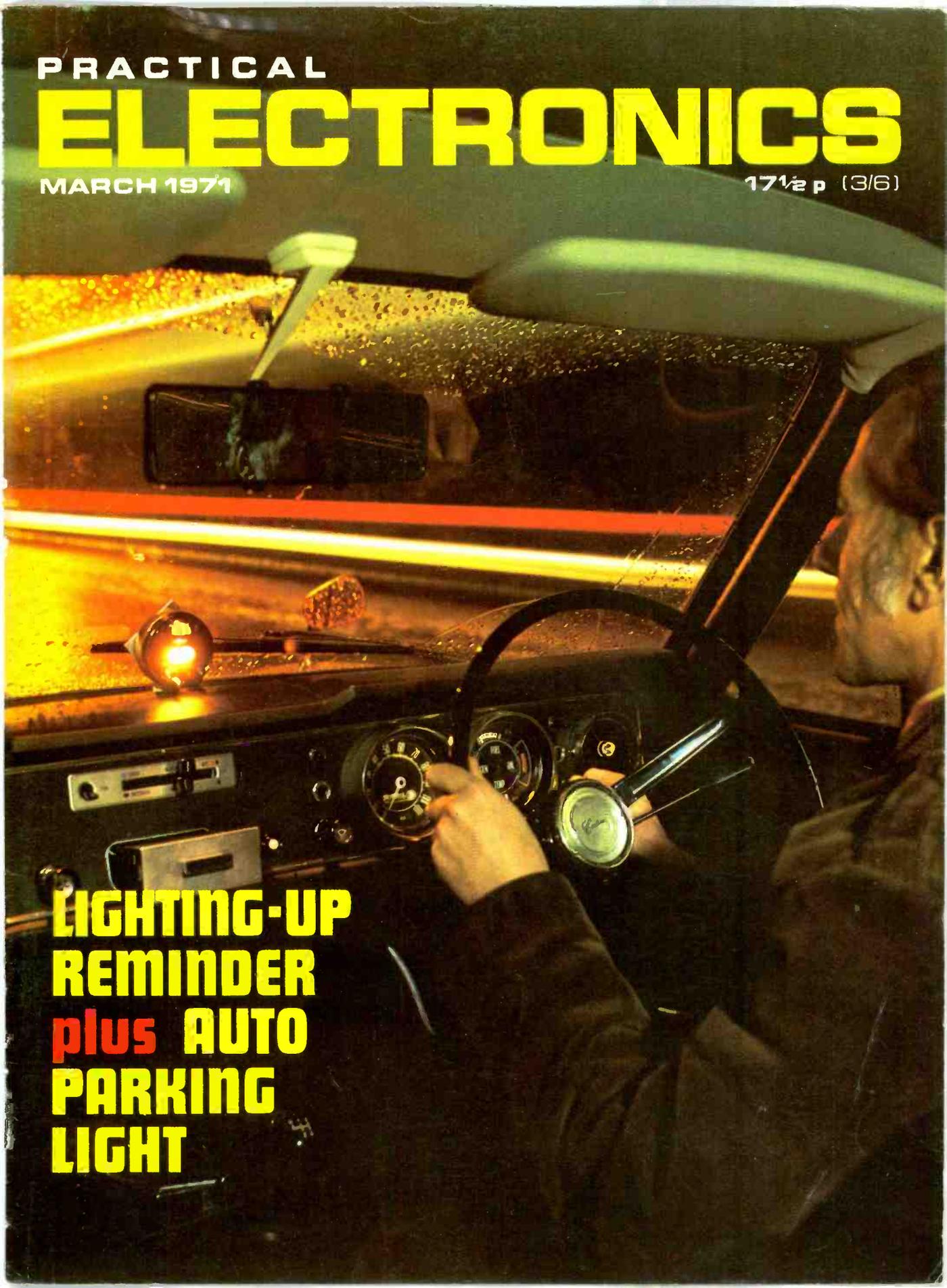


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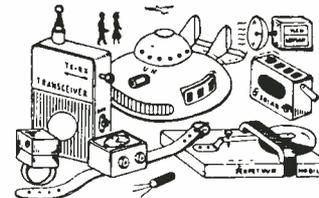
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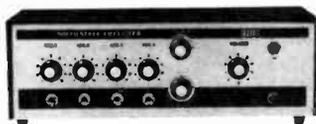
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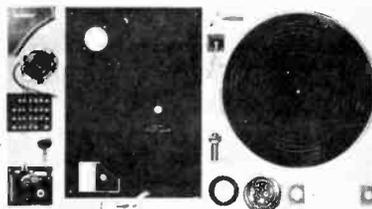
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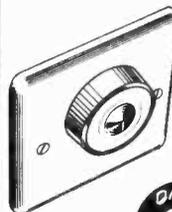
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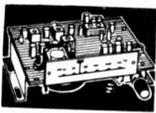
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		500μA	£2-10
		50-0-50μA	£2-10
		100μA	£2-10
		100-0-100μA	£2-10
		200μA	£2-10
		500μA	£2-10

SEMI-CONDUCTORS/VALVES

BRAND NEW & FULLY GUARANTEED

TRANSISTORS

IN914	71p	AC125	25p	BBY38	20p
IN4001	71p	AC154	15p	BBY39	22p
IN4002	71p	AC176	25p	BBY61	32p
IN4003	10p	AC187	30p	BBY66	90p
IN4004	10p	AC188	30p	BBY95A	10p
IN4005	15p	AC177	30p	BY100	17p
IN4006	15p	AC178	25p	BY124	15p
IN4007	20p	ACY19	25p	BY126	15p
IN4148	71p	ACY20	22p	BY127	20p
IN5054	22p	ACY21	22p	BY210	40p
2G301	20p	ACY22	17p	BYZ11	35p
2G302	22p	ACY28	17p	BYZ12	30p
2G303	25p	ACY40	16p	BYZ43	25p
2G306	37p	AD140	50p	BY480	97p
2G308	37p	AD149	50p	MJ481	21p
2G309	30p	AD161	37p	MFF102	42p
2G371	32p	AD162	37p	MFF103	42p
2G374	37p	AF114	32p	MFF104	37p
2G381	25p	AF115	30p	MFF105	40p
2N696	17p	AF116	32p	NKT213	25p
2N697	17p	AF117	25p	NKT214	15p
2N698	42p	AF118	62p	NKT215	22p
2N706	15p	AF119	25p	NKT216	22p
2N708	15p	AF126	17p	NKT241	27p
2N914	22p	AF127	17p	NKT261	20p
2N916	22p	AF139	30p	NKT271	25p
2N918	37p	AF178	47p	NKT272	25p
2N929	37p	AF180	52p	NKT275	25p
2N930	37p	AF181	42p	NKT278	25p
2N1181	20p	AF185	40p	NKT281	27p
2N1182	30p	AF239	42p	NKT403	75p
2N1302	20p	ASy26	25p	NKT404	62p
2N1303	22p	ASy27	32p	NKT405	75p
2N1304	25p	ASy28	25p	NKT773	29p
2N1305	25p	ASy27	42p	NKT10439	37p
2N1306	25p	AYU10	97p	OA5	15p
2N1307	25p	BAy31	71p	OA10	25p
2N1308	25p	BC107	12p	OA47	10p
2N1309	25p	BC108	12p	OA70	10p
2N1313	25p	BC113	25p	OA79	10p
2N1888	32p	BC116	40p	OA81	10p
2N1893	32p	BC125	55p	OA85	12p
2N2147	75p	BC126	55p	OA90	10p
2N2160	62p	BC147	17p	OA91	71p
2N2193	47p	BC148	18p	OA95	71p
2N2217	27p	BC149	20p	OA200	71p
2N2218	30p	BC167	15p	OA202	10p
2N2219	30p	BC172	17p	OA210	17p
2N2368	17p	BC173	37p	OC19	37p
2N2369	20p	BC177	37p	OC20	97p
2N2369A	20p	BC186	37p	OC22	47p
2N2484	20p	BC182L	20p	OC23	50p
2N2613	35p	BC122L	22p	OC24	50p
2N2646	52p	BCY30	30p	OC25	50p
2N2647	52p	BCY31	30p	OC26	25p
2N2923	17p	BCY32	30p	OC28	62p
2N2924	17p	BCY33	30p	OC29	62p
2N2925	17p	BCY34	25p	OC35	50p
2N2926G	12p	BCY35	30p	OC36	62p
2N2926Y	12p	BCY42	15p	OC41	25p
2N2926L	12p	BCY43	20p	OC42	30p
2N3053	25p	BCY71	30p	OC44	17p
2N3054	50p	BCY72	17p	OC45	15p
2N3055	75p	BCZ11	37p	OC46	27p
2N3391A	30p	BD121	65p	OC70	12p
2N3416	37p	BD122	82p	OC71	25p
2N3670	17p	BD124	20p	OC72	25p
2N3702	87p	BF115	25p	OC73	30p
2N3703	15p	BF117	47p	OC74	30p
2N3704	17p	BF167	25p	OC75	25p
2N3705	15p	BF173	30p	OC76	25p
2N3706	25p	BF180	37p	OC77	40p
2N3707	15p	BF181	37p	OC81	25p
2N3709	17p	BF182	32p	OC81D	20p
2N3710	15p	BF184	25p	OC82	25p
2N3711	12p	BF185	25p	OC83	25p
2N3819	35p	BF194	17p	OC84	25p
2N3803	35p	BF195	15p	OC189	25p
2N3804	35p	BF200	37p	OC189	20p
2N3805	37p	BF224	30p	OC170	25p
2N3806	37p	BF225	30p	OC171	30p
2N4058	17p	BFX12	22p	OC200	37p
2N4059	25p	BFX13	22p	OC201	47p
2N4061	15p	BFX29	30p	OC202	37p
2N4062	22p	BFX30	32p	OC203	37p
2N4286	15p	BFX44	37p	OC204	40p
2N4287	17p	BFX45	37p	OC205	62p
2N4288	15p	BFX86	32p	OC207	75p
2N4289	17p	BFX87	32p	OC271	97p
2N4290	15p	BFX88	25p	OPF12	60p
2N4291	15p	BFY18	25p	ORP60	40p
2N4292	15p	BFY20	25p	F346A	25p
2N5354	27p	BFY30	22p	FL4091	15p
2N5355	27p	BFY31	22p	FL4092	15p
28102	25p	BFY52	22p	FL4002	15p
28103	37p	BFY90	67p	FL4004	17p
28104	37p	BSX19	17p	FL4005	10p
40250	50p	BSX20	17p	FL4006	20p
40361	50p	BSX21	17p	FL4007	20p
40362	50p	BSX76	15p	FL1843	40p
AC107	87p	BSY26	15p	FL1844	12p
AC126	25p	BSY27	80p	FL1845	17p
AC127	25p	BSY28	17p	FL1846	17p

THYRISTORS

PIV	50	100	200	300	350	400
1A	25p	27p	40p	45p	—	47p
3A	30p	37p	40p	45p	—	50p
5A	—	55p	65p	—	—	75p
7A	—	55p	65p	70p	—	87p
100A	—	—	—	—	22-50	22-75

VALVES

32p	2Z34	30p	EL95	35p	
32p	2Z5Z	42p	EM80	40p	
32p	2Z6Z	57p	EM81	42p	
1R4	30C15	75p	EM84	37p	
1R5	30C17	75p	EM85	55p	
1R6	30C18	75p	EM87	55p	
1R7	30F35	55p	EY31	40p	
1R4	30P11	77p	EY86	40p	
1R5	30FL12	92p	EY87	42p	
32p	30FL14	77p	EZ40	37p	
30Q4	30L15	85p	EZ41	45p	
35A	30L17	85p	EZ80	27p	
3V4	40P12	80p	EZ81	27p	
5R4	55P19	75p	EZ82	47p	
5U4	30P11	77p	EZ84	55p	
5Y4	40P13L	90p	KT86	11-37p	
5Y3	30P11A	85p	KT88	11-67p	
3Z4G	37p	3Z5L6	47p	MU14	40p
6/30L2	75p	6/3W4	25p	PCB80	40p
6AC7	20P324	25p	PC86	57p	
6AG7	37p	3Z3Z5	25p	PC88	65p
6AK5	50P5B5	35p	PC88	65p	
6AK6	57p	50C5	35p	PC97	42p
6AL5	16p	80	45p	PC900	47p
6AM6	22p	80A2	37p	PC84	35p
6AS6	30P12	47p	PC85	40p	
6AS6	30P125	80p	PC88	40p	
6AT6	25p	5783	65p	PC89	52p
6AU6	25p	6146	11-50	PCC189	55p
6AV6	32p	AZ31	35p	PCF80	32p
6BA6	22p	CY31	35p	PCF82	34p
6BE6	25p	DAF91	27p	PCF84	45p
6BF6	42p	DF96	30p	PCF85	55p
6BJ6	42p	DF91	32p	PCF800	75p
6BQ7A	37p	DF96	30p	PCF801	50p
6BR7	85p	DK91	35p	PCF802	50p
6BR8	65p	DK92	45p	PCF805	75p
6BW6	60p	DK96	45p	PCF806	65p
6BZ6	67p	DL92	35p	PCF807	77p
6C2	32p	DL94	40p	PCL82	35p
6C4	30p	DL96	37p	PCL83	60p
6C6	11-15	DM70	32p	PCL84	44p
6CL6	50p	DY86	32p	PCL85	47p
6CW4	62p	DY87	35p	PCL86	47p
6F1	62p	EB8C	62p	PL200	55p
6F8G	58p	EA42	75p	PL36	55p
6F13	35p	EABC80	32p	PL81	47p
6F14	60p	EA42	60p	PL82	45p
6F15	55p	EB91	16p	PL83	40p
6F18	40p	EB41	52p	PL84	30p
6F23	77p	EB8C1	32p	PL89	75p
6F26	47p	EB8C2	40p	PL90A	30p
6F34	47p	EBF83	42p	PY32	55p
6F35	20p	EBF89	32p	PY33	62p
6G5	60p	EBL21	60p	PY80	32p
6J6	17p	EC86	60p	PY81	30p
6K7	42p	EC88	60p	PY92	30p
6K8G	30p	ECX40	55p	PY93	30p
6L6GT	45p	ECX84	60p	PY88	40p
6LD20	32p	ECX85	27p	PY800	50p
6M7	37p	ECC88	40p	PY801	50p
6O4	60p	ECF80	35p	U25	75p
6O7	30p	ECF82	35p	U26	75p
6P8T	35p	ECF86	62p	U50	30p
6R7	40p	ECF91	57p	U52	30p
6R8L	30p	ECH35	60p	U191	70p
6R8T	27p	ECH42	65p	U281	40p
6S4	40p	ECH81	27p	U282	40p
6S4T	42p	ECH83	42p	U301	57p
6V6	25p	ECL80	45p	U801	41p
6X4	60p	ECL82	32p	UABC80	30p
6X5G	27p	ECL83	62p	UAF42	52p
6X5GT	27p	EF36A	42p	UBC41	47p
6X5GT	27p	EF37A	47p	UBC81	40p
6Y7	25p	EF39	40p	UBF80	35p
10C1	90p	EF40	60p	UBF89	35p
10P13	55p	EF41	62p	UC84	30p
10P14	42p	EF42	70p	UC85	30p
12A76	25p	EF80	25p	UCF80	52p
12A77	20p	EF85	35p	UCH21	55p
12A78	25p	EF86	32p	UCH42	65p
12A79	30p	EF89	27p	UCH81	32p
12AV6	30p	EF91	22p	UCL82	35p
12B46	32p	EF92	37p	UCL83	60p
12B68	32p	EF183	32p	UF40	50p
12B77	32p	EF184	35p	UF80	37p
19AQ5	32p	EH90	40p	UF85	40p
20D1	45p	EL34	52p	UF89	35p
20F2	75p	EL33	41p	UL41	80p
20L1	55p	EL41	55p	UL94	32p
20P1	50p	EL42	57p	UL95	30p
20P3	60p	EL81	50p	UY85	30p
20P4	11-EL84	25p	VR105/30	27p	
20P5	21-EL85	41p	—	—	
25L6	37p	EL91	25p	VR150/30	25p

ZENER DIODES

400W (3-3 to 33V)	15p
1-5W (2-4 to 200V)	20p
10W (3-8 to 100V)	25p

INTEGRATED CIRCUITS

L800	40p	L914	49p
LM32	62p	LM102	42p
LM103	42p	MC1303	30p
MC1302	42p	MC1304	42-75p
PA246	42-62p	CA3005	—
CA1271	CA3011	82p	—
CA3052	41-82p	FCH131	50p
FCH132	50p	FCH141	50p
FJH121	50p	FJH181	50p
FJH221	50p	FJH231	50p
FJH241	50p	FJH251	50p
FJJ121	87p	FJJ131	87p
FJJ211	FJJ211	11-2	

RUSSIAN C1-16 DOUBLE BEAM OSCILLOSCOPES

5MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated triggered sweep from 0.2µsec to 100µsec/cm. Supplied complete with all accessories and instructions. £87. Carr. paid.

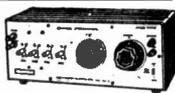


MARCONI CT44/TF956 AF ABSORPTION WATTMETER

1 µwatt to 6 watts. £80. Carr. £1.

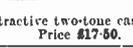
TE111 DECADE RESISTANCE ATTENUATOR

Variable range 0-11dB. Connections. Unbalanced T and Bridge T. Impedance 600Ω range (0.1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (1-3dB). Accuracy: ±0.5dB. ±indication dB: 0-0.1. 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 18-20,000Hz. Output max +10dB (10kΩ). Operation internal batteries. Attractive two-tone case 7 1/4" x 5 1/2" x 2 1/2". Price £17.50. Carr. 17p.



Attractive two-tone case 7 1/4" x 5 1/2" x 2 1/2". Price £17.50. Carr. 17p.



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. 51-51.31. Complete with instructions and leads. £7.97. 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 x 150mm x 120mm. Price £27.50. Carr. 25p.



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

10 meg. input 10 ranges: -0.1 / 0.03 / 0.1 / 0.3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. ±0.5%. Complete with instructions. 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. £2.12; H.V. £2.50.



AUTO TRANSFORMERS

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

150W. £2.37. P. & P. 17p.
300W. £2.25. P. & P. 22p.
500W. £2.97. P. & P. 32p.
1,000W. £7.22. P. & P. 37p.
1,500W. £8.97. P. & P. 42p.

SOLID STATE VARIABLE A.C. VOLTAGE REGULATORS

Compact and panel mounting. Ideal for control of lamps, drills, electrical appliances, etc. Input 220/240V a.c. Output continuously variable from 20V to 230V. Model MR2305 5A 6A x 46 x 43mm, £8.37. Model MR2310 10A 90 x 88 x 60mm, £11.97. Postage 12p.



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. £1.97. P. & P. 12p.

MODEL TE-500. 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 TE-70. 30,000 O.P.V. with overload protection, mirror scale 0/5/25/100/250/500/1,000V a.c. 0/10/50/250/500/1,000V d.c. 0/10/50/250/500µA/500mA. 12 amp. d.c. 0/60K/6 Meg./60 Meg. £3.71. 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. 48 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-dB. £8.87. P. & P. 17p.

TE-900 20,000 Ω/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. 0/25/125/500/2500/10,000V d.c. 0/50µA/110/100/500mA/10A d.c. 0/2K/200K/20 meg. ohm. £15. P. & P. 25p.

MODEL 5025. 57 ranges, giant 5 1/2in meter, polarity reverse switch. Sensitivity: 50K/Volt d.c. 5K/Volt a.c. D.c. Volts: 0-125, 0-25, 1-25, 6, 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: 1K, 10K, 100K, 1 meg., 10 meg. Decibels: -20 to +85dB. £12.50. P. & P. 17p.

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. 0/60K/600K/6meg/60. Megohm 50PF. 2 MF. £5.97. P. & P. 17p.

FTC-401 TRANSISTOR TESTER

Full capabilities for measuring A, B and ICO, μ in or μ pp. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. £6.97. P. & P. 15p.



"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality Low price Immediate delivery

MODEL S-260 General Purpose Bench Mounting

1A	£5.50
2.5A	£6.75
5A	£9.75
8A	£14.50
10A	£16.50
12A	£21.00
20A	£37.00

MODEL S-260 B Panel Mounting

1A	£5.50
2.5A	£6.62

Please add postage

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

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. £3.47. 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. £5.97. 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/60K/600K/6 Meg. £4.87. 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 a.c. 0-0.3/0.6/600mA. d.c. 16K/160K/1.6/16 meg. -20 to +63dB. £7.50. P. & P. 15p.

TMK MODEL TW-200C. 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 +82dB. £11.50. P. & P. 17p.

MODEL AB-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. 17p.

TMK LAB TESTER. 100,000 O.P.V. 6 1/2in scale buzzer short circuit check. Sensitivity: 100,000 O.P.V. d.c. 5V/Volt a.c. D.c. volts: 0-5, 2.5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 600, 1,000V. D.c. current: 10, 100µA, 10, 100, 600mA, 2-5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: -10 to +49dB. Plastic case with carrying handle. Size 7 1/4" x 6 1/2" x 3 1/2". £18.90. P. & P. 25p.

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 20µA/6/60/600mA. Resistance 10K/100 K/1Meg/10 Meg. Decibels -20 to +57dB £7.50. P. & P. 15p.

270° WIDE ANGLE 1mA METERS
MW1-6 60mm square £3.75. MW1-8 80mm square £4.97. P. & P. extra.



UNR-30 RECEIVER
4 Bands covering 560KHz-30MHz. B.F.O. Built in Speaker 220/240V a.c. Brand new with instructions. £16.75. Carr. 37p.

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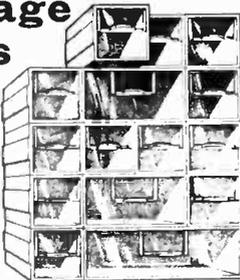
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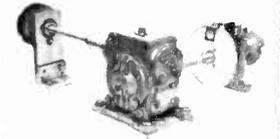
Synchronous motor driven timer providing manual adjusted delay. Delay time is set on graduated dial. Press button closes contact and drives motor which drives an arm until it actuates the load switch. The arm then returns to initial position for repeat action. Various ranges available. 230V 50Hz Load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

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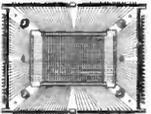
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2N698	20p	2N2711	30p	2N3713	£1-50	2N5308	37p	AC188	37p	BC118	38p	BDY19	£3-12	BFY53	22p	GET873	12p	NKT264	30p	OC26	32p
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2N706	12p	2N2713	30p	2N3819	35p	2N5310	42p	ACV18	25p	BC125	55p	BDY38	97p	BFY73	30p	GET887	20p	NKT272	20p	OC29	75p
2N708	15p	2N2714	30p	2N3823	£1-12	2N5354	27p	ACV19	25p	BC126	65p	BDY60	£1-80	BFY76	42p	GET889	22p	NKT274	20p	OC33	40p
2N708	15p	2N2865	62p	2N3826	30p	2N5355	27p	ACV20	25p	BC134	57p	BDY61	£1-80	BFY77	57p	GET890	22p	NKT275	20p	OC36	62p
2N719	62p	2N2904	35p	2N3854	27p	2N5356	32p	ACV21	25p	BC134	57p	BDY62	£1-37	BFY90	67p	GET896	22p	NKT281	20p	OC41	25p
2N718	25p	2N2904A	40p	2N3854	27p	2N5356	32p	ACV22	20p	BC140	37p	BFY15	25p	BFY98	27p	GET897	22p	NKT401	87p	OC42	25p
2N718A	30p	2N2906	40p	2N3855	27p	2N5356	32p	ACV28	20p	BC147	17p	BFY17	47p	BFY99	25p	GET898	22p	NKT402	80p	OC44	20p
2N728	30p	2N2906A	45p	2N3855A	30p	2N5357	37p	ACV40	20p	BC148	15p	BFY17	47p	BFW59	25p	MAT100	30p	NKT403	75p	OC45	12p
2N727	30p	2N2906	40p	2N3856	30p	2N5357	37p	ACV41	25p	BC149	15p	BFY18	25p	BFX23	£1-35	MAT101	30p	NKT404	62p	OC46	15p
2N914	17p	2N2906A	32p	2N3856A	35p	2N5357	37p	ACV42	40p	BC157	50p	BFY19	32p	BFX29	£1-80	MAT120	30p	NKT405	62p	OC70	15p
2N916	17p	2N2907	40p	2N3858	25p	2N5358	37p	AD140	40p	BC158	17p	BFY20	£1-80	BFY20	£1-80	MAT121	30p	NKT406	62p	OC71	15p
2N918	30p	2N2923	40p	2N3858A	25p	2N5358	37p	AD149	57p	BC158	17p	BFY21	£1-80	BFY21	£1-80	MAT122	30p	NKT407	62p	OC72	12p
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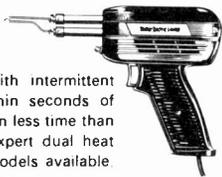


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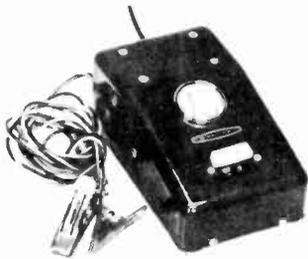


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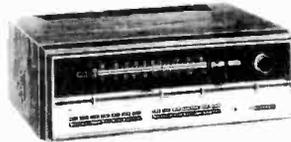


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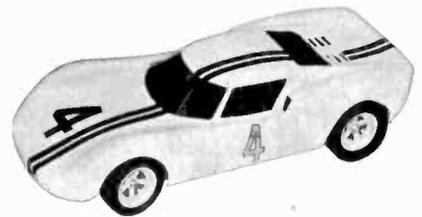
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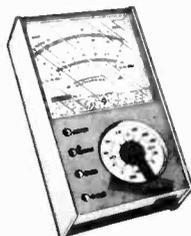


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McDONALD PROFESSIONAL SERIES FOUR SPEED SINGLE PLAY UNIT



POST 35p

LASKY'S PRICE £11.50

complete with plinth and cover **£15.00 POST 40p**

610 AUTOMATIC TURNTABLE

Same specifications as the MP.60 but with synchronous four pole motor and full automatic change facilities.

