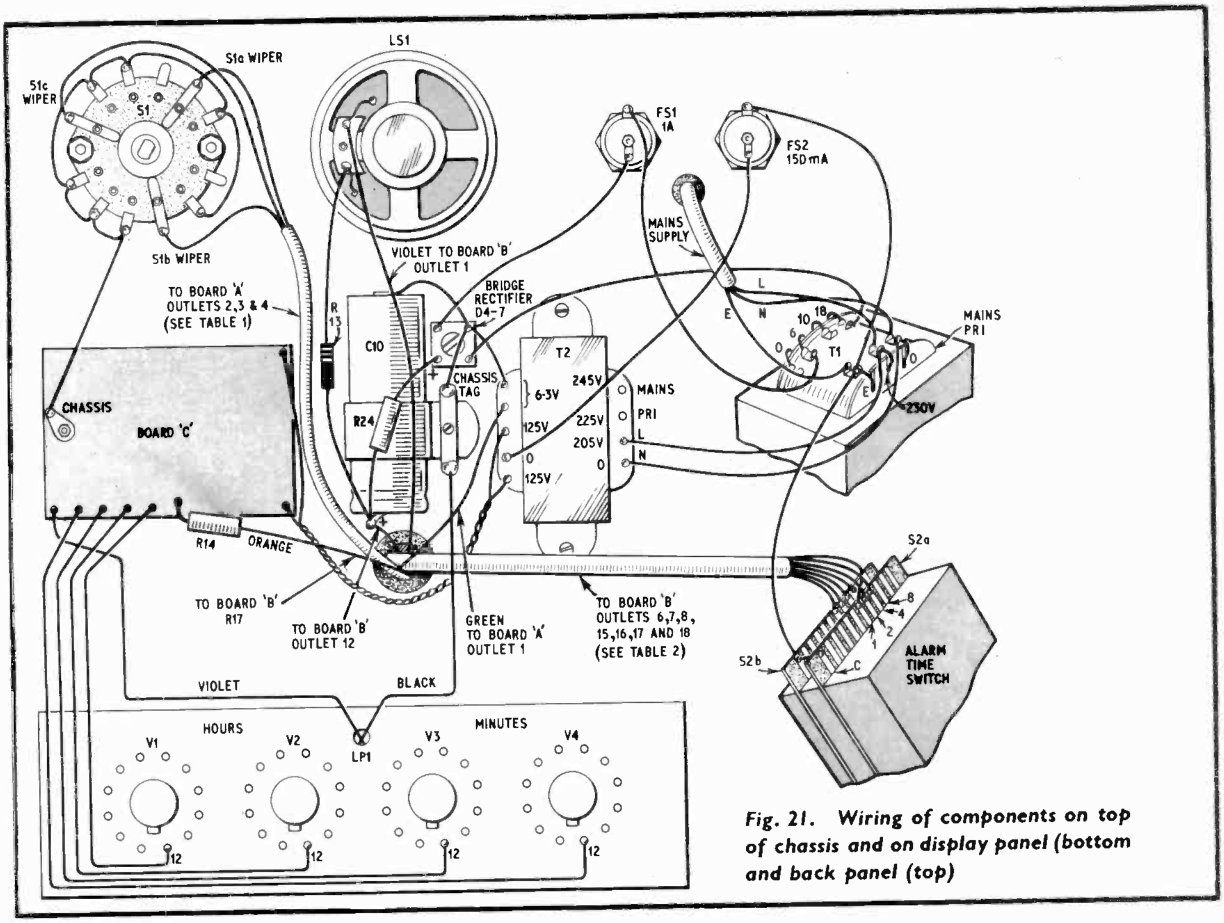


Fig. 21. Wiring of components on top of chassis and on display panel (bottom and back panel (top)

Table 2: CONNECTIONS TO ALARM BOARD "B"
Copper side terminations only

IC Number	Hole Number	Board "B" Outlet	Wire Colour	Destination
19	7D	1	violet	LS1
15	3H	2	yellow	Board A14
15	3F	3	pink	Board A7
15	3A	4	orange	Board A6
15	7B	5	red	Board A5
15	3E	6	black	S2a/4
15	3B	7	violet	S2a/2
15	6C	8	brown	S2a/1
16	2H	9	green	Board A9
16	3F	10	brown	Board A13
ALL	Ground Rail	11	black	chassis
ALL	$+V_{cc}$ rail	12	red	Board A12 (5V)
16	2A	13	blue	Board A10
16	6B	14	violet	Board A8
16	6H	15	orange	S2b/8
16	3E	16	grey	S2b/4
16	3B	17	red	S2b/2
16	6C	18	blue	S2b/1
18	6D	19	orange	S3 (OFF)
(collector of TR1)		20	red	TR2 collector (10V).
Resistor R21, 22	4B	21	yellow	TR2 emitter
(TR1 emitter)	3F	22	green	TR2 base

PRINTED BOARDS "A" AND "B"

The circuit boards carrying the i.c.'s are mounted on the chassis by means of 6BA bolts passing through each corner. Remember that the printed sides of these boards are adjacent to the chassis in the final assembly, and it will be necessary to make breaks in some cases in the printed tracks near the corner holes to prevent shorts to the chassis via the spacer nuts. Any breaks made for this purpose must be reconnected with wire links on the wiring side of the board.

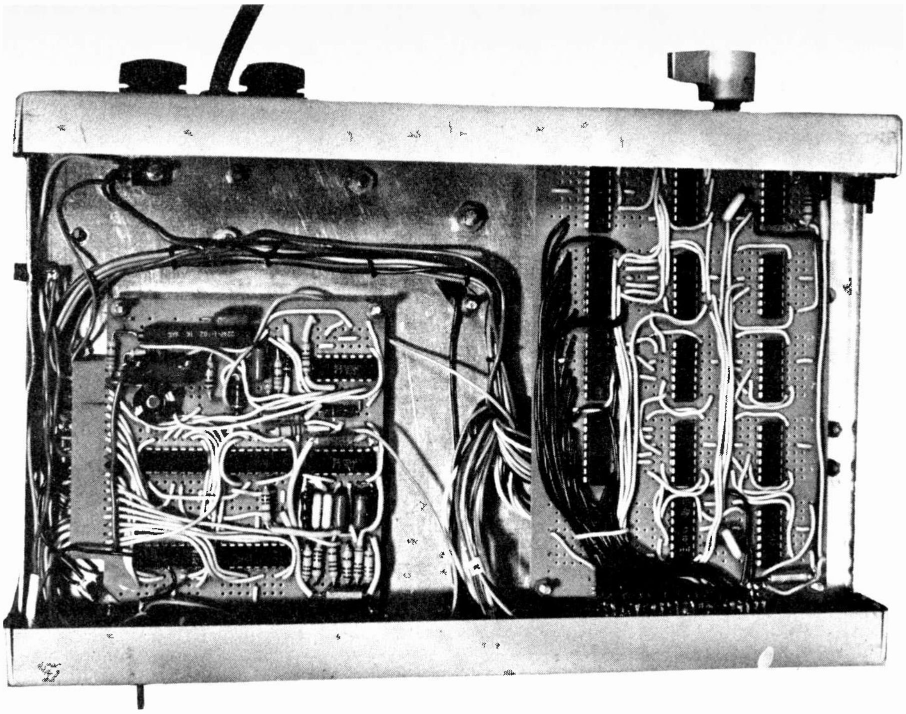
Note that in Fig. 13 last month C8 should be connected to the link wire to C7 and pin 4 of IC19.

Using 1in long bolts at the board corners allows their use as "legs" to support the chassis during wiring up, damage to the delicate boards being avoided. The transformers perform a similar task on the other side of the chassis.

WIRING UP

Once all the major components have been mounted on the chassis and the circuit boards have been tested for accuracy of fit, wiring up of the power supplies can be carried out. There is no need to attach the back panel wiring permanently at this stage, although it should be hooked in temporarily while the power supplies are tested, before proceeding further.

When the power supplies are operating satisfactorily, the interboard wiring can be started, remembering that the 5V regulator board has two wires leaving it which do not pass through the edge connector. All connections are given in Tables 1 and 2 for the boards



carrying the i.c.s. It is most important that only very fine p.v.c. covered flexible wire be used for this stage of the wiring, no other type of wire is suitable, as will become obvious as you proceed to wire up the Main Clock Board "A" edge connector with its 42 connections.

On completion of the interboard wiring the front and rear panels and their associated components can be attached to the chassis and the wiring finished off. The alarm speaker should be glued carefully to the rear panel with contact adhesive, making sure that it does not foul the smoothing capacitor or bridge rectifier wiring. The orange tinted Perspex filter is also fixed to the outside of the "Nixie" window front-panel cut-out with contact adhesive, and of course it is important that this operation be carried out with care to ensure a neat appearance.

The front and rear panels are finished off with "Letraset" dry print transfer lettering. The lettering should be sprayed with clear lacquer fixative to avoid damage during handling.

TESTING

There are no controls on the Digi-Clock which have to be set-up before operation, except the voltage control on the 5V regulator which should be set-up when the regulator wiring is completed, before its connection to the V_{cc} lines to the i.c. boards. This control setting should be rechecked with the clock operating normally, to ensure that the 5V line is as accurate as possible.

If on switching on for the first time, all appears healthy, the set-time switch may be used to set the display to the correct time.

With the switch set to the "fast" position, the minutes counter will be counting 600 times faster than normal, making it a simple job to set the display to within about 15 minutes of the correct time. The slow position is then used to facilitate the final setting, a minute being clocked up every second. As soon as the display is correct the switch is returned to the "normal" position, and the clock continues normally.

If all is still well, the alarm circuit can now be checked. With the alarm "reset" switch in the "off" position, any valid time may be entered on the thumbwheel switches, after which the "alarm reset" switch is returned to the "set" state. When the "hours" and "tens of minutes" display counts to the same time as the alarm setting, the alarm should sound, and may be silenced by returning the "reset" switch to the "off" position. This check can be carried out with the clock running at a fast speed, making it a quick job to test all the alarm settings.

FAULT LOCATION

If problems are encountered during any of these tests, a constructor who has become familiar with the logic of the Digi-Clock should find it a fairly simple matter to trouble-shoot with the aid of a logic probe such as that shown in Fig. 22 or even a multimeter set to the low voltage range.

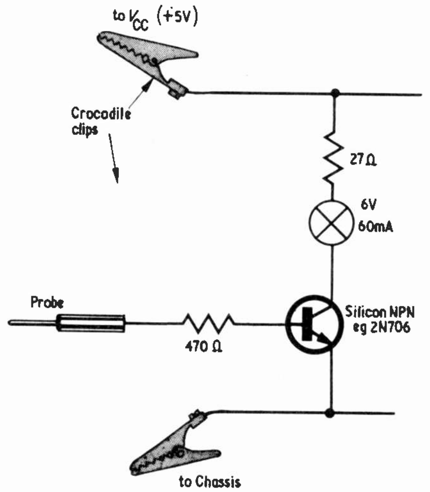


Fig. 22. Simple test circuit or logic probe

The important thing to remember if a fault is present in the logic circuitry, is that ten minutes working out what could be the problem with a pencil and paper, is worth hours of aimless probing and measuring. Logic faults, providing they have symptoms observable through the display, are not hard to find because they always follow some form of sequence, which, when analysed, usually yields the answer, without any testing in the usual sense.

One of the easiest faults to occur is the incorrect sequence of time indication, possibly with more than one digit showing on one tube. In this case, check that there are no short circuits or solder runs between adjacent outlets on the Main Clock Board "A". If erroneous alarm triggering should occur, check for a similar fault on the Alarm Board "B". Also make sure that the copper strips are cut correctly as shown at "X" in the first photograph (last month).

Check for solder runs between adjacent strips of copper; where these should not occur remove the solder. The wiring diagrams in Figs. 5 and 13 show the only places where these may occur intentionally.

The wiring tables and diagrams give colours to the wires as they were in the prototype. There is no reason why these should not be changed, but they are given to help the constructor to follow the wiring through if a fault is apparent.

TENS OF HOURS DISPLAY

Readers may have noticed that in the block diagram given in part one of this project, the tens of hours "Nixie" has two connections to its cathodes, one being a dotted line to the "0" numeral. This connection was shown in this way because it is a matter of personal taste whether the "0" needs to be used at all, a more conventional readout being given by allowing this tube to be completely blank during the hours of one to nine o'clock.

The decoder is, of course, able to accommodate either method, and the wiring diagram given in part one includes an edge connector contact for the "0" at outlet 15 of Board "A" so that it can be wired up if desired. This would be connected to pin 10 of V1.

MODIFICATIONS

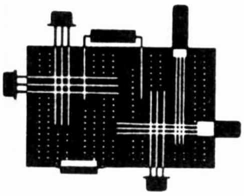
Apart from the alarm expansion scheme discussed in Part 2, many other improvements can be incorporated in the Digi-Clock if required. The operation of the clock counters could be altered to conform to the 24 hour system, counting could be extended to include an a.m./p.m. flip-flop, or even a calendar, provided the extra components required could be accommodated.

A slave display, or even several slave displays, could be driven by the basic circuit. In this case the outputs of the clock counters should be buffered by TTL gates or inverters and fed to lines which terminate in further buffers at the slave end.

Fairly long lines could be driven by this method because of the slow speed operation and the relative unimportance of noise at this end of the system. The slave units would consist of a few buffer gates as mentioned and four SN7441AN decoders to drive the "Nixies". A simple power supply would also be needed.

Finally, for anyone who finds the fairly high outlay on the Digi-Clock components unjustifiable, the master-slaves system might tip the balance, because this type of system would become more economic as more slaves were added. ★

SIMPLE REFLEX RECEIVER



A SPECIAL PROJECT FOR BEGINNERS

The crystal receiver has for a long time been for many their first introduction to table top electronics. It isn't difficult to seek out the reason for its appeal, for this first-time project can be an unending source of entertainment pleasure for a modest outlay.

For the T-Dec form of plug-in construction that has been maintained throughout this series, the choice of receiver circuit was based on the requirements of good stability, that is no "howls" or unwelcome oscillations, and excellent volume with little aerial and no earth in areas of good signal strength.

REFLEX ACTION

Radio signals are characteristically of high frequency. For the medium wave-band which this receiver will tune to, this covers the range from 500 to 1,500kHz (200 to 600 metres).

Since many transmitters are sending out signals in this band, the receiver must be able to select the one required. In the block diagram of the receiver Fig. 1, the tuned circuit enables such selection to be made.

Since the currents generated in the aerial system are extremely weak, it is necessary to amplify them before they reach the diode detector.

The detector has the job of removing the desired audio signal from the high frequency signal which has, in effect, carried it pick-a-back from the transmitter.

The title of the circuit, "reflex", derives from what now follows. Audio output from the detector is reflected back through the r.f. amplifier so that this stage plays a dual role in boosting first the r.f. and then the extracted a.f. signals.

The output is taken through a further amplifying stage and then to the headphones.

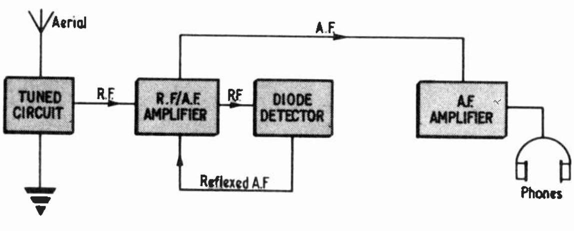


Fig. 1. Block diagram of reflex receiver

RECEIVER CIRCUIT

The complete receiver circuit diagram is given in Fig. 2. Here the tuned circuit consists of T1 primary and TC1. An aerial coupling capacitor C1 is included to improve selectivity; however, it must be borne in mind that with this simple type of single tuned circuit receiver, station separation is not ideal since it follows that the more tuned circuits used, the sharper is the tuning of that receiver.

The coils of the aerial transformer are wound on a ferrite slab which has the capacity to concentrate r.f. energy in its length and so improve signal strength. In areas where signals are very strong, it may be possible to dispense with a wire aerial and earth provided the slab aerial is orientated for maximum signal.

CHOKES

The selected r.f. signal voltage is passed to the base of TR1 by transformer action. Biasing of this amplifier is achieved by R1, R2 and R4.

The low level signal appears amplified at the collector but at this juncture it is faced with two routes to follow. The choke L1 offers a high impedance path to radio frequency signal current whilst C3 does not. Signal voltages developed across L2 are applied to the detector D1, the desired audio programme material is then "unloaded" from the r.f. carrier and passed back to the input of TR1, via C6.

The audio signal is amplified and passed directly to the load resistor R3 since at low frequencies the resistance of the choke L1 is small. The capacitor C5 passes this a.f. signal to a second amplifier stage, TR2, which provides the power for the headset.

SETTING UP

Providing the component layout of Fig. 3 is adhered to, no reception problems should be encountered.

Whilst this receiver will give a good account of itself even with a short length of wire connected to C1, a good aerial will increase the sensitivity enormously in areas of difficult reception.

To demonstrate the effectiveness of a fair sized aerial, try connecting the co-axial outer of the television aerial to C1, after first removing it from the set. Crocodile clips can be used for this. Bedtime listeners will find the bedsprings a convenient aerial, here once again, a crocodile clip will prove a suitable connector.

In general, at medium wavelengths, the receiving aerial takes the form of a vertical wire length, a common variant includes a horizontal top section of a few metres, but this sort of receptor would only be justified with the most elementary of crystal receivers.

