Easy to build projects for everyone

Everyday ELECTRONICS

DEC. 81
70p

XMAS TREE LIGHTS FLASHER

RACE TRACK SPEEDO

REACTION METER

Playful Art

By SOLID STATE

GAMES FOR ALL

Australia $1·23 New Zealand $1·30 Malaysia $4·95 IR 99p (inc. V.A.T.)

Rapid Electronics

Tel: 0322 863494
Hillcroft House
Station Road
Eynsford Kent DA4 0EJ

TTL

TTL		7413	24	7442	40	7480	45	74107	30	74155	60	74177	75
		7414	35	7444	85	7482	70	74109	32	74156	60	74179	65
7400	11	7416	25	7446	60	7483	50	74121	28	74157	43	74180	65
7401	11	7417	25	7447	48	7485	75	74122	45	74160	60	74181	135
7402	12	7420	15	7448	50	7486	25	74123	48	74161	60	74182	75
7403	14	7421	20	7450	16	7489	180	74125	40	74162	60	74190	70
7404	14	7422	20	7451	16	7490	28	74126	40	74163	60	74191	76
7405	17	7427	28	7453	16	7491	45	74132	40	74164	60	74192	70
7406	26	7428	28	7454	18	7492	40	74141	65	74165	60	74193	65
7407	26	7430	15	7460	16	7493	30	74145	65	74167	180	74194	70
7408	15	7432	25	7472	25	7494	35	74147	100	74170	185	74195	63
7409	18	7433	27	7473	28	7495	56	74148	75	74173	60	74196	63
7410	14	7437	27	7474	25	7496	45	74150	75	74174	65	74197	63
7411	20	7438	27	7475	38	7497	120	74153	45	74175	70	74198	95
7412	20	7440	17	7476	30	74100	80	74154	75	74176	55	74199	95

LS TTL

LS TTL		LS21	15	LS76	20	LS123	55	LS160	42	LS197	[illegible]	LS353	100
		LS22	16	LS76	20	LS125	30	LS161	42	LS221	60	LS365	38
LS00	13	LS26	18	LS78	24	LS126	30	LS162	42	LS240	90	LS366	38
LS01	14	LS27	15	LS83	50	LS132	45	LS163	42	LS241	80	LS367	38
LS02	14	LS30	16	LS85	70	LS136	30	LS164	50	LS242	80	LS368	50
LS03	14	LS32	18	LS86	25	LS138	35	LS165	120	LS243	85	LS373	80
LS04	15	LS37	16	LS90	35	LS139	35	LS166	85	LS244	80	LS374	80
LS05	15	LS38	16	LS92	38	LS145	75	LS170	170	LS245	120	LS375	50
LS08	16	LS40	16	LS93	35	LS147	160	LS173	70	LS247	75	LS377	90
LS09	16	LS42	38	LS95	45	LS148	95	LS174	60	LS251	40	LS378	70
LS10	16	LS47	40	LS96	110	LS151	40	LS175	60	LS257	48	LS390	75
LS11	16	LS48	80	LS107	45	LS153	40	LS190	55	LS258	45	LS393	75
LS12	15	LS51	16	LS109	30	LS154	120	LS191	55	LS259	95	LS399	220
LS13	25	LS55	30	LS112	38	LS155	65	LS192	55	LS266	25	LS541	135
LS14	48	LS73	25	LS113	30	LS156	45	LS193	60	LS273	90	LS670	175
LS15	15	LS74	25	LS114	30	LS157	35	LS195	50	LS279	50		
LS20	15	LS75	27	LS122	42	LS158	34	LS196	60	LS283	45		

CMOS

CMOS		4017	45	4036	285	4055	115	4082	20	4502	70	4529	150
		4018	60	4039	295	4059	480	4085	65	4503	50	4532	95
4000	14	4019	35	4040	55	4060	85	4086	65	4507	38	4534	495
4001	13	4020	60	4041	75	4063	90	4089	140	4508	200	4538	110
4002	14	4021	65	4042	55	4066	35	4093	38	4510	65	4543	110
4006	65	4022	70	4043	60	4067	395	4094	140	4511	50	4549	380
4007	17	4023	18	4044	65	4068	18	4095	90	4512	70	4553	295
4008	58	4024	40	4046	70	4069	18	4097	340	4514	180	4555	45
4009	30	4025	18	4047	70	4070	18	4098	85	4515	180	4556	48
4010	35	4026	96	4048	55	4071	18	4099	95	4516	75	4559	390
4011	14	4027	30	4049	28	4072	18	40106	50	4518	45	4560	180
4012	17	4028	55	4050	28	4073	20	40109	100	4520	70	4584	45
4013	30	4029	75	4051	60	4075	20	40163	100	4521	200	4585	99
4014	60	4030	35	4052	70	4076	60	40173	100	4526	80	4724	140
4015	60	4031	170	4053	60	4077	25	40175	100	4527	90		
4016	30	4034	170	4054	116	4081	18	40193	120	4528	75		

LINEAR

LINEAR		CA3160E	100	LM358	50	LM2917	200	NE566	150	TDA1022	560
		CA3162E	450	LM377	150	LM3900	50	NE567	150	TDA1024	125
709	40	CA3189E	290	LM380	80	LM3909	70	NE571	425	TLO71	45
741	14	ICL7106	790	LM381	120	LM3914	200	RC4136	90	TLO72	75
748	35	ICL8038	320	LM382	120	LM3915	200	SN76013	176	TLO81	30
AY-1-0212	680	ICM7555	80	LM386	80	LM13600	120	SN76018	150	TLO82	70
AY-1-1313	670	LF351	45	LM387	120	MC1310	150	SN76477	150	TLO84	90
AY-3-1270	840	LF353	85	LM393	100	MC3302	150	TBA641B11	250	XR2206	300
AY-3-8910	700	LF356	90	LM709	40	MC3340	135			ZN414	100
AY-3-8912	625	LM10	395	LM710	50	NE515	270	TBA800	80	ZN423	195
CA3046	60	LM301A	25	LM725	350	NE528	225	TBA810	95	ZN424	135
CA3080	70	LM311	70	LM733	75	NE531	150	TBA820	80	ZN425E	390
CA3089	215	LM318	85	LM741	14	NE544	185	TBA950	290	ZN426E	330
CA3090AQ	375	LM324	40	LM747	75	NE555	17	TCA940	170	ZN427E	650
CA3130E	90	LM339	50	LM748	35	NE556	55	TDA1004	300	ZN428E	480
CA3140E	45	LM348	90	LM1458	40	NE565	120	TDA1008	320	ZN1034E	200
								TDA1010	225		

TRANSISTORS

TRANSISTORS				BC237	8	BF184	25	BU208	170	TIP142	120	2N2905A	22
				BC238	14	BF185	25	MJ2955	99	TIP147	120	2N2906	25
AC125	35	BC141	30	BC308	15	BF194	12	MJE340	50	TIP2955	60	2N2906A	25
AC126	25	BC142	25	BC237	14	BF195	12	MJE520	65	TIP3055	55	2N2907	25
AC127	25	BC143	25	BC328	14	BF196	12	MJE521	95	TIS43	40	2N2907A	25
AC128	25	BC147	8	BC337	14	BF197	12	MJE3055	70	TIS44	45	2N2926	9
AC176	25	BC148	8	BC338	16	BF198	10	MPF102	40	TIS45	45	2N3053	23
AC187	22	BC149	9	BC477	30	BF199	18	MPF104	40	TIS90	30	2N3054	55
AC188	22	BC157	10	BC478	30	BF200	30	MPSA05	22	TIS91	30	2N3055	50
AD142	120	BC158	10	BC479	30	BF244B	18	MPSA06	25	VN10KM	45	2N3442	120
AD149	80	BC159	10	BC517	40	BF245	30	MPSA12	30	VN46AF	75	2N3702	8
AD161	40	BC160	45	BC547	10	BF256B	45	MPSA55	30	VN66AF	85	2N3703	8
AD162	40	BC168C	10	BC548	10	BF257	32	MPSA56	30	VN88AF	95	2N3704	6
AF124	60	BC169C	10	BC549	10	BF258	25	MPSU05	55	ZTX107	12	2N3705	9
AF126	50	BC170	6	BCY70	18	BF259	35	MPSU55	60	ZTX108	12	2N3706	8
AF139	40	BC171	10	BCY71	18	BF337	40	MPSU56	60	ZTX109	12	2N3707	10
AF186	70	BC172	8	BCY72	18	BFR40	23	TIP29	35	ZTX300	14	2N3708	10
AF239	75	BC177	10	BD115	80	BFR80	25	TIP29A	40	ZTX301	16	2N3709	10
BC107	10	BC178	10	BD131	35	BFX29	25	TIP29B	55	ZTX302	15	2N3772	190
BC107B	12	BC179	10	BD132	35	BFX84	25	TIP29C	60	ZTX304	17	2N3773	210
BC108	10	BC182	10	BD133	50	BFX85	25	TIP30	45	ZTX341	30	2N3819	15
BC108B	12	BC182L	8	BD135	50	BFX86	28	TIP30A	40	ZTX500	15	2N3820	40
BC108C	12	BC183	10	BD136	30	BFX87	25	TIP30B	50	ZTX501	15	2N3823	85
BC109	10	BC183L	10	BD137	30	BFX88	25	TIP30C	60	ZTX502	15	2N3866	90
BC109C	12	BC184	10	BD138	30	BFY50	23	TIP31A	45	ZTX503	18	2N3903	16
BC114	22	BC184L	7	BD139	35	BFY51	23	TIP31B	45	ZTX504	25	2N3904	10
BC115	22	BC212	10	BD140	35	BFY52	23	TIP31C	55	2N697	20	2N3905	6
BC117	22	BC212L	10	BD204	110	BFY53	32	TIP32A	45	2N698	40	2N3906	10
BC119	35	BC213	10	BD206	110	BFY55	32	TIP32B	55	2N706A	20	2N4037	45
BC137	40	BC213L	10	BD222	85	BFY56	32	TIP32C	60	2N708	20	2N4058	10
BC139	40	BC214	10	BF180	35	BRY39	40	TIP33A	60	2N918	35	2N4060	10
BC140	30	BC214L	8	BF182	35	BSX20	20	TIP33C	75	2N1132	22	2N4061	10
						BSX29	35	TIP34A	60	2N1613	30	2N4062	10
						BSY95A	25	TIP34C	85	2N2218A	25	2N5457	36
						BU205	160	TIP35A	160	2N2219A	25	2N5458	36
						BU206	200	TIP35C	180	2N2221A	25	2N5459	30
								TIP36A	170	2N2222A	20	2N5485	34
								TIP36C	195	2N2368	25	2N5777	45
								TIP41A	60	2N2369	17	2N6027	30
								TIP42A	60	2N2484	25	40360	40
								TIP120	90	2N2646	45	40361	50
								TIP121	90	2N2904	20	40362	50
								TIP122	90	2N2904A	20	40408	70
								TIP141	120	2N2905	22	40594	100

HARDWARE

PP3 Battery clips	6p
Red or Black crocodile clips	6p
Black pointer control knob	15p
Pair ultrasonic transducers	350p
TO220 twisted vane heatsink	28p
20mm panel fuseholder	25p
4mm terminals (various colours)	33p
TO18 transistor socket	15p
Submin relay SPCO 12V	170p
64mm 64 ohms min. speaker	70p

BOXES

Dimensions in inches. Aluminium.