LASKY'S PRICE £13.95 POST 35p WITH PLINTH AND COVER £17.75 POST 40p

510 AUTOMATIC TURNTABLE

Counter balanced pick-up arm, pressed steel turntable, bias compensator, viscous cueing and synchronous four pole motor.

LASKY'S PRICE £11.75 POST 35p WITH PLINTH AND COVER £15.50 POST 40p

310 AUTOMATIC TURNTABLE

Low mass square section pick-up arm, cue and pause lever, visual stylus pressure indicator, slide in cartridge carrier, four pole motor.

LASKY'S PRICE £9.95 POST 35p WITH PLINTH AND COVER £13.75 POST 40p

BSR McDONALD PACKAGES

PACKAGE No. 1

BSR McDONALD 510 4 Speed Autochange	£16.03
AUDIO DEVELOPMENT AD76K Magnetic Cartridge	£ 4.50
BSR Afromosia Plinth with black mounting board	£ 4.44
BSR Smoked Perspex Dust Cover	£ 3.17
Recommended retail price	£28.14

LASKY'S PRICE £23.25 POST 40p

ADD £5.50 if M2100/E is preferred
ADD £6.50 if Shure M44/5 is preferred

PACKAGE No. 2

BSR McDONALD 310 4 Speed Autochanger	£12.95
AD76K Magnetic Cartridge	£ 4.50
BSR Afromosia Plinth with black mounting board	£ 4.44
BSR Smoked Perspex Dust Cover	£ 3.17
Recommended retail price	£25.06

LASKY'S PRICE £21.50

ADD 50p if BSR Ceramic Cartridge is preferred

NOW AVAILABLE LASKY'S EXCLUSIVE

LASKY-McDONALD plinth and cover available separately at

£4.75 POST 25p

WAFER TYPE ELECTRO DYNAMIC

This revolutionary idea in sound reproduction functions in a similar manner to the cone loudspeaker system. In place of the conventional paper cone is a flat, rigid plastic panel only a fraction of the depth of the equivalent cone structure. With a flat rectangular panel a larger piston area is also available thereby reducing the size compared with an equivalent cone loudspeaker. Power capacity: 20 watts (peak). Freq. range, 40Hz-20,000 Hz. Input imp.: 8 ohms. Size: 1 1/2in x 1 1/4in x 1 1/4in. Weight: 9oz.



Only 1 1/4" THICK!!

LASKY'S PRICE £5.75 each £11 for two.

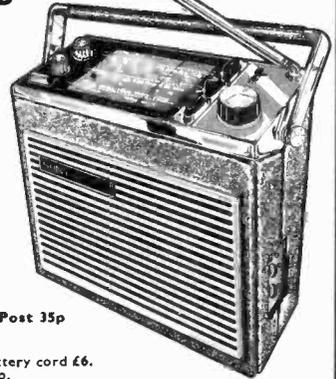
Post 20p each

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 entertain your leisure hours anywhere, anytime with exciting sound, news, sport music, etc. Technical specification: Freq. range. FM 87-108 MHz, LW150-285kHz, 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: 9½(W)×8½(H)×3½(D). Complete with earphone and battery.



Post 35p

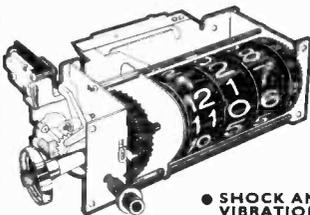
MANUFACTURER'S LIST PRICE **£29.75**

LASKY'S SPECIAL OFFER LIST 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.

EXCLUSIVE Sinclair Project 60

DIGITAL CLOCK SCOOP!



- SHOCK AND VIBRATION PROOF
- BUILT IN ALARM BUZZER

- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
- MAINS OPERATION
- 12-HOUR ALARM
- AUTO "SLEEP" SWITCH
- HOURS, MINUTES AND SECONDS READ-OFF
- FORWARD AND BACKWARD TIME ADJUSTMENT
- SILENT OPERATION SYNCHRONOUS MOTOR

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 4½W × 1½H × 3½D (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

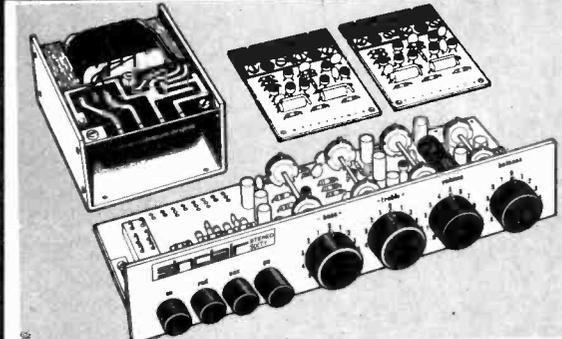
SPECIAL QUOTATIONS FOR QUANTITIES

TTC C-1051 METER

A completely new design 20,000 U.P.V. pocket multimeter with mirror scale and built-in thermal protection. Exceptionally large easy to read meter with D'Arsnonval 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-6mega. DC current: 0-60A-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 4½ × 3¼ × 1½in. Two colour buff/green finish. Complete with test leads and battery.



LASKY'S PRICE **£4.25** Post 13p



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 unbalanced 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: **£9.97** ½
IV ● Signal to noise: better than 70dB ● Front panel: brushed aluminium with black knobs and controls ● Size: 5¼ × 1½ × 4in. 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: 3¼ × 2¼ × 4in. **£4.47** ½ Post 17½p

PZ5

30V unbalanced—sufficient to drive two Z-30's and a Stereo 60 for domestic applications. **£4.97** ½ Post 12½p

PZ6

35V stabilised—ideal for driving two Z-30's and a Stereo 60 for low efficiency speakers. **£7.97** ½ Post 12½p

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

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2kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2kW), switch down for half heat (1kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £8.75. Post and ins. 38p.

12 volt Car Battery Trickle Charger. Made in Japan, this is very small and neat. Regular use will keep your car battery in good trim throughout the winter. Silly price £1.25 plus 23p postage and insurance.

QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. £1.25, post and insurance 14p. 12v. car model also available £1.



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Suitable for most auto changers, teak base with tinted perspex cover, £4.25 plus 33p postage. Special set for Balfour autochanger £4.25 plus 33p postage.



THRYSOR LIGHT DIMMERS

Will dim incandescent lighting up to 600 w. from full brilliance to out. Assembled and wired ready to install. £3.



AUTO-ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in. or fully retractable. Suitable for 12v. positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. £5.95 plus 25p post and ins.



COMPUTER TAPE

2,400 ft of the best magnetic tape money can buy. Made by E.M.I., 1in. wide almost unbreakable and on a 10in. metal computer spool. Users have claimed successful results with video as well as sound recordings £1 plus 33p post. Cassette to hold spool 20p extra.

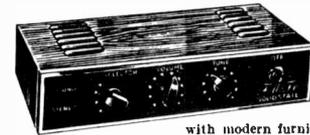


HORSTMANN "TIME & SET" SWITCH (A 30 Amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price £1.50. Post and ins. 23p.

1 HOUR MINUTE TIMER Made by famous Smiths company, these have a large clear dial, size 4 1/2in. x 3 1/2in., which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch, £1.15.



THE FULL-FI STEREO SIX



with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. Price is £9 plus 33p post and insurance.

The amplifier sensation of the year

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet, elegantly styled and teak finished to blend

STANDARD WAFER SWITCHES

Standard size 1 1/2 wafer—silver-plated 5-amp contact, standard 1in spindle 2in long—with locking washer and nut.

No. of Poles 2 way 3 way 4 way 5 way 6 way 8 way 9 way 10 way 12 way

1 pole	38p	33p	38p	33p	38p	33p	38p	33p	38p
2 poles	38p	38p	38p	38p	38p	38p	38p	38p	38p
3 poles	38p	38p	38p	38p	55p	55p	55p	55p	55p
4 poles	38p	38p	38p	38p	55p	55p	55p	55p	55p
5 poles	38p	38p	55p	55p	75p	75p	75p	75p	75p
6 poles	38p	55p	55p	55p	75p	75p	75p	75p	75p
7 poles	55p	55p	55p	75p	95p	95p	95p	95p	95p
8 poles	55p	55p	55p	75p	95p	95p	95p	95p	95p
9 poles	55p	55p	75p	75p	£1.15	£1.15	£1.15	£1.15	£1.15
10 poles	55p	55p	75p	95p	£1.15	£1.15	£1.15	£1.15	£1.15
11 poles	55p	75p	75p	95p	£1.35	£1.35	£1.35	£1.35	£1.35
12 poles	55p	75p	75p	95p	£1.35	£1.35	£1.35	£1.35	£1.35

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

SPARTAN Portable RADIO

Long and medium wave, 7 transistors, size 6in. x 4in. x 1 1/2in. with larger than usual speaker giving very good tone. Built-in ferrite aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carry sling, carplug and case. £3.75 plus 25p post and ins.



MULTI-SPEED MOTOR

Replacement in many well known food mixers. Six speeds are available. 500, 850, and 1,100 r.p.m. from either or both of the nylon sockets (where the beaters of the food mixers normally go) and 8,000, 12,000 and 15,000 r.p.m. (ideal polishing speeds) from the main drive shaft. Very powerful and useful motor size approx. 2in. diameter 5in. long. Price 90p plus 23p post and ins.



MAINS OPERATED CONTACTOR

220/240V 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10A. Extremely well made by a German Electrical Company. Overall size 2 1/2 x 2 x 2in. £1 each.



DOUBLE ENDED MAINS MOTOR

On feet with holes for screw-down fixing. To drive models, oven, blower heater, etc. 50p each, plus 18p post and insurance, 6 or more post free.



0.005mFd TUNING CONDENSER

Proved design, ideal for straight or reflex circuits. 18p each, £1.20 doz.



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4-STATION INTERCOM



£6.75

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 6ft. and other accessories. P. & P. 40p.

MAINS INTERCOM

No batteries—no wires. Just plug in the mains for instant two-way, loud and clear communication. On/off switch and volume control with lock system. Price £12.95. P. & P. 45p extra.

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£3.15

Same as 4-Station Intercom for two-way instant communication. Ideal as Baby Alarm and Door Phone. Complete with 6ft. connecting wire. Battery 12p. P. & P. 25p.

Transistor TELEPHONE AMPLIFIER



£2.98

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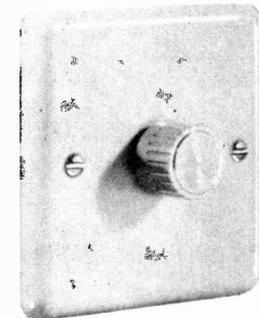
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March issue OUT NOW 17p.

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The DIMMASWITCH is an attractive and efficient dimmer unit which fits in place of the normal light switch and is connected up in exactly the same way. The ivory mounting plate of the DIMMASWITCH matches modern electric fittings. The bright chrome control knob activates an on-off switch and controls 40-600 watts of all lights except fluorescents at mains voltages from 200-250 V, 50 Hz. The DIMMASWITCH has built-in radio interference suppression. Price: £3. 4. 0d plus 1/6d post and packing Kit Form: £2. 14. 0d plus 1/6d post and packing Please send C.W.O. to:-

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As supplied to H.M. Government Departments, Hospitals, Local Authorities, etc.

ELECTRIC CLOCK WITH 25 AMP SWITCH

Made by Smiths, these units are fitted to make 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 the recorder. 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.



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 5 1/2 x 3 1/2 x 2 1/2 in. deep. Metal encased, glass fronted with chrome surround. Offered at £2.40 plus postage and insurance 23p.



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.



FLOUORESCENT 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 lab tanks and indoor plants. Chokes are super-efficient, metal 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 MFL is for 8in, 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 MFL 18p on first kit then 18p on each two kits ordered.

BLANKET SWITCH

Double pole with neon lead 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 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.

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.—12 1/2 in. over mounting lugs. Overall height 5 1/2 in. A £10 speaker offered this month for £27 plus 38p post and ins.



CONTROL DRILL SPEEDS

DRILL CONTROLLER
Electrically 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 and full insurance.



£1.50, plus 13p post and insurance.

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 thermostats 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.



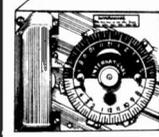
INTEGRATED CIRCUIT BARGAIN

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 3 ICs all new and perfect, first-grade devices, 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 x 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 2 1/2 x 2 1/2 in.—complete with soft leather zippered bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1,600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 455 Kc/s or 455 Kc/s. Power output: 40mW. Antenna: ferrite rod. Loudspeaker: Permanent magnet type. In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new. Price only £1.25 plus 13p post and insurance, less batteries, 6 for £7, post free. Rechargeable batteries 43p pair. Charger 43p.



REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types. **Miniature.** 1in long x approximately 1/4 in diameter. Will make and break up to 1A up to 300 volts. Price 18p each, £1.20 dozen. **Standard.** 2in long x 1/4 in diameter. This will break currents of up to 1A, voltages up to 250 volts. Price 10p each, 80p per dozen. **Flat.** Flat type, 2in long, 1/4 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 8p each, 80p dozen.

HIGH CAPACITY ELECTROLYTICS

Brand new, not ex-equipment. 100 mfd. 25V, 8p each 60p doz. 200 mfd. 25V, 8p each 75p doz. 250 mfd. 50V, 16p each £1.65 doz. 400 mfd. 40V, 22p each £2.80 doz. 500 mfd. 12V, 10p each £1.05 doz. 500 mfd. 20V, 18p each £1.80 doz. 500 mfd. 50V, 22p 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. 2000 mfd. 12V, 10p each £1.05 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 £11 doz. 70,000 mfd. 13V, £2 each £20 doz.

3 AMP 18V 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.

6 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. **18 AMP SOCKETS, FLUSH MOUNTING.** Bakelite, cream, less switch, 5 for £1.

2 AMP 3 PIN SWITCHED SOCKETS for surface mounting, brown bakelite, 40 doz. 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 50p per year, including our completed 1971 catalogue when this is published.

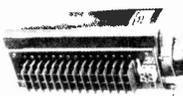
19-PIECE SOCKET SET

Complete with wall or bench rack. An ideal gift for the motorist. 80p + 23p; post and insurance. Most useful sizes from 1/4 in to 1 1/2 in.



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 13 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 3 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 23p 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 fuse—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 £17-80
Model 2411 for up to 10 amps £27-80



Where postage is not stated then orders over £5 are post free. Below £5 add 14p. Semiconductor 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

WATERPROOF HEATING ELEMENTS

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



MICRO SWITCH

5 amp, changeover contacts, 8p each, 90p doz. 15 amp Model 10p each or £1.05 doz.



BI-PAK = LOW COST I.C.'s

BI-PAK Semiconductors now offer you the largest and most popular range of I.C.'s available at these **EXCLUSIVE LOW PRICES**. TTL Digital 74N Series fully coded, brand new. Dual in-line plastic 14 and 16 pin packages.



BI-PAK Order No.	Similar Types to:—Description	Price and qty. prices		
		1-24	25-99	100 up
BP00 7400N	Quad 2-input NAND gate	0-83	0-27	0-28
BP01 7401N	Quad 2-input NAND gate—open collector	0-83	0-27	0-28
BP04 7404N	HEX inverter	0-83	0-27	0-28
BP10 7410N	Triple 3-input NAND gate	0-83	0-27	0-28
BP20 7420N	Dual 4-input NAND gate	0-83	0-27	0-28
BP30 7430N	Single 8-input NAND gate	0-83	0-27	0-28
BP40 7440N	Dual 4-input buffer gate	0-83	0-27	0-28
BP41 7441N	BCD to decimal decoder and NIT driver	1-18	1-00	0-87
BP42 7442N	BCD to decimal decoder (TTL O/P)	1-18	1-00	0-87
BP50 7450N	Dual 2-input and/or not gate—expandable	0-83	0-27	0-28
BP53 7453N	Single 8-input and/or not gate—expandable	0-83	0-27	0-28
BP60 7460N	Dual 4-input—expandable	0-83	0-27	0-28
BP70 7470N	Single JK flip-flop—edge triggered	0-45	0-40	0-35
BP72 7472N	Single master slave JK flip-flop	0-45	0-40	0-35
BP73 7473N	Dual master slave JK flip-flop	0-50	0-45	0-43
BP74 7474N	Dual D flip-flop	0-50	0-45	0-43
BP75 7475N	Quad bistable latch	0-55	0-50	0-47
BP76 7476N	Dual master slave flip-flop with preset and clear	0-55	0-50	0-47
BP83 7483N	Four bit binary adder	1-30	1-18	1-00
BP89 7490N	BCD decade counter	1-18	1-00	0-87
BP92 7492N	Divide by 12 4-bit binary counter	1-18	1-00	0-87
BP93 7493N	Divide by 16 4-bit binary counter	1-18	1-00	0-87
BP94 7494N	Dual entry 4-bit shift register	1-18	1-00	0-87
BP95 7495N	4-Bit up-down shift register	1-18	1-00	0-87
BP96 7496N	5-Bit shift register	1-20	1-06	0-93

Data is available for the above Series of Integrated Circuits in booklet form, price 13p

LINEAR I.C.'s

Type No.	Case	Leads	Description	Price		
				1-24	25-99	100 up
BP 201C—8L201C	TO-5	8	G.P. Amp	65p	55p	45p
BP 701C—8L701C	TO-5	8	OP Amp	65p	55p	45p
BP 702C—8L702C	TO-5	8	OP Amp Direct OP	65p	55p	45p
BP 702 —72702	D.I.L.	14	G.P. OP Amp (Wide Band)	53p	45p	40p
BP 709 —72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P—8LA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP 741 —72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
8A 703C—8LA703C	TO-5	6	R.F.—I.F. Amp	48p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	55p
TAA 293—	TO-74	10	G.P. Amp	90p	75p	70p

TTL INTEGRATED CIRCUITS

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

PAK No.	8p	PAK No.	8p
UIC00	7400N 0-50	UIC73	7473N 0-50
UIC01	7401N 0-50	UIC74	7474N 0-50
UIC02	7402N 0-50	UIC75	7475N 0-50
UIC03	7403N 0-50	UIC76	7476N 0-50
UIC04	7404N 0-50	UIC80	7480N 0-50
UIC05	7405N 0-50	UIC82	7482N 0-50
UIC10	7410N 0-50	UIC83	7483N 0-50
UIC20	7420N 0-50	UIC86	7486N 0-50
UIC40	7440N 0-50	UIC90	7490N 0-50
UIC41	7441N 0-50	UIC92	7492N 0-50
UIC42	7442N 0-50	UIC93	7493N 0-50
UIC60	7460N 0-50	UIC94	7494N 0-50
UIC51	7451N 0-50	UIC95	7495N 0-50
UIC60	7460N 0-50	UIC96	7496N 0-50
UIC70	7470N 0-50	UICX1	ASST'D 74's 1-50
UIC72	7472N 0-50		

Packs cannot be split but 20 assorted pieces (our mix) is available as PAK UICX1. Every PAK carries our BI-PAK Satisfaction or money back GUARANTEE.

DUAL IN-LINE LOW PROFILE SOCKETS

14 and 16 lead sockets for use with dual-in-line Integrated Circuits.

Order No.	Price each
T8014 14 pin type	1-24 35p 25-99 25p 100 up 20p
T8016 16 pin type	1-24 45p 25-99 35p 100 up 30p

RTL FAIRCHILD (U.S.A.) I.C.'s

RTL Micrologic Circuits	Qty. prices each
Epoxy case To-5 temp. range 15°C to 55°C	1-11 12-24 25-99 100 +
μL 900 Buffer	40p 35p 30p 27p
μL 914 Dual two-input gate	40p 35p 30p 27p
μL 923 J-K flip-flop	53p 50p 47p 45p

Full data and circuits for I.C.'s in Booklet form, price 7p.

DTL DIGITAL I.C.'s

DTL dual-in-line package	Price each
Type MC844P expandable dual 4-input NAND Power-Gate	60p each
Type MC846P clocked flip-flop	75p each

FULL DATA SUPPLIED WITH UNITS

All prices quoted in New Pence. Please send all orders direct to our warehouse and despatch department.

BI-PAK SEMICONDUCTORS

P.O. BOX 6, WARE, HERTS.

Postage and packing add 7p. Overseas add extra for Airmail. Minimum order 50p. Cash with order please. Giro No. 388-7006.

YATES ELECTRONICS

(FLITWICK) LTD.

(FLITWICK) LTD.

RESISTORS

1/4W Iskra high stability carbon film—very low noise—capless construction. 1/4W Mullard CR25 carbon film—very small body size 7.5 x 2.5mm. 4W Erie wire wound.

Power	Tolerance	Range	Valves available	Price
watts				1-99 100+
1/4	5%	4.7Ω-2.2MΩ	E24	1-0p 0-7p
1/4	10%	3.3MΩ-10MΩ	E12	1-0p 0-7p
1/4	10%	1Ω-3.9Ω	E12	1-0p 0-7p
1/4	5%	4.7Ω-1MΩ	E12	1-0p 0-7p
4	10%	1Ω-10Ω	E12	7 1/2p 7 1/2p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0.5 watt 5% Iskra resistors 5 off each value 4.7Ω to 1MΩ. E12 pack 325 resistors £2.20. E24 pack 650 resistors £4.20.

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 2 1/2p. 0.0068μF, 0.01μF, 0.015μF, 0.022μF, 0.033μF, 3p. 0.047μF, 0.068μF, 0.1μF, 4p. 0.15μF, 6p. 0.22μF, 7 1/2p. 0.33μF, 11p. 0.47μF, 13p. 160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 3p. 0.1μF, 0.15μF, 0.22μF, 4p. 0.33μF, 6p. 0.47μF, 7 1/2p. 0.68μF, 11p. 1.0μF, 12 1/2p.

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0.01μF, 0.015μF, 0.022μF, 3p. 0.033μF, 0.047μF, 0.068μF, 3 1/2p. 0.1μF, 4p. 0.15μF, 0.22μF, 5p. 0.33μF, 6 1/2p. 0.47μF, 8 1/2p. 0.68μF, 11p. 1.0μF, 13p.

MYLAR FILM CAPACITORS

100V: 0.001μF, 0.002μF, 0.005μF, 0.01μF, 0.02μF, 2 1/2p. 0.04μF, 0.05μF, 0.068μF, 0.1μF, 3 1/2p.