SPANNING THE BAND

To cover the medium waveband, it may be necessary to adjust the aerial coils on the ferrite slab. This merely involves moving the coil former until, say, Radios 1 to 4 can be tuned using TC1. ★

COMPONENTS . . .

Resistors
R1 20kΩ
R2 3·9kΩ
R3 6·8kΩ
R4 4·7kΩ
R5 27kΩ
R6 10kΩ
R7 3·3kΩ
All ±10%, ¼ watt carbon

Capacitors
C1 100pF
C2 0·01μF
C3 0·001μF
C4 25μF elect. 6V
C5 10μF elect. 15V
C6 8μF elect. 15V
C7 0·01μF
C8 25μF elect. 6V

Transistors
TR1 OC44
TR2 AC126

Diodes
D1 IGP10
or OA81 (germanium)

Aerial Transformer
T1 FS3 Ferrite slab aerial
(G. W. Smith & Co. (Radio) Ltd)

Inductors
L1, L2 1·5mH r.f. chokes (2 off)

Tuning Capacitor
TC1 208pF variable

Miscellaneous
X1 High impedance headphones or earpiece,
BY1 9 volt battery
T-Dec, wire links

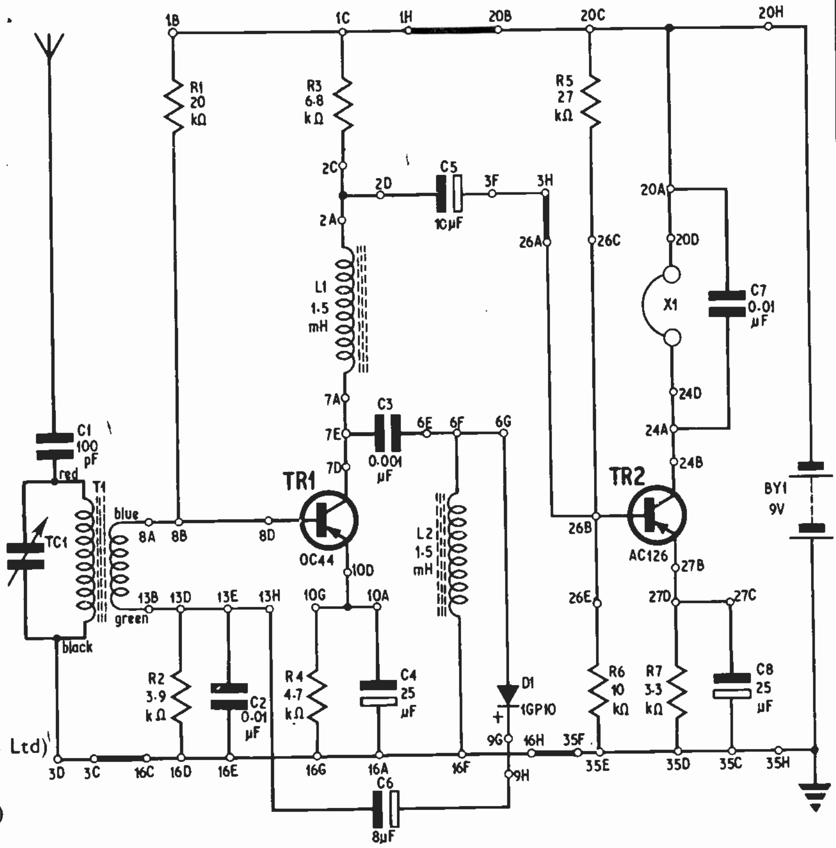


Fig. 2. Circuit diagram showing T-Dec connections. Thick lines indicate wire links

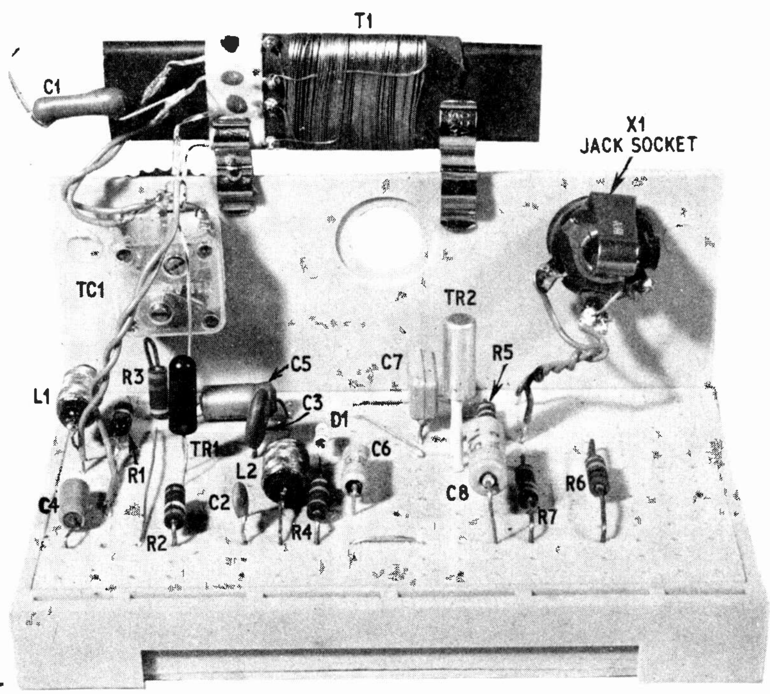
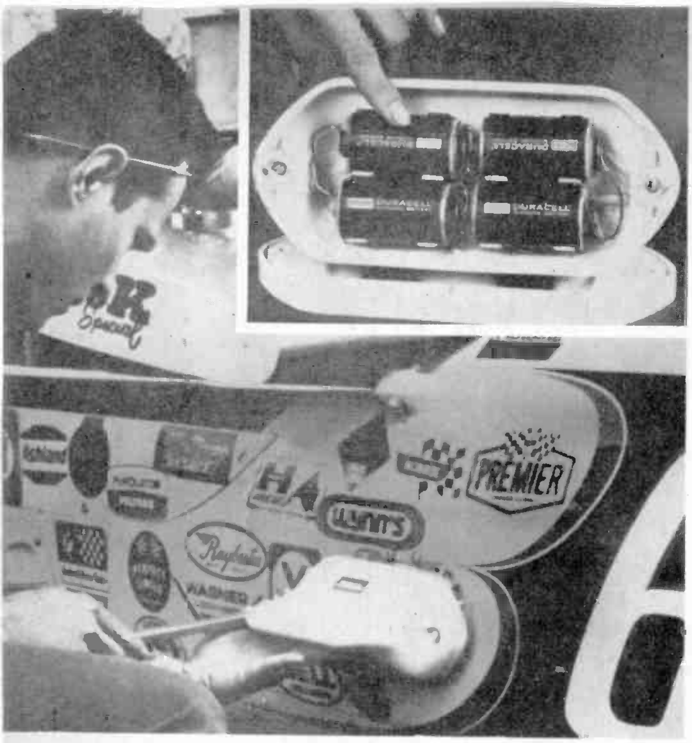


Fig. 3. Component layout on T-Dec. Small Terry clips connected back-to-back are used for aerial retention



Racing Car Data Display

MINIATURE, battery powered transmitters, fitted to the sides of racing cars, are being used for the first time in America, to increase spectator interest. They give instant, continued information on the position of every car on the track.

Underground sensors at the track—Ontario Motor Speedway, California—enable the transmitters accurately to "fix" the car's position at all stages of a race. The transmitters feed this information direct to a computer which evaluates it, prints out the race order, and relays the race data direct to visual displays on three 60 foot pylons.

The radio transmitters used in this revolutionary scoring system rely upon the power provided by four 1·5V Mallory alkaline batteries (left).

The innovation has proved so popular with spectators that the track organisers now plan to install an additional and even more sophisticated display—a mammoth animated sign which gives times, laps, car numbers and other digital information.

Unfortunately electronics does not always keep everybody happy. Used on the race track it has information and entertainment value and probably upsets or inconveniences nobody, however a slightly different application—still relating to cars—and many motorists get hot under the collar and start writing letters to magazines and the police about unfair and unashamed trickery. The application is of course the radar speed meter and no doubt many readers will be interested to know that an improved version has recently been announced by Shorrock Developments Ltd., part of the Hawker Siddeley Group Ltd. (see below).

Above: A transmitter being fitted to a racing car
Below: One of the 60 foot display pylons

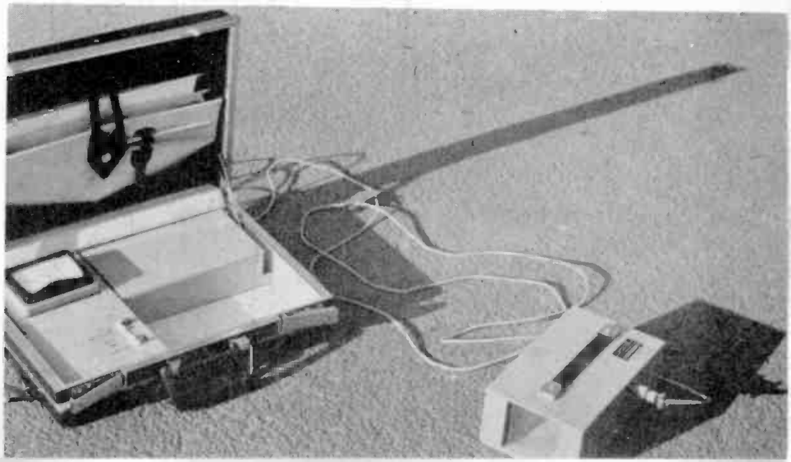
ELECTRONORAM

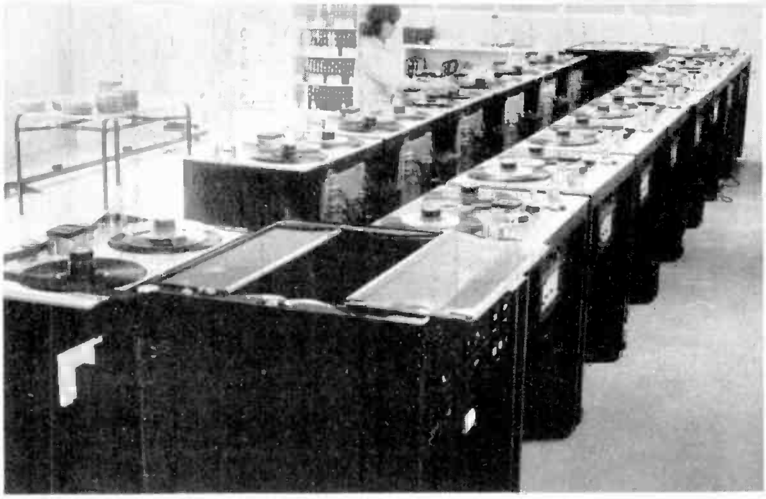
New Sh(orr)ock for Fast Drivers

The Shorrock microwave radar meter has two advantages over equipment at present used by the police: firstly, it is about two-thirds cheaper; and, secondly, it is much less obtrusive.

The Shorrock equipment is contained in a standard document case, weighing 20lb (9kg) complete. For use, the radar head is left at the roadside and a cable is run to the document case which can be used from a car parked in a side turning or other *comfortable* site. Power is provided by two 9V dry batteries and calibration can be carried out using the tuning fork provided.

More than 40 county authorities are using Shorrock speed indication equipment and police forces are showing interest in it.

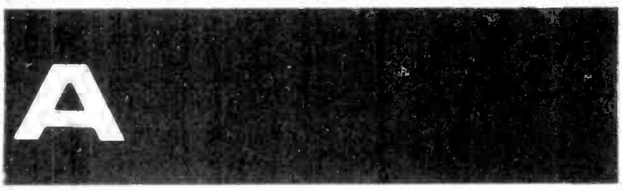




Quietened noise on Musicassettes

DECCA 8-track stereo Musicassettes are now in full production at the Company's own factory at Bridgnorth and made exclusively from master tapes utilising the Dolby "A" noise reduction system which produces a significantly improved signal to noise ratio. It is claimed that these Musicassettes offer the best quality of sound now available on this format and that this single factor will be one of the most significant selling points.

The tape duplicating equipment consists of two mother reproducers (also known as "master machines"), two loop bins and 13 slave recorders. One mother reproducer and loop bin is seen in the foreground of the photograph.

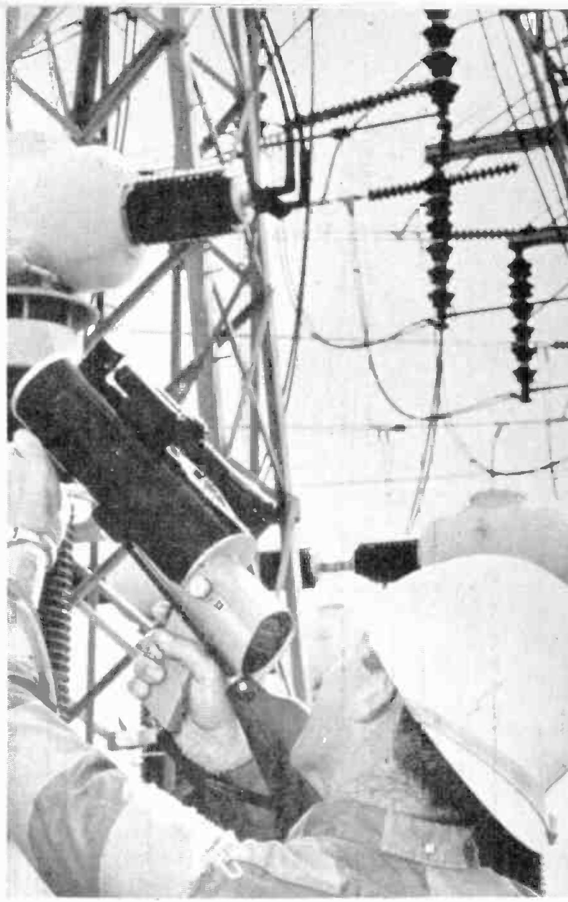


Computerised Telephone Trouble Shooter

AN aptly-named Argus computer system to watch over the reliability of the telephone service has been ordered by the Post Office from Ferranti Ltd. The Argus 500 configuration is to be installed in Leicester about the end of 1971 for trials that could lead country-wide to the faster detection of faults, further improvements of service for customers, and cost savings.

Acting as a round-the-clock trouble shooter, the £180,000 on-line computer system will monitor performance, draw instant attention to faults and impending breakdowns and alert maintenance engineers, enabling them to start repair work much sooner. Repairs will often be completed without the customers being aware that a fault has ever developed.

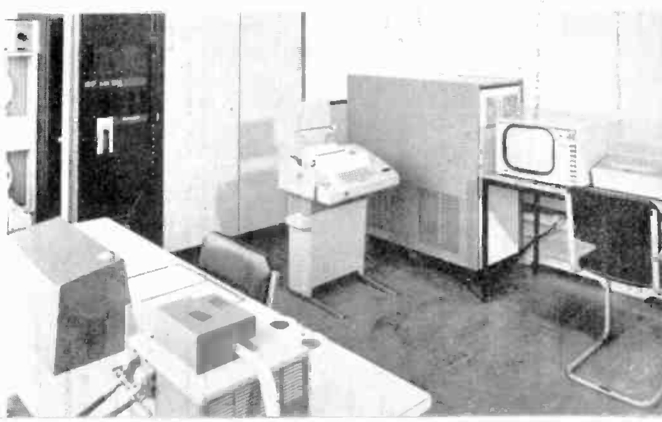
The computer will help network development staff to provide additional plant where it is needed by tracing the pattern of calls and identifying the most commonly used routes, and by keeping a constant check on the volume of calls being made. It will also analyse signals from the equipment-testing devices already used to provide engineers with information on fault-prone equipment. The computer's analysis of these tests of individual pieces of exchange will show where overhaul is needed and provide an additional safeguard against breakdown.



Infra-red Thermometer Finds Faults in Wiring

A NEW infra-red thermometer—the LR120 Raynger—has recently been announced by A. Levermore and Co. Ltd. The LR120, shown above, has many industrial uses but the prime applications are in the electricity generating and distribution industry for locating faults in overhead cable connectors, transformers, splices, etc. which show themselves by small temperature rises.

To cope with these difficult operating conditions, the Raynger, which is battery operated and completely portable, has been designed to measure temperatures between 0 and 100 degrees Centigrade above ambient, giving a resolution of better than 2 degrees. The ratio of distance to object size is 120:1, e.g. a 2 inch diameter area can be accurately measured at 20 feet distant.



Right—a typical Argus 500 configuration, this is a similar system to that to be installed at West Wigston Exchange, Leicester.

A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.
This is YOUR page and any idea published will be awarded payment according to its merit.

FUSE FAILURE INDICATOR

A SIMPLE way of giving an indication of when a mains fuse has blown is to connect a neon and its series resistance in parallel with the fuse as in Fig. 1. When the fuse is intact the resistor and neon are shorted, but when the fuse has blown they are effectively connected across the mains via the load resistance and the neon will strike.

A neat way of using a neon to indicate in a positive manner if the fuse is intact or not, is to have the neon lit steadily under normal conditions and for it to flash at a desired rate, should the fuse blow. The circuit evolved is a simple modification to an RC relaxation oscillator in which a capacitor is charged via a resistor (see Fig. 2a) until it reaches the striking voltage of the neon. At this point the neon strikes, discharging the capacitor to a level at which the neon extinguishes. The capacitor then commences to recharge and the cycle repeats, Fig. 2b.