3 × 2 × 1	70p	6 × 4 × 2	120p
4 × 3 × 1½	85p	6 × 4 × 3	150p
4 × 3 × 2	100p	8 × 6 × 3	180p

CONNECTORS

DIN	Plug	Socket	Jack	Plug	Socket
2 pin	9p	9p	2·5mm	10p	10p
3 pin	12p	10p	3·5mm	10p	8p
5 pin	13p	11p	Std.	16p	20p
Phono	10p	12p	Stereo	24p	25p
1mm	13p	13p	4mm	18p	17p

★ COMPONENT KITS ★

An ideal opportunity for the beginner or the more experienced constructor to obtain a wide range of components at reduced prices.

¼W 5% Resistor Kit. Contains 10 of each value from 4·7Ω to 1M (650 resistors) 480p

Ceramic Capacitor Kit. Contains 5 of each value from 22p to 0·01 (135 caps.) 370p

Polyester Capacitor Kit. Contains 5 of each value from 0·01 to 1μF (65 caps.) 575p each

Preset Kit. Contains 5 of each hor. value from 100Ω to 1M (total 65 presets). 425p

Nut and Bolt Kit. Total 300 items. 140p

25 6BA ½" bolts	25 4BA ½" bolts
25 6BA 1" bolts	25 4BA 1" bolts
50 6BA washers	50 4BA washers
50 6BA nuts	50 4BA nuts

TRANSFORMERS

Miniature mains.
606V, 909V, 12012V all @ 100mA 100p each

High quality. Split bobbin construction.

6VA 0-6, 0-6V @ 0·5A; 0-9, 0-9V @ 0·4A 0-12, 0-12V @ 0·3A. 220p each

12VA 0-6, 0-6V @ 1A; 0-9, 0-9V @ 0·6A; 0-12, 0-12V @ 0·5A; 0-15, 0-15V @ 0·4A 275p each (plus 40p carriage).

24VA 0-6, 0-6V @ 1·5A; 0-9, 0-9V @ 1·2A; 0-12, 0-12V @ 1A; 0-15, 0-15V @ 0·8A 330p each (plus 60p carriage).

50VA 0-15-20-24-30V @ 1·5A; 0-12, 0-12V @ 2A; 0-15, 0-15V @ 1·5A; 0-25, 0-25V @ 1A 400p each (plus 70p carriage).

100VA 0-30, 0-30V @ 1·5A; 0-50, 0-50V @ 1A; 0-20-35-33-40-50V @ 2A 920p each (plus 80p carriage).

Please add carriage charges to our normal postage charges.

SOLDERING IRONS

Antex CX 17W Soldering iron	420p
2·3mm and 4·7mm bits to suit	55p
CX 17W element	190p
Antex X25 25W soldering iron	440p
3·3mm and 4·7mm bits to suit	55p
X25 25W element	190p
Solder pump desoldering tool	480p
Spare nozzle for above	70p
10 metres 22 swg solder	100p

SOCKETS

8 pin	7p	22 pin	20p
14 pin	9p	24 pin	22p
16 pin	10p	28 pin	26p
18 pin	15p	40 pin	32p
20 pin	18p		

REGULATORS

Positive		Negative	
78L05	30p	79L05	65p
78L12	30p	79L12	65p
78L15	30p	79L15	65p
7805	45p	7905	50p
7812	50p	7912	45p
7815	60p	7915	50p
LM309K	130p	LM323K	350p
LM317T	180p	LM723	40p

RESISTORS

¼W 5% Carbon film E12 series 4·7Ω-10M 1p each
¼W 5% Carbon film E12 series 4·7Ω-4M7 2p each
¼W 1% Metal film. E24 series 10Ω-1M. 8p each

OPTO

3mm red	7p	5mm red	9p
3mm green	14p	5mm green	14p
3mm yellow	14p	5mm yellow	14p

Clips to suit 3p each.

Rectangular		TIL32	40p
red	16p	TIL78	40p
green	17p	TIL111	60p
yellow	17p	ORP12	85p

Seven Segment Displays

Com. cathode		Com. anode	
DL704 0·3in	95p	DL707 0·3in	95p
FND500 0·5"	90p	FND507 0·5"	90p
TIL313 0·3"	105p	TIL312 0·3"	105p
TIL322 0·5"	115p	TIL321 0·5"	115p

All seven segment displays are supplied with connection details.

2N5777 45p Dual colour LED 65p

SWITCHES

Submin. toggle
SPST 55p SPDT 60p DPDT 75p

Miniature toggle
SPDT 80p SPDT centre off 90p
DPDT 90p DPDT centre off 100p

Standard toggle
SPST 35p DPDT 48p

Miniature DPDT slide 14p
Push to make 15p Push to break 22p

Rotary type adjustable stop
1P12W, 2P6W, 3P4W, 4P3W all 55p

DIL switches all SPST
4 SPST 80p 6 SPST 80p 8 SPST 100p

VERO

Size 0·1 matrix	
2·5 × 1"	22p
2·5 × 3·75"	75p
2·5 × 5"	85p
3·75 × 5"	95p
VQ board	160p
Veropins per 100	
Single sided	50p
Double sided	60p
Spot face cutter	105p

CABLES

20 metre pack single core connecting cable, ten different colours	65p
Speaker cable	10p/m
Standard screened	16p/m
Twin screened	24p/m
2·5A 3 core mains	23p/m
10 way ribbon	65p/m
20 way ribbon	120p/m

PANEL METERS

Size 60 × 46 × 35mm.

0-50μA	0-500mA
0-100μA	0-1A
0-500μA	0-50V AC
0-1mA	VU
0-10mA	0-300V AC
0-50mA	0-25V
0-100mA	0-30V DC

450p each

POTENTIOMETERS

Rotary. Carbon single Log or Lin 5K-1M 32p
Slide. 60mm travel single Log or Lin 5K-500K 63p
Preset. Submin horiz. 100Ω-1M. 7p

DIODES

BY127	12p	1N4001	3p	1N914	4p
OA47	10p	1N4002	5p	1N4148	2p
OA90	8p	1N4006	7p	1N5406	17p
OA91	7p	1N4007	7p	400mW zen.	6p
OA200	8p	1N5401	15p		
OA202	8p	1N5404	16p		

CAPACITORS

Polyester. Radial leads. 250V C280 type.
0·01, 0·015, 0·022, 0·033, 6p; 0·047, 0·068, 0·1 7p; 0·22, 9p; 0·33, 13p; 0·47, 13p; 0·68, 20p; 1·0, 23p.

Electrolytic. Radial leads.
0·47/63V, 1/63V, 2·2/63V, 4·7/63V, 10/25V, 7p; 22/25V, 47/25V, 8p; 100/25V, 9p; 220/25V, 14p; 470/25V, 20p; 1000/25V, 30p.

Tantalum bead.
0·1, 0·22, 0·33, 0·47, 1·0 @ 35V, 12p; 2·2, 4·7, 10 @ 25V, 20p; 15/16V, 30p; 22/16V, 27p; 33/16V, 45p; 47/6V, 27p; 47/16V, 70p; 68/6V, 40p; 100/10V, 90p.

Polystyrene. 5% tolerance.
10p-1000p 6p. 1500p-4700p 8p. 6800P-0·012 10p.

Ceramic.
22p-0·01u. 50V type. 3p each.

Trimmers. Mullard 808 series.
2-10pF 22p. 2-22pF 30p. 5·5-65pF 35p.

BRIDGE RECTIFIERS

1A 50V	22p	4A 400V	85p
1A 400V	35p	6A 100V	80p
2A 200V	40p	6A 200V	90p
2A 400V	45p	6A 400V	95p
4A 200V	90p		

TRIACS + SCRS

SCRs		TRIACs	
C106D	35p	400V 4A	60p
400V 8A	70p	400V 8A	70p
400V 12A	99p	400V 16A	105p

PCB MATERIALS

Alfac transfer sheets	45p
Dalo etch resist pen	100p
Fibre glass board 3·75 × 8"	70p
Ferric Chloride 250ml bottle	100p

CRYSTALS

100KHz	290p	6·144M	180p
200KHz	370p	7·00M	250p
1MHz	300p	8·0M	170p
1·008M	370p	10·0M	180p
1·8432M	300p	12·0M	290p
2·0M	270p	16·0M	240p
2·4576M	220p	18·0M	240p
3·276M	240p	18·432M	220p
3·579M	120p	19·968M	300p
4·0M	150p	26·69M	300p
4·194M	150p	27·145M	240p
4·43M	125p	38·6667M	320p
5·0M	240p	48·0M	220p
6·0M	200p	116M	300p

★ SPECIAL OFFER ★

Verobloc Solderless Breadboard as used in Teach-In '82. 360 reliable contacts. Will take any IC. 350p

ORDERING INFO

All prices exclude VAT. Please add to total order. Please add 50p carriage on all orders under £10 in value. Send 42p for our catalogue. Official orders welcome from Colleges, Universities etc.

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WK-7 INSERTION EXTRACTION KIT

MOS 2428
MOS-2428 24-28 PIN, MOS, CMOS SAFE INSERTER

For highly sensitive MOS & CMOS I.C.'s. Ground strap may be easily attached. Durable chrome platted ABS construction features precision parts for long life and easy-one-hand operation.

EX2
CMOS SAFE DIP I.C. EXTRACTOR TOOL

MOS 40
MOS-3640 36-40 PIN
CMOS SAFE INSERTER

MOS 1416
MOS-1416 14-16 PIN, MOS, CMOS SAFE INSERTER

EX1
EXTRACTOR TOOL

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Microdigitol Ltd., Liverpool. 051-227-2535
Electronica C G Ltd., Manchester. 061-788-0656
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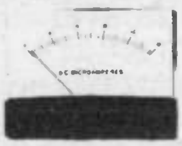

METERS: 110 × 82 × 35mm
30μA, 50μA, 100μA. £6·10.
Post 50p.

METERS: 45 × 50 × 34mm
50μA, 100μA, 1mA, 5mA, 10mA, 5A. £3·42. Post 30p.

METERS: 60 × 47 × 33mm
50μA, 100μA, 1mA, 5mA, 10mA, 100mA, 1A, 2A, 5A, 25v, 50v, 50-0-50μA, 100-0-100μA. £4·76.
VU meters. £5·18.
Post on above meters 30p.

MULTI-METER
7N 360TR
20,000 ohm/volt
RESISTANCE RANGES
X1, X10, X1K, X10K
£13·30
P.&P. 60p

TRANSFORMERS
240v Primary

3-0-3v	100mA	82p
6-0-6v	100mA	87p
6-0-6v	250mA	£1·22
12-0-12v	50mA	92p
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Time, auto calendar, calculator, alarm, hourly chimes, stopwatch
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AX-210 Specification

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* Professional 1/100 second stopwatch.

Hourly time signal. Daily alarm-electronic buzzer or 3 selectable melodies.
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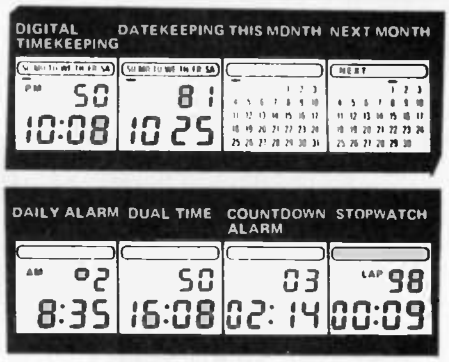
9.4 x 35.4 x 36mm.



COMMON SPECIFICATIONS: * High quality modules and cases * Mineral glass face * Accurate to +/- 15 seconds per month * Water resistant to withstand day-to-day splashing, rain, etc.