CERAMIC DISC CAPACITORS

100pF to 10,000pF, 2p each.

CAPACITOR DEVELOPMENT PACK

Selection of 100 ceramic and polyester capacitors, 100pF to 1.0μF, £2.90.

ELECTROLYTIC CAPACITORS—One Price—5p Each

Mullard C426 series (μF/V): 25/6.4, 50/6.4, 100/6.4, 200/6.4, 320/6.4, 16/10, 32/10, 64/10, 125/10, 200/10, 10/16, 20/16, 40/16, 80/16, 125/16, 6.4/25, 12.5/25, 25/25, 50/25, 80/25, 4/40, 8/40, 16/40, 32/40, 50/40, 2.5/64, 5/64, 10/64, 32/64.

Miniature P.C. mounting (μF/V): 10/12, 50/12, 100/12, 200/12, 5/25, 10/25, 25/25, 100/25.

POTENTIOMETERS

Carbon track 5kΩ to 1MΩ, log or linear (log 1/4W, lin 1/4W). Single, 12 1/2p. Dual gang (stereo), 40p.

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0-1 matrix). Sub-miniature 0-1 watt, 4p each. Miniature 0.25 watt, 5p each.

SEMICONDUCTORS

AC126 15p	BFY52 22 1/2p	OC81 15p	2N3055 72p
AC127 15p	BSY56 30p	OC82 15p	2N3702 15p
AC128 15p	B5X21 25p	ORP12 47 1/2p	2N3703 14p
AD140 40p	BY124 7 1/2p	IN4001 7 1/2p	2N3704 17 1/2p
AF115 17 1/2p	BYZ10 30p	IN4002 10p	2N3705 15p
AF117 17 1/2p	BYZ13 20p	IN4003 11p	2N3706 12p
BC107 14p	OA85 7 1/2p	IN4004 12 1/2p	2N3707 18 1/2p
BC108 10p	OA91 7 1/2p	IN4005 14p	2N3708 10p
BC109 14p	OA202 7 1/2p	IN4006 15p	2N3709 11p
BFY50 22p	OC71 15p	IN4007 16p	2N3710 12p
BFY51 19p	OC72 15p	2N2926 11p	2N3711 14p

ZENER DIODES

400mW 5% 3.3V to 30V, 17 1/2p.

VEROBOARD

0-1	0-15	0-15	0-1
2 1/2 x 3 1/2	22p 16p	17 x 3 1/2 (plain)	52 1/2p
2 1/2 x 5	24p 24p	17 x 2 1/2 (plain)	37 1/2p
3 1/2 x 3 1/2	24p 24p	2 1/2 x 5 (plain)	17 1/2p
3 1/2 x 5	27p 27p	2 1/2 x 3 1/2 (plain)	15p
17 x 2 1/2	75p 57 1/2p	Pin insertion tool	47 1/2p
17 x 3 1/2	100p 75p	Spot face cutter	37 1/2p
17 x 5 (plain)	75p	Pkt. 36 pins	15p 15p

ROTARY SWITCHES

2P2W, 1P12W, 2P6W, 3P4W, 4P3W, 22 1/2p.

PLUGS AND SOCKETS

Standard 1/4 in screened	17 1/2p	2.5mm insulated	7 1/2p
Standard 1/4 in insulated	14p	3.5mm insulated	7 1/2p
Stereo 1/4 in screened	35p	3.5mm screened	12 1/2p
Standard 1/4 in socket	15p	2.5mm socket	7 1/2p
Stereo 1/4 in socket	17 1/2p	3.5mm socket	7 1/2p

BRUSHED ALUMINIUM PANELS

12" x 6" — 25p; 12" x 2 1/2" — 15p; 6" x 1 1/2" — 10p.

C.W.O. please. Post and packing, please add 7 1/2p to orders under £2. Data sheets are available for most of the components listed, and will be sent free on request.

8E39 ELSTOW STORAGE DEPOT, KEMPSTON HARDWICK, BEDFORD

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 x 5 1/2 x 3 1/2 in. 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.

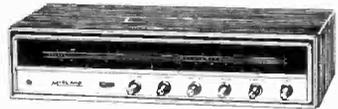
PREMIER PRICE £47 Carr. £1.75

MIDLAND AM/FM STEREO TUNER AMPLIFIERS

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



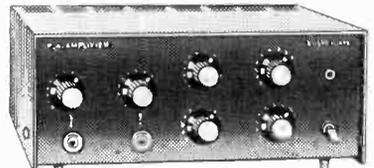
MODEL 19-520



MODEL 19-542

Specifications	Model 19-520	Model 19-542
Semi	19 transistors, 12 diodes, conductors 2 varistors	22 transistors, 12 diodes
Tuning range	FM 88-108 MHz FM Stereo Multiplex AM 530-1635 kHz	FM 88-108 MHz FM Stereo Multiplex AM 535-1695 kHz
Aerial	Internal AM and external FM	Internal AM and external FM
Frequency Response	50-17,000 Hz	35-20,000 Hz
Power Output	2 1/2 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" x 8 1/2" x 3 1/2"	16 1/2" x 9 1/2" x 3 1/2"
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 Ohm) Phono/Aux 300mV (100k Ohm). Frequency response 50-20,000Hz. Fused output and thermal overload protection. A.C. Mains 220-250V, 50/60Hz. Size 13 1/2 in x 9 in x 5 in.

PREMIER PRICE £39 P. & P. 50p

E.M.I. 13x8in. HI-FI SPEAKERS

Fitted two 2 1/2 in tweeters and crossover network. Available with 8 or 15 ohm impedance. Handling capacity 10W. Brand new.



£3.47 P. & P. 40p

HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2 1/2 in. 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

VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 1/2 x 3 1/2 in. 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

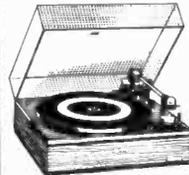
POCKET SIZE MULTI-TESTER

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, 10µµf-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 Parapex Cover. Total list Price over £24.
PREMIER PRICE £18.90
P. & P. 50p



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. 3p

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



"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	LP6 5 1/2' 1200' P.V.C.	62p
TT3 3' 450' POLYESTER	37p	DT6 5 1/2' 1800' POLYESTER	£1.12
DT3 3 1/2' 600' POLYESTER	57p	TT6 5 1/2' 2400' POLYESTER	£1.87
SP5 5' 800' P.V.C.	42p	SP7 7' 1200' P.V.C.	62p
LP5 5' 900' P.V.C.	50p	DT7 7' 1800' P.V.C.	75p
DT5 5' 1200' POLYESTER	75p	DT7 7' 2400' POLYESTER	£1.25
		TT7 7' 3600' POLYESTER	£2.50

TAPE SPOOLS 3" 5p, 5 1/2" 7" 9p.
Post and Packing 3" 5p, 5 1/2" 8p, 7" 10p. (3 reels and over Post Free.)

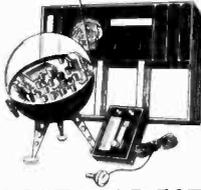
PREMIER RADIO

10 & 23, TOTTENHAM COURT ROAD, LONDON, W.1 TEL: 01-636 3451/2639
HEAD OFFICE & MAIL ORDER DEPT. 23, TOTTENHAM C.T.R. TEL: 01-636 3451



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 4 1/2" 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



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.T. 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



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



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.

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 (3 1/4 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.



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

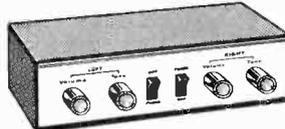
PROFESSIONAL SOLID STATE FOUR BAND COMMUNICATION RECEIVER Model R.135

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.

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



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



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: 65dB. AM frequency range: 535-1,605kHz. Usable sensitivity: 280µV.

PRICE £21-00



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



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

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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.

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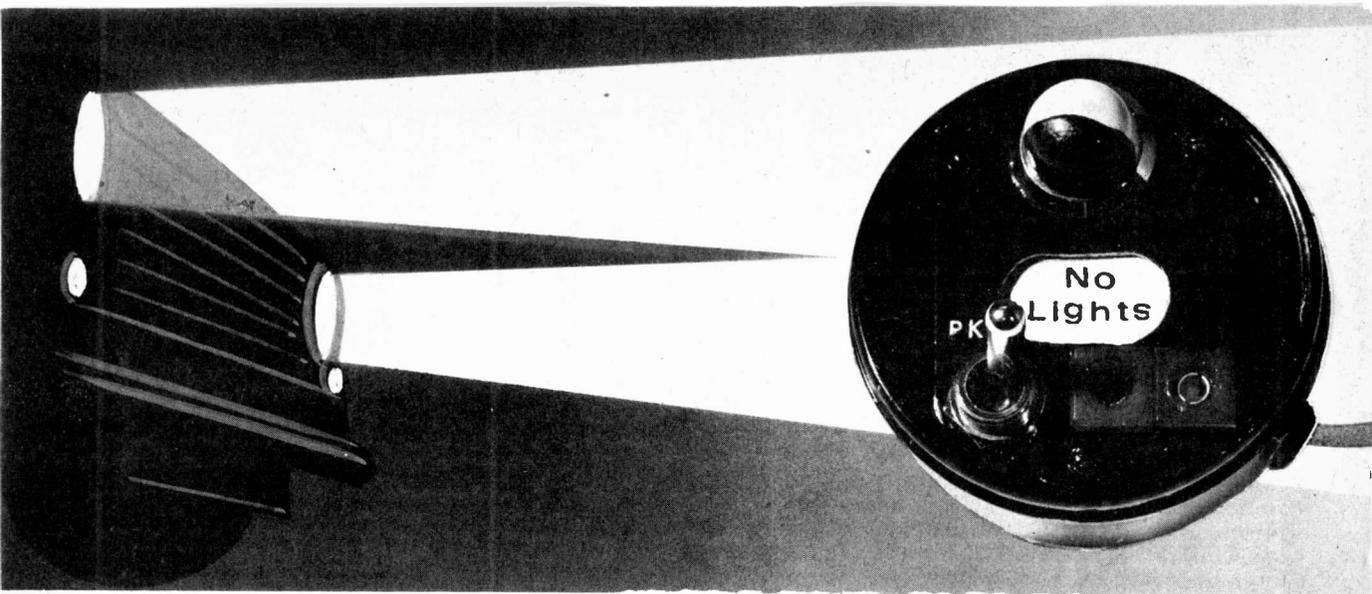
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Our April issue will be published on
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MANY drivers are not regular users of parking lamps and tend to use side lights when parking in a strange situation. Because they would not use an automatic parking 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.

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

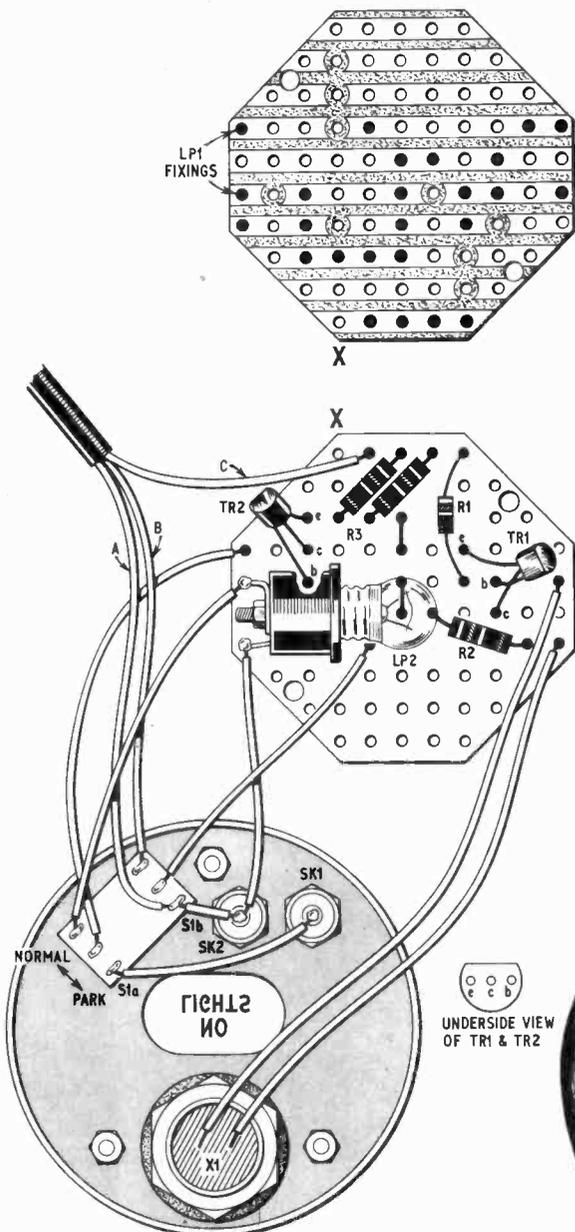


Fig. 2. Layout and wiring diagram of the prototype unit housed in a tobacco tin case. This is the negative earth system; for positive earth version the wire connected to S1b wiper is removed and reconnected to SK2, link between SK2 and S1b is removed. Wire "C" is taken to S1b wiper and a new wire—which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

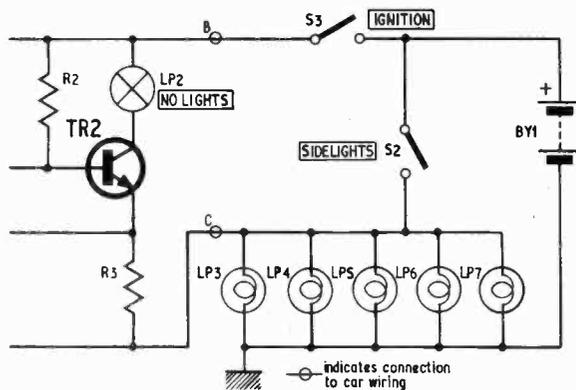


Fig. 3. Circuit diagram of the negative earth system for lighting up reminder only. Connections "B" and "C" are reversed for a positive earth system

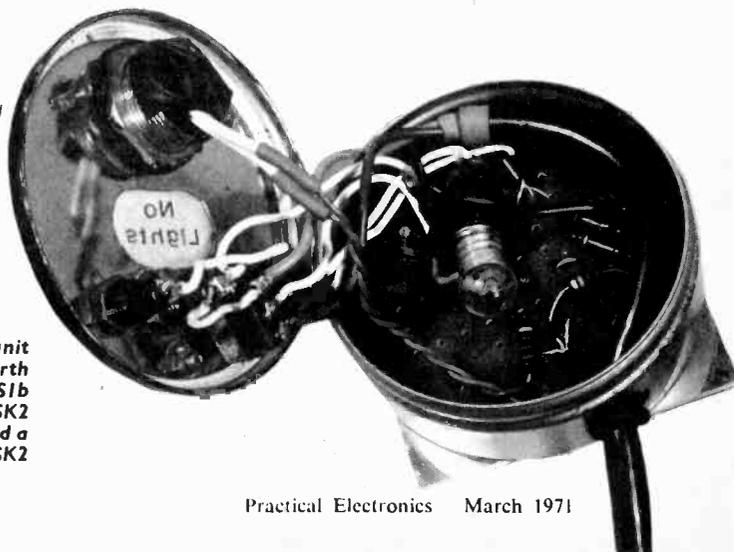
special socket to suit the parking light. The three core lead that connects the circuit to the car wiring can be taken out through a grommet hole in the side of the case.

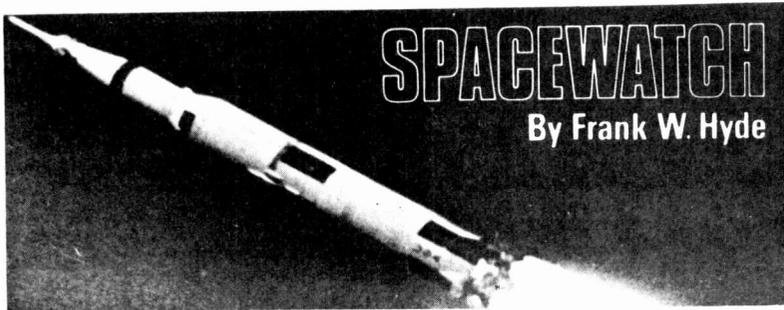
Components in the prototype were mounted on a piece of 0.2 inch matrix Veroboard, fixed inside the tin by two 6B.A. screws and spacers (see Fig. 2). The inside of the tin should be protected by insulation tape so that no connection is made between the circuit and earth on the car. It is, of course, possible 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 70 μ m at the surface to 120 μ m 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.

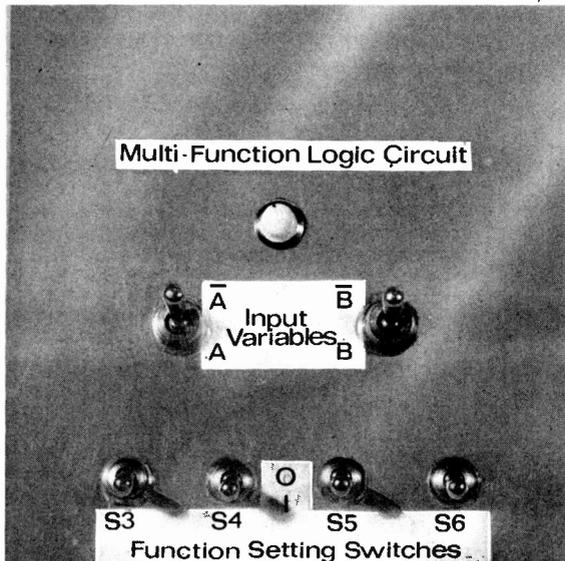
The present instrumentation could be built into a manned cabin without modification. From this it could well be surmised that a manned landing is still part of Soviet plans. Also there is a distinct suggestion that the Russians are looking further afield to Mars for automated surface units.

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 co-operative 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.



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	$\bar{A}\bar{B}$	$A\bar{B}$	$\bar{A}B$	AB
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

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:

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

These four conditions could produce a 0 or 1 at the output, depending on the circuit logic, hence a total of 2⁴ or 16 functions are possible.

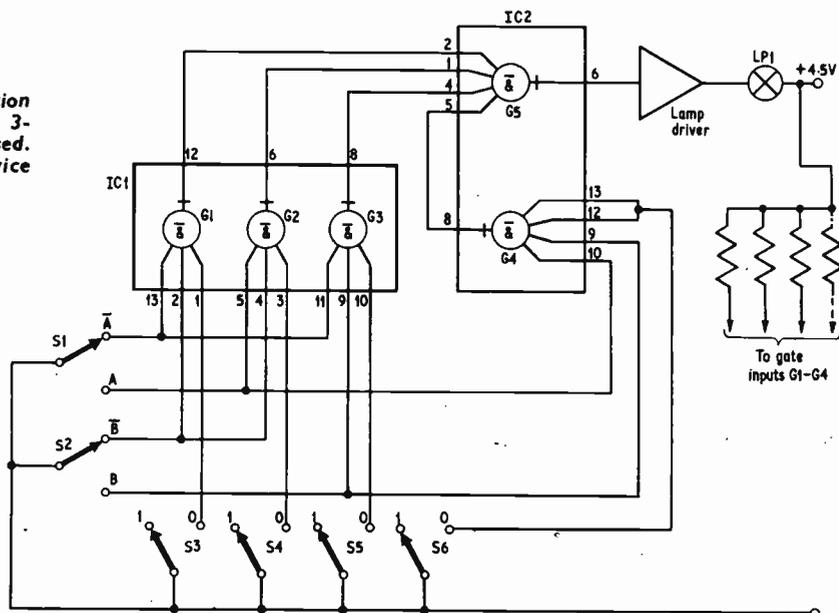
function setting switches and on the particular combination of the A, B inputs.

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



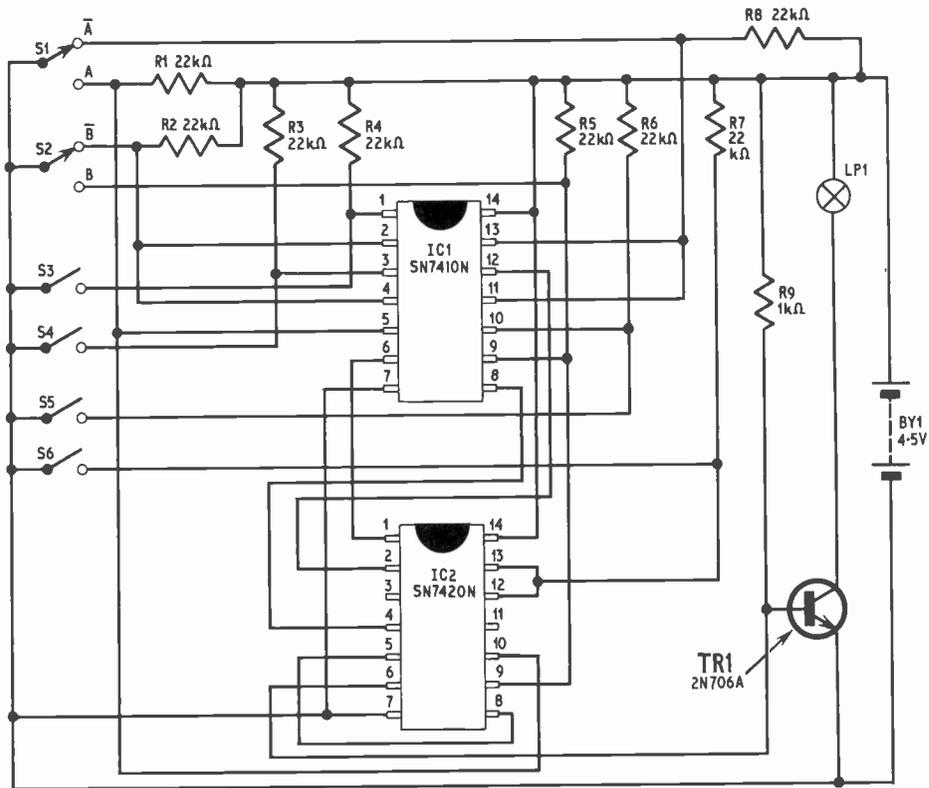


Fig. 2. Circuit diagram of unit. Note that all gate inputs have a positive bias

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.