Referring to Fig. 3, with the fuse intact, on positive half cycles current is fed to the neon and capacitor via D1, D2, R1, and R2, whose resultant resistance is such that good, even illumination of the neon takes place. Should the fuse blow, however, diode D2 is connected via the load to the neutral side of the supply and is therefore reverse biased. Current is then limited by the larger resistance R1 to give a long time constant. The capacitor takes longer to reach the striking voltage of the neon with the result that the neon flashes repeatedly drawing the attention of the operator to it. One advantage of this circuit is that the neon will flash irrespective of the load resistance, whether it is open or short circuit.

The flash rate can be adjusted by altering the value of either C1 or R1, but if R1 is altered then corresponding alterations will have to be made to R2.

One point to notice is that as C1 is charged to the striking voltage of the neon, the diodes should have a peak inverse voltage rating greater than peak mains plus this striking voltage.

S. J. Forrest,
Witney,
Oxford.

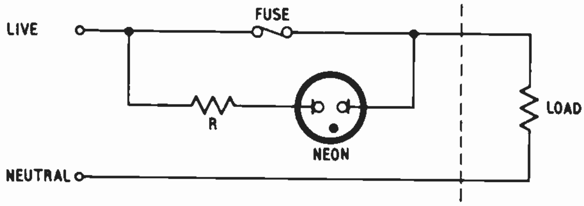


Fig. 1. Simple fuse failure circuit diagram

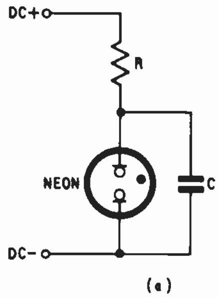


Fig. 2a. Circuit diagram for a flashing neon indicator

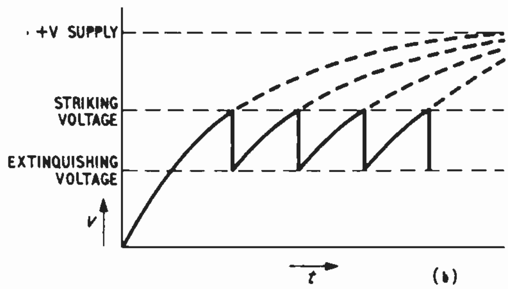
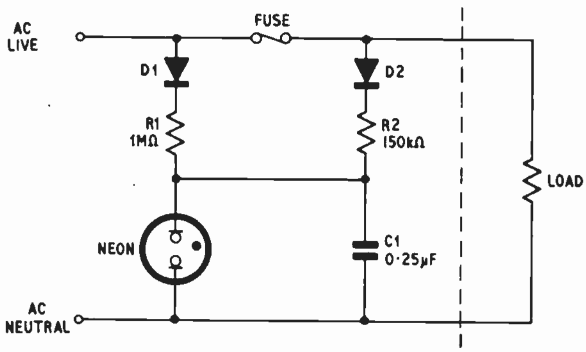


Fig. 2b. Graph showing the effect of the capacitor on the voltage across the neon



FLASH RATE FOR VALUES GIVEN = APPROX. 2 PER SEC

Fig. 3. Final circuit diagram for the flashing neon version of the fuse failure indicator

LINEAR SCALE OHMMETER

I ENCLOSE a circuit for a linear scale ohmmeter which may be of interest to your readers.

The circuit diagram Fig. 1a consists of a constant current generator TR1 and TR2, and a high input impedance meter driver TR4. A constant current is sent through the unknown resistor R_x and the voltage across it measured. Transistor TR3 compensates for the V_{be} drop across TR4. The current is set by varying potentiometer VR1, which can be replaced by several resistors to give switched ranges, Fig. 1b.

On setting up, a one per cent resistor of value equal to the desired f.s.d. is used as R_x and VR1 is adjusted to give full scale deflection. The meter will then read any value resistor in that range as a linear proportion of full-scale.

For very high ranges, the single emitter follower should be replaced by a two-stage circuit as shown in Fig. 2. In theory there is no limit to the range, but in practice, components limit the maximum range.

The advantages of this circuit over conventional linear ohmmeters is that a cheap meter can be used, and the unit is accurate over a wide range of temperatures.

Ian R. Hornby,
Timperley,
Cheshire.

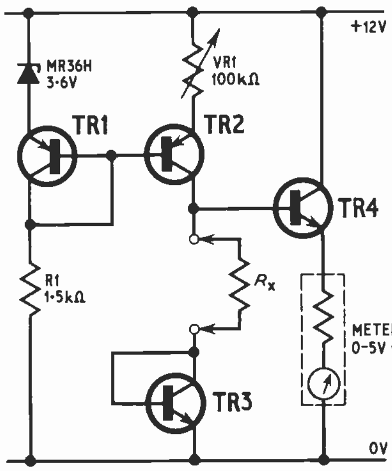


Fig. 1a. Circuit diagram of the linear scale ohmmeter

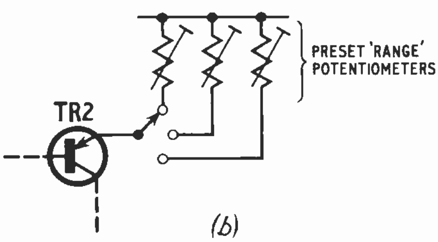


Fig. 1b. Adding a switched range

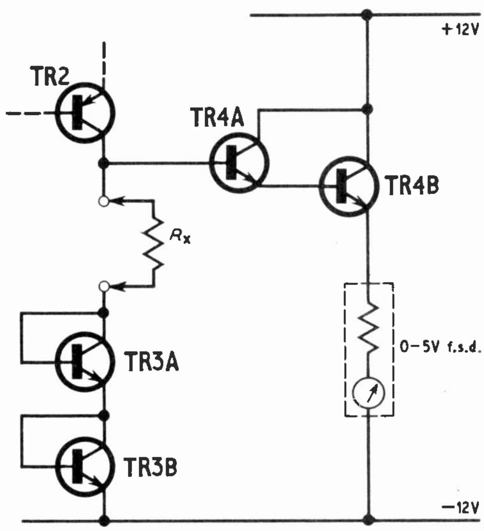
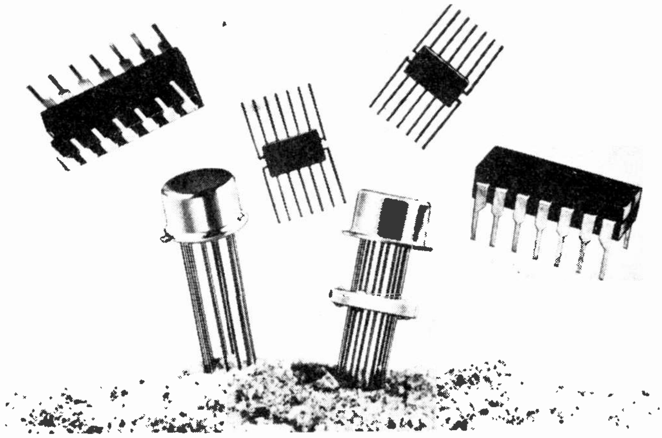


Fig. 2. Two-stage version for very high ranges

MAKING THE MOST OF LOGIC IC's



PART NINE—By R. W. COLES
MEDIUM SCALE INTEGRATION

All monolithic i.c.s start off as discs of silicon, an inch or so in diameter, on which may be built several thousand simple gates. We have already seen that by connecting together gates only, it is possible to build many different types of flip-flop, and by connecting together flip-flops it is possible to build counters and shift registers.

It is only a short step from this line of reasoning, that counters and shift registers could be built at the i.c. processing stage, by joining together a large number of gates to produce the logic required. This is, in fact, how MSI devices are built.

BASIC MSI CONCEPT

A chip of silicon cut from the disc and containing around 30 gates, has a layer of metal deposited as an interconnection pattern, perhaps to form a four stage binary counter. The finished chip is mounted on a lead frame and packaged in the usual way as there are no space problems to worry about.

A dual-in-line pack is vast compared with the silicon chip it contains, whether it forms a flip-flop or a counter. The limitation to this process comes only with the restricted number of lead-outs the standard package can accommodate, not the size of the chip it can contain.

Fortunately the lead-out problem is not as severe as one might imagine, because most of the interconnections required to produce a complex function device are performed internally. Only the essential inputs and outputs are required to see the light of day.

What does this process do to help the designer or experimenter? The most obvious effect is the reduction in cost, a decade counter built using separate gate and flip-flop packages could cost in the region of £3 10s (£3·5), whereas the same function can be obtained from the MSI range for about £2. The number of packages in this example is reduced by a factor of three, another very important saving.

Using MSI, it is possible to think in terms of counters as building blocks instead of just flip-flops. The design of this larger block has already been carried out by the manufacturer, so a system is much easier to design, or it may be more complex for the same design effort.

All these things add up to an impressive list of advantages, which can be put to good use by the amateur constructor.

BUILDING BLOCKS

TTL complex functions are contained in the usual 14- and 16-pin dual-in-line packages, and their equivalent in the flat-pack range; there is no external difference apart from the way the pins protrude. The inputs and outputs are completely compatible with the rest of the family, and usually employ the same type of circuitry.

However, the gates used inside the package are sometimes different in construction, because internal gates may not need the fan-out capability of others which have to drive external circuits. It is not intended here to go too deeply into the internal workings of MSI devices; earlier articles have already described the individual circuits in the TTL range.

We need only treat them as the useful building blocks that they are.

MSI COUNTERS

Several different counters are available in the 74 series, each of which may be used for many different jobs and connected in several different configurations. Let us have a look at a typical example, the 7490 decade counter, which is shown in Fig. 9.1.

This counter, like the others in the series, is a ripple type, made up of four master/slave flip-flops; three of them are JK types and one a set/reset. It consists of two separate sections, a divide-by-five stage and a divide-by-two stage, which may be externally interconnected to give two different count modes, depending on the application.

The asynchronous flip-flop inputs are connected to two internal NAND gates which, when enabled, allow the counter to be reset either to zero (0000) or nine (1001).

If the count input is connected to the divide-by-two input, and the output of flip-flop A is connected to the divide-by-five input, the counter will count in the binary coded decimal code, as shown in the truth table in Fig. 9.1a. In this mode the counter behaves as a normal four-stage binary counter until it reaches the count of nine; the next clock pulse sets the counter to the all zeros state.

This type of counter is employed when the outputs have to be decoded to drive indicator tubes, for instance in a frequency counter, or integrating digital voltmeter.

The secondary count mode is obtained by connecting the count input to the divide-by-five input, and the output of flip-flop D to the divide-by-two input, in effect causing the output of the divide-by-five counter to be divided by two, the opposite of the first count mode.

The truth table for this type of count is also shown in Fig. 9.1b, and it can be seen that the divide-by-ten output is taken from flip-flop A as a symmetrical waveform, up for five counts and down for five counts. This kind of count code is generally called the 1245 code, and is useful where these counters are used just as frequency dividers, for instance in frequency synthesisers.

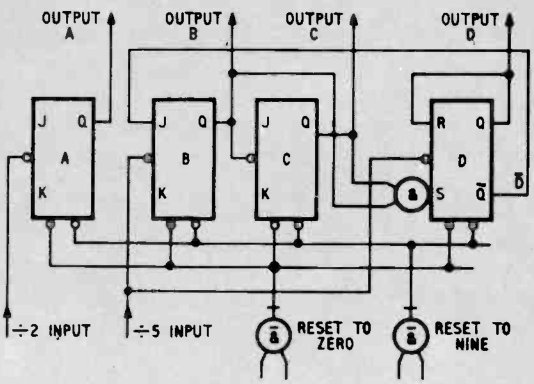
These counters may be used to divide by numbers less than ten by using the reset gates to detect the desired final count plus one, and reset the counter to 0000, or even nine, at this time. Any division by less than ten is possible, and an application is shown in Fig. 9.2, where a 7490 is used as a divide-by-six counter.

The other two counters in the series are similar to the 7490, but have a divide-by-six and divide-by-eight section respectively, instead of the divide-by-five of the 7490. They also do not have the facility of nine reset, only the zero reset is included.

MSI DECIMAL DECODERS

Very often, the output of a decade counter is required to be decoded to the "one-of-ten" decimal equivalent of the binary count, in order that it may be displayed on some form of indicator. It is not surprising then, to find that the 74 MSI range contains several circuits which are capable of achieving this.

As an example let us look at the 7441 decoder/driver package. The 7441 takes a four-line binary coded decimal input word, and by means of gates and inverters, decodes this information into its decimal form, giving ten separate outputs. The outputs in this case are not designed to drive other logic gates, but to drive neon number indicating tubes such as "Nixies".



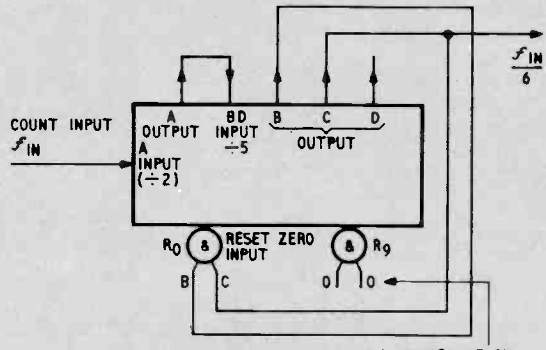
(a)

COUNT	OUTPUT			
	A	B	C	D
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

(b)

COUNT	OUTPUT			
	D	C	B	A
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	0	0	0	1
6	1	0	0	1
7	0	1	0	1
8	1	1	0	1
9	0	0	1	1

Fig. 9.1. The SN7490 decade counter with truth tables for (a) binary coded decimal (b.c.d.) count mode and (b) symmetrical ÷ 10 mode



COUNT	OUTPUT			
	A	B	C	D
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
	0	0	0	0

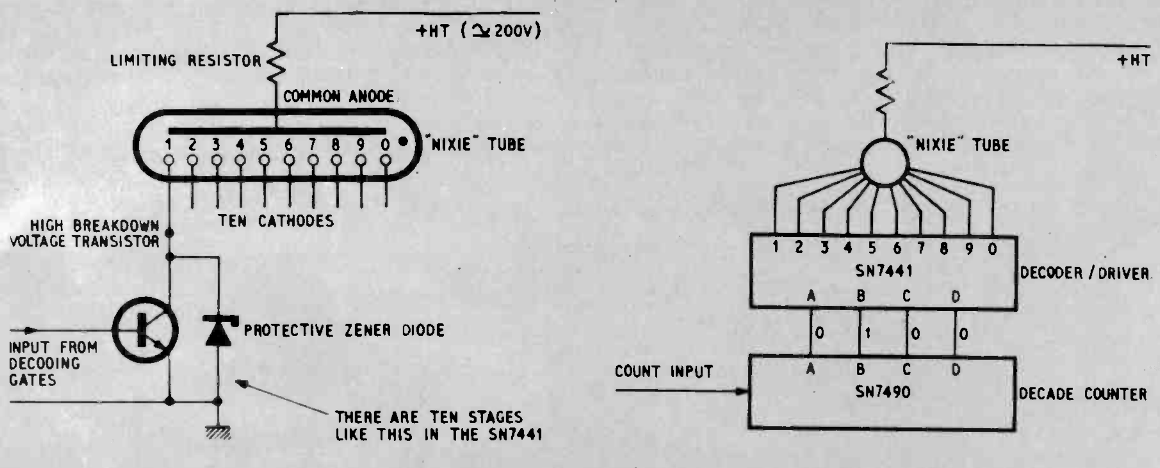
AS SOON AS THIS COUNT APPEARS COUNTER IS RESET TO ZERO THEREFORE IT IS ONLY A TRANSIENT STATE

Fig. 9.2. The SN7490 used as a ÷6 counter with truth table

This type of indicating tube uses ten separate cathodes, each in the shape of a decimal character, and a common anode. The anode is connected, through a limiting resistor, to an h.t. supply of the order of 200 volts. When a particular cathode is grounded the number it represents is illuminated by the ionisation of the neon gas surrounding it.

Fortunately, it is not necessary to use transistors which will stand 200 volts on their collectors to drive these tubes, because reducing the voltage across them by only (say) 50 volts is sufficient to extinguish them, as this reduces the total voltage to below the "striking" potential.

In fact, the output transistors of the 7441 will withstand at least 55 volts, and to ensure that this rating is not exceeded a Zener diode is connected from collector to ground. The basic idea of the output circuits used with these i.c.s is shown in Fig. 9.3.



(a) The final stage of each decoder in the SN7441 is connected to the cathode of a numerical display tube

(b) A count input frequency to decade counter SN7490 is processed through decoder/driver SN7441, which converts binary code to decimal for driving a "Nixie" display tube

Fig. 9.3. MSI used to drive a cold cathode display

To drive the ten output stages the four line binary word at the input to the 7441 has to be decoded by appropriate gating, and to carry out this decoding correctly, complementary information is necessary, i.e. A and NOT A, B and NOT B, etc. The generation of the inverted form of the input word is carried out internally, which makes things much easier, as only the true information needs to be supplied.

There is no doubt that this i.c. represents excellent value for money when compared with any of the possible discrete approaches. Even if i.c.s were employed to perform the gating, the price of ten high breakdown transistors would be more than a single 7441, which is a fraction of the size.

Fig. 9.3b shows the 7441 being used to decode the output of a 7490 decade counter, which has reached a count of two. This could represent one stage of a frequency counter.

Many other types of decoding may be performed with the large range of circuits available in the 74 series. Some have the standard TTL output stage, others will drive incandescent lamps. Some will even drive seven segment display systems, and in these, more than 35 separate gates are employed.