100 METRE RESISTANT

W-100 (left RRP £22.95. **£19.95.** Black resin case/strap otherwise same specification as W-150 below.

W-200 (right) RRP £19.95. **£17.95.** Black resin case/strap. Displays hours, minutes and date; seconds or day. Alarm, hourly chimes and 1/10 second stopwatch.

NEW

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F-81/F82 (left) RRP £12.95. **£10.95.** Black resin case/strap.

A-851 (right) RRP £16.95. **£14.95.** Stainless steel jacket and bracelet.

Displays hours, minutes and date; seconds or day. Alarm, hourly chimes and 1/10 second stopwatch.

W-150. (left) RRP £27.95. **£24.95.** Stainless steel case/bracelet.

W-150C (right) RRP £24.95. **£21.95.** Stainless steel case/resin strap.

Time and auto calendar. Alarm hourly chimes, countdown alarm timer with repeat memory function, professional 1/100 sec and stopwatch. Time is always on display, regardless of display mode

THESE SPACE INVADERS WILL ALARM YOU

Casio's most amazing watches ever.

CA-90 (left) RRP £22.95. **£19.95.** Black resin case/strap.

CA-901 (right) RRP £34.95. **£29.95.** Chrome plated case, S/S bracelet.

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50 METRE WATER RESISTANT

W-51 (left) RRP £25.95. **£22.95.** All S/S. specification as W-150.

LW-5. RRP £10.95. **£895.** Resin case and strap. Colours as available. Three display modes hours and minutes; month and date; seconds display. 7 year battery life.

NEW

LADIES MODELS (shown full size)

NEW

LM-3 (left) RRP £16.95 **£14.95.** Resin case and strap. Colours as available. Ladies melody alarm chronograph. Time and calendar, 3 selectable alarm melodies, hourly chimes, professional stopwatch.

AN-8GL (right) RRP £27.95. **£24.95.** Gold plated case. Leather strap.

Gentleman's slim dress watch. LCD/analog display of hours and minutes. Sweep second hand or radial seconds. No other functions.

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Fortune Teller, Matchmaker, Calendar and Alarm Clock

FT-7

RRP £18.95
ONLY £16.95

Predictions of individual fortunes (Health, Gambling/Investment, Business and Love) or the compatibility between two persons on any given day.
Hourly time signals. 5/16 x 2½ x 4¼ inches. Wallet.

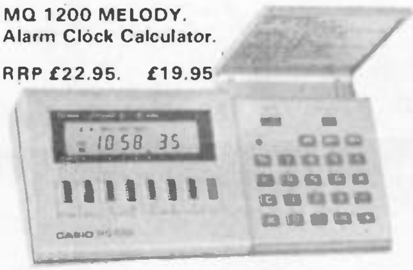
BQ-1100 BIOLATOR
Alarm Clock Calculator

Calendar, two alarms, countdown alarm, stop-watch, time memory, three date memories, date and **BIORHYTHM CALCULATIONS.**
¼ x 2-7/16 x 4⅜"

RRP £18.95 £16.95

MQ 1200 MELODY.
Alarm Clock Calculator.

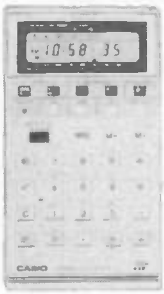
RRP £22.95. £19.95



12 Melodies, 2 alarms, date memories, anniversary memories, calendar, night light.
1-9/16 x 6 x 2¾ inches. 7 ounces

MELODY ALARM CLOCK CALCULATORS

ML-120 **ML-2000**



RRP £16.95.
£14.95

RRP £25.95
£22.95

12 melodies, 2 alarms, date memories, anniversary memories, calendar, stopwatch.
ML-120: 7/32 x 2½ x 4½". Wallet.
ML-2000: Office. 1¾ x 4 x 6¼".

ML-75: Card version of above. £14.95.

BANKING AND FINANCE
BF-100 RRP £16.95. ONLY £14.95.

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MA-1
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Mozart No. 40 or Buzzer.
Hourly chimes.
Snooze facility
1¾ x 4½ x 3in.

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More mental agility-less manual dexterity

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Three missile buttons for three level attack. 8 arcs of fire make "aiming off" essential.

Basic calculator with full memory and %

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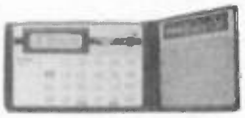
MG-880 DIGITAL INVADERS
Our best selling calculator last Christmas.

MG-880 MG-770 Card Size



RRP £14.95. **£12.95**

RRP £12.95 **£10.95**

Quick reactions and fast fingerwork are called for.
Basic calculator with full memory and %.

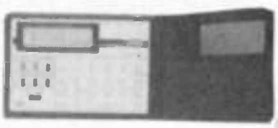
UC-365 MELODY
Alarm Clock Calculator.

RRP £21.95
ONLY £19.95

Three melodies, universal calendar, date memories, 2 date alarms, daily alarm, countdown alarm/stopwatch, time memory.
⅛ x 4½ x 2½. 2.2ozs. Wallet.

MELODY ALARM CLOCK CALCULATORS

UC-360 Card Size **UC-3000**



RRP £21.95 **£19.95.**

Specifications as UC-365 above.

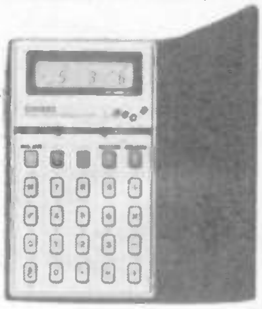
RRP £30.95
£27.95

UC-360 7/32 x 3⅜ x 2⅜". 1.8ozs. Wallet
UC-3000. Office. 1¾ x 4 x 6¼".

GENERAL SPECIFICATIONS
All casio calculators listed have liquid crystal displays for long battery life and a (minimum) 8 digits, with floating decimal point.
Alarm clock calculators all have a one year battery life, pre-programmed automatic calendar adjustment* and hourly time signals. (*Except FX-6100).

NEW
INSTANT MUSICIAN!
Electronic Musical Instrument and Calculator

VL-80



Records and plays back notes as a melody.
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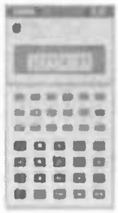
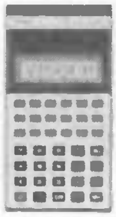
AUTO PLAY
Manual play
Melody demonstration
Vibrato effect
8.5 x 68 x 118.5mm

Price/delivery on application.

SCIENTIFICS at discount prices.

FX-81 **FX-100** **FX-550**



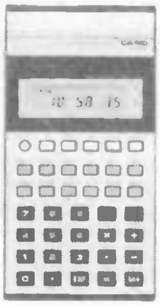


£12.95 **£16.95** **£19.95**

FX-81 8 digits, 30 scientific functions. 2x AA batteries last 4,000 hours. ¾ x 3 x 5⅞"
FX-100. 10d, 44 sc.f, otherwise as FX-81
FX-550. 50 sc.f. 1,300 hour lithium battery. 5/16 x 2⅞ x 5¼". Wallet.

WITH CLOCK AND ALARM

FX-6100 **FX-8100**

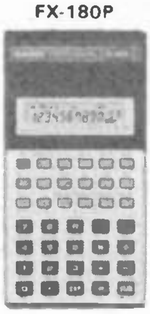


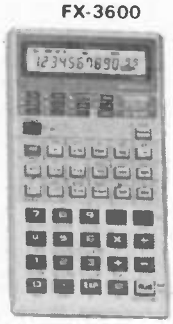
£14.95 **£24.95**

FX-6100. 8d, 39 sc.f, clock with hourly time signals, alarm, countdown alarm timer, 1/100 second stopwatch. 2 x AA batteries last 1 year. ¾ x 3 x 5⅞".
FX-8100. Similar to above but 49 sc.f, auto calendar, additional timer alarm and powered by 2 silver oxide batteries. ¼ x 2¾ x 5⅛". Wallet.

LOW COST PROGRAMMABLES

FX-180P **FX-3600**





£19.95 **£22.95**

FX-180P. 10d, 55 sc. f, including Integrals and **REGRESSIONAL ANALYSIS.** Up to 38 program steps and 2 programs; One independent memory, 6 constant memories; all non-volatile. 2 x AA batteries give 7,000 hours use. ¾ x 3 x 5⅞".
FX-3600P. Wallet version of above with hyperbolics and 1,300 hour lithium battery. 9/32 x 2⅞ x 5¼"

"BASIC" POCKET COMPUTER

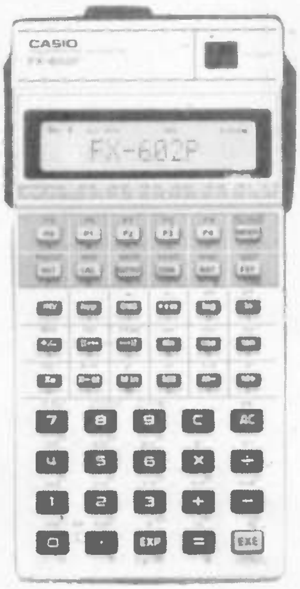
FX-702P

RRP £134.95
ONLY £119.95

LCD scrolling display of alpha/numeric (dot matrix) characters. Input can be varied from 1680 programme steps, with 26 independent memories, to 80 programme steps with 226 memories. (All retained when switched off). Up to 10 programmes can be stored (P0 to P9). Subroutine: Nested up to 10 levels. FOR NEXT looping: Nested up to 8 levels. Straightforward programme debugging by tracing. Editing by moving cursor. 55 built-in scientific and statistical functions, including regression analysis and correlation coefficient, can be incorporated in programmes. Programme/data storage on cassette tape via optional FA 2. Optional FP 10 mini printer available soon. Two lithium batteries give approx. 200 hours continuous operation, with battery saving Auto Power Off. Dimensions: 17 x 165 x 82mm (⅝ths x 6½ x 3¼"). Weight: 180g (6.3oz).

ADVANCED PROGRAMMABLE

FX-602P



- LCD alpha/numeric (dot matrix) scrolling display (86 types).
- Variable input capacity from 32 functional program steps with 88 independent memories, to 512 steps with 22 memories.
- Memory and program retention when switched off.
- Up to 10 pairs unconditional jumps (GOTO). Manual jump.
- Conditional jumps and count jumps. Indirect addressing.
- Up to 9 subroutines. Nesting possible up to 9 levels.
- 50 built-in scientific functions, all usable in programmes.
- PAM (Perfect Algebraic Method) with 33 brackets at 11 levels.
- Ultra high speed calculations.
- Program storage on cassette tape using optional FA-1.
- Compatible with FX-501/2P.
- 2 lithium batteries. Approx 660 hours continuous use.
- Battery saving Auto Power Off.
- Only 9.6 x 71 x 141.2mm. 100g.

Optional FP-10 printer available soon.

RRP £84.95 **ONLY £74.95**

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Official Timekeepers, 1980 Olympic Games

PROFESSIONAL STOPWATCH

ONLY £33.95

MICROSPLIT 1030

- 1/100 second timing up to 9 hours, 59 minutes, 59.99 seconds.
- Selectable lap or split timing.
- Quartz accuracy, certified 0.0004%.
- Water resistant case. (It floats!).
- Low battery warning indicator.
- Two year continuous battery life.
- Colour coded buttons, with precise clicking action for reassurance.
- Lightweight, shock resistant, easy-grip cases, with lanyard.

Other models available. Details on request.

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CITIZEN Fast overtaking SEIKO as the world's largest manufacturer of high quality watches, with 28 million sold in 1980.