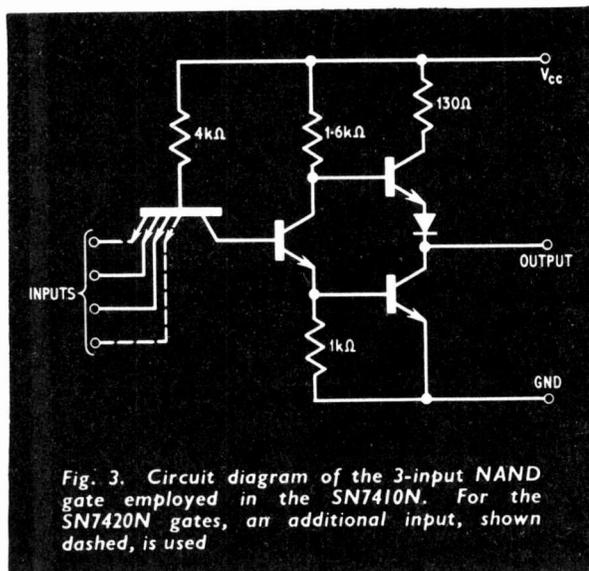


Fig. 3. Circuit diagram of the 3-input NAND gate employed in the SN7410N. For the SN7420N gates, an additional input, shown dashed, is used

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	$A \cdot B$	AND
2	0 0 1 0	$\bar{A} \cdot B$	
3	0 0 1 1	B	B
4	0 1 0 0	$A \cdot \bar{B}$	
5	0 1 0 1	A	A
6	0 1 1 0	$\bar{A} \cdot B + A \cdot \bar{B}$	Exclusive OR
7	0 1 1 1	$A + B$	OR
8	1 0 0 0	$\bar{A} \cdot \bar{B} = \overline{A + B}$	NOR
9	1 0 0 1	$A \cdot B + \bar{A} \cdot \bar{B}$	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	$\bar{A} + \bar{B} = \overline{A \cdot B}$	NAND
15	1 1 1 1	1	1
16	0 0 0 0	0	0

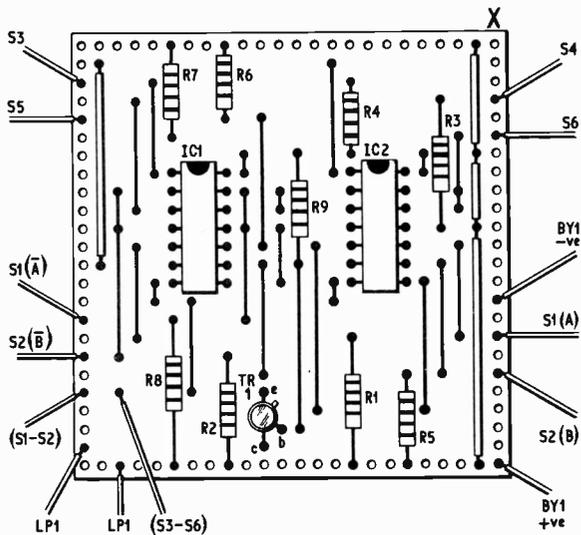


Fig. 4. Component layout and wiring for topside and underside of Veroboard

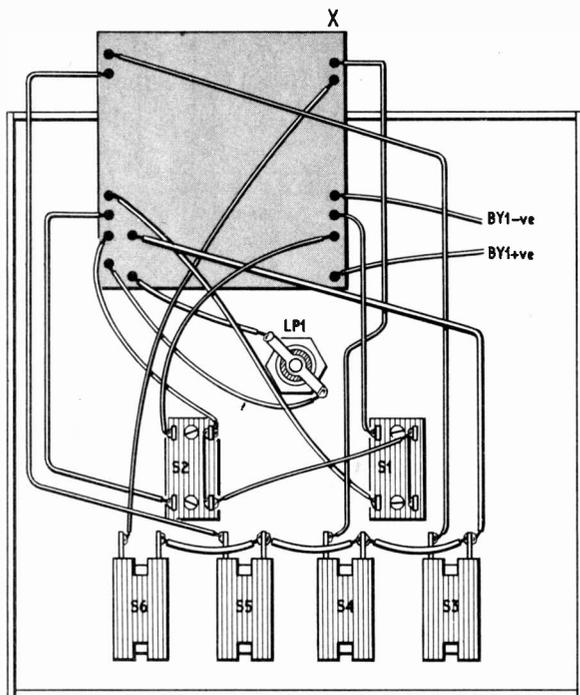
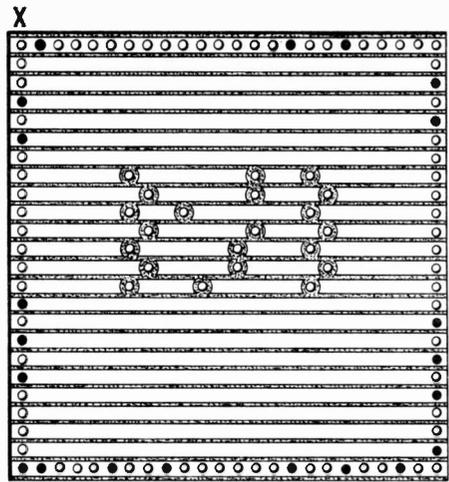


Fig. 5. Veroboard and control panel interwiring on an aluminium chassis plate

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 22k Ω (8 off)
R9 1k Ω
All 10%, 1/4 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

LPI Miniature indicator 6V 0.06A (Electroniques)

Miscellaneous

0.1in matrix Veroboard 2 1/2in x 2 1/2in, Vero pins (14 off), Aluminium chassis 8in x 6in x 1 1/4in

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.

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 push-button 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.

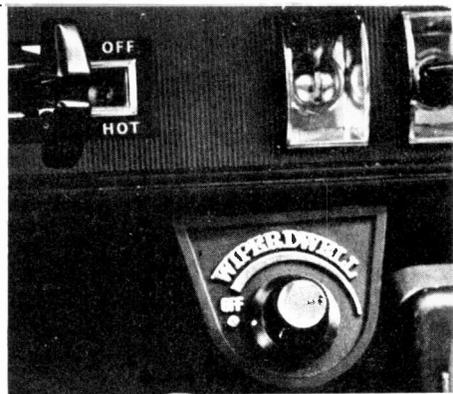
Also, we have been informed that Gothic Electronic Components, Beacon House, Hampton Street, Birmingham 19, have been appointed stockists and distributors of the complete range of standard and miniature thumbwheel switches from Birch-Stolec.

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



Wiperdwell windscreen wiper control from Automents

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 (¾in) × 10.5mm (¾in) 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 cassette 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.

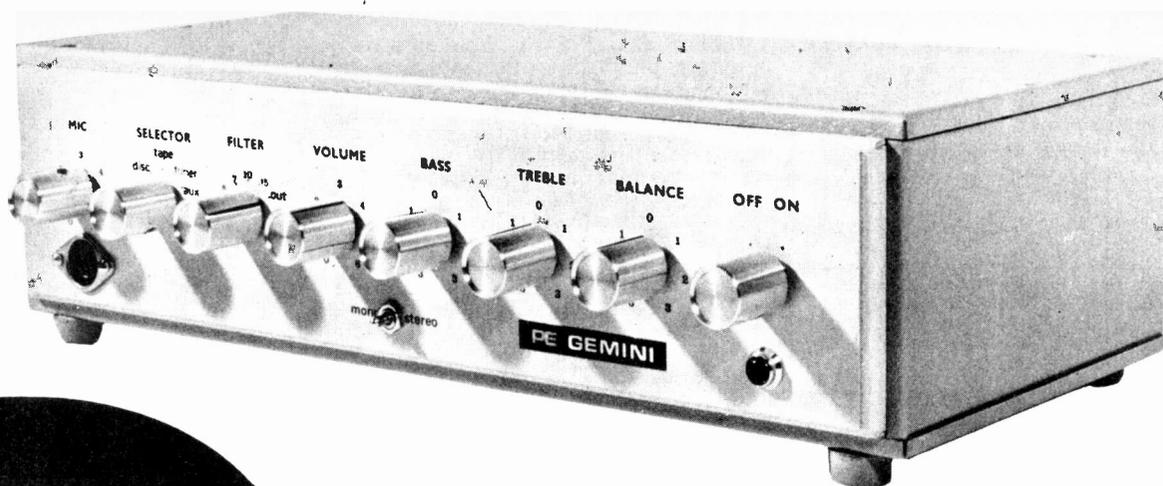
Supplied in a plastics container the Bib Size 31 cassette tape head cleaner retails at 53p (10s. 7d.) and is available from most hi fi shops.

Osmor 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 $12\frac{1}{2}$ in \times $2\frac{1}{4}$ in \times 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

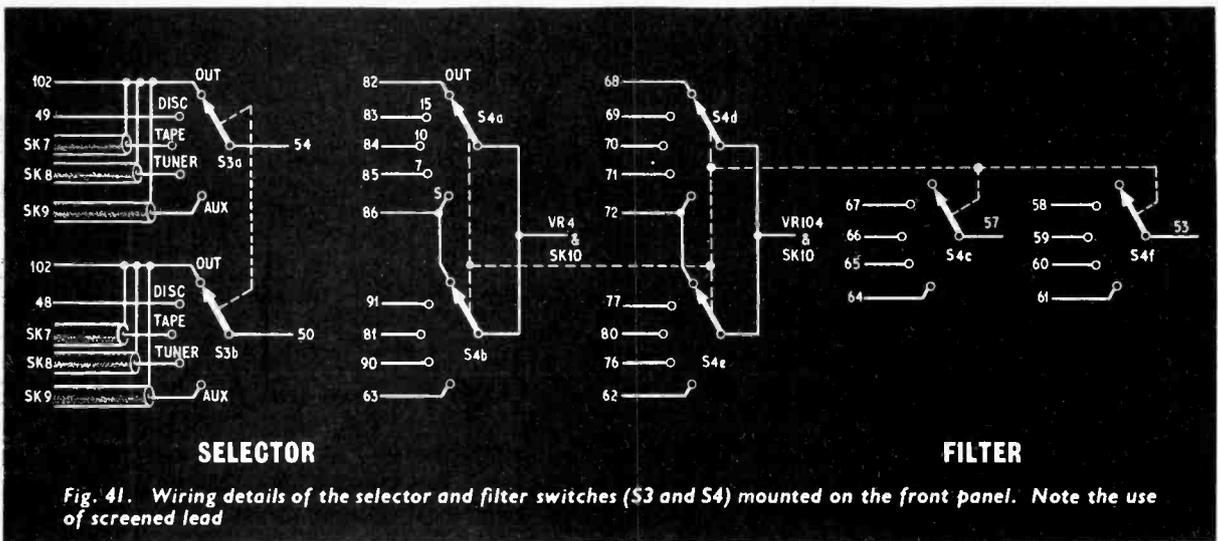
The front and rear panels can now be labelled using the same method as for the main amplifier cabinet, i.e. one light coat of Letracote gloss, apply the letters and then a further two coats of Letracote. As can be seen in the photographs, the prototype controls have numbers of relative magnitude arranged 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



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

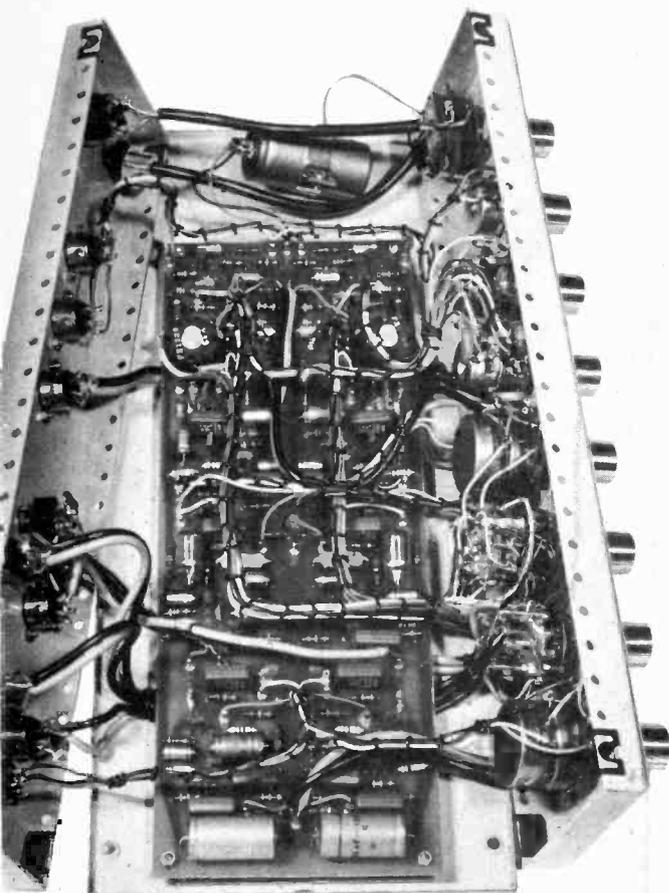
screens being connected to a stout tinned copper wire joining the "Out" positions of the selector switch. The sole connection between the case and the negative rail must be at SK5 as indicated, or complications may arise due to an earth loop being formed which could result in an incurable hum. The earth 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

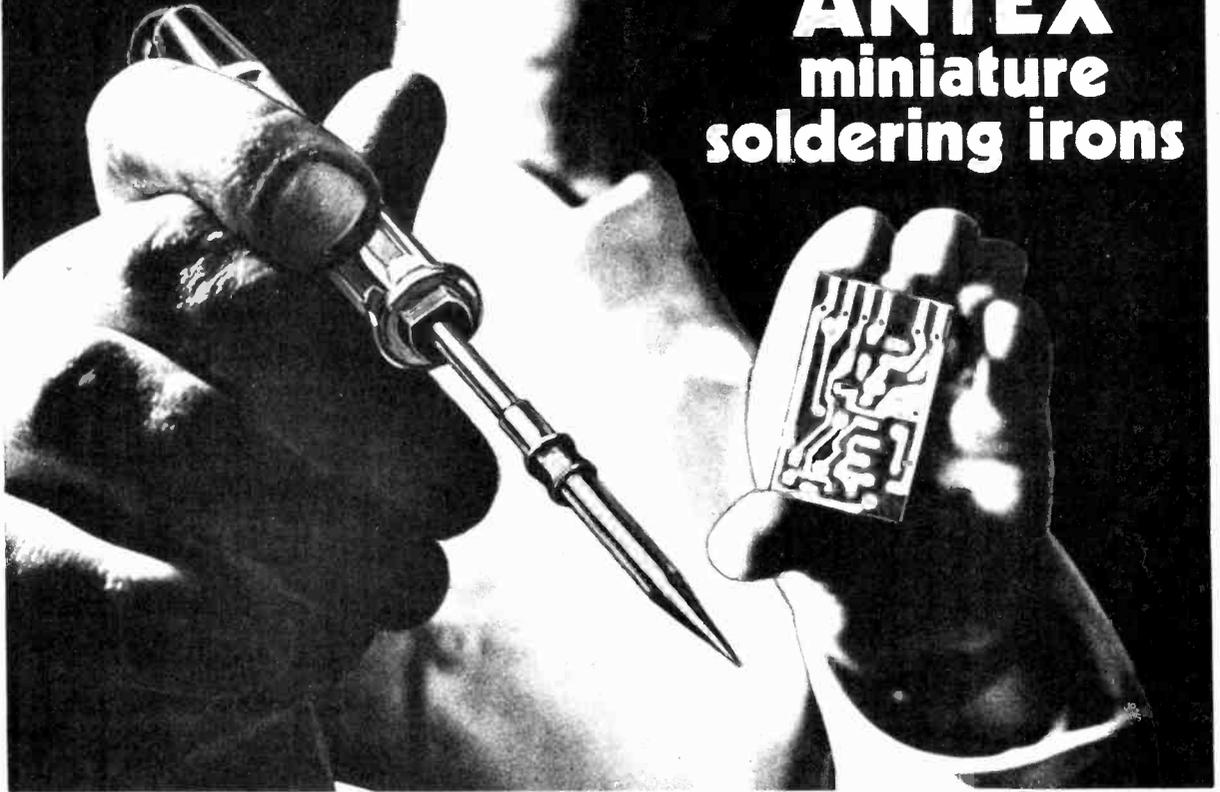
The cable which supplies power to the pre-amplifiers and audio to the main amplifier must be made a suitable length to suit the particular installation. Any multi-core (at least three core) screened cable can be used since the output impedance of the pre-amplifier is quite low. We have not given any 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.



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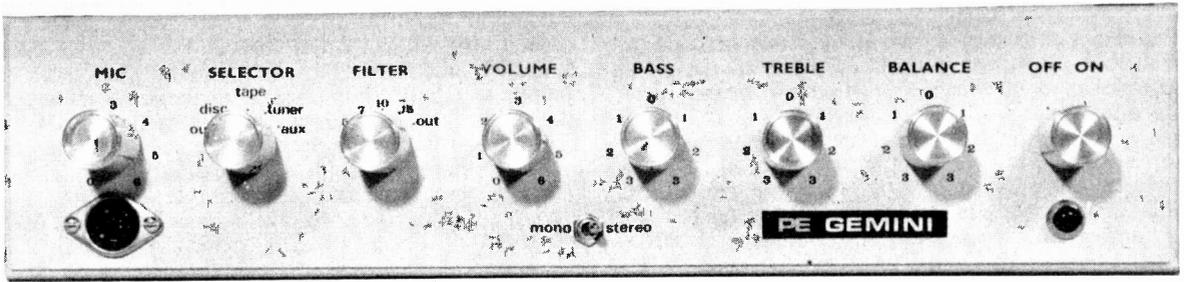
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Photograph of the front panel showing control designations

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 its 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.

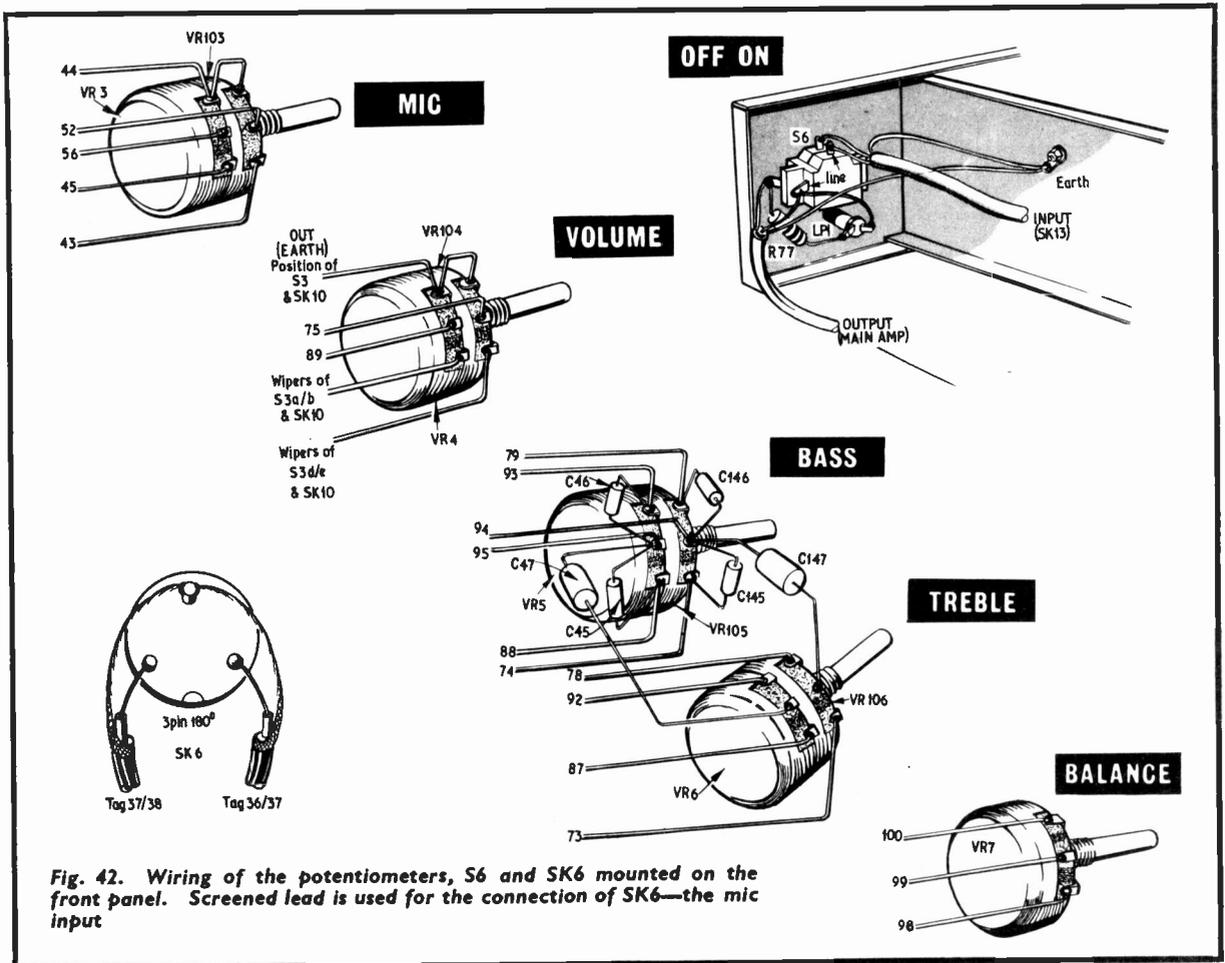


Fig. 42. Wiring of the potentiometers, S6 and SK6 mounted on the front panel. Screened lead is used for the connection of SK6—the mic input

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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2N706	12p	2N2926	11p	AG107	46p	BC153	35p	BFY50	23p
2N930	29p	2N3033	27p	AC126	20p	BC154	38p	BFY51	20p
2N1131	36p	2N3225	54p	AC127	20p	BC157	19p	BFY52	23p
2N1132	40p	2N3702	13p	AC128	20p	BC158	17p	B8X20	16p
2N1302	10p	2N3703	13p	AC153K	25p	BC159	18p	C407	17p
2N1303	18p	2N3704	13p	AC176	27p	BC167	15p	MC140	26p
2N1304	25p	2N3705	13p	ACY20	20p	BC168	11p	MP86531	25p
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	BC185L	11p	NKT403	65p
2N1711	25p	2N3704	15p	AF114	30p	BC184L	15p	NKT405	79p
2N1893	54p	2N3904	15p	AF115	35p	BC212L	25p	OC71	29p
2N2147	95p	2N3906	35p	AF117	28p	BC213L	25p	OC81	29p
2N2218	33p	2N4058	20p	AF124	30p	BC214L	25p	OC81D	17p
2N2218A	43p	2N4059	20p	AF127	28p	BCY70	18p	ZTX300	25p
2N2219	38p	2N4060	20p	AF130	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	25p
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	25p	ZTX503	25p
2N2905	44p	2N4291	15p	BC126	55p	BFX84	25p	ZTX504	60p
2N2905A	47p	2N4292	15p	BC147	15p	BFX85	34p		

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

Power	Kit price	Suitable unreg. power supply kit
12W	£5.40 net	£4.60
25W	£9.50 net	N/A
40W	£10.50 net	£5.75
70W	£12.60 net	£6.94

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99	100 up
C	1/20W	5%	82Ω-220kΩ	E12	7p	6p	6p
C	1W	5%	4.7Ω-330kΩ	E24	1p	0.8p	0.7p
C	1W	10%	4.7Ω-10MΩ	E12	1p	0.8p	0.7p
C	1W	5%	4.7Ω-10MΩ	E24	1.2p	1p	0.9p
C	1W	10%	4.7Ω-10MΩ	E12	2.5p	2.5p	1.9p
MO	1W	±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 Electroisol 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 decales. E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decales.

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

SINGLAI IC10 complete with instruction book giving amplifier circuit details and range of applications. £2.85 net. Components pack for stereo inc. mains transformer, controls, etc., £4.75 net.

PLESSEY 5L40SA. Only £2.75 each net. 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 P.D.T.

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Square bezel, red only ... 19p
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Toggle switches, 250V a.c. 1.5A. Chrome dolly and chrome nilled nut S.P.S.T. 19p; S.P.D.T. 22p; D.P.D.T. 28p; S.P.D.T. centre off 26p.

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Axial leads: 30/50 8p; 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.

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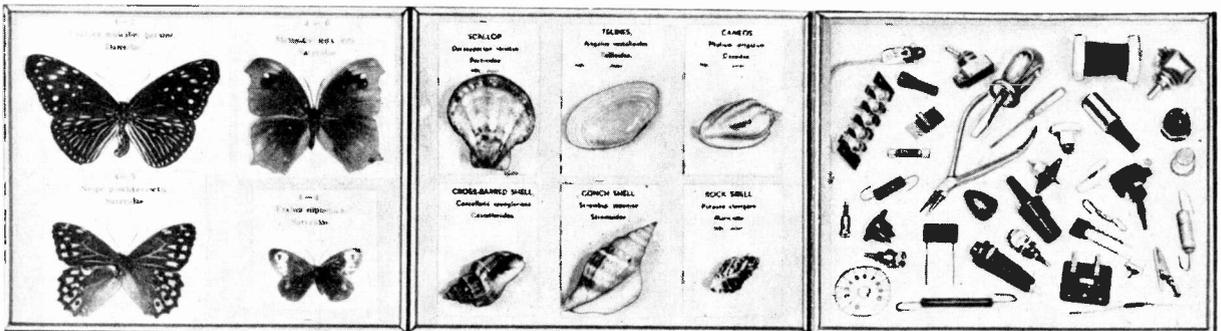
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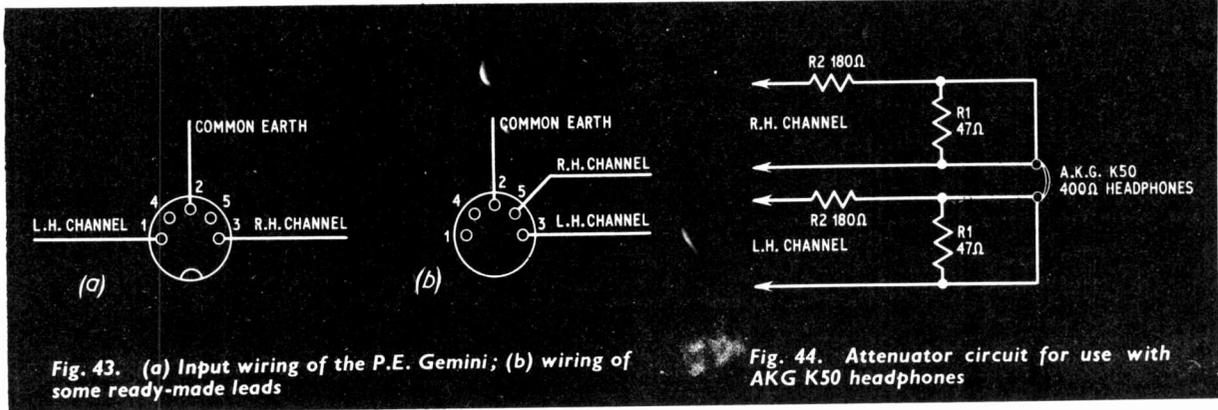
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TAPE INPUT

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.