MSI ADDERS

Adder circuitry, as we have already seen, is fairly complex, and now that computers are growing faster and faster, the use of parallel arithmetic is increasing, bringing with it a demand for large numbers of separate "full-adder" blocks.

The 74 MSI range offers three separate types of full-adder. The one which is, perhaps, most interesting is the 7483, so let us have a closer look at this one as an example.

The 7483 has four complete full-adders crammed into one 16-pin dual-in-line package. Because it is intended for use in parallel addition computers, the carry line is internally connected between the four adders, making it possible to add two four-bit numbers together in less than 50ns.

There are A and B inputs to each adder, with a single carry input to the first stage, and a single carry out from the fourth stage; four separate sum outputs are provided.

The logic of the 7483 is shown in Fig. 9.4; it is left to the interested reader to work out the truth table of the entire system, which will be in line with that given with the discrete-gate version in the section on gates.

Readers may think that it is unlikely they will be building a parallel arithmetic computer in the near future, and so this particular i.c. is of little interest, but a

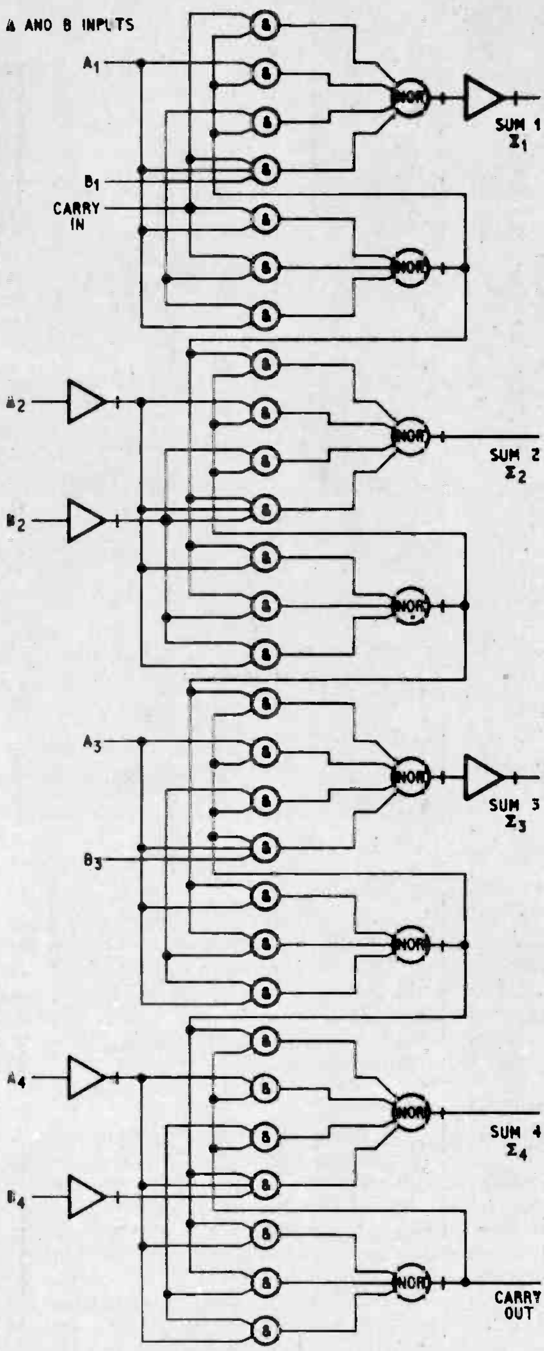


Fig. 9.4. Quad adder type SN7483 logic diagram. A total of 90 transistors, including multi-emitter versions, are incorporated in this one package with 10 diodes and 70 resistors

package such as this could come in handy for all sorts of uses, apart from computer arithmetic.

Counters of a most useful type can be built using this package in conjunction with a shift register. Counting is, after all, just the repeated addition of one to the contents of a store. Counting down requires the subtraction of one; both operations are made simple with these adders.

If the carry input is grounded, and two changing words applied to the A and B inputs, the four sum outputs will only go to a 1 when the two input words are exactly opposite, or complementary. By feeding the sum outputs to a 4-input NAND gate, a four bit non-equivalence gate emerges using only one and a half packages, a useful device indeed which can be better appreciated by looking at Fig. 9.5.

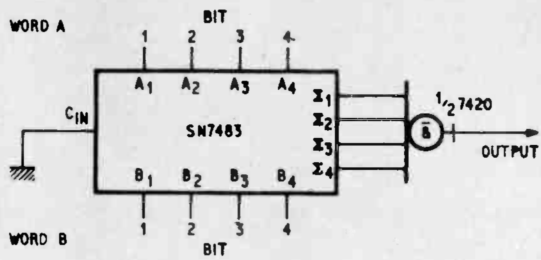


Fig. 9.5. Using the SN7483 as a non-equivalence array. By using inverted data for one of the words, this array will detect equivalence instead. The output goes low only when the two input words are exactly complementary

The other adders in the series are the 7480 single-bit and the 7482 double-bit devices, both of which have greater versatility than the 7483 due to the extra pins available on the package.

MSI SHIFT REGISTERS

Several types of shift register are available in this series, and between them they cover almost all the likely applications. All the shift registers use RS master/slave flip-flops, but because the clock input to these devices is buffered, and therefore inverted, they shift data on the positive edge of the input clock.

As all these registers have different applications and we have already gone over basic principles in the TTL flip-flop section last month. It is only necessary here to have a brief look at them all. The block diagrams and package layouts are shown in Fig. 9.6.

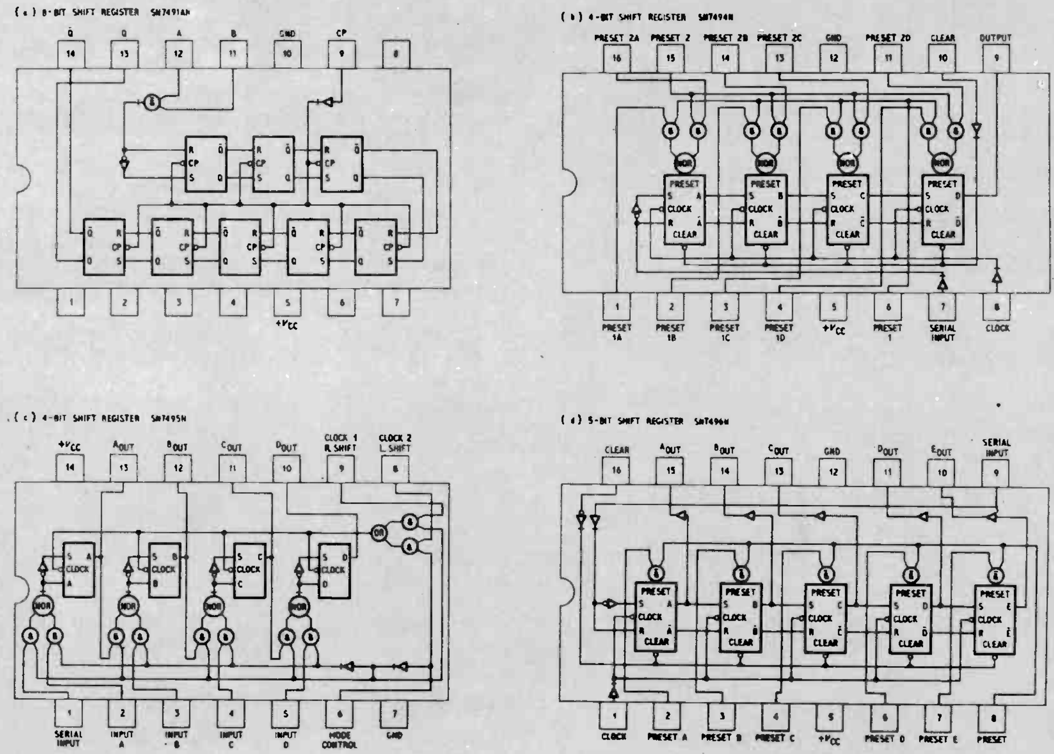


Fig. 9.6. ***Package diagrams of 74 Series shift registers***

7491 *Eight-bit Register*

The 7491 is an eight-bit serial register, and information must be both inserted and withdrawn serially, as no individual inputs or outputs are available from the separate flip-flops. As with the other registers the clock input is buffered and therefore represents only one load. Data input gating is provided allowing "input enable" logic to be performed.

7494 *Four-bit Register*

This register is organised as a dual source parallel to serial converter, data being entered by means of the asynchronous inputs. Two preset enable inputs allow the data to be entered from either of the two sources, through four AND-OR-INVERT gates. The common clock and clear lines are buffered, and a serial input is provided.

7495 *Four-bit Register*

The 7495 is a versatile register which has both parallel inputs and outputs provided. Parallel entry is synchronous, and is entered through AND-OR-INVERT gates which are controlled by the mode control input. When the mode control input is low, the register will shift data serially, from left to right.

Separate clock inputs are available for the two operational modes, and these are again controlled by the mode control input. By using external gates it is possible to make this register shift in both directions, i.e. right to left or left to right.

7496 *Five-bit Register*

The 7496 is similar to the 7494 except that asynchronous data can be entered from only one source, but parallel outputs from each flip-flop are available. A preset enable input is provided. As all inputs and outputs are available from each stage parallel/serial, parallel/parallel, serial/parallel and serial/serial operation may be employed.

VERSATILITY

As can be seen, these shift registers leave little to be desired in the way of versatility, and of course by cascading several of them it is possible to build a register of any length which may be required. Apart from their use as storage devices it is also possible to build counters of various kinds, including the Unitary and Johnson types.

We have, in this brief introduction, only scratched the surface of the series 74 MSI, but the examples examined should set many an inventive mind buzzing, and there is really no reason why simple computers should not be designed by amateur constructors, using these devices, almost all of which are now available from advertisers in this magazine.

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400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·23	0·34	0·45	1·85
800	0·10	0·17	0·13	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·15	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·33	0·57	0·75	—

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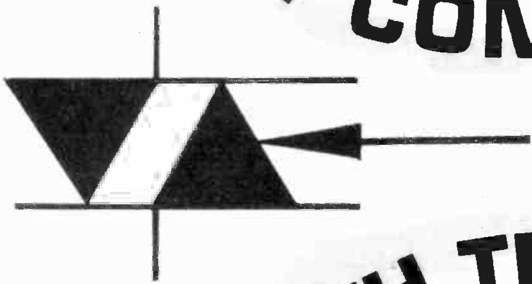

BY W. WILLIAMSON

TRIAC is the name used to identify the triode a.c. semiconductor bidirectional switch. It is basically two reverse blocking triode thyristors or silicon controlled rectifiers connected in inverse parallel, but with a common control electrode (gate). As the triac is a development of the thyristor, it is logical to describe this first and then compare with the triac to show the advantages and disadvantages of both devices.

REVERSE BLOCKING THYRISTOR

The thyristor is a four-layer semiconductor device which has two stable states, one being the conducting state and the other the non-conducting state. The characteristics are shown in Fig. 1.

In the forward blocking region, i.e. when the anode is positive with respect to the cathode, an increase in the voltage across the device has little or no effect on the leakage current until the forward breakover voltage is reached. Increasing the voltage past this point causes the current through the device to increase rapidly, and the voltage across it to fall to about a volt.

The device is now in the conducting state and will remain in this state providing the anode current is above a certain minimum value known as the holding current. If the current through the device falls below the holding current, the device again reverts to the non-conducting state.

If the voltage across the thyristor is increased in the reverse direction, only a small current flows until the voltage reaches the reverse avalanche region where the anode current increases very rapidly and may destroy the device.

Looking again at Fig. 1, we can see that as the gate current I_g is increased, the breakover voltage is reduced. If the gate current is high enough, the device will act like a rectifier.

Normally the thyristor is used in applications where the voltage across the device is well below the forward breakover voltage and is triggered into the conducting region by increasing the gate current. This method requires only small gate currents to switch large anode currents and is therefore the most useful method of turning the device on.

Once the thyristor goes into the conducting state, the gate has no control, and the device continues to conduct, therefore the gate current may be removed as soon as the device is turned on. This typically takes 20μs, and so a fast pulse can be used for triggering.

TRIAC

The characteristics of the triac are shown in Fig. 2.

From the characteristics it can be seen that the triac operates like the thyristor, but can breakover into the conducting state for either polarity of applied voltage. The triac, like the thyristor, can be triggered into the conducting state by a gate signal, but unlike the thyristor it can be triggered by a positive or negative gate signal. Thus the triac has four possible modes of operation within first and third quadrants of current/voltage characteristic:

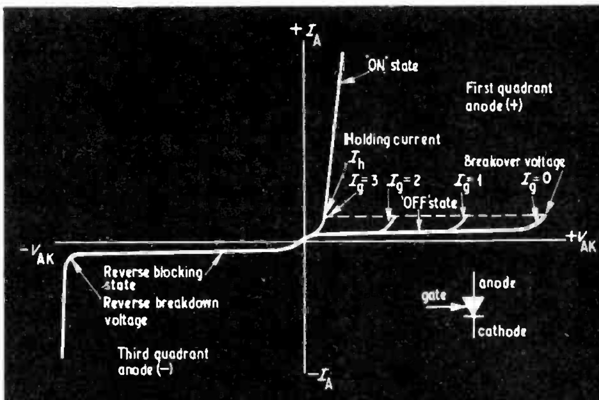

Fig. 1. Voltage current characteristic of a reverse blocking triode thyristor and circuit symbol

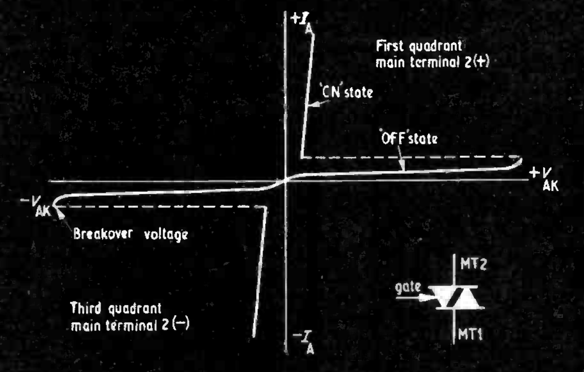

Fig. 2. Voltage current characteristic of a bidirectional triode thyristor or triac and circuit symbol

I(−) MT2 positive and gate signal negative with respect to MT1
I(+) MT2 positive and gate signal positive with respect to MT1
III(−) MT2 negative and gate signal negative with respect to MT1
III(+) MT2 negative and gate signal positive with respect to MT1

MT1 and MT2 are "main terminals 1 and 2" and used in place of cathode and anode, because the device conducts in either direction.

With no gate signal, the triac blocks in both directions so long as the voltage across it remains below the breakover voltage. If the voltage does exceed the breakover voltage, the triac turns on, and providing the current through it is limited to a safe value, then the device is unharmed, unlike the thyristor which may be damaged by an excessive reverse voltage.

Once in the conducting state, the triac will remain so until the current through the device is reduced to less than the holding current, and only then will the device turn off.

If the voltage applied to a triac is reversed in a very short time, then the triac, instead of turning off as the thyristor would do, merely turns on in the opposite direction. In order to ensure that the triac turns off reliably, it is necessary to reduce the current through it to below the holding current for a period of time before reapplying a voltage. This limits the frequency of operation of the triac to somewhere over the 60Hz mark, but as the main use for the triac is in 50Hz and 60Hz control circuits, this is not a serious limitation.

TRIGGERING

The triac may be triggered into conduction by either d.c., a.c. or pulsed signals applied to the gate. If d.c. is used, the voltage must exceed about 3V, but the power in the gate circuit must be limited.

An example of d.c. triggering is shown in Fig. 3. This type of circuit is useful for switching large currents using a low current switch.

A.C. triggering is perhaps the most useful method to use for a.c. mains power control, because the gate signal is synchronised from the controlled supply. An example of a.c. triggering is shown in Fig. 4.

TRIGGER DIODE

A.C. triggering may also be achieved by using a bidirectional trigger diode (diac), the characteristics of which are shown in Fig. 5.

From these characteristics it can be seen that the device has similar properties to that of the triac, but because the negative resistance portion of the characteristic extends over the whole operating range the device does not latch into the conducting state. A typical breakover voltage for the trigger diode is ±30V.

An example of a circuit using a trigger diode and triac is given in Fig. 6. More will be said about this type of circuit later.