41-8510-51 Analog/Digital Alarm Cronograph

Analog time, with luminous hands. Digital second time, or calendar, with night time illumination. Professional 1/100 second stopwatch to 1 hour, then seconds to 24 hours. Alarm and hourly chimes. Countdown alarm timer, with repeater function. 100 METRE WATER RESISTANT S/S case, with crystal glass.

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WITH REMOTE CALL-IN BLEEPER
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£135 inc VAT
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SCHOOLS DESIGN AWARD

It is with great pleasure that we announce in this issue the Schools Electronic Design Award Competition organised jointly by Mullard Ltd and EVERYDAY ELECTRONICS.

In these difficult times schools are feeling the effects of reduced budgets and are having to make do and improvise in many ways, not least in scientific equipment. It is the sponsors' earnest hope that this Competition will generate further initiative and self-help.

The fundamental purpose of the Mullard/EVERYDAY ELECTRONICS Competition is to encourage the efforts of individual scholars who are already interested and involved in electronics. We hope to channel their creative thoughts into the direction of some particular piece of equipment that would play a useful and permanent part within their school. We have no doubt as to the high degree of inventiveness to be found amongst school children for many interesting circuit ideas are sent into this magazine from boys and girls of various ages.

Valuable prizes are offered to the winning schools. Yet in truth there will be no losers amongst the entrants, for the fruits of each team's labours will surely find a place within that school and become a valuable addition to the Science Department. Details appear on page 811.

PLAYFUL ART

With only a few weeks to go, small and easy to build projects will have the most appeal to constructors already feeling the pressures of Christmas preparations of one sort or another.

If you're worried sick thinking about presents, an answer or two might be found in our pages. Yes, some of this month's projects could become useful gifts—something different and not usually available in the shops.

All of our current bumper selection are intended for pleasure and amusement. Here's a quick run-down. What would Christmas be without a tree? Our *Tree Lights Flasher* provides variable rates of scintillation so catering for all moods. *Pegboard* is one of those simple but cunningly devised games of skill calling for a steady hand. The *Reaction Meter* seeks out the alert eye, quick reflex action combination. If, on the other hand, you prefer a straight gamble, *Square Six* and *Heads or Tails* offer just this.

Apart from all this, there's a device to permit an electric guitar to be played through the hi fi amplifier and a speedo for a model car race track. Enough to fill any spare time in the coming weeks we guess.

Fred Bennett.

Our January issue will be published on Friday, December 18. See page 819 for details.

Readers' Enquiries
We cannot undertake to answer readers' letters requesting modifications, designs or information on commercial equipment or subjects not published by us. All letters requiring a personal reply should be accompanied by a stamped self-addressed envelope.
We cannot undertake to engage in discussions on the telephone.

Component Supplies
Readers should note that we do not supply electronic components for building the projects featured in EVERYDAY ELECTRONICS, but these requirements can be met by our advertisers.

Everyday ELECTRONICS

VOL. 10 NO. 12 DECEMBER 1981

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

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Certain back issues* of EVERYDAY ELECTRONICS are available worldwide price 80p inclusive of postage and packing per copy. Enquiries with remittance should be sent to Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. In the event of non-availability remittances will be returned.
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SEE PAGE 811

REACTION METER

BY I.K.CRAWFORD

THE Reaction Meter is a device to measure the speed of a person's response to stimulation of the optic nerve by monitoring how fast one can react to an l.e.d. lighting after a random period of time has elapsed.

Although 1 per cent tolerance components are used for clocking the 555 timer, 100 per cent accuracy cannot be assured, however a very good indication of response time can be given. Moreover if only comparison of results are required then accuracy of the timer is no longer important.

CIRCUIT DESCRIPTION

The circuit diagram of the Reaction Meter is shown in Fig. 1. When the RESET button S3 is pressed IC3 is triggered and its output pin 3, goes high. This signal resets both counters IC6 and IC7 and inhibits the latch composed of IC4a to IC4c. S3 also triggers IC3 into a monostable time period which is dependent on the value of the resistor chain R1 to R4. The value of the resistor chain is in turn dependent on which of the switches in IC2 are held open or closed by IC1. When the monostable period has timed out, the output, pin 3 of IC3, goes low lighting D3. The counters are no longer held reset and a signal to astable IC5 causes it to send clock pulses to IC7. The carry out of IC7 clocks IC6. STOP button S2 is then pressed and a high output signal from the latch stops both counters from counting but displays the accumulated number of clock pulses on the two 7-segment displays. The complementary output from the latch is used to clock IC1 so that a different binary signal is read from its internal flip-flops by IC2 on every "go".

IC4d is wired as an inverter driving the decimal point of X2 from the carry output of IC6, thus indicating seconds. If a reaction time is measured at less than one second the decimal point remains unlit. However, if a time of more than one second is recorded the decimal point lights indicating a very slow response indeed! The counter automatically resets after counting 1·99 seconds.

When the displays are lit and D3 is on current consumption rises to over 100mA, added to the fact that the unit remains on for extended periods makes battery power costly and impractical. However CMOS i.c.s have excellent noise immunity and the simple power supply involving T1, D1, D2 and C1 is adequate.

100Hz CLOCK OSCILLATOR

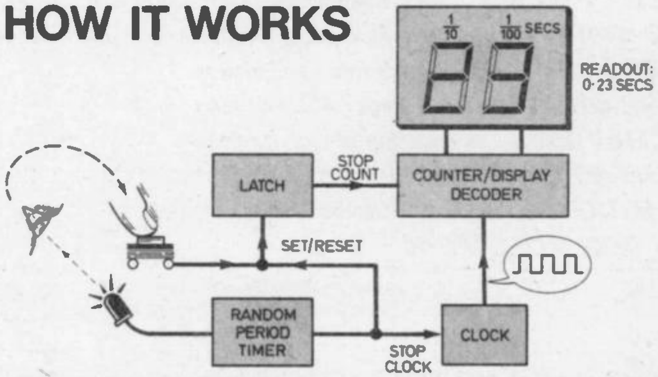
The 555 timer i.c., IC5, is wired in the astable mode. When it receives a high signal from IC4a it begins sending clock pulses to IC7. The frequency of the clock pulses is given by:

$$f=\frac{1\cdot 44}{(R10+2\times R11)C3}\text{Hz}$$

where the resistances are in ohms and the capacitance in farads.

Substituting in the values for R10 and C3, the value for R11 comes out to be 670kΩ for the required frequency of 100Hz. Such a resistance value is not available as such but can be made up from preferred values wired in series. In the prototype the chosen values were 470kΩ+100kΩ+100kΩ=670kΩ. Using one per cent tolerance components for R10, C3 and composite R11 will bring the frequency within one hertz of that required.

HOW IT WORKS

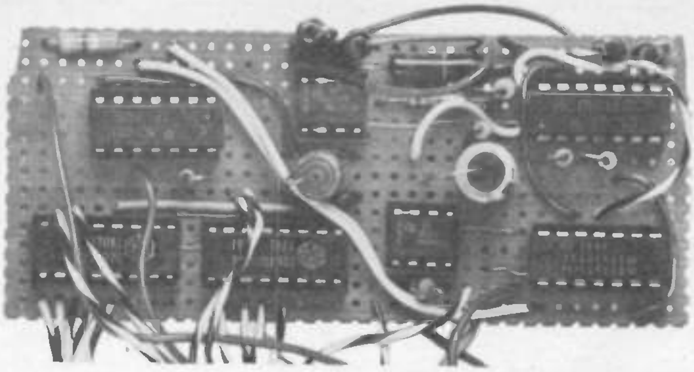


When the period produced by the RANDOM PERIOD TIMER has elapsed, the l.e.d. lights up. At the same time the CLOCK is turned on and its output pulses reach the COUNTER. The end of the time period also sets the LATCH which enables the counter, so the number of clock pulses it receives are displayed on the read-out. Pressing the STOP button resets the latch which freezes and displays the count so far.

The clock frequency has been chosen so that the time between the l.e.d. turning on and the stop button being pressed is read as your *reaction time* in 1/10 and 1/100ths of a second. A reset button, not shown, re-starts the cycle.

THE 4026

The 4026 integrated circuit is worth a mention here, as one may feel this chip a trifle expensive. It is described as a "decade counter with 7-segment decoded outputs", but also has clock enable, display enable, and reset inputs along with display enable out and carry output pins making it a very flexible and sophisticated MSI circuit. It also works out cheaper than the 4024 binary counter and the 4511 b.c.d. to 7-segment decoder together, and is well fitted to its role in the reaction timer.



Close-up view of the completed prototype main circuit board.

CASE PREPARATION

The entire Reaction Meter is housed in a plastic case 118×98×45mm, and the circuit is built up on two pieces of 0·1in matrix stripboard. The power supply section has 9 strips by 36 holes and the main circuit is built on a piece 36 strips by 15 holes.

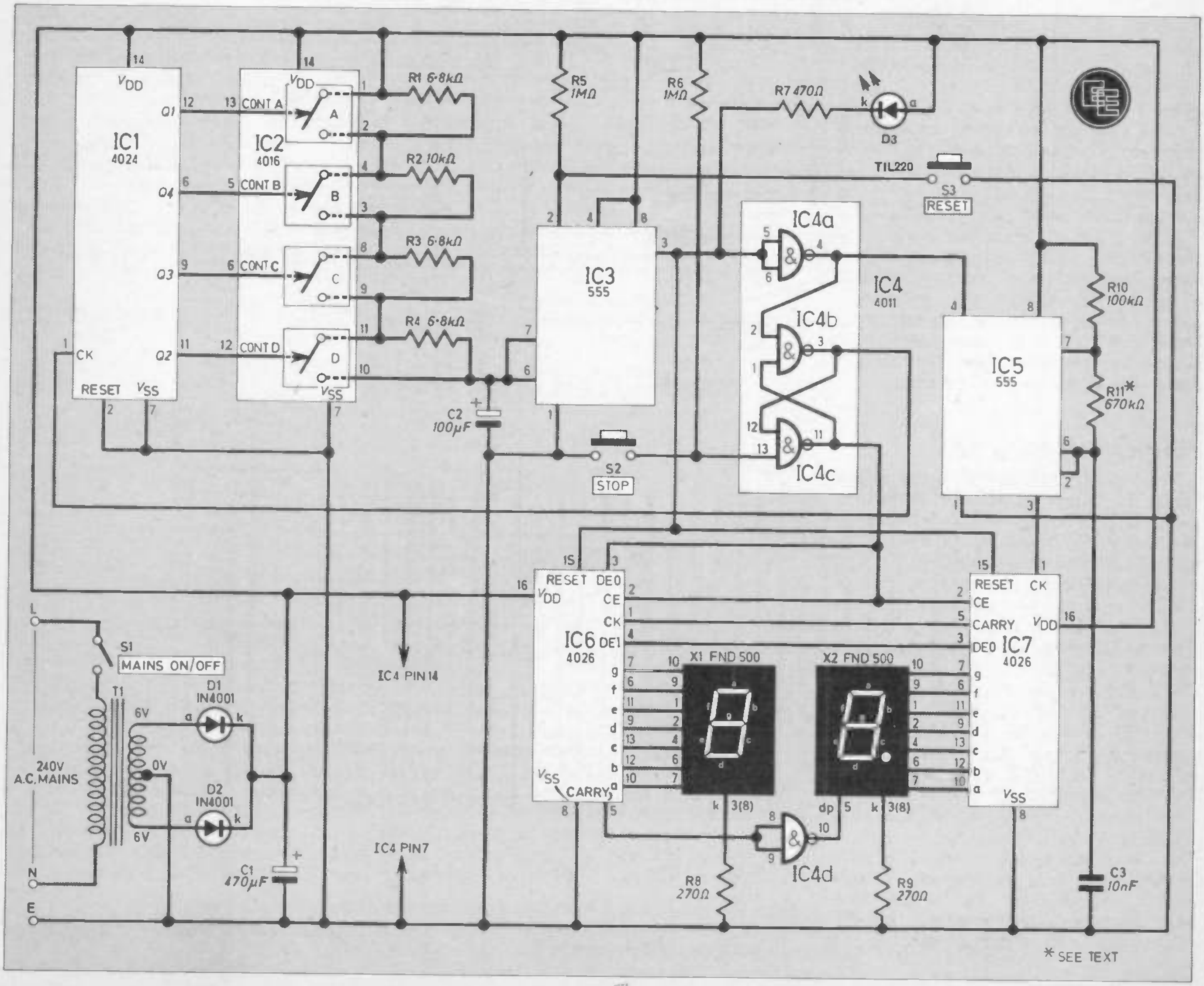
Begin with the case by cutting out a window for the two displays, large enough for them to show through side by side. This may be done by marking out the rectangular hole and then drilling around just inside the mark with a small diameter drill. With the use of a fine file the hole may be shaped, and with continuous checking with the displays a neat fitting can be obtained. Holes should also be cut for D3, the two push button switches, the mains on/off switch and the mains cable to pass through a rubber grommet.