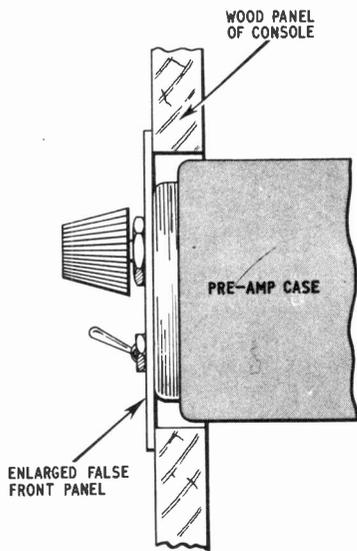


Fig. 45. Method of mounting the pre-amplifier in a console

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.

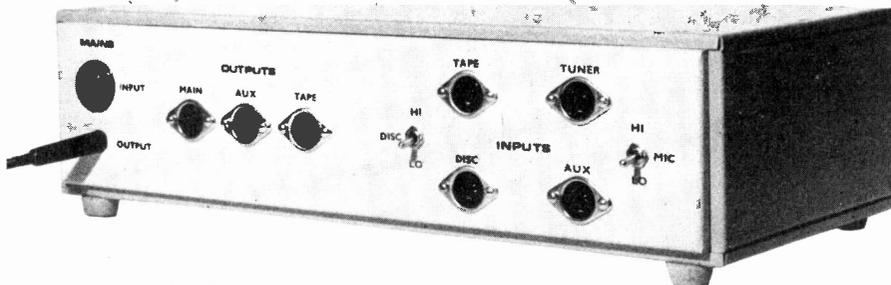
CASES

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.

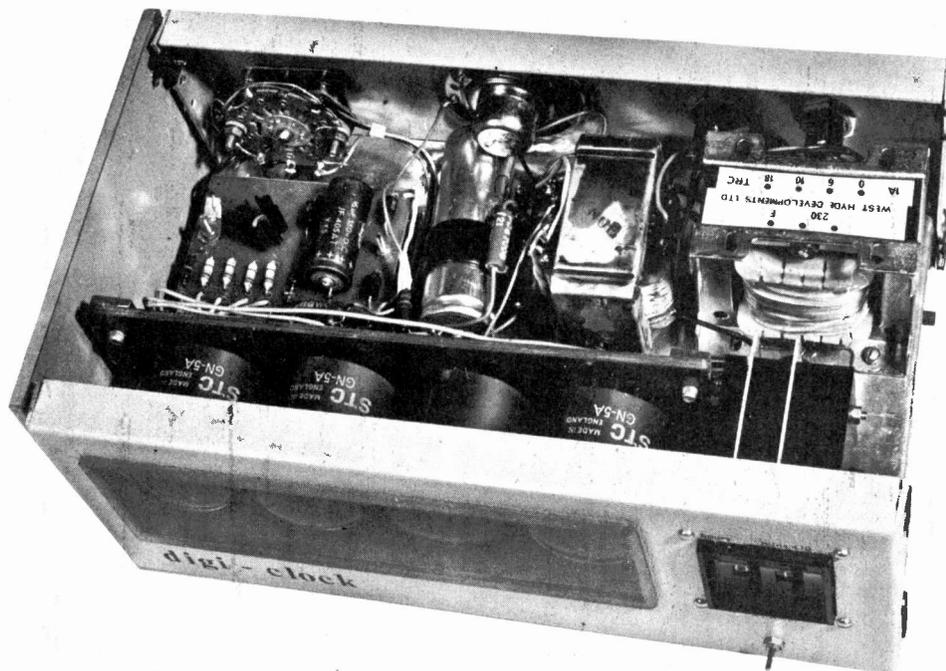
The series pass transistor TR2 employed by the 5V regulator uses the chassis as a heat sink; it is vital that this transistor is isolated from the aluminium by an insulating mica washer of the type normally supplied with this type of device.

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 $\frac{1}{8}$ in 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 $\frac{3}{8}$ in 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.



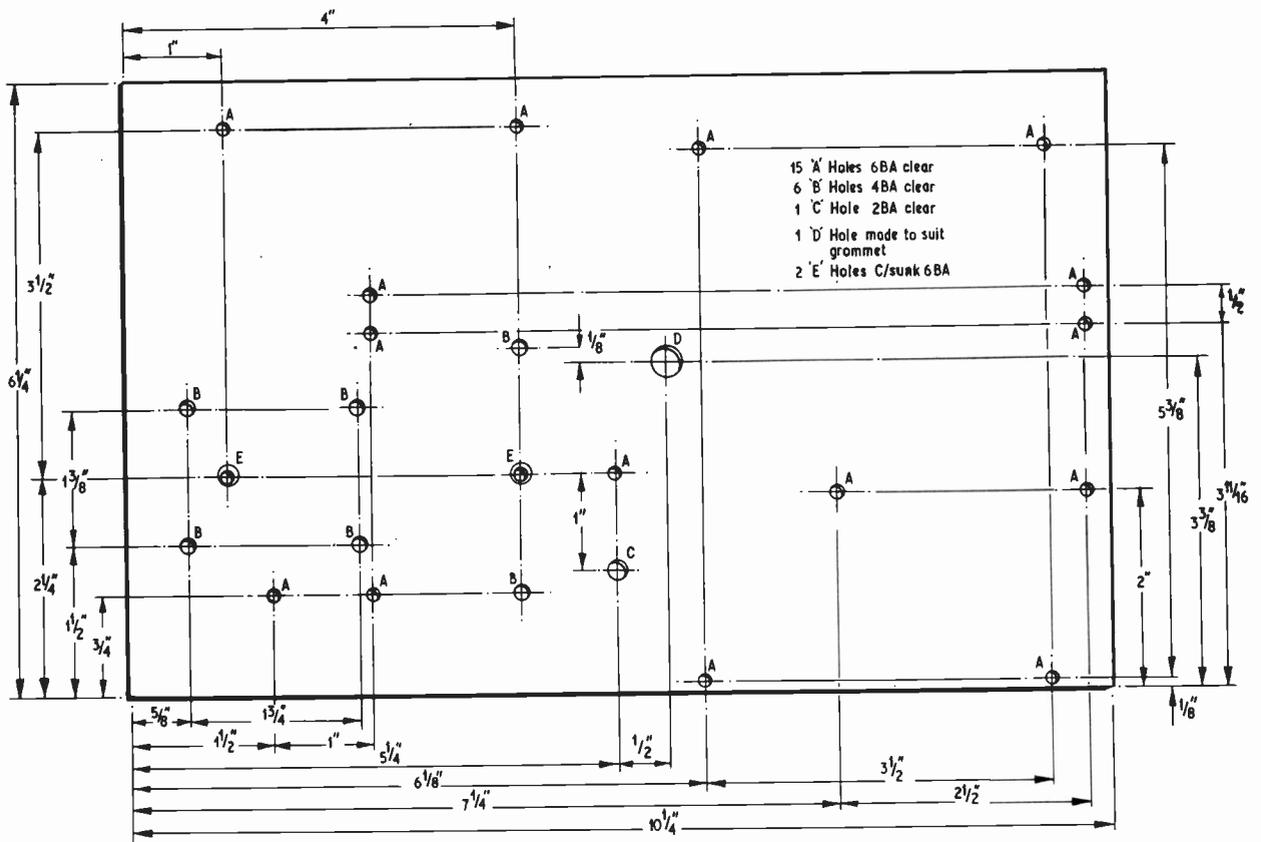


Fig. 17. Chassis drilling details assuming components used are as specified in the components list. Modifications may be necessary for variations of component type. Clearance above chassis $2\frac{3}{4}$ in

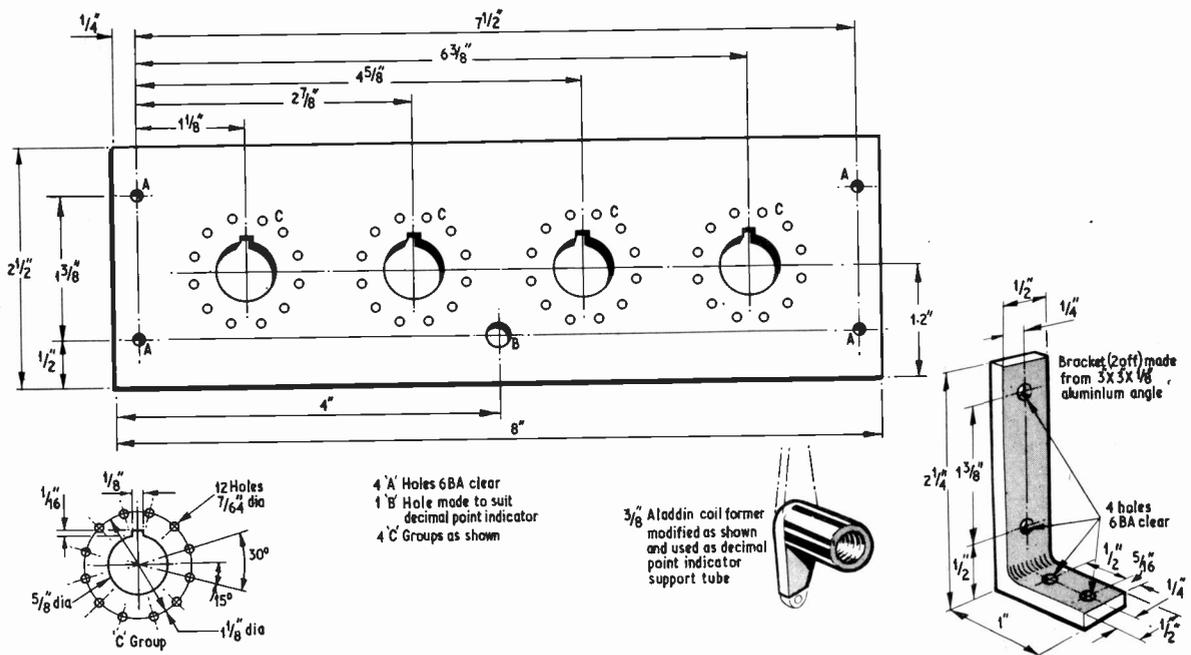


Fig. 18. Display panel drilling for "Nixie" tubes

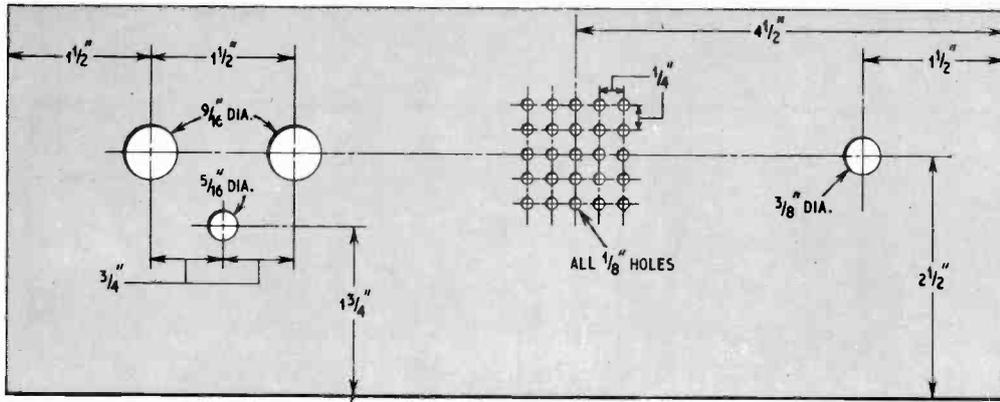


Fig. 19. Back panel drilling details for components specified

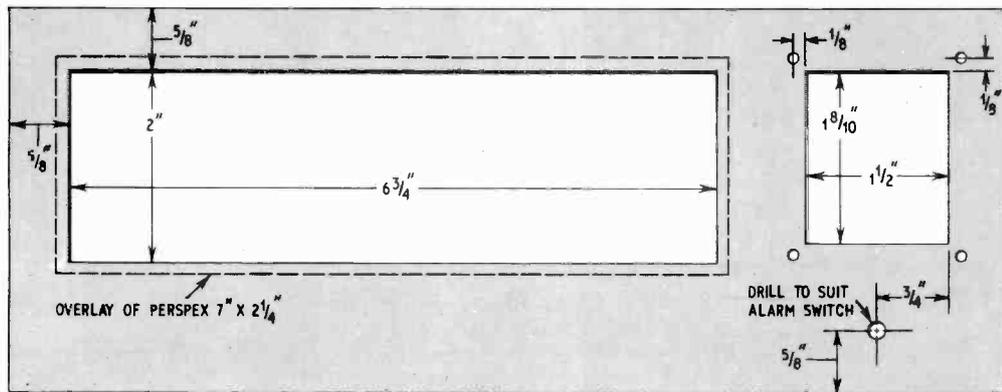


Fig. 20. Front panel drilling details for components specified

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	6E	1	green	T2, 6.3V
6	2E	2	black	S1a wiper
6	6A	3	red	S1c wiper
13	4F	4	orange	S1b wiper
13	3C	5	red	Board B5
13	3B	6	orange	Board B4
9	2H	7	pink	Board B3
12	3E	8	violet	Board B1
9	2F	9	green	Board B9
ALL	Ground Rail	10	blue	Board B13
ALL	+V _{cc} rail	11	black	chassis
11	7G	12	red	Board B12
13	6H	13	brown	Board B10
13	6G	14	yellow	Board B2
13	3A	15	yellow	(optional hours × 10 zero line to V1 pin 10)
13	6A	16	yellow	V1 pin 1
13	7E	17	grey	V3 pin 10
13	6A	18	pink	V3 pin 1
13	7E	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

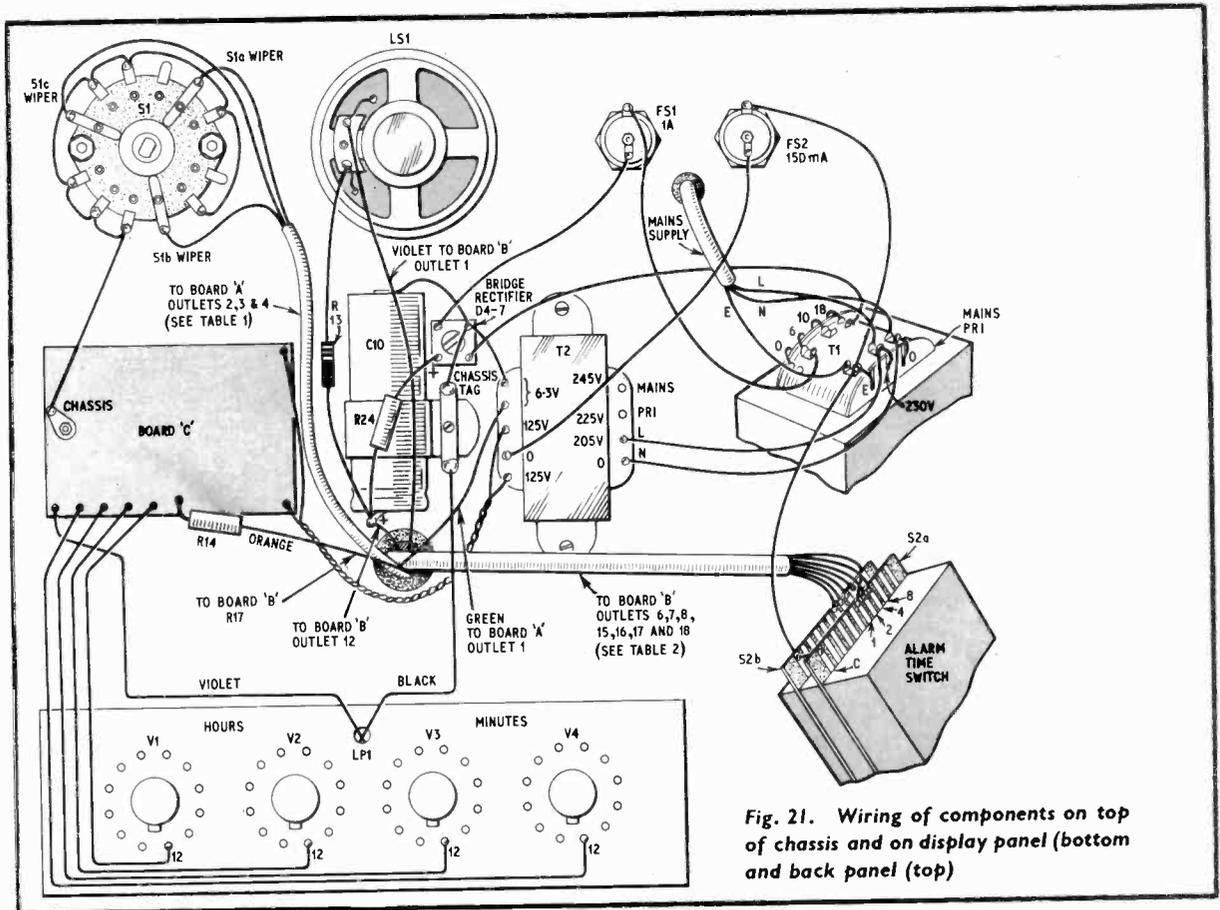


Fig. 21. Wiring of components on top of chassis and on display panel (bottom and back panel (top))

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.

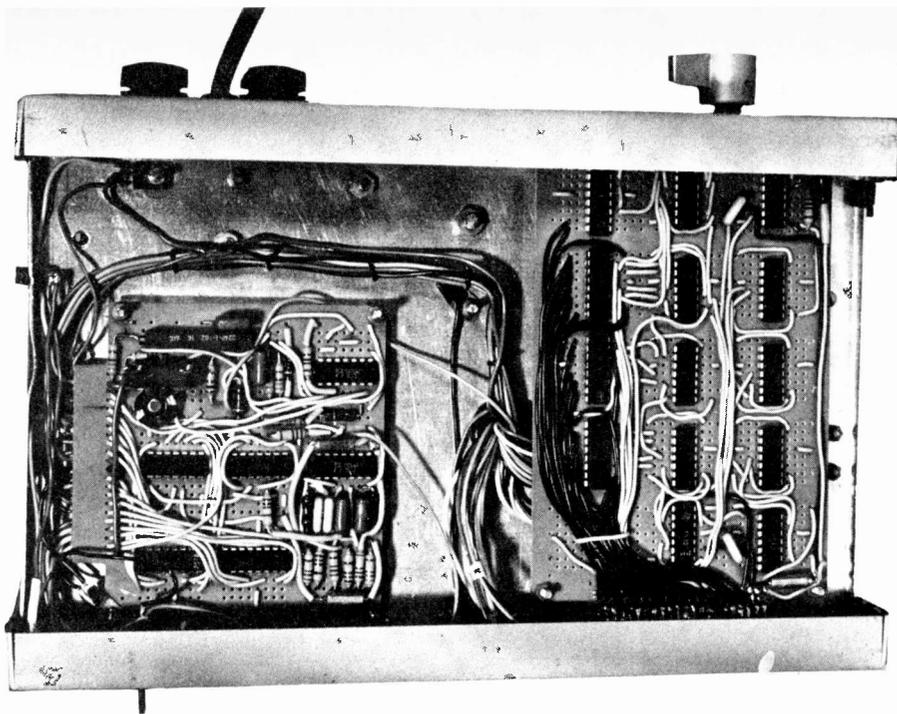
Note that in Fig. 13 last month C8 should be connected to the link wire to C7 and pin 4 of IC19.

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 "Letra-set" 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.

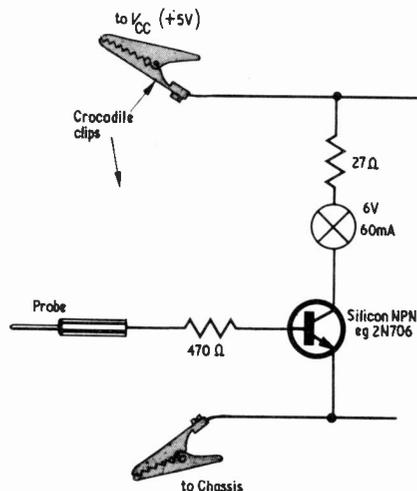


Fig. 22. Simple test circuit or logic probe

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. ★



SOUND CONTROLLED LIGHT DISPLAY

Following its recent success at the Audio & Music Fair, Practical Electronics now presents the full do-it-yourself details of this fascinating addition to the sound scene. Part one of this series appears in the April issue.

P.E. Aurora is a controlled colour light display system which can be fed from any audio amplifier to provide the appropriate mood setting in the home or discotheque. It will respond to serious music or pop and can be arranged to give random displays from a digital sequencer.

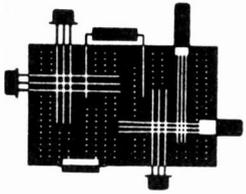
Also:

- ★ BOAT SPEED INDICATOR
- ★ DOOR YODELLER

PRACTICAL
ELECTRONICS

APRIL ISSUE ON SALE
MARCH 19

SIMPLE REFLEX RECEIVER



**A SPECIAL
PROJECT FOR
BEGINNERS**

RECEIVER

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.