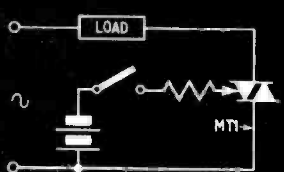

Fig. 3. Simple d.c. triggering for a triac

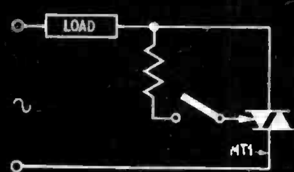

Fig. 4. Synchronous a.c. triggering for a triac

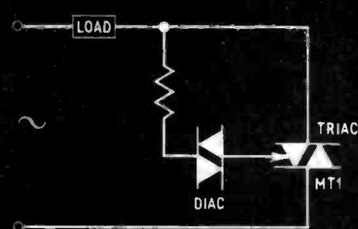

Fig. 6. A diac used for synchronous a.c. triggering of a triac

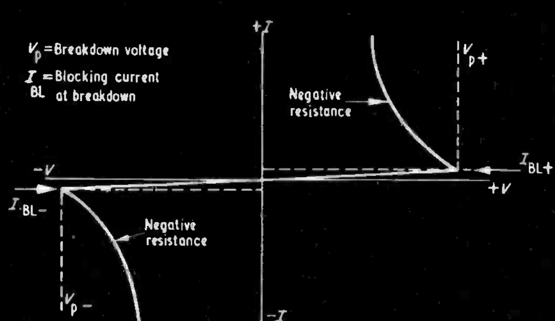

Fig. 5. Voltage current characteristic of a bidirectional trigger diode or diac

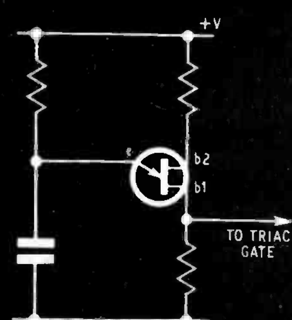

Fig. 7. Relaxation oscillator with a u.j.t. for triggering a thyristor or triac

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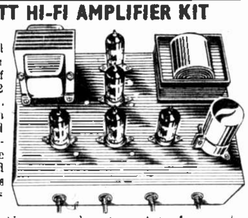

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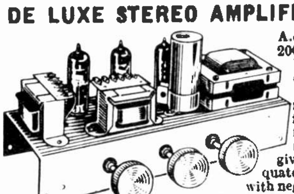

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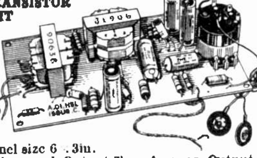

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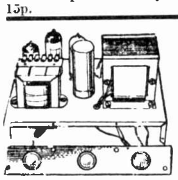

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4·75.** P. & P. 30p.

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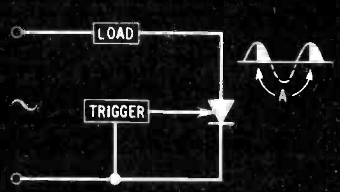

Fig. 8. Phase control triggering of a thyristor

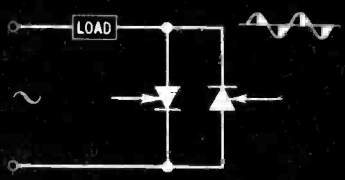

Fig. 9. Phase control triggering of two thyristors back to back in inverse parallel

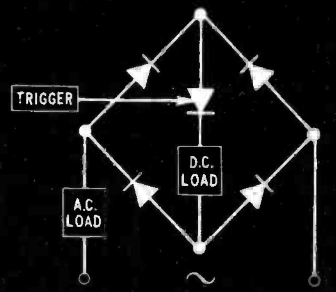

Fig. 10. Full wave phase control with a bridge rectifier arrangement

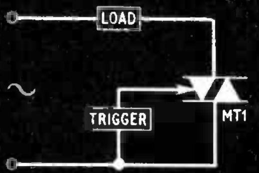

Fig. 11. Simple full wave control of a triac with a trigger circuit

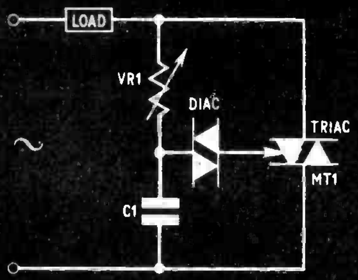

Fig. 12. Simple triac phase control

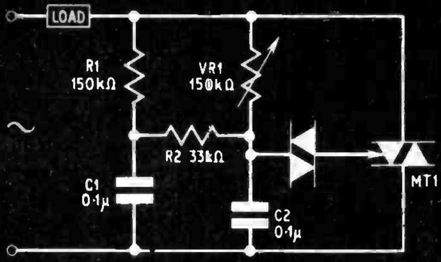

Fig. 13. Obtaining smooth power control of a lamp with two timing circuits

UNIJUNCTION TRANSISTOR TRIGGERING

The third type of triggering mentioned is pulse triggering and this is sometimes achieved by using a unijunction transistor. The basic u.j.t. relaxation oscillator used for triggering purposes is shown in Fig. 7.

There are many other methods of triggering thyristors and triacs such as pulse transformers and neon lamps, but the last few examples illustrate the main methods of triggering.

The most common applications for the triac is in motor speed control, heater control, or light dimming.

By using the triac instead of the thyristor, a considerable saving in components may be made.

This coupled with the fact that the triac is less expensive than using two thyristors makes the triac very attractive indeed.

PHASE CONTROL

In the majority of domestic controllers, such as lamp dimmers, phase control is used to vary the brightness. In phase control, current from an a.c. supply is connected to the load for part of each cycle. The length of time during each cycle for which the current is connected to the load, determines the amount of power dissipated in the load. Therefore if the load is a lamp, then the brightness of the lamp may be varied.

Using a thyristor for phase control, as in Fig. 8, we can achieve half-wave control, i.e. only positive half-cycles are controlled, negative ones being blocked by the thyristor. If the thyristor is triggered at point A in Fig. 8, then the white portion of the waveform represents the power supplied to the load. Thus if the triggering point is moved to a point earlier in each half-cycle, then more power will be dissipated in the load, and vice versa.

FULL WAVE CONTROL

If we use two thyristors, as in Fig. 9, then we can achieve full-wave control, one switching the positive half-cycles and the other switching the negative half-cycles. Unfortunately this method requires insulated gate signals for the two thyristors, which is commonly achieved by using pulse transformers in the gate circuits.

Yet another way of achieving full-wave phase control using a thyristor is illustrated in Fig. 10. This circuit has the great advantage that it may be used for controlling a.c. or d.c. loads, but for purely a.c. control it is an expensive method as it requires four diodes with a high p.i.v., and a current rating equal to that of the load.

By far the most simple and reliable method of full-wave a.c. control is the circuit shown in Fig. 11. This circuit uses a triac as the controlling element and requires only a simple trigger circuit to make it function.

The simplest practical triac phase control circuit is shown in Fig. 12. This circuit is extremely economical as it uses only four components, the function of which are as follows. VR1 and C1 form a phase shift network, the amount of phase shift varying with the setting of VR1.

When the voltage on C1 exceeds the breakover voltage of the diac, it conducts and C1 is partially discharged into the triac gate. The triac is triggered into conduction for the remainder of the half-cycle.

Unfortunately this simple circuit has a limited range of control the load current jumping from zero to some intermediate value as the control is advanced and only then may be controlled smoothly up to full power. This effect may be reduced by using a circuit with a double time constant as shown in Fig. 13, giving very smooth power control.

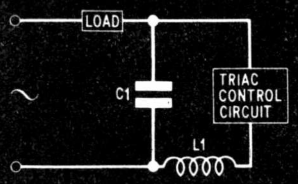

Fig. 14. Simple suppression of r.f. interference

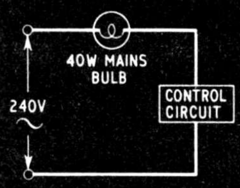

Fig. 15. The dimmer circuit in Fig. 13 is connected in series with the load

INTERFERENCE SUPPRESSION

In thyristor and triac control circuits, the load current rises from zero to maximum in a few microseconds. This sharply rising current causes radio frequency interference to be generated, which can cause great annoyance on the a.m. bands. Fig. 14 shows a very simple method of interference suppression.

A small inductor of a few microhenries is used to slow the rate of rise of current, but if used on its own, the interference can still be sufficient to be annoying. The addition of the shunt capacitor C1 further reduces the interference to negligible proportions for domestic applications.

TRIAC LAMP DIMMER

The circuit given in Fig. 13 can form the basis of a triac lamp dimmer which can be fitted behind a wall switch plate, giving continuously variable light control. It is advisable to incorporate the suppression shown in Fig. 14 to reduce interference, starting with component values of $0{\cdot}1\mu F$ for C1, and adjusting for the best results, with an r.f. choke rated at a minimum of 2A. This choke could be made by winding about 40 turns of thin single core p.v.c. connecting wire on a ferrite ring core or rod.

The triac should be rated at a minimum of 400V p.i.v. 3A for domestic lamp dimming. There are several available that would suit the purpose; the author used a General Electric type SC35D in conjunction with diac type ST2. Some readers may prefer to try a quadrac which incorporates a triac and diac in one encapsulation.

The triac is mounted on a small "L" shaped bracket which is mounted on to a small component board. No difficulty should be experienced in constructing the unit and providing care is taken, the unit is perfectly safe.

The potentiometer may be wired to give full brightness immediately the switch on the potentiometer goes on, and then dim the light as the control is advanced, or to give minimum brightness rising to maximum as the control is advanced. The triac should be rated to withstand initial surge of current which occurs due to the cold filament, when the lamp is first switched on.

CHECKING AND FITTING

When the circuit has been wired up, the circuit may be tested by wiring it in series with a mains bulb and connecting these across the mains as in Fig. 15. The control should give smooth flicker-free control of the lamp up to full brightness, and the lamp should be extinguished by the switch.

Before fitting the dimmer, it is wise to wrap a piece of heavy polythene around the circuit to ensure that nothing shorts to the metal switch box. It may be found that the switch box is too shallow for the body of the potentiometer. If this is the case then it will be necessary to obtain a deeper box from an electrical shop.

After fitting the unit, the mains should be reconnected and the unit tried out. If everything has been carefully insulated, then no trouble should be encountered.

This dimmer should only be used with incandescent filament lamps rated at 230–250 volts a.c. 50Hz. The lamp power should not exceed 500 watts. Fluorescent lights are not suitable. ★

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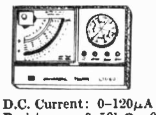
C.1050 MULTI-TESTER



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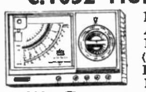

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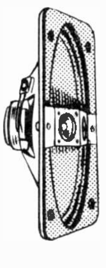

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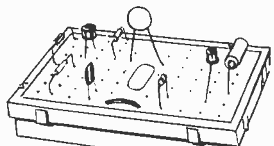

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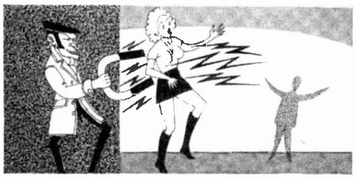
ON THE FRINGE



Exsanguinated

There I lay, exchanging platitudes with this bright young nurse, as 450 odd milligrams of my life-blood trickled into some remote bottle. Would it, I wondered, be converted direct to plasma, or perhaps help to save some drunken driver's neck the following week-end. As I, somewhat mechanically, continued with the conversation my mind entered a reverie of ideas about this rather wonderful stuff that we would all find it so hard to do without.

Blood is supposed to contain a fair quantity of iron, I mused. Could it be magnetic? It is difficult to remember ever having sufficient amounts of it to experiment with and, in any case, not being charged with the motive to become a second "Dracula", had never really given such matters another thought!

Nevertheless, it now occurred to me that if, indeed, blood was magnetic (or perhaps, more likely, magnetically susceptible), the possibilities could be quite awe-inspiring. For example, the earth's magnetic field might have some influence on the flow of blood around our systems, and what about the effect of stray fields from transformers and the like? The effect on the capillary action of the smaller blood vessels could be quite dramatic could'nt it? Surely, I told myself, things were getting out of all proportion.

Not to be deterred, I changed tack slightly away from the gory path, and began entertaining thoughts about the chances of inducing currents in the nervous system through similar agencies. "Do you think", I butted into the, now one-sided, conversation, "that it would be a possibility to influence the brain with magnetic fields?". As you may imagine, the nurse knew little more about what I was talking about than I did, and she replied in a hushed whisper, as though to one demented, "You've nearly given your pint, I 'spect you'll feel better after your tea 'n biscuits".

Putting an optimistic face on the situation and dropping back onto my pillow, I lapsed into day dreaming again. Electric currents can be induced in copper wires, so why shouldn't the same apply to the effects of magnetism on liquids.

Subtle influence

If such really is the case this could mean that, quite unbeknown to us, magnetic fields might have some kind of modulating influence upon certain parts of the body and, who knows, perhaps even modify our very thoughts in certain subtle ways!

No, this was too much to accept in one go; the loss of blood must obviously be having its effect I considered, so decided to re-examine the idea later and in the meantime put up with the good-natured ministrations of my N.B.T.S. attendant.

Two months later I was chatting with an old friend of mine, a librarian, about this rather crazy idea of mine and, would you believe . . ., he referred me to a paper written only a couple of years or so ago about the effect on reaction-time performance by magnetic fields! The paper concerned was pretty lengthy, so only the main import of its discussion will be given here.

Apparently, three individuals of the medical profession, and all from the Syracuse area of New York, have discovered quite a profound relationship between the difference in the time taken to react to the appearance of a light source with and without the influence of a fairly weak (5 to 11 gauss) magnetic field. Initially, the field, which was generated by a couple of 14·5in diameter Helmholtz coils placed near the head, was non-oscillatory and showed no effect.

Later, instead of a d.c. current being used to drive the coils, a low frequency a.c. signal was employed. Immediately, there appeared to be a perceptible change in the rate of response and, indeed, this was confirmed over some four groups of 50 subsequent trials. Every time the field was present a distinct increase in the reaction time occurred.

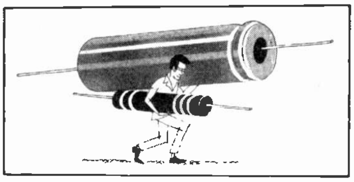
It is extremely difficult to know just what to make of their findings. One thing though is sure, never will I go out again in a magnetic storm without first donning my lead-lined crash hat!

By any other name

Only a matter of months ago I was nattering about tomatoes showing electrical reactions to the application of heat to their skins! Well it seems they are not the only ones among the vegetable kingdom to "blow their cool" in this way! The latest addition to the "psychosensitive" list is the "veg" which one would have thought held first place; it's the rose.

This time it is the Russians who have un-earthed the effect. It seems that hundreds of experiments have recently been performed at the Moscow Agricultural Academy which reveal that in addition to the rose reacting to tactile (touch) stimuli, it also displays a form of crude memory. According to *Pravda*, the Communist newspaper, the researches show that rose bushes exhibit electrical activity similar to nerve discharges observed in man!

All this has yet to be demonstrated to me; perhaps we shall be hearing a lot more of these findings in the not too distant future though.



So long

Wouldn't it be nice if we could gain access to the methods (whatever they may be) employed in man and other animals for generating huge time-constants? I mean if someone says "See you in an hour and a half", the chances are that, provided they said where, you *will* see them.

Yes, I agree, we would probably be using our watch, or maybe available clocks; who knows, we may even be relying upon the position of the sun in the sky. Assuming though that none of these methods were available, we would still feel fairly confident that the time period could be judged with a reasonable degree of accuracy. How?

Well, "hunger-pains" aside, no one is by any means certain. It could have an oscillatory principle I am told, and someone has even suggested a pulse coincidence basis.

Actually, in electronic practice, this latter idea works well for generating long time-constants; perhaps you would like to try it. Fig. 1 shows the general arrangement. An AND gate receives the outputs from two astable pulse generators, the frequencies of which are both very low and slightly different; the gate thus only returns an output when the input pulses are coincident.

With the frequencies given, only one pulse should appear at the output of the gate approximately every hour! This can be used to set a bistable or whatever application one may have in mind.

Only one problem exists with this kind of timer . . . one has to wait such a long time during the setting-up periods to establish that the correct frequencies exist!

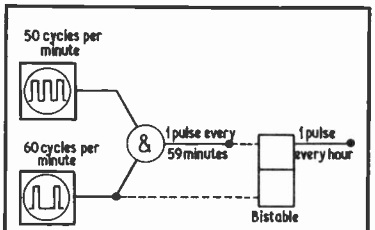
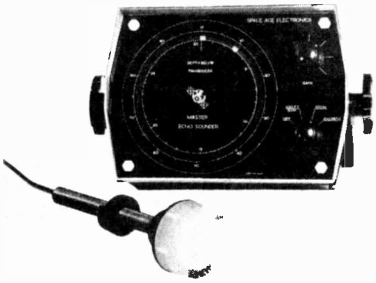


Fig. 1.

Acoustron 2-11 echo ranger and computer (above)

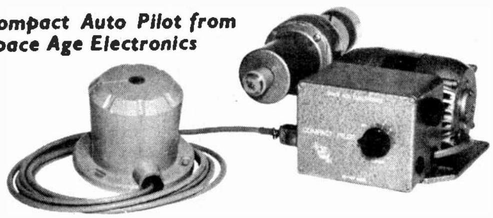
Seafarer depth sounder (right)

BOAT SHOW 1971

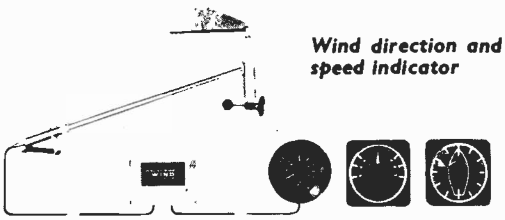


Echo sounder from Space Age Electronics

Compact Auto Pilot from Space Age Electronics



Wind direction and speed indicator



It is always interesting to note the developments in marine electronics during the past year at the London International Boat Show. Last year in our Boat Show report we noted that there were more firms displaying electronic gear and a greater range of instruments available; the same trend is repeated this year.

The advantages of solid state electronics in marine equipment were particularly evident from two new equipments, these are: the Acoustron 2-11, forward looking echo ranger and computer by Apollo Electronics Ltd., and a digital readout echo sounder by Marine Electronics Ltd. These instruments use integrated circuits to provide, compact design with clear, unmistakable readout, low power consumption and greater reliability than more conventional designs.