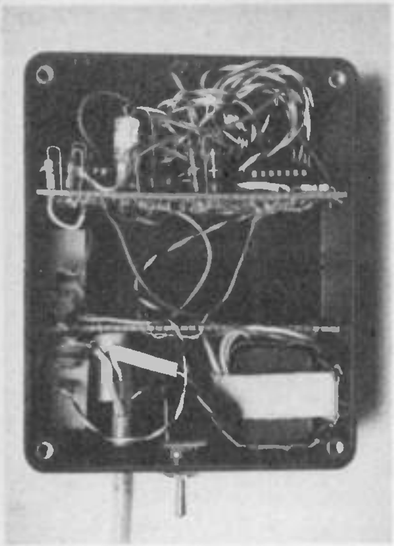
The type of case used in the prototype had vertical slots for mounting the circuit boards, so the two boards must be trimmed to slide in without being too loose or too tight.

ASSEMBLY

First, make the breaks in the copper strips of board *A* according to Fig. 2 and then solder in the wire links that lay *under* the i.c. sockets (note

Fig. 1. The complete circuit diagram of the Reaction Meter.

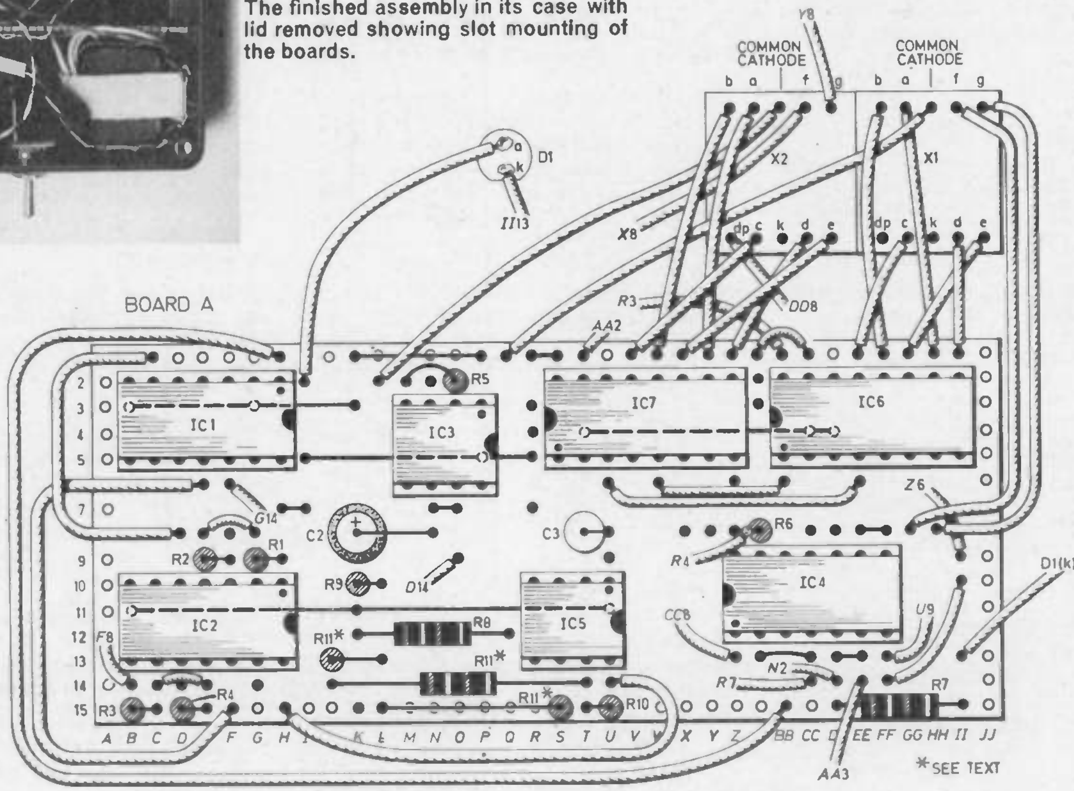




REACTION METER

COMPONENTS approximate cost £14 (excluding case)

The finished assembly in its case with lid removed showing slot mounting of the boards.



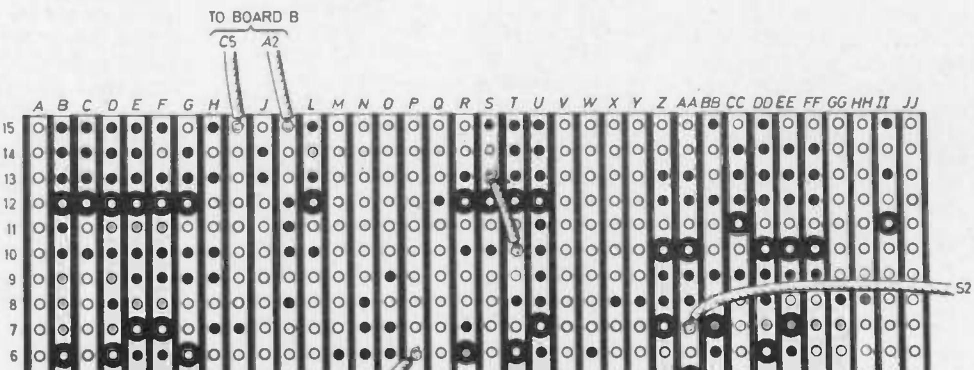


Fig. 2. (upper) The layout of the components and link wires on the topside of the stripboard with wiring to opto devices. Note that some link wires share a locating hole; (lower) the breaks and connections to be made on the track side of the stripboard.

COMPONENTS

Resistors
R1 6·8kΩ R4 6·8kΩ R7 470Ω
R2 10kΩ R5 1MΩ R8 270Ω
R3 6·8kΩ R6 1MΩ R9 270Ω
R10 100kΩ ± 1% metal oxide
R11 670kΩ made up from 100kΩ + 100kΩ + 470kΩ } ±1% metal oxide—see text
All ¼W carbon ± 5% except where stated otherwise

Capacitors
C1 470μF 10V elect. radial leads
C2 100μF 10V elect radial leads
C3 10nF ±1% polystyrene

See **Shop Talk** page 804

Semiconductors
D1, 2 IN4001 silicon rectifier diodes (2 off)
D3 TIL220 0·2 inch red light emitting diode
X1, 2 FND500 7-segment 0·5 inch common cathode displays (2 off)
IC1 4024BE CMOS 7-stage binary counter
IC2 4016BE CMOS Quad bilateral switch
IC3 NE555 timer i.c.
IC4 4011BE CMOS Quad 2-input NAND
IC5 NE555 timer i.c.
IC6 4026BE CMOS decade counter 7-segment outputs
IC7 4026BE CMOS decade counter 7-segment outputs

Miscellaneous
S1 s.p.s.t. mains toggle
S2, 3 push-to-make non-locking push switches (2 off)
T1 mains primary 6-0-6V 200mA secondary
Stripboard: 0·1 inch matrix 36 strips by 15 holes and 9 strips by 36 holes; 8-pin d.i.l. sockets (2 off), 14-pin d.i.l. sockets (3 off), 16-pin d.i.l. sockets (2-off); clip for D3; plastic case 118 × 98 × 45mm, with internal board mounting slots; p.v.c. covered stranded connecting wire; 3-core mains cable; rubber grommet.

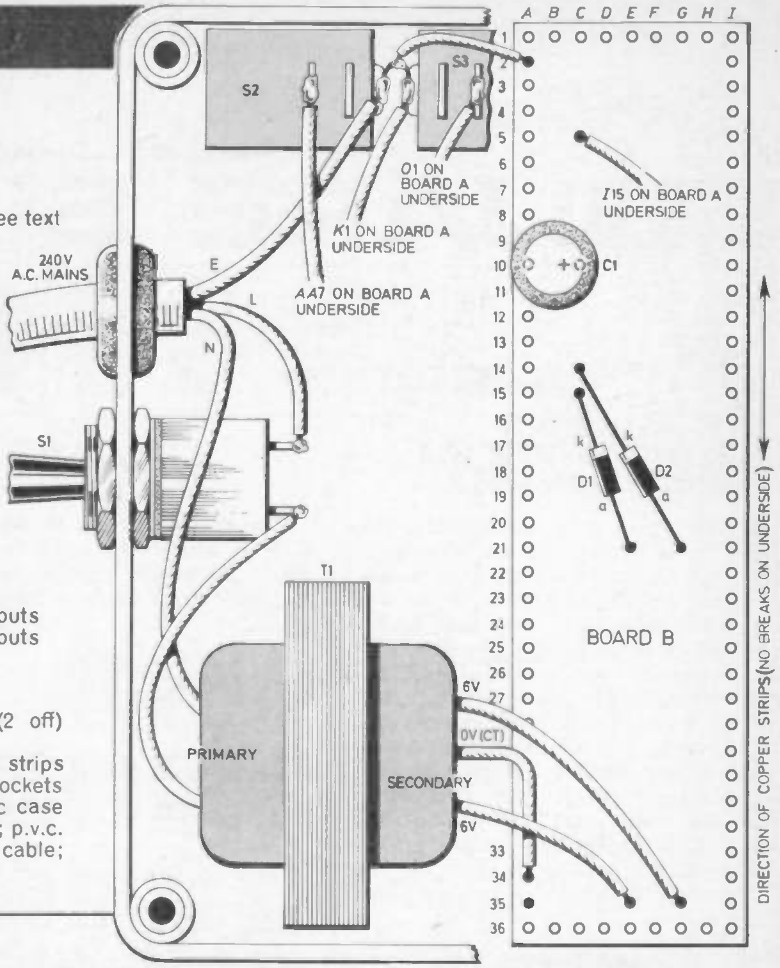


Fig. 3. The mains power supply section. No fixing bracket is shown on the transformer—see text

that a number of these and other links share a hole at one end) followed by all the i.c. sockets—their use is strongly recommended. Do not insert the i.c.s until later. All other components should then be soldered onto the top side of the board observing capacitor and diode polarity. Solder in all the remaining link wires on the topside of the board. Note that some of these are bare and some are p.v.c. covered. There are also two link wires on the underside of the board, below IC3 and IC5 positions. These are soldered directly to the appropriate i.c. sockets pins. P.V.C. covered wire is essential for these links.