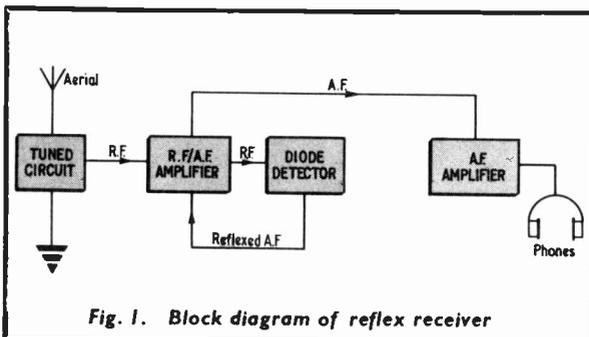


Fig. 1. Block diagram of reflex receiver

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 20k Ω
- R2 3.9k Ω
- R3 6.8k Ω
- R4 4.7k Ω
- R5 27k Ω
- R6 10k Ω
- R7 3.3k Ω
- All $\pm 10\%$, $\frac{1}{4}$ watt carbon

Capacitors

- C1 100pF
- C2 0.01 μ F
- C3 0.001 μ F
- C4 25 μ F elect. 6V
- C5 10 μ F elect. 15V
- C6 8 μ F elect. 15V
- C7 0.01 μ F
- C8 25 μ F elect. 6V

Transistors

- TR1 OC44
- TR2 AC126

Diodes

- D1 1GPI0
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

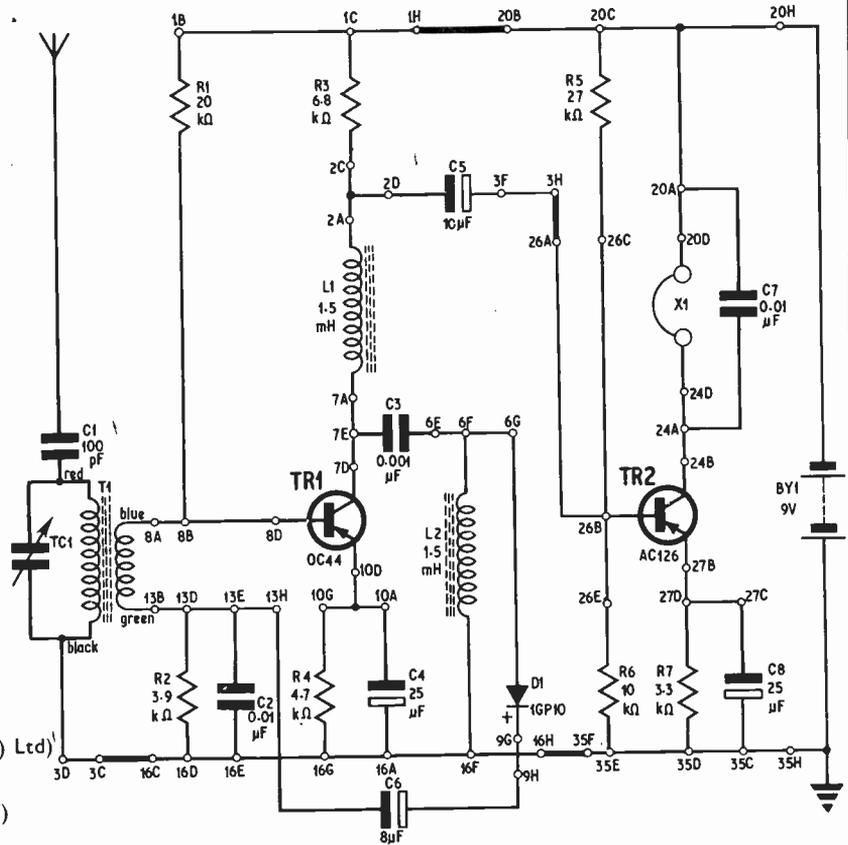


Fig. 2. Circuit diagram showing T-Dec connections. Thick lines indicate wire links

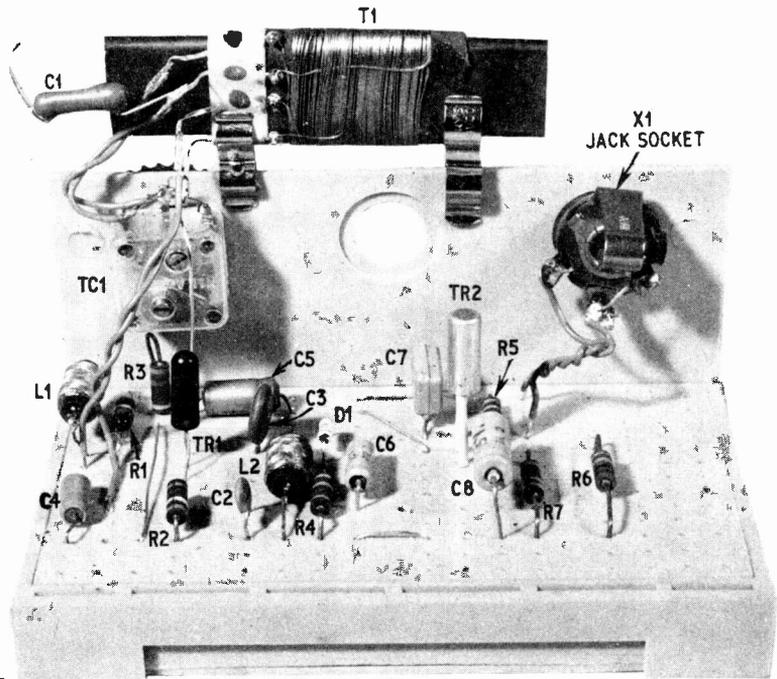


Fig. 3. Component layout on T-Dec. Small Terry clips connected back-to-back are used for aerial retention



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

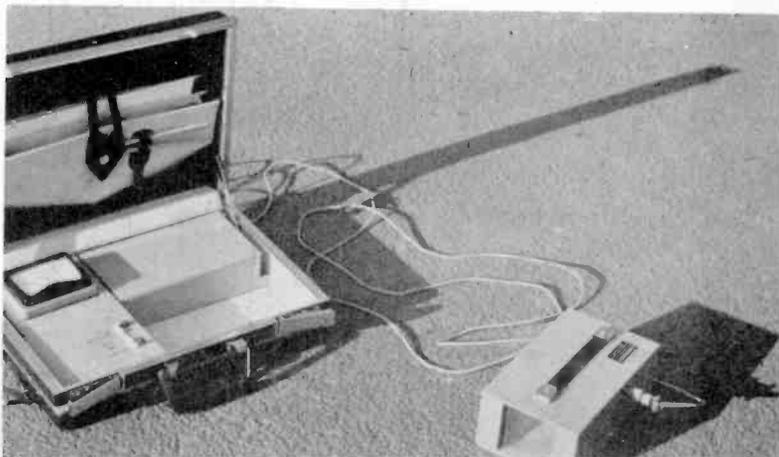


New Sh(orr)ock for Fast Drivers

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.

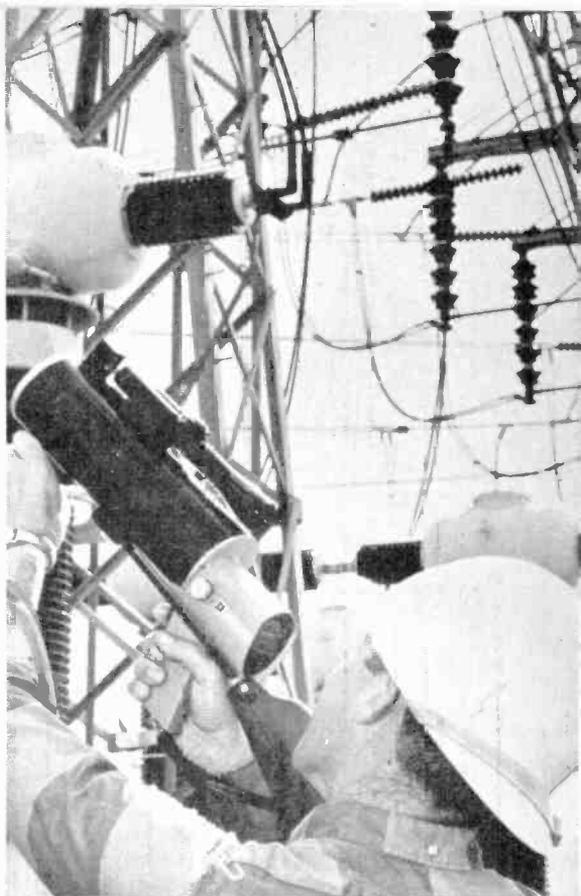




Quietened noise on Musicassettes

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.



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.

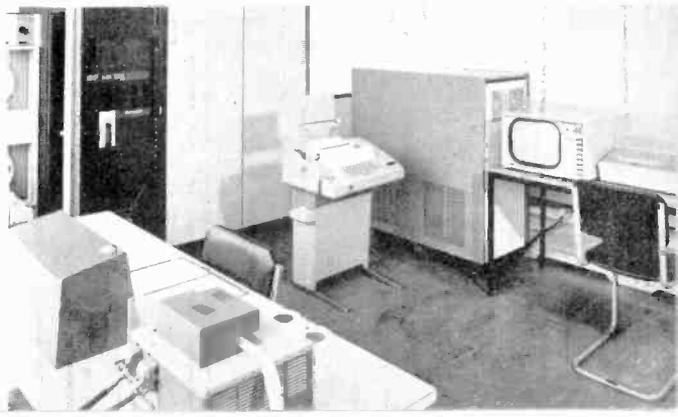
To cope with these difficult operating conditions, the Raynger, which is battery operated and completely portable, has been designed to measure temperatures between 0 and 100 degrees Centigrade above ambient, giving a resolution of better than 2 degrees. The ratio of distance to object size is 120:1,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

Computerised Telephone Trouble Shooter

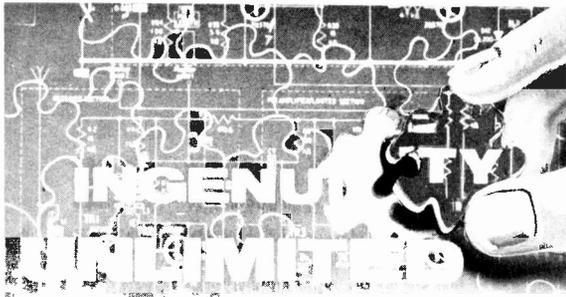
AN aptly-named Argus computer system to watch over the reliability of the telephone service has been ordered by the Post Office from Ferranti Ltd. The Argus 500 configuration is to be installed in Leicester about the end of 1971 for trials that could lead country-wide to the faster detection of faults,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



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.

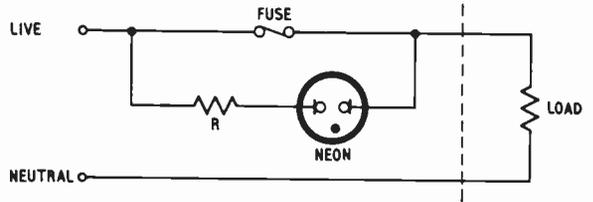


Fig. 1. Simple fuse failure circuit diagram

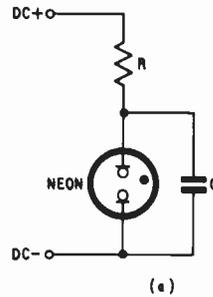


Fig. 2a. Circuit diagram for a flashing neon indicator

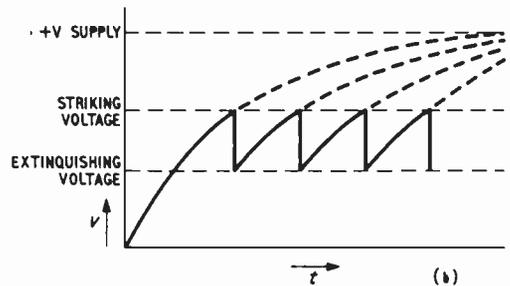
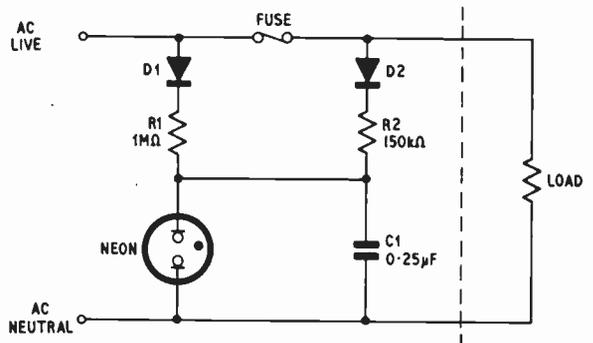


Fig. 2b. Graph showing the effect of the capacitor on the voltage across the neon



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

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.

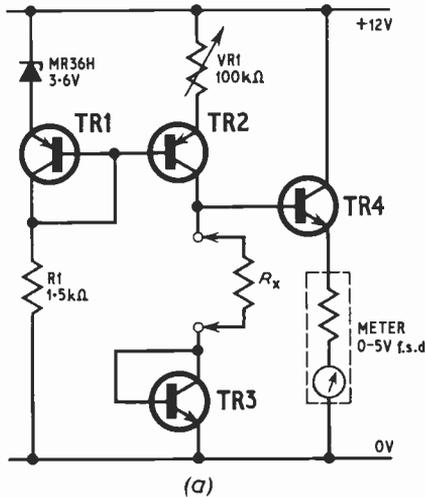


Fig. 1a. Circuit diagram of the linear scale ohmmeter

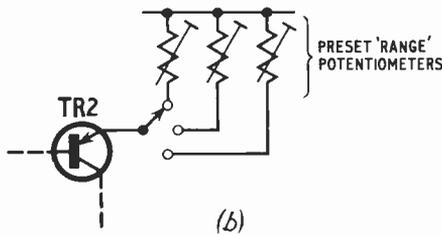


Fig. 1b. Adding a switched range

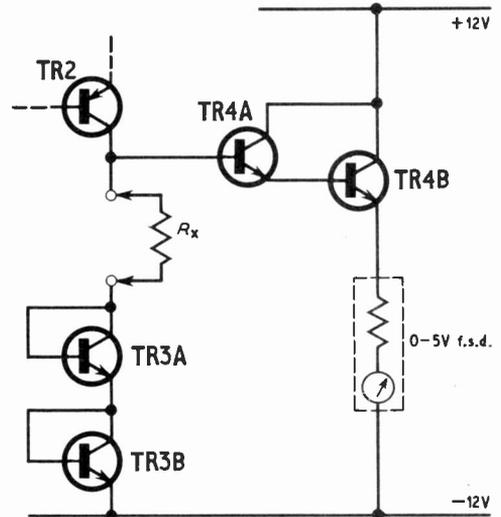


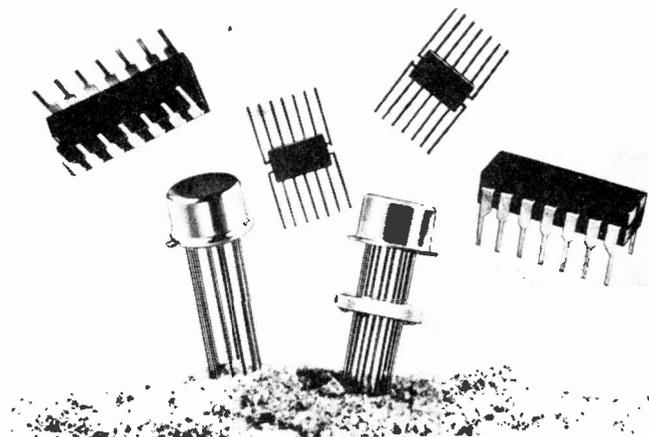
Fig. 2. Two-stage version for very high ranges

Lights!

The "P.E. Aurora Lighting Display" will be included among the exhibits making up the *Electric Theatre*. This is an exhibition of artistic works which make specific use of electrics, electronics and mechanics to create effects with light and sound.

The *Electric Theatre* will be held at the Institute of Contemporary Arts, Nash House, The Mall, London, S.W.1., from March 18 to April 18 inclusive, 11 a.m. to 10.30 p.m. daily. Admission (at the door) 25p, students and members ICA 15p.

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".

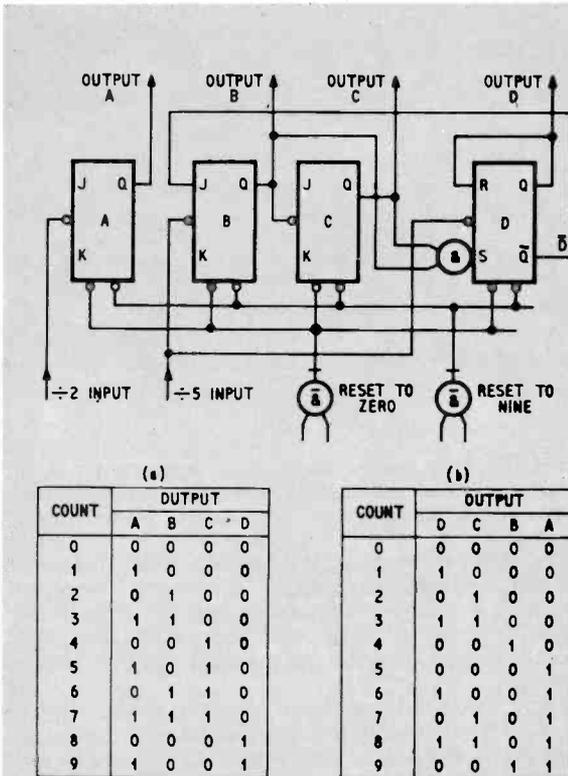


Fig. 9.1. The SN7490 decade counter with truth tables for (a) binary coded decimal (b.c.d.) count mode and (b) symmetrical ÷10 mode

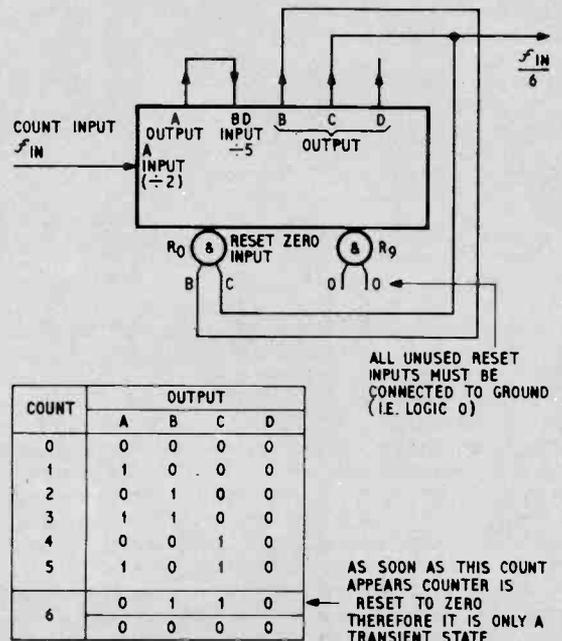


Fig. 9.2. The SN7490 used as a ÷6 counter with truth table

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

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.

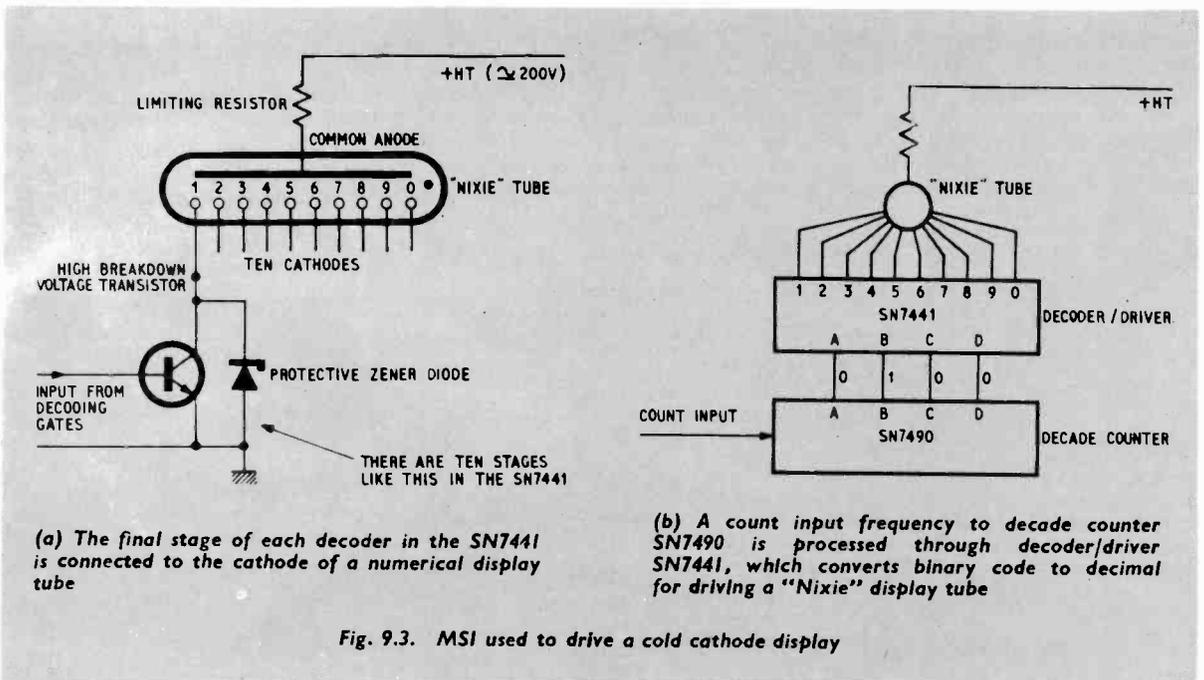


Fig. 9.3. MSI used to drive a cold cathode display

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.

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.

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

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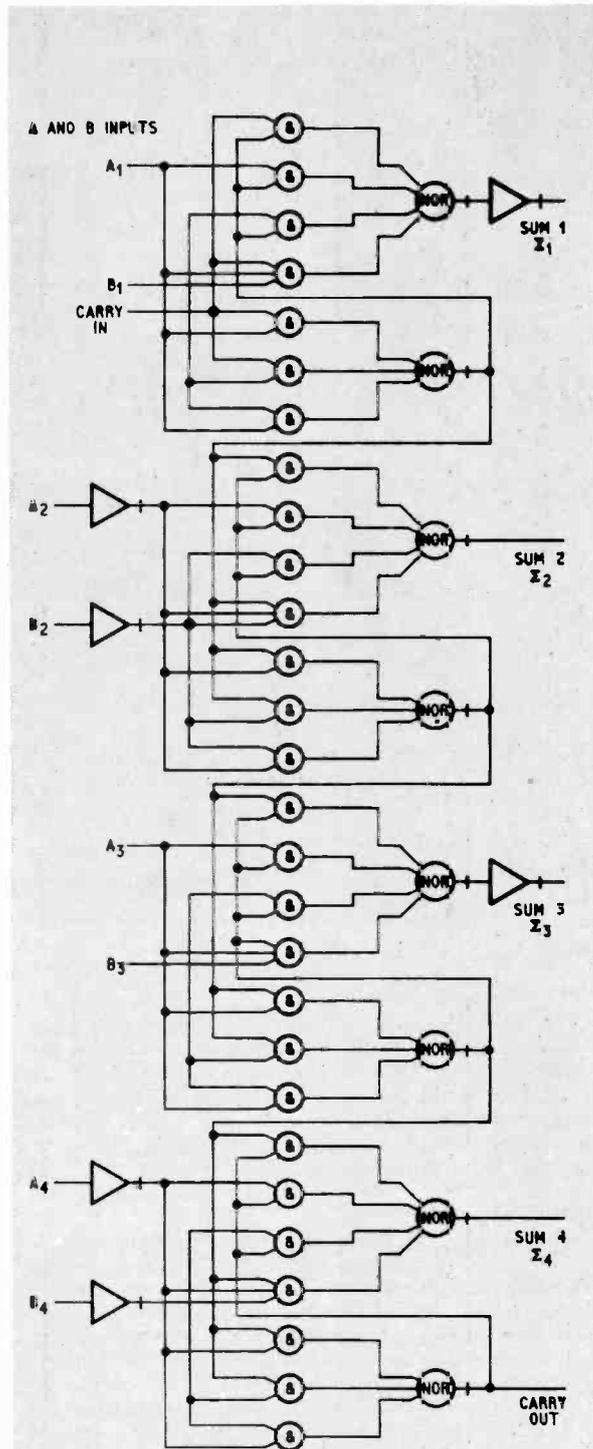


Fig. 9.4. Quad adder type SN7483 logic diagram. A total of 90 transistors, including multi-emitter versions, are incorporated in this one package with 10 diodes and 70 resistors

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

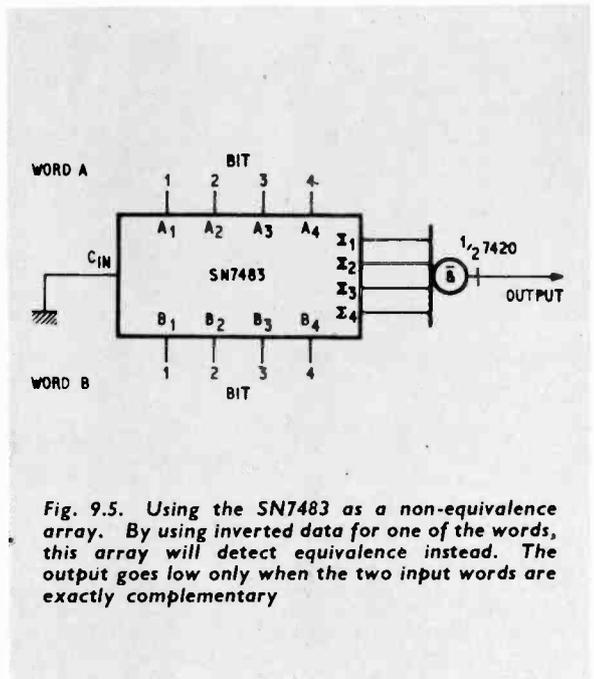


Fig. 9.5. Using the SN7483 as a non-equivalence array. By using inverted data for one of the words, this array will detect equivalence instead. The output goes low only when the two input words are exactly complementary

packages, a useful device indeed which can be better appreciated by looking at Fig. 9.5.