Acoustron 2-11 will no doubt interest almost every owner of power craft of a reasonable size. This computerised sonar uses two narrow transducer beams to probe under and ahead of the boat. The resultant echoes are used by computer circuitry to predict the possibility of grounding and to give visual and audible warning of impending danger. Warning time and depth warning can be selected as can the memory time to suit various coastlines and conditions.

LOW COST RADAR AND SONAR

Low cost is always an attraction when buying equipment, particularly if it is well constructed and has a good specification. This year has seen the first under £500 radar for small boats from Electronic Laboratories (Marine) Ltd.; the radar, called Seascan, is completely housed in two units—the scanner transceiver and the display unit. It has a working range from 25 yards to 16 nautical miles, which is covered in six switched ranges. If this radar is as popular as the Seafarer depth sounder from the same firm, and we think at the price (£450) it will be, both yachtsmen and Electronic Laboratories should be very pleased.

Space Age Electronics Ltd. are marketing what is claimed to be the world's most powerful small boat echo sounder for £35, using neon readout, and an auto pilot costing £99 that is claimed to be the world's cheapest pilot for small yachts and motor cruisers. This company is one to watch for future developments and they have said that they should be showing some interesting new instruments next year. Marine Electronics are marketing a neon echo sounder for £39 with built-in depth warning; they also sell a meter type sounder and the digital readout unit mentioned earlier.

WIND SPEED INDICATOR

New developments in equipment from Brookes and Gatehouse consist of a simplified, lightweight wind direction and speed indicator—Hengist and Horsa model C—although primarily intended for the cruising yachtsman, these models will no doubt appeal to the racing man since they are lighter in weight, more simple to use and the masthead unit will give slightly less windage.

From chatting to various stand holders, it is apparent that most of the firms are engaged in development of various new equipments and some, such as Baron Instruments and Space Age Electronics, are hinting strongly of exciting new projects next year. The added competition from new firms that have launched marine electronic equipment within the last few years, has brought about a fast moving industry that is quality and price conscious and that will have to be up to date to survive. ★

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G2/5	10/6V	4p	H2/2	64/2·5V	4p	H4/14	500/4V	4p	H7/4	25/25V	8p	H7/13	75/15V	8p
G2/6	8/12V (REV)	4p	H2/6A	24/275V	5p	H5/7	30/6V	3p	H7/4A	25/20V	8p	H7/14	100/4V	5p
G3/7	100/25V	10p	H2/8	32/150V	5p	H5/11	400/6·4V	4p	H7/5	40/15V	8p	H8/2	2/50V	5p
G3/14	100/180V	10p	H2/9A	2/150V	5p	H5/12	320/10V	5p	H7/6	50/3V	3p	H8/3	3/50V	5p
G5/9	8/8/450V	15p	H2/10A	16/32/350V	10p	H5/14	5/6V	3p	H7/6A	26/50V	8p	H8/6	8/50V	5p
G6/13A	40/450V	10p	H2/11A	32/275V	8p	H6/6	200/3V	3p	H7/7	50/12V	8p	H8/7A	15/15V	8p
H1/1	1/6V	3p	H3/7A	500/12V	8p	H6/7	200/16V	8p	H7/7A	50/10V	5p	H8/10	2/75V	5p
H1/3	4/4V	3p	H3/8	750/12V	8p	H6/13	500/3V	4p	H7/8	50/15V	8p	H8/11A	250/12V	8p
H1/4	6/6V	3p	H3/10A	30/10V)	3p	H7/1	10/12V	4p	H7/9	60/12V	8p	H8/15	100/25V	10p
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G2/5	125/200V (REV)	25p	G4/7A	40/40/450V	13p	G5/7A	45,000/12V	75p	G6/12A	1,000/12V	25p	H3/4	1,000/50V	30p
G2/10	50/50V	5p	G4/11	2,000/25V	15p	G6/1	12,000/15V	75p	H5/4	325/25V	8p	H3/6	2,500/9V	13p
G3/4	650/300V	38p	G4/12	150/30V	5p	G6/3	2,000/50V	38p	G6/14	400/275V	15p	H3/9	100/275V	10p
G3/9	100/200/250V	30p	G4/13	100/200/16/275V	30p	G6/3A	2,000/15V	15p	H1/5	2,000/18V	15p	H3/13	16/16/375V	10p
G3/10	40/20/10/350V	15p	G5/1	8,000/70V	50p	G6/5	1,000/1,500/25V	38p	H1/6	125/200V	10p	H4/3	500/12V	8p
G3/13A	2,000/30V	10p	G5/3	35,000/15V	75p	G6/5A	1,600/80V	38p	H1/12	200/275V	10p	H4/9	500/6V	5p
G4/1	300/700/320V	38p	G5/4	39,000/10V	50p	G6/6	1,000/60V	30p	H2/6	50/275V	8p	H4/11	75/400/16/275V	38p
G4/5A	60/350V	5p	G5/4A	500/100V	15p	G6/8	200/250V	15p	H2/9	16/16/450V	10p	H8/13	6,000/6V	20p
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TAG ENDS

REF. No.			REF. No.			REF. No.			REF. No.			REF. No.		
G1/4	4/150V	2p	G1/12	40/450V	10p	G4/5	16/300V	5p	G6/4	1,000/50V	30p	H3/5	250/150V	10p
G1/5	8/275V	5p	G2/4	40/300V	8p	G4/9	8/8/350V	10p	G6/7	100/275V	10p	H4/2	250/25V	8p
G1/5A	32/350V	8p	G2/13	100/50V	5p	G4/10	350/25V	10p	G6/12	1,000/12V	10p	H4/7A	32/32/275V	13p
G1/7	16/16/275V	10p	G4/3A	200/25V	8p	G6/1A	3,000/15V	15p						

PRINTED CIRCUIT, CAN TYPE

REF. No.			REF. No.			REF. No.			REF. No.			REF. No.		
G1/6	16/32/450V	10p	G3/11	100/350V	13p	G5/13	40/100/350V	13p	H3/9	100/275V	10p	H5/2	64/32/8/275V	10p
G1/8A	16/350V	5p	G3/12	100/200/16/16/300V	25p	G5/13A	40/40/40/40/350V	13p	H3/10	100/250V	10p	H5/8	32/32/275V	8p
G1/10	32/275V	5p	G3/13	64/275V	10p	G6/11	40/350V	5p	H3/13A	16/16/275V	8p	H5/9	100/100/150V	10p
G1/14	16/275V	5p	G4/3	250/150V	10p	G6/12	250/25V	10p	H4/4	400/6 (REV)	10p	H5/13	32/32/8/300V	10p
G2/10	100/100/350V	15p	G4/4	50/50/200V	10p	H1/10A	10/10/350V	8p	H4/6	64/275V	10p	H5/9	50/50/50/350V	15p
G2/12	100/150V	10p	G4/8	40/40/450V	10p	H1/12	200/275V	10p	H4/7	32/32/350V	10p	H6/4	150/150V	8p
G2/14	20/10/10/450V	10p	G5/6	60/100/275V	13p	H1/13	250/150V	10p	H4/8	8/8/8/275V	13p	H8/11	250/25V	10p
G3/1	60/100/350V	15p	G5/10	100/100/50/350V	15p	H2/4	50/80/300V	10p	H4/10	10/10/425V	13p	H8/12	3,000/6V	15p
G3/6	100/250V	10p	G5/11	100/200/25V	10p	H2/6	50/275V	8p	H4/13	400/250V	15p	H8/13A	100/200/25V	8p
G3/6A	50/50/350V	10p	G5/12	100/20/10/350/20/50V	13p	H2/11	32/32/250V	8p	H5/1	150/200V	10p	H3/11	150/200V	10p
G3/8A	100/25V, 100/12V	10p				H2/12	50/50/150V	8p						

PRINTED CIRCUIT TYPE, WIRE LEADS

REF. No.			REF. No.			REF. No.			REF. No.			REF. No.		
G1/9	16/275V	8p	H3/15	350/12V	8p	H6/5	150/25V	8p	H6/14A	900/15V	10p	H8/4	5/15V	5p
H2/7	10/25V	5p	H5/1	150/30V	8p	H6/10	300/9V	5p	H7/12	65/15V	8p	H8/8	20/9V	5p
H2/12A	350/12V	5p	H5/14A	1,100/10V	11p	H6/11	300/15V	8p	H7/15	100/16	8p	H8/9	40/15V	5p
H2/15	12·5/40V	8p												

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10 watts	10	50p
Multi-tapped	12	50p
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Miniature	100	50p
ELECTROLYTIC CONDENSERS Suitable for Mains Radio/TV	10	50p
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3¾in × 3¾in × 0·15in **20p**	17in × 3¾in × 0·15in **74p**	5in × 3¾in × 0·1in **28p**
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Readout—
A SELECTION FROM OUR POSTBAG

Correspondents wishing to have a reply must enclose a stamped addressed envelope. We regret we are unable to guarantee a reply on matters not relating to articles published in the magazine. Technical queries cannot be dealt with on the telephone.

Shipwreck

Sir—I recently finished making your game "Operation Seasearch" and I am writing to point out a defect in the circuit given for this game in your December 1970 edition. I feel that this should be pointed out to other readers who may be considering building the game. This defect will not usually cause difficulty but it may in certain circumstances as explained below.

This difficulty is as follows. With reference to the enclosed diagram, Fig. 1, it can be seen that if the "Raider" is at say, *Aa*, and the "Supply Ship" at *Ba*, current can pass to S5 when it is in position "*A*" or "*B*". If S6 is in position "*a*", current will be passed to S2a and thus to LP1 when S9 is depressed. Thus S5 can be in position "*B*" and on depressing S9 LP1 will glow showing that the raider has been detected, when in fact it hasn't. This situation can occur in a number of positions.

D. W. Guest,
St. Helens,
Lancs.

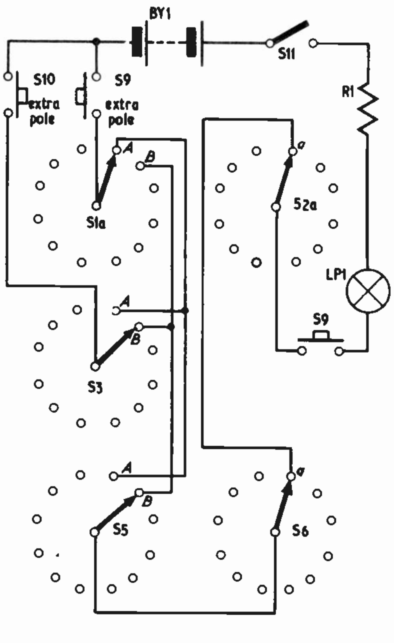


Fig. 1

Mr. Guest is quite right; this is a point that was omitted in the original article. The condition occurs when either searching ship is in line with the "Raider" along one axis and also in line with the "Supply Ship" along the other axis. Overcoming the condition can be done quite simply by inserting a second pole of each push button where indicated. This was not done in the prototype on the grounds of economy, as a second pole was needed in the later "Submarine Game", and three pole push buttons come a bit expensive!

Actually, in the game situation the phenomenon is not so drastic as it might appear. Firstly, the chances of the right conditions arising in any one game move are approximately 70 to 1 against. (Suffice to say that in innumerable games, it has occurred only two or three times.) Secondly, since both players take turns to control the "Raider", the chances against each player are exactly equal.

On the few occasions that the situation has arisen, we have attributed the discovery of the "Raider's" position to an accidental sighting by long-range aircraft, which satisfied our sense of the proprietry of things—it gave the searcher another "fix" on the "Raider's" position just as he has in variations 3 and 6, page 989.—D.R.D.

Economic damper

Sir—May I congratulate you on the series of articles currently running on using logic i.c's; they are very useful to me. Also, the "Digital Clock" is a very useful design but, as is very often the case, the difficulty in obtaining parts (Nixie tubes in this case) at the right price, tends to put a damper on one's enthusiasm.

After several enquiries and visits to shops I may be able to satisfy my requirements, given several more weeks. Of course, I know it is possible to get anything if your are prepared to pay top prices, but I begrudge doing this when I know that someone must be selling the equivalent article much cheaper.

Referring to Gerry Brown's brake fluid level detector (*On The Fringe*, November 1970 issue), I had the same idea myself a few months ago but on trying it out I found that as soon as the fluid was shaken up a thin film of fluid adhered to the insulated cap, thus permanently shorting the probe, see Fig. 1 (below).

Did Mr. Brown have this trouble or was it just a theoretical circuit?

John Westmoreland,
Bispham,
Blackpool.

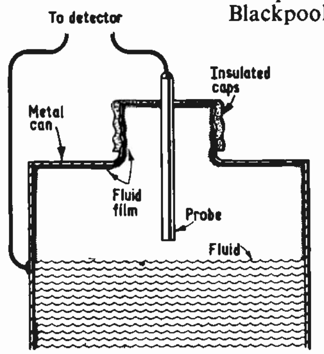


Fig. 1

Fuzz thump

Sir—Reference to the "Fuzz Circuit" included in *Ingenuity Unlimited*, December 1970 issue. Having constructed this circuit, I found as have probably many of your readers, that it needs quite a considerable clout, on even the lowest guitar string (open *E*) to set off the trigger circuit, once it is stable, and it has zero response to the top *E* and *B* strings at standard tuning.

Modifying the circuit by wiring resistor R1 (1MΩ) directly between the base and collector of TR1 and changing the value of C5 to 10μF 10V working should cure the above problems.

B. K. Cox,
Wellingborough,
Northants.

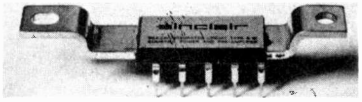
DECIMAL CURRENCY AND P.E.

Readers throughout the world are probably aware that British currency is being decimalised with effect from February 15, 1971. The following notes are issued for their guidance when writing to Practical Electronics.

1. Cheques and postal orders should show amounts payable in decimal currency. Leaflets are available at all branches of British Banks.
2. Readers' cheques and postal orders written in £ s d will not be accepted by the publishers of *Practical Electronics* after February 15, 1971.
3. Handwritten cheques of more than £1 which include new pence, should use a hyphen in place of the decimal point (e.g. £7-80, £30-06).
4. Postage rates in the U.K. on and after February 15 will be 2½p second class and 3p first class for up to 4 ounces. Old £ s d stamps used on and after this date must be at the new rate of 6d second class, 7d first class for up to 4 ounces. Readers requiring a reply to correspondence are asked to use the correct postage rate on s.a.e.

Sinclair IC10/Q16/Micromatic

IC10



The world's most advanced high fidelity amplifier

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

Circuit Description

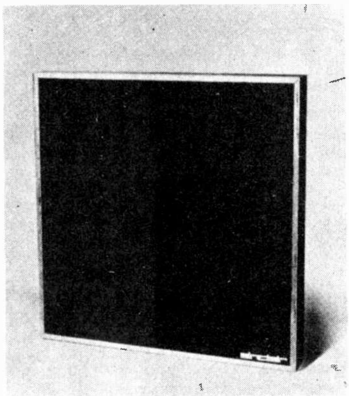
The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. There is generous negative feedback round both sections and the amplifier is completely free from crossover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

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

Specifications:

Output: 10 watts peak, 5 watts RMS continuous.
Frequency response: 5Hz to 100kHz 1 ± dB.
Total harmonic distortion: Less than 1% at full output.
Load impedance: 3 to 15 ohms.
Power gain: 110 dB (100,000,000,000 times) total.
Supply voltage: 8 to 18 volts. (A Sinclair power unit, PZ.7 is available for mains operation).
Size: 1 x 0.4 x 0.2 in. plus heat sink and tags.
Sensitivity 5 mV.
Input impedance: Adjustable externally up to 2.5 Mohms.
Price (with manual) **59/6** (£2 97½) post free.

Q16



High fidelity loudspeaker

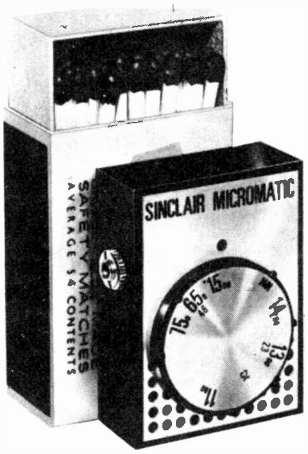
The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much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

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

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts TMS.
Input impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz, confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and a special cone suspension for excellent transient response.
Size and styling: 9¾ in square on face x 4¾ in. deep with neat pedestal base. Black all-over cellular foam front with natural solid teak surround.
Price £8.19.6. (£8.97½).

Micromatic



Britain's smallest radio

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

Specifications:

Size: 36 x 33 x 13 mm ($1\frac{4}{5}$ x $1\frac{3}{10}$ x ½ in.)
Weight: including batteries, 28.4 gm (1 oz.).
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies, (550 to 1,600 Hz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder **49/6** (£2.47½).
Ready built, tested and guaranteed, with earpiece **59/6** (£2.97½).
Two Mallory Mercury betteries type RM675 required. From radio shops, chemists, etc.