Next solder the wires between the 7-segment displays and the main circuit board according to Fig. 2 (there are 17 in all). When this has been completed and thoroughly checked, connect sufficient lengths of flying lead to the four positions on the underside of board *A* to reach the switches S2, S3 and board *B*.

The power supply board (*B*) is made up separately, see Fig. 3, and therefore can be tested before it is connected to the main circuit. Care must be taken when making mains connections, ensure they are well insulated.

The transformer used in the prototype was held in place by board *B*. Small low current transformers such as used here are light and usually require minimal fixing.

The transformer in the prototype was enclosed in a screening shell which allowed this type of "fixing" to be made. However, we advise that some kind of bracket be made to hold T1. The fixing holes on conventional transformer frames would normally be used.

Once S1, D1, D2 and C1 have been soldered in position the assembly can be connected to the mains. About 6V d.c. should appear across C1. This should fall only fractionally when a 60 ohm load is placed across it.

When the power supply is complete it can be wired up to the main circuit board. Connections can also be made to D3 and the two push button switches. The seven integrated circuits should then be pushed into their appropriate sockets, making sure they are correctly orientated. The two boards may then be slotted in place.

TESTING

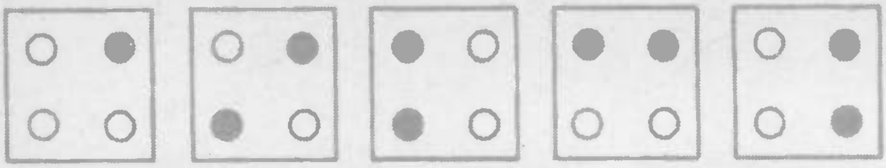
Place the back of the case on the unit and turn it over. Switch the power on and press STOP button S2 if D3 is lit, if not wait for it to light and then press S2. The displays should light displaying a number between 00 and 99, the decimal point may or may not be alight.

When the RESET button S3 is pressed, the displays and D3 should go off. After a short period of time D3 should light and although the displays remain dark, the decimal point should flash on and off once every second. Press S2 once more, the displays should light. If all is well at this stage then the unit can be considered to be functioning satisfactorily and the back can be screwed on.

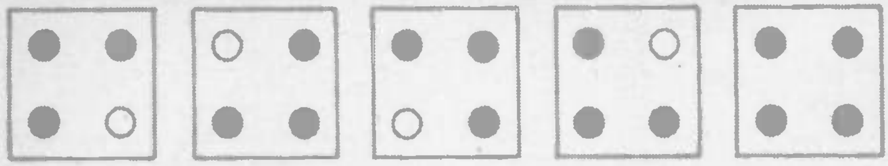
If strange numerals appear on pressing S2, check connections to the displays. Also check to see that all track breaks are sound, that solder is not linking two strips and that all connections on and between the boards are correct and soldered securely. Check once more the alignment of all i.c.s. and that D3 is wired correctly.

The prototype unit used ex-stock computer key action push button switches for S2 and S3. Whatever type used it is advisable to spend a little more on hard wearing ones since they will receive a lot of punishment.

It is possible to get a zero reading from the meter by anticipating the moment when the l.e.d. lights, also by holding down S2 and waiting until the l.e.d. comes on, in other words, cheating. ☒



SQUARE SIX



By F. G. RAYER

In most electronic die circuits, the six faces of the die are simulated on a dot matrix consisting of seven l.e.d.s in an "H" formation. In the design described here, only four l.e.d.s are employed and the logic circuit is of a simpler nature than that required for the driving of seven l.e.d.s.

The four display indicators are arranged in a square format and two of these are allocated a score of two points each whilst the remaining pair are worth only one point each, see Fig. 1. In this way scores from one to six points can be achieved by turning on the l.e.d.s in various combinations.

CHANCE

Although the author has attempted to create a cheaper and simpler alternative to an electronic die, it is not strictly speaking a direct replacement since the chance of getting any particular score with this circuit is not identical to the chance of getting the same score with a "true" die. For example, as the Square Six game has ten possible outputs (see Fig. 1) and only one of these is a "six" (all four l.e.d.s on), the probability of scoring six is one in ten. However, the probability of scoring a six with a real die is only one in six.

Nevertheless the game is still one of chance with the output being purely random.

CIRCUIT DESIGN

The circuit consists of a counter i.c. with four l.e.d.s connected to its outputs and an oscillator to drive the counter when the "throw" switch, S1, is pressed. The circuit diagram is shown in Fig. 2.

The oscillator is a basic astable (free running) multivibrator consisting of TR1, TR2, C1, C2 and R1 to R4. When S1 is made, this circuit will oscillate. The output is taken from the collector of TR2 and it clocks IC1, a binary coded decimal counter.

The outputs of the counter at pins 8, 9, 11 and 12 are used to drive the l.e.d.s D1 to D4, with R5 to R8 limiting the current to these displays.

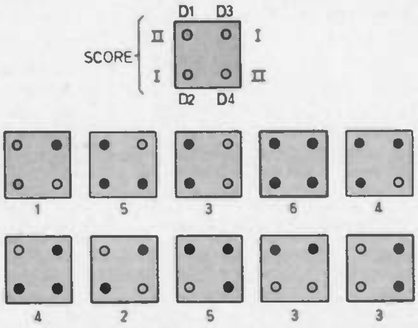


Fig. 1. Ten possible score combinations from the Square Six game.

Depending upon the output state of IC1, the l.e.d.s will display one of the combinations shown in Fig. 1 when S1 is released. Thus when D3 alone is on the score is "1", when D1 and D2 are on the score is "3", when all four diodes are on the score is "6", and so on.

It can be seen that some numbers do repeat but as it is the same for all players this should be of no practical disadvantage.

S2 is the unit on-off switch and power is supplied by four 1·5V batteries, diode D5 being included to drop the six volts from the batteries to a TTL compatible level in the order of 5·3V.

CIRCUIT BOARD

The stripboard component layout and track breaks are shown in Fig. 3.

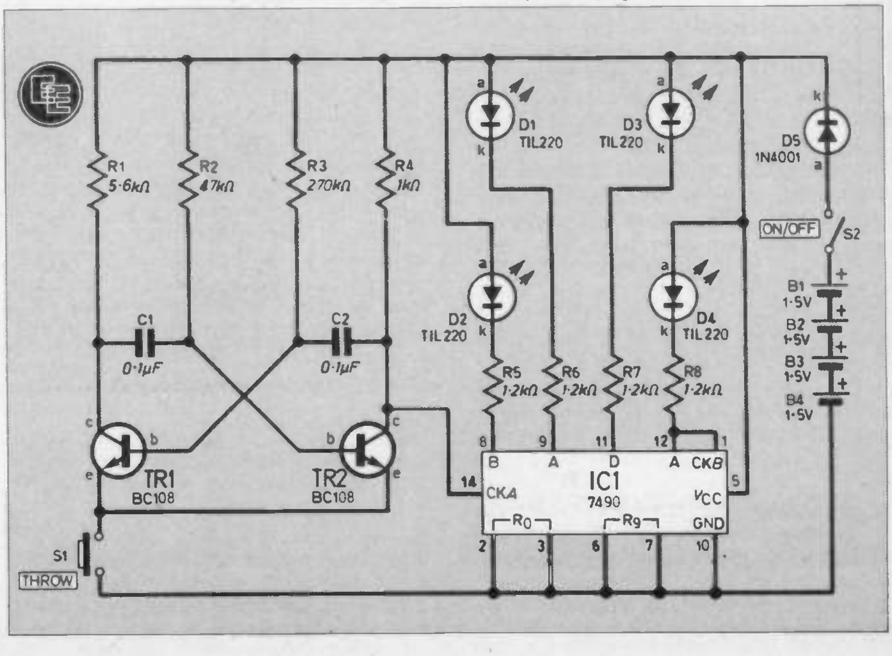
The components and links should be soldered in the positions indicated with IC1 mounted in an i.c. socket. L.e.d.s, D1 to D4, should be left until last as they are mounted in a special fashion.

The switches S1 and S2 are to be wired in with flying leads, these to be of sufficient length to suit the layout of components in the case. The leads to the battery connector are wired in as shown in Fig. 3.

L.E.D.S

The four l.e.d.s are to be mounted as shown in Fig. 4 with pieces of p.v.c. sleeving 12mm long pushed over the legs of the devices. This is so they will stand proud of the board, all at the same height and permit the display to protrude through the case when mounted on the 15mm spacers. Care must be taken to get the polarity of the l.e.d.s correct, the cathode (k) is usually indicated by a "flat" or a "notch" on the side of the l.e.d. body.

Fig. 2. Circuit diagram of the Square Six game.



CASE

When selecting a suitable case for this project, bear in mind the size of the battery holder for the four AA size batteries and the component board itself as this has to be mounted directly under the lid of the case chosen using the two 15mm long spacers and two long M3 or 6BA screws and nuts as shown in Fig. 4.

The holes required to mount the board are shown in Fig. 5 but remember that the lid illustrated is only a typical example therefore the outline may vary slightly with individual choices.

The positions of the two switches, S1 and S2, are left up to the constructor though the photograph of the prototype may be used as a guide.

Once mounted, the display can be labelled up as shown using roman numerals as these can easily be read from either side.

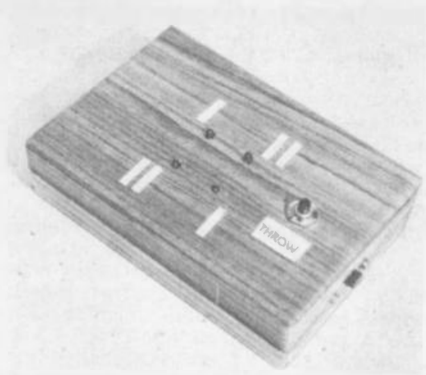
OPERATION

When the THROW switch, S1, is closed the multivibrator will generate a pulse train to clock the counter which will then run through all the possible output states very rapidly (too fast for the eye to follow so therefore impossible to predetermine the result).

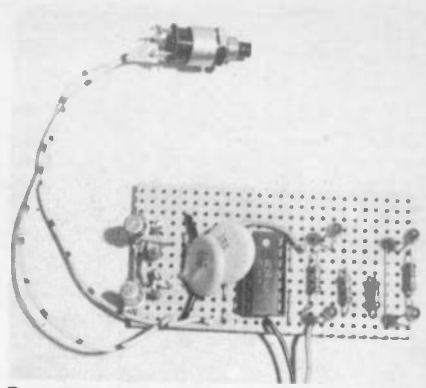
On releasing S1, the display will show one of the scores given in Fig. 1.

If no display is present it is possible to check for an output signal on the collector of TR2 when S1 is made with a high impedance earpiece coupled through a 10nF capacitor whereby a "buzzing" sound should be heard.

If no signal is detected examine TR1 and TR2 and the power supply. If a buzzing is heard but there is still no display look for faults in the wiring of IC1 and the orientation of D1 to D4.



Finished model showing Roman numerals on the top panel and switch positions.



Prototype board assembly. Note that there is a slight variation between this and the layout in Fig. 3.