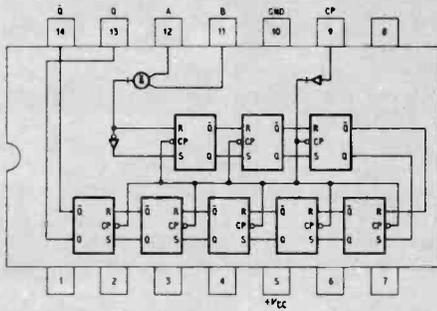
The other adders in the series are the 7480 single-bit and the 7482 double-bit devices, both of which have greater versatility than the 7483 due to the extra pins available on the package.

MSI SHIFT REGISTERS

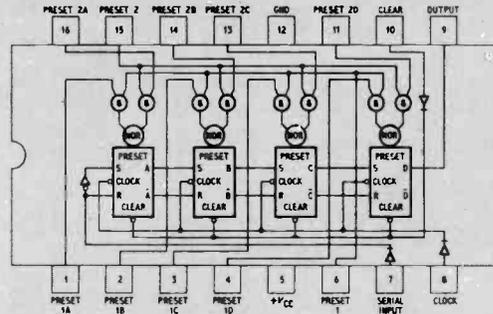
Several types of shift register are available in this series, and between them they cover almost all the likely applications. All the shift registers use RS master/slave flip-flops, but because the clock input to these devices is buffered, and therefore inverted, they shift data on the positive edge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

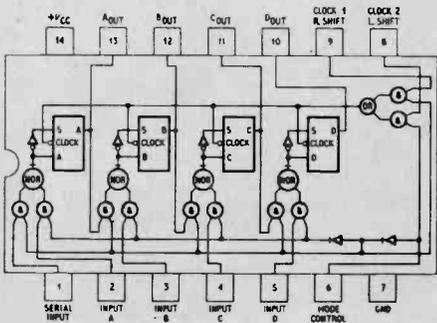
(a) 8-BIT SHIFT REGISTER SN7491A



(b) 4-BIT SHIFT REGISTER SN7494A



(c) 4-BIT SHIFT REGISTER SN7495A



(d) 5-BIT SHIFT REGISTER SN7496A

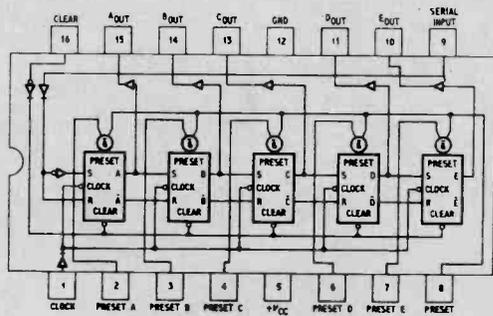


Fig. 9.6. Package diagrams of 74 Series shift registers

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.

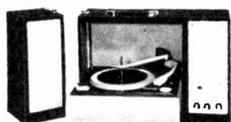
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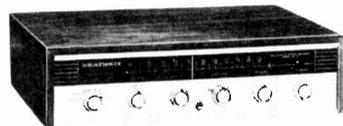
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	TO-5	TO-66										
50	\$0.23	\$0.25	\$0.47	\$0.50	\$0.53	\$0.58	\$0.68	\$0.75	\$1.15	\$1.40	\$1.60	\$1.80
100	\$0.25	\$0.33	\$0.58	\$0.61	\$0.68	\$0.75	\$1.15	\$1.40	\$1.60	\$1.80	\$2.00	\$2.20
200	\$0.35	\$0.37	\$0.57	\$0.61	\$0.68	\$0.75	\$1.15	\$1.40	\$1.60	\$1.80	\$2.00	\$2.20
400	\$0.48	\$0.47	\$0.67	\$0.75	\$0.83	\$0.93	\$1.25	\$1.50	\$1.75	\$2.00	\$2.25	\$2.50
600	\$0.53	\$0.57	\$0.77	\$0.87	\$0.95	\$1.05	\$1.40	\$1.60	\$1.80	\$2.00	\$2.25	\$2.50
800	\$0.68	\$0.70	\$0.90	\$1.00	\$1.10	\$1.20	\$1.50	\$1.75	\$2.00	\$2.25	\$2.50	\$2.75

SIL. RECTS. TESTED

PIV	300mA		750mA		1A		1.5A		3A		10A		30A	
	\$p													
50	\$0.04	\$0.05	\$0.05	\$0.07	\$0.14	\$0.21	\$0.21	\$0.21	\$0.47	\$0.50	\$0.53	\$0.58	\$0.68	\$0.75
100	\$0.04	\$0.05	\$0.05	\$0.13	\$0.16	\$0.23	\$0.23	\$0.23	\$0.47	\$0.50	\$0.53	\$0.58	\$0.68	\$0.75
200	\$0.05	\$0.09	\$0.06	\$0.14	\$0.20	\$0.24	\$0.24	\$0.24	\$0.50	\$0.53	\$0.58	\$0.68	\$0.75	\$0.80
400	\$0.06	\$0.13	\$0.07	\$0.20	\$0.27	\$0.37	\$0.37	\$0.37	\$0.68	\$0.75	\$0.83	\$1.15	\$1.40	\$1.60
600	\$0.07	\$0.16	\$0.10	\$0.23	\$0.34	\$0.45	\$0.45	\$0.45	\$0.75	\$0.83	\$0.93	\$1.25	\$1.50	\$1.75
800	\$0.10	\$0.17	\$0.13	\$0.25	\$0.37	\$0.55	\$0.55	\$0.55	\$0.83	\$0.93	\$1.05	\$1.40	\$1.60	\$1.80
1000	\$0.11	\$0.25	\$0.15	\$0.30	\$0.46	\$0.63	\$0.63	\$0.63	\$0.93	\$1.05	\$1.20	\$1.50	\$1.75	\$2.00
1200	---	---	---	\$0.33	\$0.57	\$0.75	\$0.75	\$0.75	---	---	---	---	---	---

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VBOM	2A		6A		10A	
	TO-1	TO-66	TO-88	TO-1	TO-66	TO-88
100	\$0.50	\$0.63	\$1.00	\$0.50	\$0.63	\$1.00
200	\$0.70	\$0.90	\$1.25	\$0.70	\$0.90	\$1.25
400	\$0.90	\$1.00	\$1.60	\$0.90	\$1.00	\$1.60

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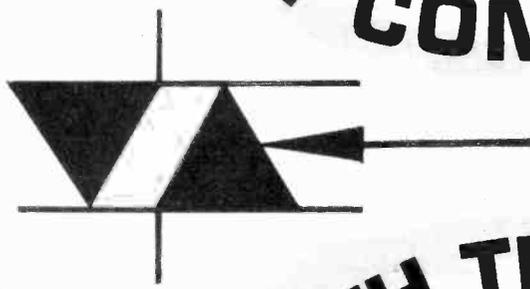
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POWER CONTROL



BY W.WILLIAMSON

WITH TRIACS

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 $20\mu s$, 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:

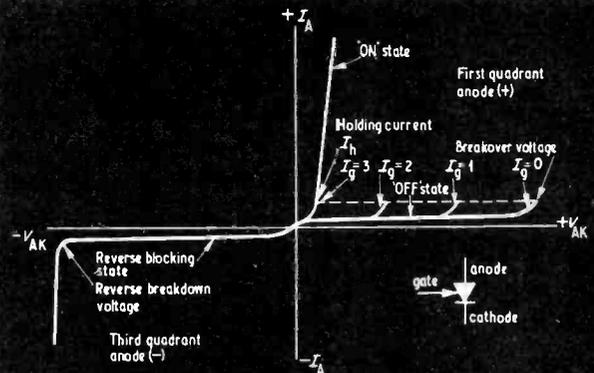


Fig. 1. Voltage current characteristic of a reverse blocking triode thyristor and circuit symbol

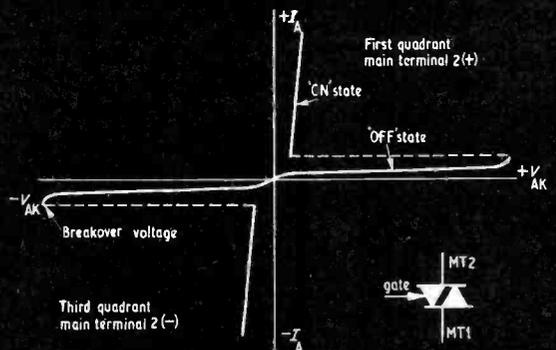


Fig. 2. Voltage current characteristic of a bidirectional triode thyristor or triac and circuit symbol

- 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 break-over 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 $\pm 30V$.

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.

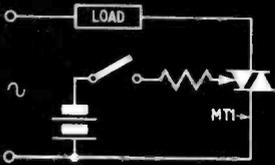


Fig. 3. Simple d.c. triggering for a triac

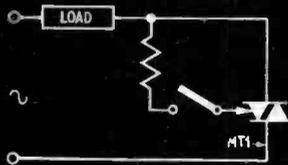


Fig. 4. Synchronous a.c. triggering for a triac

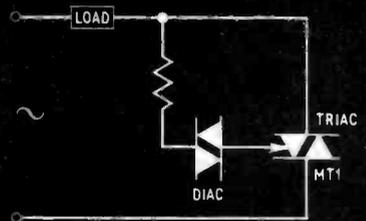


Fig. 6. A diac used for synchronous a.c. triggering of a triac

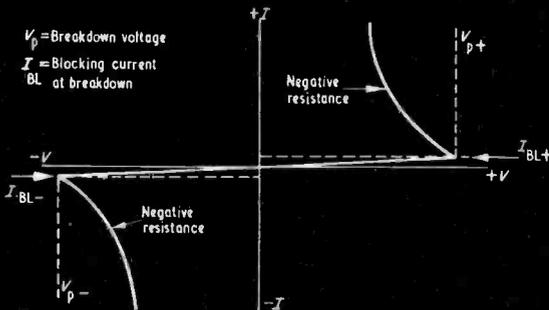


Fig. 5. Voltage current characteristic of a bidirectional trigger diode or diac

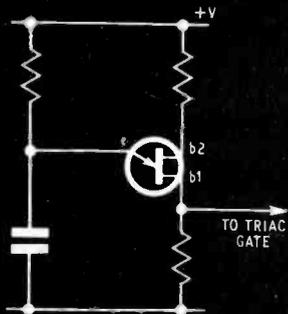


Fig. 7. Relaxation oscillator with a u.j.t. for triggering a thyristor or triac

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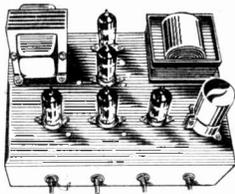
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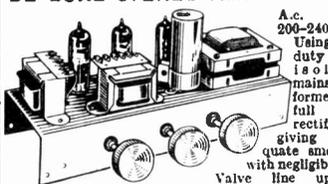
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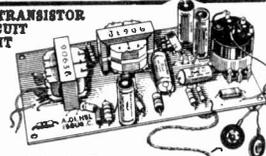
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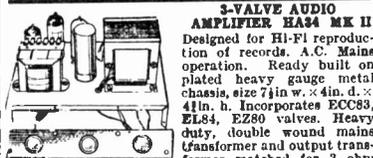
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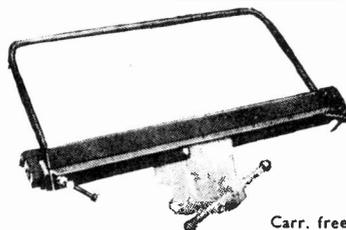


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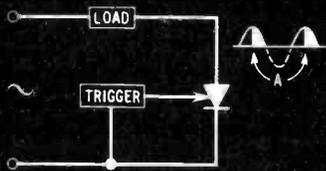


Fig. 8. Phase control triggering of a thyristor

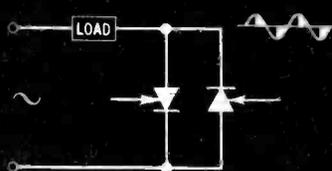


Fig. 9. Phase control triggering of two thyristors back to back in inverse parallel

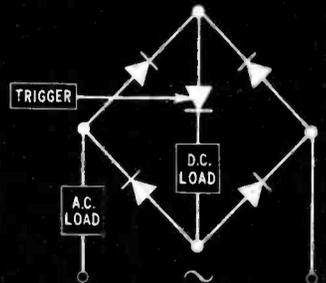


Fig. 10. Full wave phase control with a bridge rectifier arrangement

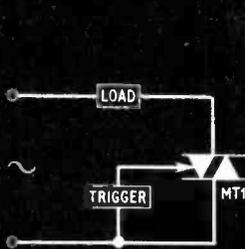


Fig. 11. Simple full wave control of a triac with a trigger circuit

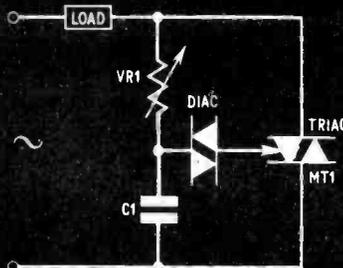


Fig. 12. Simple triac phase control

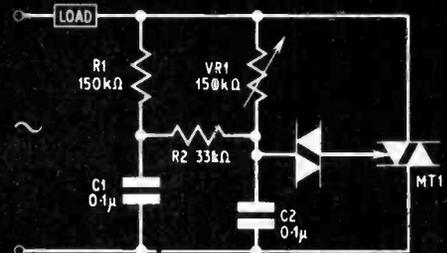


Fig. 13. Obtaining smooth power control of a lamp with two timing circuits

UNIUNCTION 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.

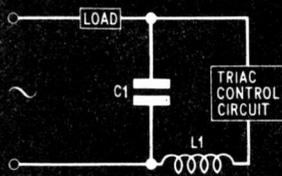


Fig. 14. Simple suppression of r.f. interference

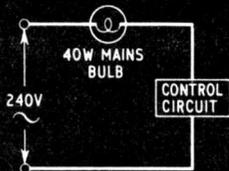


Fig. 15. The dimmer circuit in Fig. 13 is connected in series with the load

INTERFERENCE SUPPRESSION

In thyristor and triac control circuits, the load current rises from zero to maximum in a few micro-seconds. 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 $0.1\mu\text{F}$ 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 quadac 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. ★

SOUND '71

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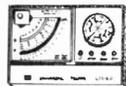
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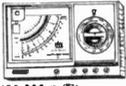
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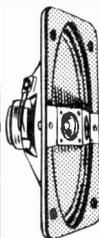
C.1052 MULTI-TESTER



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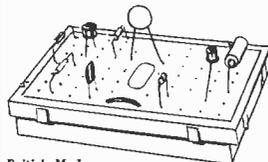


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ON THE FRINGE



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 couldn't 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, had 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!

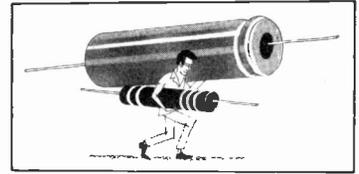
By any other name

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!

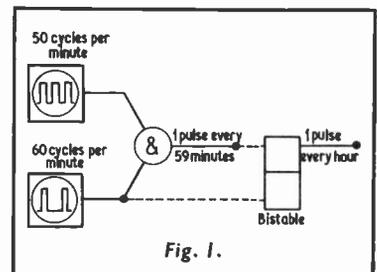


Fig. 1.



Acoustron 2-11
echo ranger and
computer
(above)



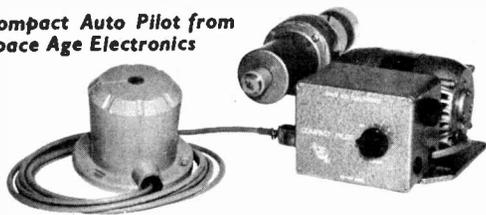
Seafarer depth
sounder (right)

BOAT SHOW 1971

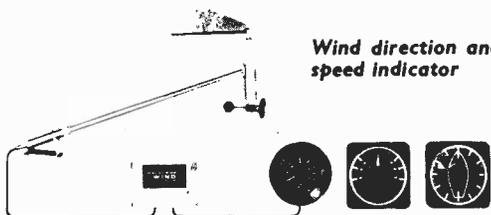


Echo sounder
from Space Age
Electronics

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.

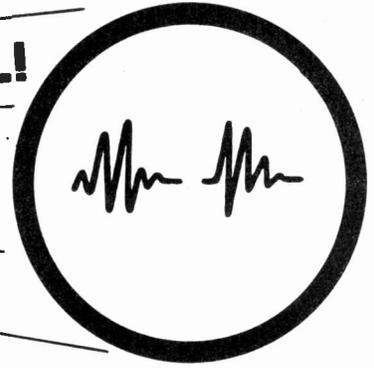


LOOK!

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VISUAL!

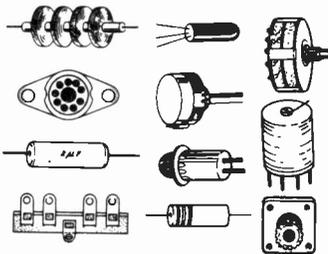
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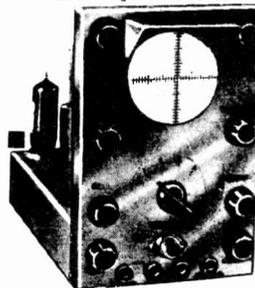
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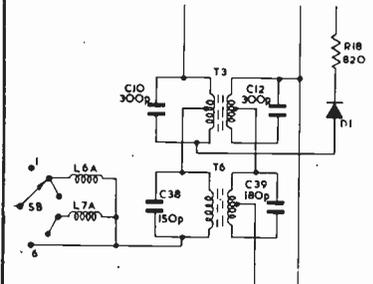


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G2/6	8/12V (REV)	H2/6A	24/275V	H5/7	30/6V	H7/4A	25/20V
G3/7	100/25V	H2/8	32/150V	H5/11	400/6.4V	H7/5	40/15V
G3/14	100/180V	H2/9A	2/150V	H5/12	320/10V	H7/6	50/3V
G5/9	8/8/450V	H2/10A	16/32/350V	H5/14	5/6V	H7/6A	26/50V
G6/13A	40/450V	H2/11A	32/275V	H6/6	200/3V	H7/7	50/12V
H1/3	1/6V	H3/7A	500/12V	H6/7	200/16V	H7/7A	50/10V
H1/4	4/4V	H3/8	750/12V	H6/13	500/3V	H7/8	50/15V
H1/5	6/6V	H3/10A	30/10V	H7/1	10/12V	H7/9	60/12V
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G2/1	6,000/30V	G4/7	40/40/275V	G5/7	100/400/300V	G6/9	60/200/300V
G2/5	125/200V (REV)	G4/7A	40/40/450V	G5/7A	45,000/12V	G6/12A	1,000/12V
G2/10	50/50V	G4/11	2,000/25V	G6/1	12,000/15V	H5/4	325/25V
G3/4	650/300V	G4/12	150/30V	G6/3	2,000/15V	H6/14	400/275V
G3/9	100/200/250V	G4/13	100/200/16/275V	G6/4	2,000/15V	H1/5	2,000/18V
G3/10	40/20/10/350V	G5/1	8,000/70V	G6/5	1,000/1,500/25V	H1/6	125/200V
G3/13A	2,000/30V	G5/3	35,000/15V	G6/5A	1,600/80V	H1/12	200/275V
G4/1	300/700/320V	G5/4	39,000/10V	G6/6	1,000/60V	H2/6	50/275V
G4/5A	60/350V	G5/4A	500/100V	G6/8	200/250V	H2/9	16/16/450V
G4/6	60/200/275V						

TAG ENDS		TAG ENDS		TAG ENDS		TAG ENDS	
REF. No.	Value	REF. No.	Value	REF. No.	Value	REF. No.	Value
G1/4	4/150V	G1/12	40/450V	G4/5	16/300V	G6/4	1,000/50V
G1/5	8/275V	G2/4	40/300V	G4/9	8/8/350V	G6/7	100/275V
G1/5A	32/350V	G2/13	100/50V	G4/10	350/25V	G6/12	1,000/12V
G1/7	16/16/275V	G4/3A	200/25V	G6/1A	3,000/15V		

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

PRINTED CIRCUIT TYPE, WIRE LEADS		PRINTED CIRCUIT TYPE, WIRE LEADS		PRINTED CIRCUIT TYPE, WIRE LEADS		PRINTED CIRCUIT TYPE, WIRE LEADS	
REF. No.	Value	REF. No.	Value	REF. No.	Value	REF. No.	Value
G1/9	16/275V	H3/15	350/12V	H6/5	150/25V	H6/14A	5/15V
H2/7	10/25V	H5/1	150/30V	H6/10	300/9V	H7/12	65/15V
H2/12A	350/12V	H5/14A	1,100/10V	H6/11	300/15V	H7/15	100/16
H2/15	12.5/40V						

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Suitable for Mains		2G378 Output, Marked	4 50p
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Transistor types	20 50p	ASY 22, Marked	5 50p
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 1,000pf, 1,200pf, 1,500pf, 1,800pf, 2,200pf, 15p per dozen (all 400V working). 0.15µf, 0.22µf, 0.27µf, 30p per dozen (all 160V working). 25% discount for lots of 100 of any one type.

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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.

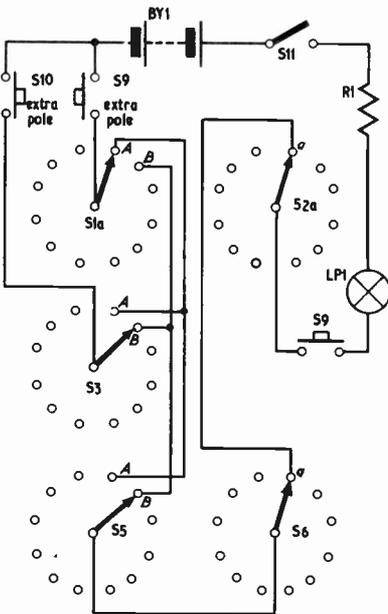


Fig. 1

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 propriety 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 you 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.

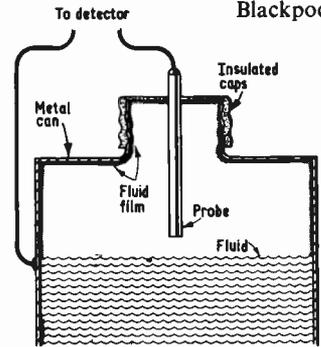


Fig. 1

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 (1M Ω) directly between the base and collector of TR1 and changing the value of C5 to 10 μ F 10V working should cure the above problems.

B. K. Cox,
Wellingtonborough,
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 Project 60



the world's most advanced high fidelity modules

Sinclair Project 60 presents high fidelity in such a way that it meets every requirement of performance, design, quality and value and now that the remarkable phase lock loop stereo FM tuner is available, it becomes the most versatile of high fidelity systems. With Project 60, it is possible to start with a

modest mono record reproducer and expand it to a sophisticated stereophonic radio and record reproducing system of fantastically good quality to hold its own with any other equipment, no matter how expensive. Project 60 is a unique high fidelity module system where compactness and ease of assembly are combined with

circuitry that is far in advance of any other manufacturer in the world. Thus it is extraordinarily easy to assemble any combination of modules using nothing more complicated than the simplest of tools, and you certainly do not have to be experienced to build with complete confidence. The 48 page manual free with Project 60 equipment makes everything easy and you can house your assembly in an existing cabinet, motor plinth, free standing cabinet or virtually any arrangement you wish. Once you have completed your assembly you will have superlatively good equipment to give you years of service and enjoyment. You will have obtained superb value for money because Project 60 is the best selling modular system in Europe and can therefore be produced at extremely competitive prices and with excellent quality control.