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2N2646	50p	BCY30	25p	MPF104	37p
2N2904	30p	BCY31	30p	MPF105	40p
2N2904A	32p	BCY32	50p	NKT213	25p
2N2905	37p	BCY33	25p	NKT214	15p
2N2906	30p	BCY34	30p	NKT216	37p
2N2906A	32p	BCY38	40p	NKT217	40p
2N2907	37p	BCY39	60p	NKT277	20p
2N2926	12p	BCY40	50p	NKT403	75p
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2N3705	15p	BCY78	30p	OA81	10p
2N3707	15p	BCY79	30p	OA85	12p
2N3709	12p	BCZ10	35p	OA90	10p
2N3710	12p	BCZ11	40p	OA91	7p
2N3819	35p	BD112	50p	OA95	7p
2N3820	60p	BD121	65p	OA200	7p
2N4058	17p	BD123	80p	OA202	10p
2N4061	15p	BD124	62p	OC16	50p
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2N5458	37p	BD131	75p	OC22	50p
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AAY30	10p	BDY61	£1·25	OC41	25p
AAY42	15p	BDY62	£1·00	OC42	30p
AAZ13	12p	BF115	25p	OC43	40p
AAZ17	10p	BF152	30p	OC44	17p
AC107	37p	BF154	40p	OC45	15p
AC126	25p	BF158	30p	OC70	12p
AC127	25p	BF159	60p	OC71	15p
AC128	25p	BF167	25p	OC72	25p
AC176	25p	BF170	35p	OC73	30p
AC187	30p	BF173	30p	OC74	30p
AC188	30p	BF177	40p	OC75	25p
ACY17	30p	BF178	25p	OC76	25p
ACY18	25p	BF179	40p	OC77	40p
ACY19	25p	BF180	37p	OC81	25p
ACY20	22p	BF181	37p	OC82	25p
ACY21	22p	BF182	32p	OC83	25p
ACY22	17p	BF184	25p	OC84	25p
ACY39	50p	BF185	25p	OC139	25p
ACY40	15p	BF194	17p	OC140	37p
AD140	50p	BF195	15p	OC141	62p
AD149	50p	BF196	15p	OC170	25p
AD161	37p	BF197	15p	OC171	30p
AD162	37p	BF200	37p	OC200	40p
AF114	25p	BF274	37p	OC201	60p
AF115	25p	BFW87	25p	OC202	75p
AF116	25p	BFW88	23p	OC203	40p
AF117	25p	BFW89	20p	OC204	40p
AF118	62p	BFW90	22p	OC205	75p
AF124	25p	BFW91	20p	OC206	90p
AF125	20p	BFX13	25p	OC207	90p
AF126	17p	BFX29	30p	OCP71	97p
AF127	17p	BFX30	32p	ORP12	50p
AF139	30p	BFX37	32p	ORP60	40p
AF178	47p	BFX84	30p	ORP61	42p
AF179	47p	BFX85	40p	ZTX107	15p
AF180	52p	BFX86	32p	ZTX300	12p
AF181	42p	BFX87	32p	ZTX500	20p
AF186	40p	BFX88	30p	ZTX503	20p
AF239	42p	BFY18	30p	ZTX531	30p
ASY26	25p	BFY50	22p		
ASY27	32p	BFY51	20p	10% Discount	
ASY28	25p	BFY52	22p	12+	
ASY29	30p	BFY53	17p	15% Discount	
ASY67	47p	BFY64	42p	25	
ASZ21	42p	BFY90	65p		
BA115	7p	BSX20	17p		
BA164	10p	BSX21	37p	QUANTITY	
BAX13	6p	BSX76	15p	PRICES 100+	
BAX16	7p	BSY95	15p	PHONE	
BAY31	7p	BSY95A	15p	EXT. 4.	

HENRY'S LOW COST INTEGRATED CIRCUITS

WE OFFER FROM STOCK AN EXCLUSIVE RANGE OF BRAND NEW CERAMIC FULL SPECIFICATION LOW COST TTL 7400 RANGE OF INTEGRATED CIRCUITS

Part No.	Description	Price 1–49	Price 50–99	Price 100+	Price 500+
7400	Quad 2—Input Nand Gate	25p	20p	18p	15p
7401	Quad 2—Input Nand Gate Open Collector	25p	20p	18p	15p
7402	Quad 2—Input Positive Nor Gate	25p	20p	18p	15p
7404	HEX Inverter	25p	20p	18p	15p
7405	HEX Inverter With Open Collector	25p	20p	18p	15p
7410	Triple 3-Input Nand Gate	25p	20p	18p	15p
7430	Single 8-Input Nand Gate	25p	20p	18p	15p
7440	Dual 4-Input Buffer Gate	25p	20p	18p	15p
7441	BCD To Decimal Decoder and NIX Driver	£1·00	90p	80p	75p
7442	BCD To Decimal Decode (TTL)	£1·00	90p	80p	75p
7450	Dual 2-Input And/Or/Not Gate—Expandable	25p	20p	18p	15p
7453	Single 8-Input And/Or/Not Gate—Expandable	25p	20p	18p	15p
7460	Dual 4-Input—Expandable	25p	20p	18p	15p
7470	Single JK Flip Flop—Edge Triggered	40p	35p	30p	25p
7472	Single Master Slave JK Flip Flop	40p	35p	30p	25p
7473	Dual Master Slave JK Flip Flop	45p	40p	35p	30p
7474	Dual D Flip Flop	45p	40p	35p	30p
7475	Quad Bistable Latch	50p	45p	40p	35p
7476	Dual Master Slave Flip Flop With Preset	50p	45p	40p	35p
7483	Four Bit Binary Counter	£1·00	90p	80p	75p
7490	BCD Decade Counter	£1·00	90p	80p	75p
7492	Divide by 12. 4 Bit Binary Counter	£1·00	90p	80p	75p
7493	Divide by 16. 4 Bit Binary Counter	£1·00	90p	80p	75p
7494	Dual Entry 4 Bit Shift Register	£1·00	90p	80p	75p
7495	4 Bit Up Down Shift Register	£1·00	90p	80p	75p
7496	5 Bit Shift Register	£1·00	90p	80p	75p

Data available for above series in booklet form, price 10p. Larger quantity prices, Extn. 4. Dual Inline 14-pin Sockets 30p each. 16-pin 35p each.

TRIACS GENERAL ELECTRIC

(All stud mounting)

	P.I. Volts	Current	1–49	50+	100+	500+
SC35A	100	3A	90p	75p	65p	60p
SC35B	200	3A	95p	80p	70p	65p
SC35D	400	3A	£1.00	85p	75p	70p
SC40A	100	6A	£1·00	85p	75p	70p
SC40B	200	6A	£1·20	£1·00	85p	80p
SC40D	400	6A	£1·25	£1·10	£1·00	90p
SC45A	100	10A	£1·25	£1·10	£1·00	90p
SC45B	200	10A	£1·35	£1·20	£1·10	£1·00
SC45D	400	10A	£1·50	£1·35	£1·20	£1·10
SC50A	100	15A	£1·65	£1·50	£1·35	£1·20
SC50B	200	15A	£1·75	£1·60	£1·45	£1·30
SC50D	400	15A	£2·00	£1·75	£1·60	£1·40
SC40E	500	6A	£1·50	£1·25	£1·10	£1·00
SC45E	500	10A	£1·75	£1·50	£1·35	£1·25
SC50E	500	15A	£2·25	£2·00	£1·75	£1·55

DIAC ST2 20p

Larger Quantity Prices on Application. Ext. 4.

R.C.A. INTEGRATED CIRCUITS—LINEAR TYPES

CA3005	£1·20	CA3035	£1·25
CA3011	75p	CA3036	90p
CA3012	90p	CA3039	85p
CA3013	£1·10	CA3041	£1·10
CA3014	£1·45	CA3042	£1·10
CA3018	£1·10	CA3043	£1·40
CA3020	£1·25	CA3044	£1·25
CA3021	£1·55	CA3045	£1·25
CA3022	£1·30	CA3046	85p
CA3023	£1·25	CA3048	£2·25
CA3026	£1·00	CA3051	£1·35
CA3028A	£1·20	*Application notes 10p for each type*	

INTEGRATED CIRCUITS

PA246	5 Watt	£2·65
TAA263	Mullard	75p
TAD100	Mullard	£2·00
TAD110	Mullard	£2·00
MC1303	Motorola	£2·60
UL900	Fairchild	40p
UL914	Fairchild	40p
UL923	Fairchild	60p
LA709C	Fairchild	75p
MC1304	Motorola	£2·75

SILICON RECTIFIERS

1 AMP MINIATURE WIRE ENDED PLASTIC RECTIFIERS

	P.I.V.	1–49	50 +	100 +	500 +	1000 +
IN4001	50	8p	7p	6p	5p	4p
IN4002	100	9p	8p	7p	5½p	4½p
IN4003	200	10p	9p	7½p	6p	5p
IN4004	400	10p	9p	8p	7p	6p
IN4005	600	12p	10p	9p	7½p	7p
IN4006	800	15p	14p	12p	11p	9p
IN4007	1000	20p	16p	13p	12p	10p

1·5 AMP MINIATURE WIRE ENDED PLASTIC RECTIFIERS

	P.I.V.	1–49	50 +	100 +	500 +	1000 +
PL4001	50	10p	9p	8p	7p	6p
PL4002	100	11p	10p	9p	8p	7p
PL4003	200	12p	11p	10p	9p	8p
PL4004	400	12p	11p	10p	9p	8p
PL4005	600	15p	13p	11p	10p	9p
PL4006	800	17p	15p	13p	12p	10p
PL4007	1000	20p	17p	15p	13p	11p

3 AMP PLASTIC WIRE ENDED RECTIFIERS

	P.I.V.	1–49	50 +	100 +	500 +	1000 +
PL7001	50	20p	18p	17p	16p	14p
PL7002	100	20p	19p	18p	17p	15p
PL7003	200	22p	20p	19p	18p	16p
PL7004	400	25p	23p	21p	20p	18p
PL7005	600	26p	24p	23p	22p	20p
PL7006	800	27p	25p	24p	23p	21p
PL7007	1000	30p	28p	26p	24p	22p

POTTED BRIDGE RECTIFIERS (SILICON) SIZE ½in × ½in × ⅜in

Type	P.I.V.	Current	1–49	50+	100+	500+
502	50	2A	55p	50p	45p	40p
1002	100	2A	60p	55p	50p	45p
2002	200	2A	70p	65p	60p	55p
4002	400	2A	80p	75p	70p	65p
504	50	4A	60p	55p	50p	45p
1004	100	4A	70p	60p	55p	50p
2004	200	4A	75p	70p	65p	60p
4004	400	4A	80p	75p	70p	65p
1006	100	6A	75p	70p	65p	60p
2006	200	6A	80p	75p	70p	65p
4006	400	6A	£1·10	£1·00	90p	80p

ZENER DIODES

400M/W 5% MINIATURE
BZY88 range all voltages 3·3V–33V 15p each
25 + 12p
100 + 10p
500 + 9p
1000 + 8p
any one type

1 WATT 5% PLASTIC WIRE ENDS
6·8V all voltages to 100V 25p each
25 + 20p
100 + 18p
500 + 16p
1000 + 15p
any one type

3 WATT PLASTIC WIRE ENDS 5%
All voltages 6·8–100V 30p each
25 + 27p
100 + 25p
500 + 23p
1000 + 21p
any one type

7 WATT STUD MOUNTING 5%
All voltages 5·1V–100V 40p each
25 + 35p
100 + 30p
any one type

POWER RECTIFIERS

SILICON RECTIFIERS STUD MOUNTING 6 AMP RANGE

	P.I.V.	1–49	50+	100+
BYZ10	800	40p	35p	30p
BYZ11	600	35p	30p	25p
BYZ12	400	30p	25p	20p
BYZ13	200	25p	20p	17p
10 AMP RECTIFIERS				
SK103	100	45p	40p	37p
SK203	200	50p	45p	42p
SK403	400	55p	50p	45p
SK603	600	60p	55p	50p
SK803	800	75p	70p	65p
15 AMP RECTIFIERS				
SL1	100	55p	50p	45p
SL2	200	60p	55p	50p
SL4	400	65p	60p	55p
SL6	600	75p	70p	65p
SL8	800	90p	85p	80p

SEMICONDUCTORS

LOOK AT THESE PRICES FOR QUANTITIES FROM STOCK

AF114 25p Mullard 25 + 20p 100 + 17p

AF115 25p Mullard 25 + 20p 100 + 17p

AF116 25p Mullard 25 + 20p 100 + 17p

AF117 25p Mullard 25 + 20p 100 + 17p

2N3055 75p Mullard 115W Silicon Power 25 + 65p 100 + 55p

2N3819 35p Texas 25 + 30p 100 + 25p 500 + 23p

BFY90 65p 1000MC/S 25 + 60p 100 + 52p 500 + 48p

2N2646 50p Motorola Unijunction 25 + 44p 100 + 37p 500 + 33p

AF139 30p Siemens V.H.F. 25 + 25p 100 + 22p 500 + 19p

AF186 40p Mullard V.H.F. 25 + 35p 100 + 30p 500 + 25p

OC170 25p 25 + 21p 100 + 17p 500 + 15p

BYZ13 25p Mullard 6A 200V 25 + 20p 100 + 17p 500 + 15p

OC171 30p 25 + 27p 100 + 22p

BC107, BC108 BC109 12p I.T.T. Planars 25 + 11p 100 + 10p 500 + 8p 1000 + 6p

BY127 20p Mullard 1,000V 1 amp Plastic 25 + 17p 100 + 15p

BC113 25p 5GS 25 + 20p 100 + 17p 500 + 15p

OCP71 97p Mullard Photo 25 + 85p 100 + 80p 500 + 75p

OA202 10p SILICON Diodes 25 + 8p 100 + 6p 500 + 5p

OC28 62p Mullard Power 100 + 50p 25 + 55p 100 + 50p 500 + 42p

OC42 30p Mullard 25 + 25p 100 + 23p 500 + 21p

OC71 15p Mullard 25 + 12p 100 + 10p 500 + 8p

OC45 15p Mullard 25 + 13p 100 + 12p 500 + 10p

ORP12 50p Mullard 25 + 45p 100 + 42p 500 + 40p

OC75 25p Mullard 25 + 21p 100 + 17p 500 + 15p

2N930 25p 25 + 23p 100 + 20p 500 + 17p

OC20 97p Mullard 100V 25 + 85p 100 + 80p 500 + 75p

OC72 25p 25 + 20p 100 + 17p 500 + 15p 1000 + 13p

OC44 17p Mullard 25 + 15p 100 + 13p 500 + 11p

OC83 25p 25 + 20p 100 + 17p 500 + 15p 1000 + 13p

OC139 25p Mullard 25 + 20p 100 + 17p 500 + 15p

OC84 25p 25 + 20p 100 + 17p 500 + 15p 1000 + 13p

OC81 25p 25 + 20p 100 + 17p 500 + 15p

AF239 42p 25 + 35p 100 + 30p 500 + 25p

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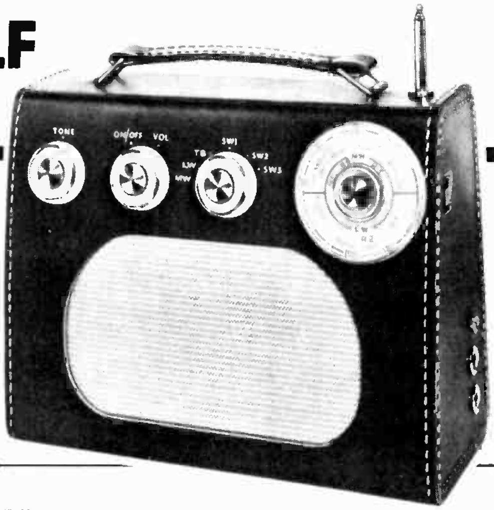


NEW! roamer eight mk 1

WITH VARIABLE TONE CONTROL

7 Tunable Wavebands: Medium Wave 1, Medium Wave 2, Long Wave, S.W.1, S.W.2, S.W.3, and Trawler Band. Built-in ferrite rod aerial for Medium and Long Waves. 4 section 24in. retractable chrome plated telescopic aerial for Short Waves for maximum performance. Push-pull output using 600Mw type transistors. Socket for car aerial. Tape record socket. Selectivity switch. Switched earpiece socket complete with earpiece for private listening. 8 transistors plus 3 diodes. Famous make 7 × 4in speaker. Air spaced ganged tuning condenser. On/off switch volume control. Wave change switch and tuning control. Attractive case in rich chestnut shade with gold blocking. Size 9 × 7 × 4in approx. Easy to follow instructions and diagrams make the Roamer Eight a pleasure to build. Parts price list and easy build plans 25p (5/-) (FREE with parts).

Total building costs £6·98 (£6.19.7) P. & P. 38p (7/7) Overseas P. & P. 85p (17/-)

roamer seven mk IV

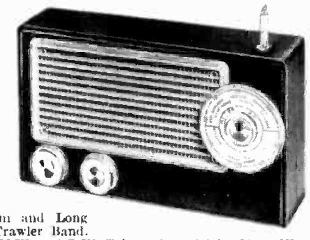
7 FULLY TUNABLE WAVEBANDS M.W.1, M.W.2, L.W., S.W.1, S.W.2, S.W.3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. Retractable 4 section 24in chrome plated telescopic aerial for peak Short Wave listening. Socket for Car Aerial. Powerful push-pull output. 7 transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in P.M. speaker. Air spaced ganged tuning condenser. Volume, on, off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in approx. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build. Parts price list and easy build plans 15p (3/-) (FREE with parts).

Total building costs £5·98 (£5.19.7) P. & P. 38p (7/7)

Personal Earpiece with switched socket for private listening, 25p (5/-) extra.