COMPONENTS

Resistors

R1	5·6kΩ
R2	47kΩ
R3	270kΩ
R4	1kΩ
R5-R8	1·2kΩ (4 off)

All ¼W carbon ±5%

Capacitors

C1, 2	0·1μF 20V ceramic disc (2 off)

Semiconductors

TR1, 2	BC108 silicon *npn* (2 off)
D1-D4	TIL 220 or similar red l.e.d. (4 off)
D5	1N4001 silicon
IC1	7490 TTL decade counter

Miscellaneous

S1	s.p. push-to-make, release-to-break
S2	s.p. on-off slide or toggle
B1-B4	4 × 1·5V size AA (HP7)

Stripboard: 0·1 inch matrix 26 holes by 13 strips; 14 pin d.i.l. i.c. socket; p.v.c. sleeving; p.v.c. coated wire; 6BA or M3 board mounting hardware; 15mm long spacer (2 off); battery holder for B1-B4; battery connector; case to suit.

Approx. cost Guidance only £4 excluding case

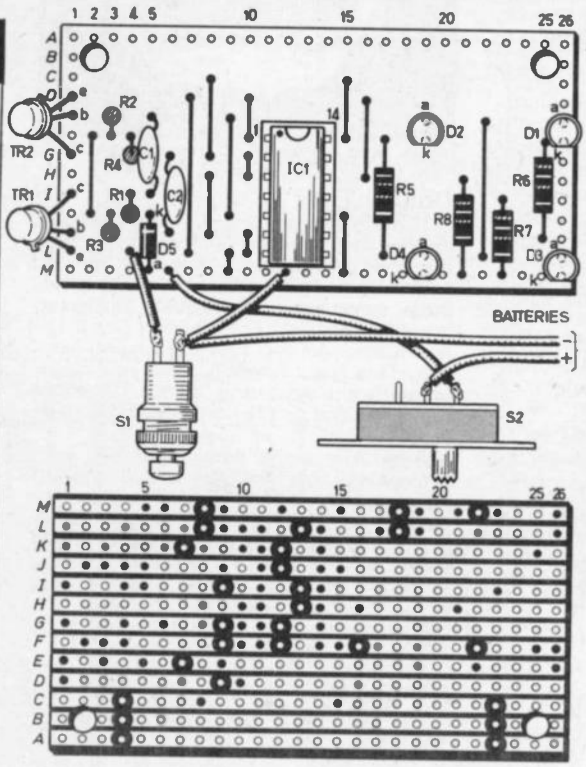


Fig. 3. Component layout, interwiring and details of breaks on the underside of the stripboard.

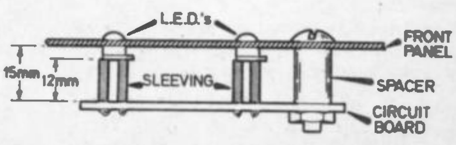


Fig. 4. Method of mounting the l.e.d.s using sleeving and board spacers.

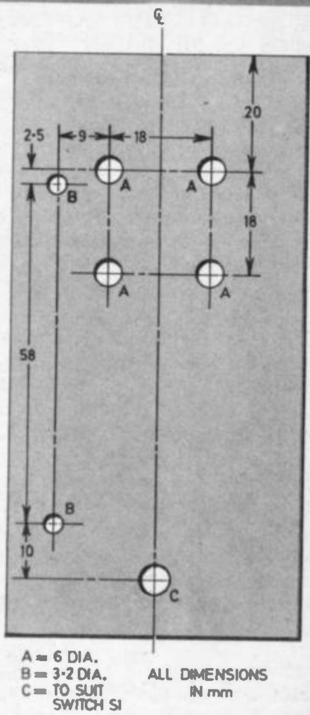
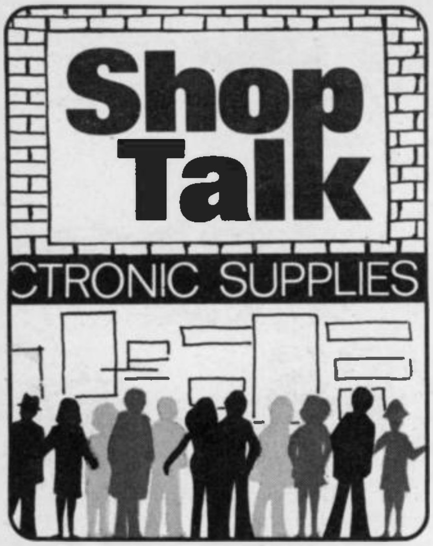


Fig. 5. Suggested drilling details for the top panel.



By Dave Barrington

Teach-In '82

The demand for *Teach-In '82* kits has, it appears, caused a temporary shortage of certain components throughout the country.

It seems that, for the moment, some of our advertisers stocks of meters and battery holders have dried up. However, as Bill Bains of Bi Pak assures us, fresh consignments of these items are on their way from the manufacturers and customers can anticipate completion of their orders for Teach-In kits very shortly.

For those readers who are "direct wiring" the first few Teach-In experiments, Vero produce a plug-in pre-pierced escutcheon plate for mounting hardware, such as potentiometers, switches, terminals and indicator lamps.

The panel has three inverted "pear" shaped cutouts, a series of drilled holes and two mounting lugs. The escutcheon plate can be slotted into the plastic interconnecting lugs on one side of the Verobloc.

The Verobloc Mounting Plate (200-22276J) cost 38p plus VAT and should be stocked by most component retailers or can be obtained from Vero direct.

Shop Front

We have just been informed by Marshall's that they have sold their two shops at Bristol and Cricklewood, London. The mail order service is continuing to operate from their head office and they will, of course, still be trading from the Edgware Road, London and Glasgow retail shops.

The Cricklewood shop is to continue trading and has been acquired by ex-Marshall's shop manager Syd Wedeles. He informs us that the shop is to be known as Cricklewood Electronics and they will be stocking a broad range of components, including many new i.c.s. for CB and r.f. equipment, Japanese transistors or equivalents, a new range of l.e.d.s and a more comprehensive range of TV components.

It is hoped to have late opening on Fridays (8 p.m.) and possibly open on Sunday, subject to planning permission. Customers are invited to ring 01-452 0161 for stock details and prices as a catalogue is still being prepared.

A new component shop has just been opened in the Camberley, Surrey area and Mike Willoughby, of Airwaves Electronics, informs us that the response from local customers has been very encouraging.

Backed by many years in the trade, Mike tells us that he intends to augment the professional approach with the family business image. To this end his wife and two children will be helping in the shop.

Carrying a comprehensive stock of components ranging from resistors to microprocessors and batteries to soldering irons, Airwaves also run a special cable and wiring service to customers specifications. Also, an innovation that should appeal to readers is the formation of a special personal account service.

Once an account has been opened it is simply a case of writing or phoning an order through, giving the account number together with a personal security number, and the goods will be dispatched immediately and the account debited.

For more details of this service and component price lists send a stamped addressed envelope to Airwaves Electronics, Dept EE, 151 London Road, Camberley, Surrey, GU15 3JY.

Casio AX-210 from Tempus.

Double Time

Those traditionalists who have always decried electronic timepieces saying they preferred the analogue face, with moving hands, to a digital readout (as they found them much easier to acquate to lapsed time) can have no complaints against the new Casio AX-210 timepiece from Tempus. This latest offering gives you simultaneous analogue and digital (12 or 24 hour) readout on the liquid crystal display face.

Apart from digital date, month and year, the watch also features a full current calendar month display and facility for calling up the following month. Other options include stopwatch and countdown alarm with progress monitored on the analogue and digital face. Additionally, while time is shown on analogue, the digital display can indicate time of daily alarm, dual time or today's date.

The Casio AX-210 alarm chronograph is available from Tempus, Dept EE, 164/167 East Road, Cambridge, CB1 1DB and cost £29·95.

Catalogue

A new 38-page catalogue from OK Machine & Tool (UK) Ltd describes the products available from their Electroware division. All of the products in the range are available to everyone involved in building electronic equipment, including the amateur.

The catalogue lists soldering irons, wire-wrapping kits, i.c. tools, circuit boards, cases, enclosures, connectors, sockets and test instruments.

Electroware is distributed throughout the UK by leading electronic and computer stores, and catalogues are free but send 30p for postage and packing to Electroware, Dept EE, Dutton Lane, Eastleigh, Hants, SO5 4AA.

Relay

It was only last month that we were experiencing difficulty in locating a suitable low-profile p.c.b. type relay for the *Infra Red Remote Control* project. This month, Ambit have just released a new range of low-profile, low voltage relays.

The KW series comprises 1, 2 and 4-pole versions, with operating voltages from 6V to 110V d.c. The contacts are rated at 220V a.c. 2A for single pole version and 0·5A for the 2 and 4-pole types.

For further details and prices contact Ambit International, Dept EE, 200 North Service Road, Brentwood, Essex, CM14 4SG.

CONSTRUCTIONAL PROJECTS

Christmas Tree Lights Flasher

For safety, we strongly recommend readers to use a three-pole shuttered, chassis mounting mains outlet socket when building the *Christmas Tree Lights Flasher*. The one used in our prototype model was the RS Components reversed mains connectors, stock no 488–797 (socket) and 488–781 (plug).

Note that the mains input plug to the control unit should carry a 7A fuse.

Race Track Speedo

The 7-segment display and the photo transistor called for in the *Race Track Speedo* seem to be in short supply and could cause purchasing problems.

The FND500 display is only listed by Rapid Electronics and Watford Electronics. Practically any common-cathode display could be used provided the final wiring agrees with the circuit diagram.

The display pinouts for the FND500 run along the top and bottom edge of this device, as against the more usual sides, so make sure when purchasing that the pinning details agree with the circuit. If they do not then the wiring will, of course, have to be altered accordingly.

Reaction Meter

The "action" switches used in the *Reaction Meter* were ex-computer keys and final choice is left to personal preference. Any momentary action pushbutton switch can be used for S2 and S3, but it is advisable to try and select hard wearing ones since they could come in for a lot of abuse during reaction tests.

The specified displays appear to be only stocked by Watford and Rapid Electronics. However, as the wiring is taken directly to the display pins, almost any common cathode device could be used. Of course, the wires will have to be taken to the relevant segments as indicated in the circuit diagram.

The remaining constructional projects this month should not present readers with any buying problems. All components seem to be readily available off-the-shelf items.

CHRISTMAS TREE LIGHTS FLASHER

BY J.R.W. BARNES

CHRISTMAS is upon us once again and as thoughts turn to the seasonal festivities and decorations, what better than a design for an electronic tree lights flasher unit.

Why build a flasher at all when so many commercial units are available? You may well ask, but how many of us have had a set of tree lights for years, so why go to the expense of replacements when you can make this simple yet effective flasher unit to convert the old set. Plus the added luxury of a variable flash rate!

TRIAC SWITCH

The design is all electronic utilising a triac to switch the lights on and off thus eliminating the use of relays and their irritating clicking sound. The flash rate can be varied from three times a second to one flash every 15 seconds.

All components are mounted on a single printed circuit board and neatly housed in an all-plastic Verobox with the switched mains output connected via a panel mounting mains socket.

It is absolutely essential that a socket is used and under no circumstances can a plug be substituted here as this would mean live mains exposed on the pins of the plug.

Although the unit is basically quite simple to build, great care must be taken, particularly by the inexperienced constructor, because of the potential dangerous mains voltages present.