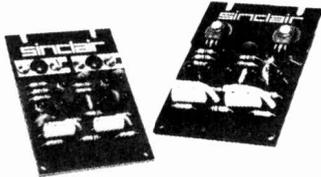
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System	The Units to use	together with	Cost of Units
A Simple battery record player	Z.30	Crystal P.U., 12V battery volume control	£9.6 (£4.47½)
B Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control etc.	£9.9.0 (£9.45)
C 20+20 W. R.M.S. stereo amplifier for most needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., most dynamic speakers, F.M. tuner etc.	£23.18.0 (£23.90)
D 20+20 W. R.M.S. stereo amplifier with high performance spkrs.	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	£26.18.0 (£26.90)
E 40+40 W. R.M.S. deluxe stereo amplifier	2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr	As for D	£32.17.6 (£32.87½)
F Outdoor P.A. system	Z.50	Mic., up to 4 P.A. speakers controls, etc.	£5.9.6 (£5.47½)
G Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£17.8.6 (£17.42½)
H High pass and low pass filters	A.F.U.	C, D or E	£5.19.6 (£5.97½)
J Radio	Stereo F.M. Tuner	C, D or E	£25.0.0

Sinclair Project 60

Z.30 & Z.50 power amplifiers



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

SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications). Power Outputs

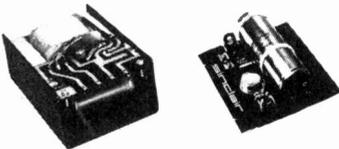
Z.30 15 watts R.M.S. into 8 ohms using 35 volts; 20 watts R.M.S. into 3 ohms using 30 volts.
Z.50 40 watts R.M.S. into 3 ohms using 40 volts; 30 watts R.M.S. into 8 ohms, using 50 volts
Frequency response: 30 to 300,000 Hz ± 1 dB
Distortion: 0.02% into 8 ohms
Signal to noise ratio: better than 70dB un-weighted.

Input sensitivity: 250mV into 100 Kohms. For speakers from 3 to 15 ohms impedance. Size $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ in.

Z.30
Built, tested and guaranteed with circuits and instructions manual **89/6 (£4.47 $\frac{1}{2}$)**

Z.50
Built, tested and guaranteed with circuits and instructions manual **109/6 (£5.47 $\frac{1}{2}$)**

Power Supply Units



Designed specially for use with the Project 60 system of your choice.

Illustration shows PZ.5 to left and PZ.8 (for use with Z.50s) to the right. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ-5 30 volts unstabilised £4.19.6 (£4.97 $\frac{1}{2}$)

PZ-6 35 volts stabilised £7.19.6 (£7.97 $\frac{1}{2}$)

PZ-8 45 volts stabilised

(less mains transformer) **£5.19.6 (£5.97 $\frac{1}{2}$)**

PZ-8 mains transformer £5.19.6 (£5.97 $\frac{1}{2}$)

Guarantee

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

Stereo 60 pre-amp/control unit



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

SPECIFICATIONS

Input sensitivities: Radio—up to 3mV. Mag. p.u. 3mV; correct to R.I.A.A. curve ± 1 dB; 20 to 25,000 Hz. Ceramic p.u.—up to 3mV; Aux—up to 3mV.

Output: 250mV.

Signal-to-noise ratio: better than 70dB.

Channel matching: within 1dB.

Tone controls: TREBLE + 15 to -15dB at 10KHz. BASS + 15 to -15dB at 100Hz.

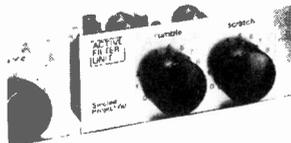
Front panel: brushed aluminium with black knobs and controls.

Size: $8\frac{1}{2} \times 1\frac{1}{2} \times 4$ ins.

Built, tested and guaranteed.

£9.19.6 (£9.97 $\frac{1}{2}$)

Active Filter Unit



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

Built, tested and guaranteed

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Stereo FM Tuner



first in the world to use the phase lock loop principle

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

SPECIFICATIONS:

Number of transistors: 16 plus 20 in I.C.

Tuning range: 87.5 to 108 MHz.

Capture ratio: 1.5dB

Sensitivity: 2 μ V for 30dB quieting; 7 μ V for full limiting.

Squelch level: 20 μ V.

A.F.C. range: ± 200 KHz

Signal to noise ratio: >65 dB

Audio frequency response: 10Hz—15KHz (± 1 dB)

Total harmonic distortion: 0.15% for 30% modulation

Stereo decoder operating level: 2 μ V

Pilot tone suppression: 30dB

Cross talk: 40dB

I.F. frequency: 10.7 MHz

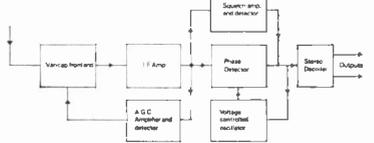
Output voltage: 2 x 150mV R.M.S

Aerial impedance: 75 Ohms

Indicators: Mains on; Stereo on; tuning indicator

Operating voltage: 25-30 VDC

Size: 3.6 x 1.6 x 8.15 inches: 91.5 x 40 x 207 mm



Price: **£25** built and tested. Post free

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Sinclair IC10 / Q16 / Micromatic

IC10



The world's most advanced high fidelity amplifier

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

Circuit Description

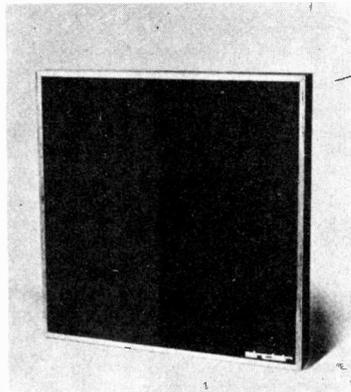
The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. There is generous negative feedback round both sections and the amplifier is completely free from crossover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

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

Specifications:

Output: 10 watts peak, 5 watts RMS continuous.
 Frequency response: 5Hz to 100kHz $1 \pm$ 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: $1 \times 0.4 \times 0.2$ 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.

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Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.
 Loading: up to 14 watts TMS.
 Input impedance: 8 ohms.
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Specifications:

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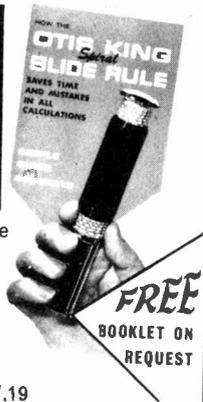
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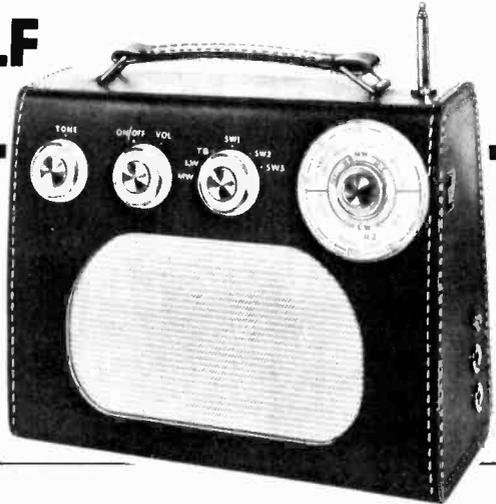
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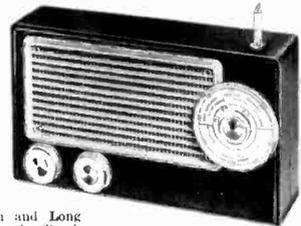


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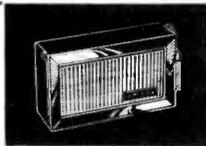


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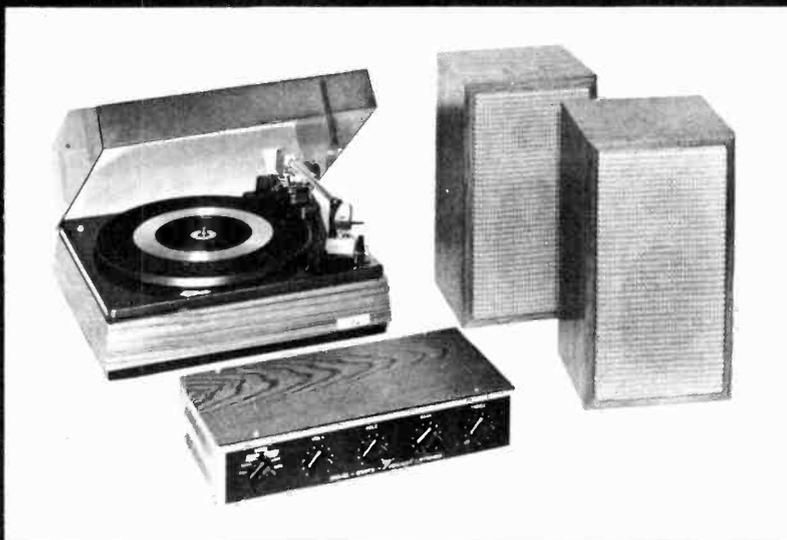
R+TV

RADIO & TV COMPONENTS (Acton) Ltd.

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 Terms C.W.O. All enquiries S.A.E.

Complete Stereo System £43

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



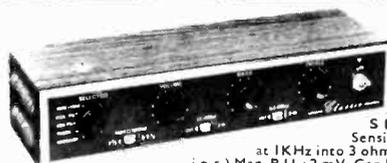
This superb stereo system is a real price breakthrough. It comprises the VISCOUNT F.E.T. Mk. I amplifier on which full details are given below, the famous Garrard SP25 (including teak veneer base and transparent cover) with diamond cartridge or 2025 TC and the very successful DUO type 2 speakers.

Measuring 17½ in. x 10½ in. x 6½ in., the Duo type 2 speakers are teak finished with matching Vynair grills. They incorporate a 3 ohm 13in. x 8in drive unit with parasitic tweeter. Maximum power hardly 10 watts, price:

£13.50 per pair plus £1.50 P. & P.

Complete stereo system £43 plus P. & P. £2.50

With Mk. II Amplifier and Magnetic Cartridge £48 plus P. & P. £2.50



The Classic

Simulated teak case

£9.50

Plus P. & P. 50p

SPECIFICATION:

Sensitivities for 10 watt output at 1KHz into 3 ohms. Tape Head: 3mV (at 3½ i.p.s.) Mag. P.U.: 2 mV. Cer. P.U.: 80mV. Tuner: 100mV. Aux. 100mV. Tape/Rec. Output. Equalisation for each input is correct to within +2dB (R.I.A.A.) from 20Hz to 20KHz. Tone Control Range: Bass: 13dB at 60Hz. Treble: ±14dB at 15KHz. Total Distortion: (for 10 watt output) < 1.5%. Signal Noise: < -60dB. A.C. Mains 200-250V. Size 12½ in long, 4½ in deep, 2½ in high. Built and tested.



THE RELIANT Mk. II

SOLID STATE GENERAL PURPOSE AMPLIFIER

£7.25 Plus P. & P. 37p

Simulated teak case

SPECIFICATION:

Output: 10 watts into a 3 ohms speaker. Inputs: (1) for mike (10mV). Input (2) for gram. radio (250mV). Transistors: 4 silicon and three germanium. Mains input: 220/250 volts. Size: 10½ x 4½ x 2½ in.



ELEGANT SEVEN Mk. III (350mW Output)

7-transistor fully tunable M.W.-L.W. Superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction. MAINS POWER PACK KIT: 9/6 (47p) extra.

£5.25 Plus P. & P. 37p. Circuit 13p Free with parts.

THE DORSET (600mW Output)

7-transistor fully tunable M.W.-L.W. Superhet portable with baby alarm facility. Set of parts. The latest modulated and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3 in. MAINS POWER PACK KIT: 47p extra. £5.25 Plus P. & P. 37p. Circuit 13p. Free with parts.



The Viscount F.E.T. Mk. I £14.25

Plus 50p P.&P.

High fidelity transistor stereo amplifier employing field effect transistors. With this feature and accompanying guaranteed specifications below, the Viscount F.E.T. vastly surpasses amplifiers costing far more.

SPECIFICATION

Output per channel—10W rms. into 3 ohms. Frequency bandwidth 20Hz to 20kHz ±1dB @ 1W. Total distortion @ 1kHz @ 9W 0.5%. Input sensitivities—CER. P.U. 100mV into 3 MΩ. Tuner 100mV into 100kΩ. Tape 100mV into 100kΩ. Overload factor—Better than 26dB. Signal to noise ratio—70dB on all inputs (with vol. max).

Controls—6 position selector switch (3 pos. stereo and 3 pos. mono), separate vol. controls for left and right channels. Bass ±14dB @ 60Hz; Treble (with D.P.S. on/off) ±12dB @ 10kHz. Tape recording output sockets on each channel.

Size 12½ in x 6 in x 2½ in simulated teak case. Built and tested.

Mk. II (MAG. P.U.) £15.75 Post & packing 50p extra. Specification same as Mk. I, but with the following inputs: Mag. P.U. CER. P.U. Tuner.

Spec. on Mag. P.U. 3mV @ 1kHz input impedance 47kΩ. Fully equalised to within ±1dB RIAA. Signal to noise ratio—65dB (vol. max.).

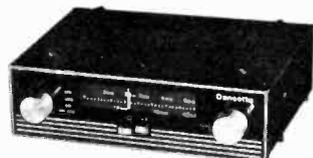
LIQUIDATED STOCK

DANSETTE

TOURISTE MK3

CAR RADIO

ALL TRANSISTOR



Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1 MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7" x 2" x 4½" deep.

Originally sold completely built for £15.4.6 (£15.23)

SET OF PARTS

Circuit diagram 13p, free with parts Speaker, baffle and fixing kit £1.25 extra plus P. & P. 20p

plus 37p P. & P. £6.30

Speaker postage free when ordered with parts

SOUND 50

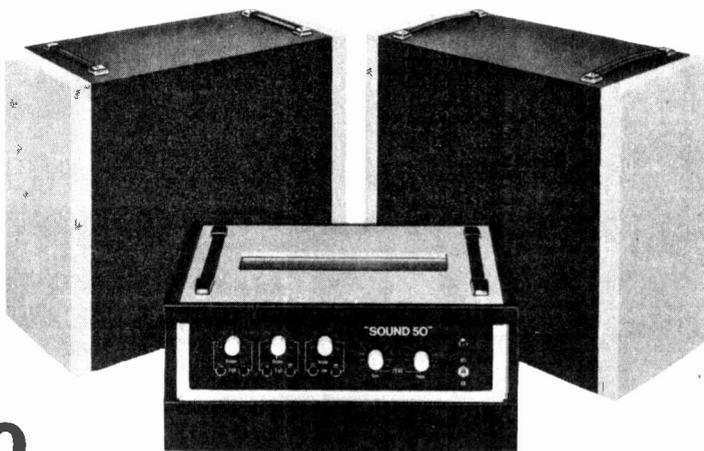
SOUND 50 AMPLIFIER AND SPEAKER SYSTEM

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" x 20" x 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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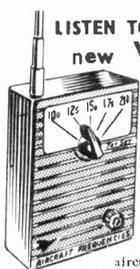
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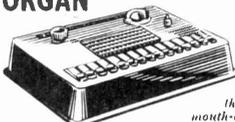
(47/6)

Listen in to AIRLINES, PRIVATE PLANES, JET PLANES. Eavesdrop on exciting cross-talk between pilots, ground approach, ground control, airport tower. Hear for yourself the disciplined voices hiding tensions on take-downs. Be with them when they have to take nerve-racking 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 4½in x 3in x 1½in. All you do is extend rod aerial, place close to any ordinary medium-wave radio (even tiny pocket radios). **NO CONNECTIONS WHATSOEVER NEEDED.** Use indoors or outdoors. **SEND NOW.** ONLY £2-37½ + 22p 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 13½in x 10in x 2½in. 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 + 22p P. & P. (55/- + 4/6) for all parts, including case, loudspeaker, transistor, 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.

FIND BURIED TREASURE! 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, WAX 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 13½in x 10in x 2½in. **Great demand expected at this remarkably low price—All parts including detector head, case, nuts, screws, wire, simple instructions, etc. Send now £2-37½ + 32p P. & P. (47/6 + 6/6)** (Telescopic handle as illustrated £1-25 (25/-) extra). Parts available separately. Made up looks worth £15.

ONLY £2-37½

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Examine at home for 7 days. Your money back if not delighted.

CONCORD ELECTRONICS LTD.

SHORTWAVE TRANSISTOR RADIO

ONLY £2-25

(45/-)



CAN BE BUILT IN ONE EVENING At last! After trying countless circuits searching for easy build, work-first-time short waver. Giving advanced world-wide performance, we chose this "Sky Roma". Anyone from 9 years up can follow the step-by-step, easy-as-ABC, fully illustrated instructions. (We built ten prototypes and every one worked first time) no soldering necessary. 75 stations logged on rod aerial in 30 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. **Eavesdrop on unusual broadcasts.** Uses PP3 battery. Transistorised (no valves). Size only 3in. x 4½in. x 1½in. As tremendous demand anticipated price held to only £2-25 + 17½p P. & P. (45/- + 3/6) for all parts incl. Cabinet, screws, instr., etc. Parts available separately.

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2N920	22p	2N3819	35p	40600	57p	BCZ10	27p	BSY37	25p	NKT453	47p
2N930	27p	2N3823	37p	AC126	15p	BCZ11	42p	BSY38	22p	NKT403F	32p
2N1090	22p	2N3824	37p	AC127	15p	BD116	11-12	BSY39	22p	NKT671F	32p
2N1091	22p	2N3834A	47p	AC107	15p	BD121	65p	BSY40	32p	NKT674F	30p
2N1181	25p	2N3855	27p	AC128	15p	BD123	82p	BSY51	32p	NKT677F	30p
2N1182	25p	2N3855A	30p	AC129	20p	BD124	60p	BSY52	32p	NKT773	30p
2N1302	17p	2N3856	30p	AC154	22p	BD131	97p	BSY53	32p	NKT781	30p
2N1303	17p	2N3856A	35p	AC176	25p	BD132	87p	BSY54	40p	NKT10419	40p
2N1304	22p	2N3856B	35p	AC187	82p	BDY11	11-12	BSY55	90p	NKT10439	37p
2N1305A	22p	2N3857A	30p	AC188	27p	BDY17	11-12	BSY78	47p	NKT10519	32p
2N1306	25p	2N3859	37p	AC177	37p	BDY18	11-12	BSY79	45p	NKT20329	47p
2N1307	25p	2N3859A	32p	AC128	20p	BDY19	11-12	BSY90	57p	NKT80111	77p
2N1308	30p	2N3860	30p	ACY19	25p	BDY20	11-97	BSY95A	12p	NKT80112	77p
2N1309	30p	2N3866	21-50	ACY20	25p	BDY38	87p	BDY60	82p	NKT80211	12-12
2N1507	17p	2N3877	40p	ACY21	25p	BDY61	82p	BDY62	21-25	C111	75p
2N1613	17p	2N3877A	40p	ACY22	20p	BDY62	21-25	BDY62	21-25	C124	40p
2N1631	35p	2N3900	37p	ACY28	20p	BDY61	82p	BDY62	21-25	C125	55p
2N1632	30p	2N3900A	40p	ACY29	20p	BDY62	21-25	BDY62	21-25	C126	40p
2N1637	30p	2N3901	97p	ACY41	25p	BDY61	82p	BDY62	21-25	C128	37p
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2N1893	37p	2N4058	17p	AD161	37p	BF178	32p	BF178	32p	D163	37p
2N2147	82p	2N4059	10p	AD162	47p	BF178	32p	BF178	32p	D164	40p
2N2148	57p	2N4060	12p	AF106	25p	BF178	32p	BF178	32p	D164	40p
2N2160	57p	2N4061	12p	AF114	25p	BF180	30p	BF180	30p	OC22	50p
2N2163	40p	2N4062	12p	AF115	30p	BF181	32p	BF181	32p	OC23	50p
2N2193A	42p	2N4244	47p	AF116	20p	BF184	42p	BF184	42p	OC24	50p
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2N2217	27p	2N4296	17p	AF117	25p	BF194	17p	GET102	30p	OC28	62p
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2N2222	30p	2N4291	17p	AF126	20p	BF200	52p	GET120	52p	OC42	25p
2N2227	01-07	2N4292	12p	AF127	17p	BF224	20p	GET873	12p	OC44	20p
2N2229	30p	2N4303	47p	AF178	42p	BF225	20p	GET880	30p	OC45	15p
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2N2540	22p	2N5176	45p	ASY26	25p	BFX12	22p	OC77	30p	OC77	30p
2N2613	35p	2N5222A	40p	ASY27	37p	BFX28	30p	MJ400	01-07	OC80	25p
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2N2646	57p	2N5248	42p	ASY29	27p	BFX30	30p	MJ421	01-12	OC82	25p
2N2696	32p	2N5249	67p	ASY29	27p	BFX43	37p	MJ430	01-02	OC83	25p
2N2711	25p	2N5265	22-25	ASY30	25p	BFX44	37p	MJ440	05p	OC89	32p
2N2712	25p	2N5266	22-75	ASY51	32p	BFX68	37p	MJ480	97p	OC130	32p
2N2713	27p	2N5267	22-62	ASY54	25p	BFX84	25p	MJ481	01-25	OC170	30p
2N2714	30p	2N5303	37p	ASY86	32p	BFX86	32p	MJ490	01-12	OC171	30p
2N2865	40p	2N5306	40p	ASZ20	37p	BFX86	32p	MJ491	01-37	OC200	37p
2N2904	30p	2N5307	37p	ASZ21	37p	BFX87	27p	MJ1800	22-17	OC201	47p
2N2904A	32p	2N5308	37p	AI103	42p	BFX88	25p	MJE340	82p	OC292	62p
2N2905	37p	2N5309	62p	AIY10	21-50	BFX89	62p	MJE520	87p	OC293	42p
2N2905A	40p	2N5310	42p	BFY10	32p	BFX93A	70p	MJE521	87p	OC294	42p
2N2906	25p	2N5354	27p	BFY11	42p	BFY10	32p	MPF102	42p	OC295	62p
2N2906A	27p	2N5355	37p	BFY11	42p	BFY11	42p	MPF103	37p	OC297	75p
2N2907	30p	2N5356	37p	BFY12	42p	BFY17	22p	MPF104	37p	OCP71	42p
2N2923	15p	2N5365	47p	BFY12	42p	BFY18	12p	MPF105	37p	ORP12	62p
2N2924	15p	2N5366	32p	BFY13	12p	BFY19	32p	MP83638	32p	ORP61	62p
2N2925	15p	2N5367	37p	BFY13	12p	BFY20	32p	NKT0013	47p	P340A	22p
2N2926	15p	2N5457	37p	BFY21	17p	BFY21	17p	NKT124	42p	T1P29A	50p
Green	12p	280045	55p	BC118	32p	BFY24	45p	NKT125	27p	T1P30A	50p
Yellow	12p	28020	22p	BC121	20p	BFY25	25p	NKT126	27p	T1P31	50p
Orange	12p	28102	50p	BC122	20p	BFY26	20p	NKT127	27p	T1P32	50p
2N3011	30p	28103	25p	BC125	55p	BFY29	50p	NKT128	27p	T1P33A	50p
2N3014	32p	28104	25p	BC126	55p	BFY30	50p	NKT129	27p	T1P34	50p
2N3033	25p	28105	32p	BC140	37p	BFY43	62p	NKT130	32p	T1P35	50p
2N3054	50p	28502	35p	BC147	42p	BFY48	62p	NKT131	32p	T1P36	50p
2N3055	75p	28503	27p	BC148	12p	BFY50	22p	NKT132	30p	T1P37	50p

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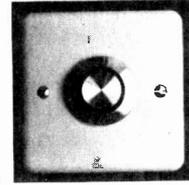
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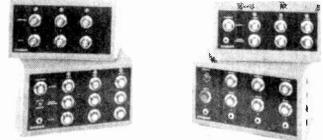
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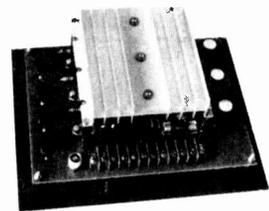
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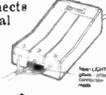
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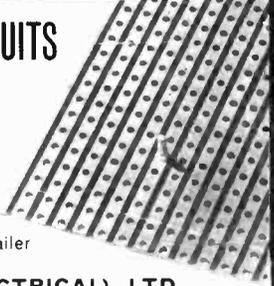
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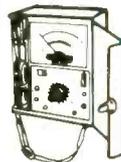
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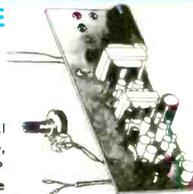
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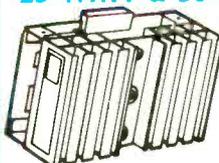
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