Overseas P. & P. 85p (17/-)

NEW! transeight



SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

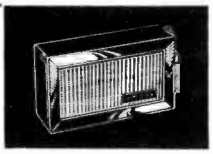
Attractive case in black with red grille and black knobs and dial with spun brass inserts. Size 9 × 5¼ × 2⅜in. approx. Tunable on Medium and Long Waves, 3 Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 8 improved type transistors plus 3 diodes. 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 (5/-) (FREE with parts).

Total building costs £4·48 (£4.9.7) P. & P. 28p (5/7)

Earpiece with switched socket for private listening 25p (5/-) extra.

Overseas P. & P. 65p (13/-)

pocket five



MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive black and gold case. Size 5¼ × 1¼ × 3¼in. Tunable over both Medium and Long Waves 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. Easy build plans and parts price list 8p (1/7) (FREE with parts).

Total building costs £2·23 (£2.4.7) P. & P. 18p (3/7)

Overseas P. & P. 50p (10/-)

transona five

MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive case with red speaker grille. Size 6¼ × 4¼in × 1¼in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker. Easy build plans and parts price list 8p (1/7) (FREE with parts).

Total building costs £2·38 (£2.7.7) P. & P. 19p (3/9)

Overseas P. & P. 50p (10/-)

IMPROVED MODEL ! roamer six

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive black case with red grille and black knobs and dial with spun brass inserts. Size 9 × 5¼ × 2⅜in. approx. Tunable on Medium and Long Waves, two Short Waves, Trawler Band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and latest telescopic aerial for Short Waves. Improved circuit. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Easy build plans and parts price list 10p (2/-) (FREE with parts).

Total building costs £3·98 (£3.19.7) P. & P. 23p (4/7)

Overseas P. & P. 65p (13/-)

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TRANSEIGHT	☐	POCKET FIVE	☐
TRANSONA FIVE	☐	ROAMER SIX	☐

Parts price list and plans for ....

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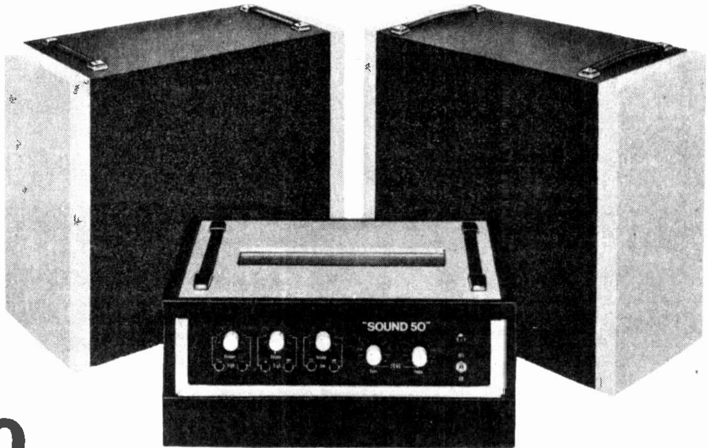
SOUND 50

SOUND 50 AMPLIFIER AND SPEAKER SYSTEM

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



Output Power 45 watts R.M.S. (Sine wave drive). **Frequency response**—3db points 30 Hz at 18 KHz. **Total distortion** less than 2% at rated output. **Signal to noise ratio:** better than 60db. **Speaker Impedance** 3, 8 or 15 ohms. **Bass Control Range** ±13db at 60 Hz. **Treble Control Range** ±12db at 10 KHz. **Inputs** 4 inputs at 5 mV into 470 K. Each pair of inputs controlled by separate volume control. 2 inputs at 200 mV into 470 K.

To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.

SPEAKERS! Size 20" × 20" × 10" incorporating Baker's 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM £50 plus £4 P. & P.

Amplifier £28·50 plus £1 P. & P.

Speakers each £12·50 plus £1·50 P. & P.

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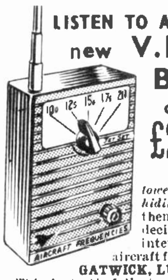
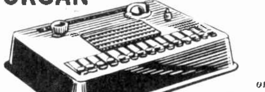


ONLY £2·37½ (47/6)

Listen in to **AIRLINES, PRIVATE PLANES, JET PLANES.** *Eavesdrop on exciting crosstalk between pilots, ground approach, ground control, airport tower. Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve ripping decisions in emergencies— tune in to the international distress frequency. Covers aircraft frequency band including **HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK, ETC.** This fantastic fully transistorised instrument **can be built by anyone nine to ninety in under two hours.** (Our design team built four—everyone worked first time). No soldering necessary. Fully illustrated simply worded instructions take you step-by-step. Uses standard PP3 battery. Size only 4⅞in × 3in × 1⅞in. All you do is extend rod aerial, place close to any ordinary medium-wave radio (even tiny pocket radios). **NO CONNECTIONS WHATEVER NEEDED.** Use indoors or outdoors. **SEND NOW. ONLY £2·37½** +22½p for all parts, including case, nuts, screws, wire, etc. etc. (parts available separately).

REAL WORKING ELECTRONIC ORGAN



ONLY £2·75 (55/-)

Don't confuse with ordinary electric organs that simply blow air over mouth-organ type reeds, etc. Eight months were spent in creating and testing this superb, revolutionary electronic organ. Fully transistorised, no valves. **Proper self-contained loudspeaker.** *Fifteen separate keys span two full octaves*—play the *"Yellow Rose of Texas", "Silent Night", "Auld Lang Syne", and lots of similar tunes* on this real working electronic organ. Size 13¾in × 10in × 2¼in. Uses standard battery. Have the thrill and excitement of building it together with the pleasure of playing a real electronic organ. *Play it anywhere.* No soldering necessary. Easy as A.B.C. to make following the fully illustrated, step-by-step instructions. **BIG DEMAND ANTICIPATED FOR THIS UNIQUE INSTRUMENT** at our low price. **ONLY £2·75**+22½p P. & P. (**55/-**+4/6) for all parts, including case, loudspeaker, transistors, condensers, resistors, knobs, transformers, volume control, wire, nuts, screws, instructions, etc. (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

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TREASURE LOCATOR—

NOW IT'S HERE AT LAST,

after experimenting for four and a half months with a multitude of different circuits and carrying out actual field tests with prototypes, our design team have come up with this real winner. This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location (no phones used—uses only transistor radio which clips inside—no connections needed). **FINDS GOLD, SILVER, LOST COINS, JEWELLERY, KEYS, WAR SOUVENIRS, ARCHAEOLOGICAL PIECES, METALLIC ORE, NUGGETS, ETC.** *Extremely sensitive, will signal presence of certain objects buried several feet below ground! Can be built with ease in one short evening* with the wonderfully clear, easy to follow, step-by-step, fully illustrated instructions. Fully transistorised — no valves. Uses standard PP3 battery. No soldering necessary. Size of detector head 13¾in × 10in × 2¼in. **Great demand expected at this remarkably low price**—All parts including detector head case, nuts, screws, wire, simple instructions, etc. Send now **£2·37½ + 32½p P. & P. (47/6 + 6/6)** (Telescopic handle as illustrated £1·25 (25/-) extra). Parts available separately. Made up looks worth £15.

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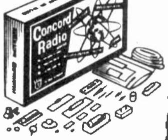

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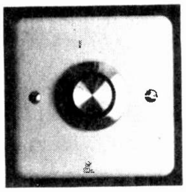

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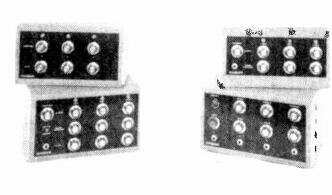

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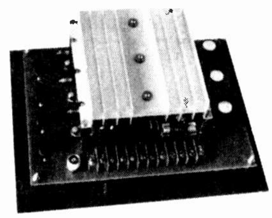

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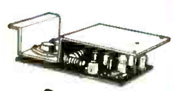
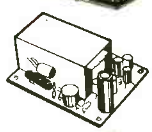
HI-FI · COMPONENTS · TEST · P.A. · DISCOTHEQUE · ELECTRONIC ORGANS · MAIL ORDER

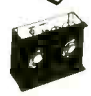
TRANSISTOR AMPLIFIERS

NEW RANGES NOW IN STOCK

(Leaflets Ref. No.: 6 and 8).
Post, etc., 20p (4/-).







4-300 4TR 9V 300mW	£1·75 (35/-)
104 4TR 9V 1W	£2·12 (42/5)
304 4TR 9V 3W	£2·47 (49/5)
555 6TR 12V 3W	£2·75 (55/-)
PA7 6TR 16V 7W	£3·62 (72/5)
608 6TR 24V 10W	£4·12 (82/5)
410 4TR 28V 10W	£4·97 (99/5)
MPA12/3 6TR 18V 12W	£4·50 (90/-)
MPA12/15 6TR 36V 12W	£5·25 (105/-)
Z30 9TR 30V 20W	£3·75 (75/-)
PA25 10TR (Special) 25W	£7·50 (150/-)
Z50 30V 40W	£5·47 (109/5)
PA50 12TR (Special) 50W	£9·50 (190/-)
100 100W with power supply	£45 post 45p (9/-)

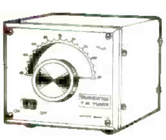
OPTIONAL POWER SUPPLIES Post, etc., 20p (4/-)

P500 Switchable (One or Two) for 104, 304 £2·62 (52/5)
PS20 Switchable (One or Two) for PA7 £3·47 (69/5)
MU24/40 Switchable (One or Two) for MPA12/3 or MPA12/15 £4·50 (90/-)
PZ5 for Z30 **£3·97 (79/5)** or PZ6 for Z30 £6·97 (139/5)
PZ8 for Z50 **£5·97 (119/5).** Transformer £2·25 (45/-)
P11 for 608 **£2·87 (57/5).** P15 for 410 £2·62 (52/5)
MU442 for 1 or 2 PA25 or 1 only PA50 £6·50 (130/-)

PROJECT 60 PACKAGE DEALS

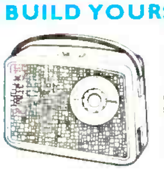
2 × **Z30** amplifier, stereo 60 pre-amp. PZ5 power supply, **£19.** Carr. 40p. Or with PZ6 power supply, **£21.** Carr. 40p. 2 × Z50 amplifier, stereo 60 pre-amplifier PZ8 power supply, **£21·50,** p.p. 40p. Transformer for PZ8 **£2·25** extra. Any of the above with Active Filter unit add **£4·87** or with pair Q16 speakers add **£16.** Also NEW FM TUNER, **£23.**

BUILD THIS VHF FM TUNER



5 MULLARD TRANSISTORS 300kc/s BANDWIDTH. PRINTED CIRCUIT. HIGH FIDELITY REPRODUCTION. MONO AND STEREO. A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it—VHF FM gives the REAL sound. All parts sold separately. Free Leaflet No. 3 and 7.
TOTAL **£6·97 (129/-),** p.p. 20p (4/-). Cabinet £1, Decoder Kit **£5·97,** Tuning meter **£1·75.** Mains unit (optional) Model PS900 **£2·47 (49/5).** Mains unit for Tuner and Decoder PS1200 **£2·62 (52/5).**

BUILD YOURSELF A QUALITY RADIO



Excellent printed circuit design with full power output. Fully tunable on both MW/LW bands. 7 Mullard transistors. Fitted 5in speaker. Room filling power. Easy to build with terrific results. Two colour leathercloth cabinet with silvered front. All local and continental stations. Complete detailed instructions.
Total cost **£6·98 (£6.19.6),** p.p. 35p (7/-). All parts sold separately. Ask for Leaflet No. 1.

HI-FI TO SUIT EVERY POCKET

CHOOSE FROM 100 STEREO SYSTEMS

and a complete range of individual units in stock—Demonstrations all day—visit our new Hi-Fi Store. LOW CASH OR CREDIT/HP TERMS (Credit terms from £30 purchase—callers only). FREE—Stock Lists Nos. 16/17 on request—BEST VALUE IN U.K.

HENRY'S LATEST CATALOGUE

Now 350 pages

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- COMPONENTS, TEST GEAR
- EQUIPMENT, MODULES
- SPECIAL OFFERS, Etc., Etc.

Everything for the constructor. Complete with 50p value discount vouchers for use with purchase. Price **41p,** post free.

FREE 8 page Transistor, IC, Diode lists No. 36

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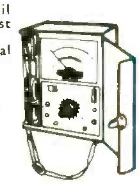
FREE Quotations for all Electronics—send list and S.A.E.

TEST EQUIPMENT FOR HOME, SCHOOL & PROFESSIONAL USE

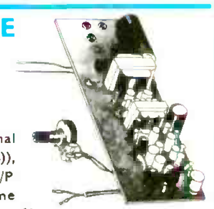
AF105 50k/V multimeter (illus.). Price **£8·50 (190/-),** p.p. 20p (4/-). Leather case **£1·42 (28/5).**
200H 20k/V. Price **£3·87 (77/5),** p.p. 20p (4/-). **Case 62p (12/5).**
500 30k/V multimeter. Price **£8·87 (177/5),** p.p. 20p (4/-). Leather case **£1·50 (30/-).**
THL33 2k/V. Price **£4·12 (82/5).** p.p. 15p (3/-). Leather case **£1·15 (23/-).**
TE65 Valve voltmeter (illus.). Price **£17·50 (350/-),** p.p. 40p (8/-).
SE250B Pocket pencil signal injector **£1·75** post paid.
SE500 Pocket pencil signal tracer **£1·50** post paid.



TE20D RF generator. Price **£15,** p.p. 40p (8/-).
TE22D Matching audio generator. Price **£17,** p.p. 40p (8/-).
TE15 Grid dip meter. Price **£12·50,** p.p. 40p.
TO3 Scope 3 in. tube. Price **£37·50,** p.p. 50p.
TE22 Audio Generator. **£17,** p.p. 40p.

(Get a copy of our latest catalogue for full specifications and further ranges.)

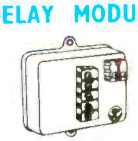
NEW MINIATURE LOW COST AMPLIFIER MODEL 4-300



9V operated or mains unit optional transformer (MT98 70p (14/-)), 1–10mV adjustable sensitivity. P/P output for 3–8 ohms. Fitted volume control and leads. Size 5½in × 1 11/16in × ¾in. Thousands of uses—takes magnetic, dynamic and crystal inputs direct. Output 300mW—very high gain—built in rectifier circuit.

Price £1·75 (35/-), p.p. 15p (3/-). Complete with FREE leaflet No. 8.

STC TIME DELAY MODULE



Ideal for experimenters, educational projects as well as for practical uses. Delay adjustable 3-15 secs. Operates 9-12 volts. Heavy Duty Relay Contacts. Complete with suggested applications sheet. Price **£1·75 (35/-)** post paid.

GARRARD TAPE DECK

Price £9·97

199/6, p.p. 33p (6/6) (3¼in. tape 300ft. and spool 40p (8/-)

9V operated 2-speed tape deck fitted Record/Replay ½ track and Erase/Bias Osc. Head. Complete with Oscillator/Record head circuit. Unit size 9in × 6⅞in × 1⅜in and 2¼in below motor board. Takes up to 4in spools. Supplied Brand New.

HENELEC SELF-POWERED PREAMPLIFIERS

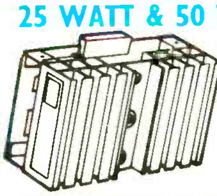
Designed for use with PA25 and PA50 Amplifiers.

SLIM MODERN DESIGNS USING THE LATEST SILICON TRANSISTORS, FET's and IC's, DIN SOCKETS, ETC., fitted. Self powered PUSH-BUTTON SELECTION, ±20dB BASS AND TREBLE BOOST AND CUT. All inputs provided plus TAPE RECORD and REPLAY.

GOLD AND SILVER FINISH, Mains operated. Supplied with all plugs, etc. ADJUSTABLE OUTPUT UP TO 1 VOLT.

- **FET9/4.** Mono with built-in mic. mixer. Accepts any ceramic or crystal cartridge. Plus tuner, tape, etc. Price **£12·50 (£12.10),** p.p. 20p. (4/-).
- **FET154** STEREO (illus.). Magnetic cart. input, tuner, tape, etc. Beautiful stereo sound. Price **£16·50 (£6.10),** p.p. 25p (5/-).
- *Also suitable for use with any power amplifier. Suggested types PA25, PA50, MPA12/3, MPA12/15.*

25 WATT & 50 WATT SILICON AMPLIFIERS



LOOK AT THE SPECIFICATIONS!

- At full power 0·3% distortion.
- At full power—1dB 11 c/s to 40 kc/s.
- Response—1dB 11 c/s to 100 kc/s.
- Rise time 2usec.
- Short circuit proof plus limiting cct. No. 25 on request.

FREE LEAFLET No. 25 on request

PA25 10 transistor all silicon differential input 400mV sensitivity. 25W Rms into 8 ohms. Supplied with edge connector harness size 5in × 3in × 2in.
PA50 12 transistor version 50W Rms into 3 to 4 ohms. Size 5in × 3in × 4in.
MU442. Power supply for one or two PA25 or one PA50.
PA25, **£7·50.** PA50, **£9·50.** MU442, **£6.** P.P. 20p each.

SIMPLICITY TO MOUNT · EASY TO USE · DESIGNED FOR QUALITY, PERFORMANCE AND PRICE

All units no soldering—just edge connectors and plugs · As specified for many "Practical Wireless" 1970 projects

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