CIRCUIT DESCRIPTION

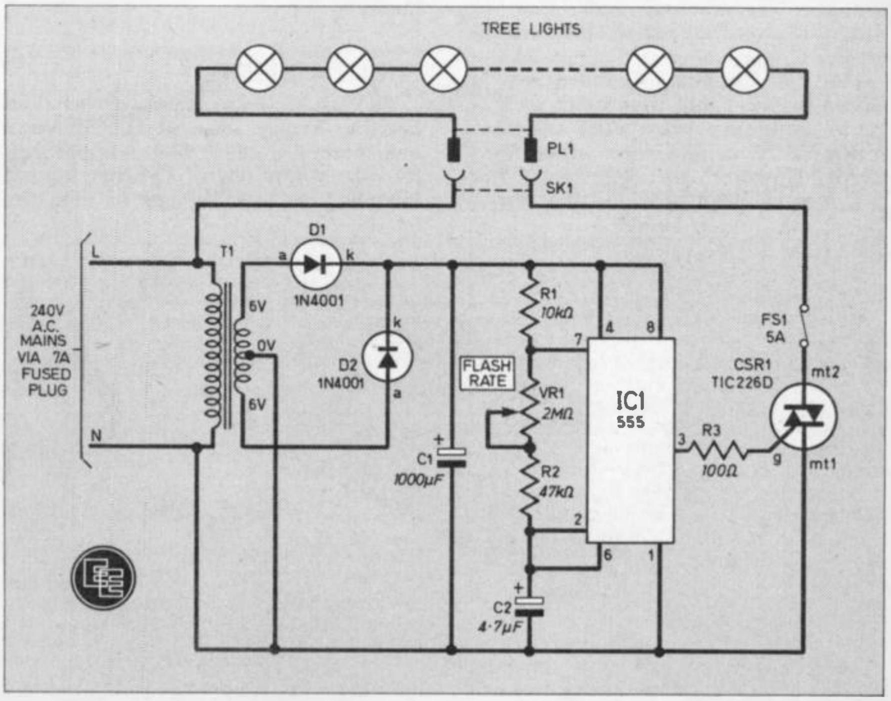
The circuit diagram of the lights flasher is shown in Fig. 1. The heart of the design is a 555 timer, IC1, in the astable (free running) multivibrator configuration, the frequency of which is determined largely by VR1 and C2. R2 is included to limit the maximum frequency of operation.

The frequency (f) of operation of the timer is given by the formula:

$$f = \frac{1{\cdot}44}{R1 + 2(R2 + VR1) \times C2}\text{Hz}$$

From this formula we can calculate the maximum flash rate by substituting the values of R1, R2, C2 and VR1 at its minimum resistance (zero ohms) into the equation and this

Fig. 1. Circuit diagram of the Christmas Tree Lights Flasher showing series connected tree lights.



comes to approximately 3Hz. For the slowest flash rate we must do the calculation with VR1 at its maximum resistance of 2MΩ and this gives approximately 0·074Hz which works out at about four flashes a minute.

The output of this oscillator is then used to trigger a triac, CSR1. The gate current is limited to about 85mA by resistor R3.

TRIAC

A triac, unlike a thyristor, can conduct in both directions when a sufficient potential is applied to its gate terminal. Therefore, in the tree lights flasher circuit, when the output of IC1 (pin 3) is high, CSR1 will conduct and the lights will be switched on as the neutral connection has now been made. The lights will remain on until pin 3 of IC1 goes low. As the triac can pass current in both directions, the bulbs will operate at full brightness as no half-wave rectification occurs. However, a suitably rated thyristor can be substituted into the circuit without further modification but the lights will be somewhat dimmer.

The triac *must* have a heatsink fitted and is protected against overload by a 5A fuse, FS1, mounted on the p.c.b.

The power for the timer circuit is supplied by transformer T1 with its rectified output producing in the order of eight to nine volts d.c., diodes D1 and D2 providing the rectification and C1 being a smoothing capacitor. No part of the circuit should be earthed.

PRINTED CIRCUIT BOARD

The use of a p.c.b. was chosen to simplify construction and also to eliminate potentially dangerous wiring errors.

The foil pattern of the p.c.b. is shown in Fig. 2 and the prototype was made using dry print etch resistant transfers on single-sided glass fibre board. However, an etch resist ink pen may be used provided that great care is taken around the tracks for the i.c. and the high voltage section (the thicker tracks).

Using Fig. 3 as a guide, the components can be soldered to the board ensuring that all polarity sensitive components are inserted the correct way round.

Transformer T1 is a subminiature type and must be securely fixed to the board using the 6BA or M3 screws and nuts and the leads must be stripped and soldered into the p.c.b.

CSR1 must be bolted to its heatsink once it has been soldered to the board.

Finally, Veropins should be inserted into the board to take the flying leads from VR1 and the mains inputs and outputs.

CASE

The prototype was housed in a Verobox type 65-2520J and this case is highly recommended being of all plastic construction and widely available. A metal or part metal case must *not* be used.

To avoid scratching the surface and to aid in marking out, it is a good idea to stick graph paper to the front and back panels with double sided sticky tape. The mounting holes are shown in Fig. 4. The rectangular hole for SK1 was made by drilling a small hole at each corner and then removing the centre with a coping saw and finally filing the edges flush.

Please note that the p.c.b. supports moulded into the base are closer together at one end of the box to prevent the board from being mounted incorrectly and it is at this end, where they are closest together, that the rectangular hole must be made.

FINAL ASSEMBLY

The p.c.b. should now be rested in position in the base of the Verobox and potentiometer VR1 mounted in its hole at one end of the case having first had its spindle cut to suit the control knob. It can now be wired to the Veropins as shown in Fig. 3.

For safety reasons the control knob is an all plastic push-fit type so as to leave no exposed metal on the outside of the case.

MAINS SOCKET

The mains socket, SK1, is a clip-in type and should have two short leads soldered to the "L" and "N" terminals before being pushed into position and once fitted these wires can be soldered to their respective positions.

The mains lead must first be passed through its grommeted hole and then firmly clamped to the p.c.b. with the "P"-Clip and the live and neutral wires (brown and blue respectively) wired to their corresponding Veropins.

Cut back the mains earth lead unless you are likely to be using metal mains bulb holders, in which case this lead should be connected to the earth terminal on SK1 to allow the holders to be earthed.

The p.c.b. can now be screwed down using four short No. 4 self tapping screws and FS1 can be clipped into position.

TESTING

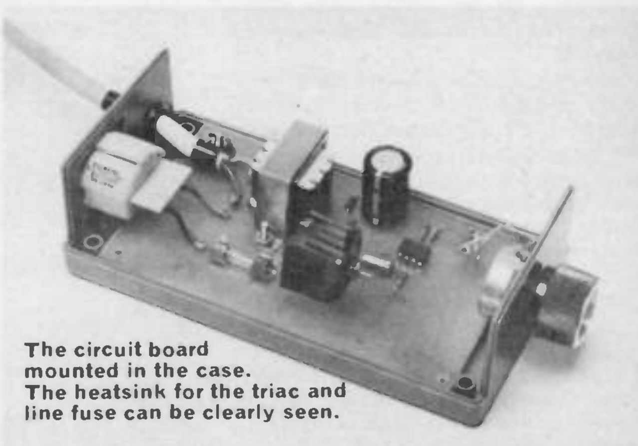
Plug PL1, the mating half of SK1, should be wired to a mains rated bulb and holder (or the tree lights themselves) and inserted into SK1.

Then with a suitably fused (7A) mains plug fitted to the mains lead, plug the unit in. This should be done with the cover in position but if the circuit is exposed whilst the unit is live **do not touch any part of the circuit.**

The lights should begin to flash immediately and rotation of VR1 will vary the flash rate between the aforementioned limits of three per second to four a minute. Should the constructor wish to expand these limits, increasing the value of C2 will slow down the rate and decreasing its value will produce a faster flash rate.

Have a good Christmas! ⌑

The finished unit showing the "shuttered" mains safety socket and lights plug.


The circuit board mounted in the case. The heatsink for the triac and line fuse can be clearly seen.

COMPONENTS

See Shop Talk page 804

Resistors
- R1 10kΩ
- R2 47kΩ
- R3 100Ω
- All ¼W carbon ±5%

Capacitors
- C1 1000μF 16V elect. radial
- C2 4·7μF 25V elect. axial

Semiconductors
- D1, 2 1N4001
- IC1 555 timer i.c. (8-pin d.i.l.)
- CSR1 TIC226D 400V 8A triac (TO-66 case)

Miscellaneous
- VR1 2MΩ carbon lin. law potentiometer
- T1 Mains transformer, 6V-0-6V 100mA secondary
- FS1 5A, 20mm
- SK1/PL1 6A mains chassis socket and in-line plug

Printed circuit board size 72 × 125mm; plastic case size 150 × 80 × 50mm (Verobox 65—2520J); control knob (plastic push-on type); heatsink (for TO-66 plastic package); "P" clip cable clamp; sleeved grommet; 1·5m 6A mains lead; 3-pin mains plug (7A fused); p.v.c. sleeved interconnecting wire; p.c.b. mounting fuse clips (for 20mm fuse—2 off); No. 4 self tapping screws (4 off); Veropins; 6BA or M3 screws and nuts.

Approx. cost Guidance only £9

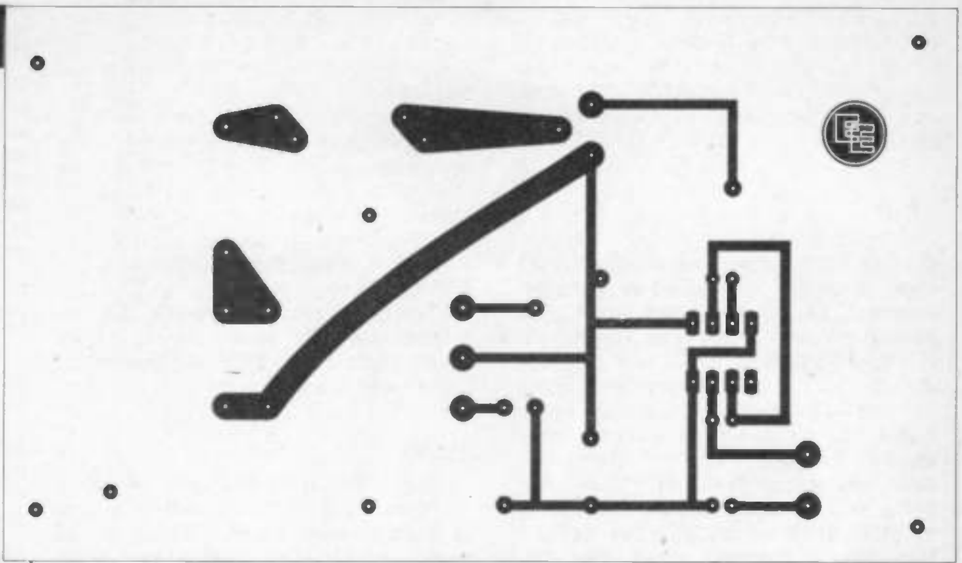


Fig. 2. Full size master of the printed circuit board.

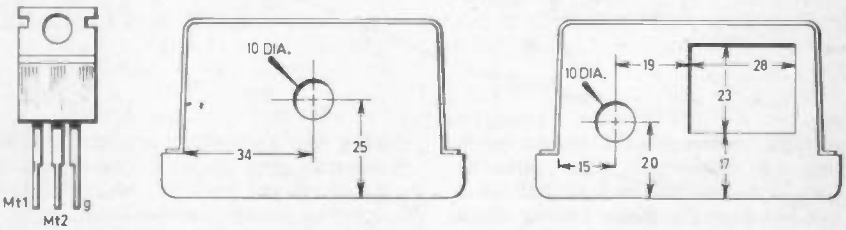


Fig. 4. Drilling and cut-out details of the case and the pin configuration of the triac CSR1.

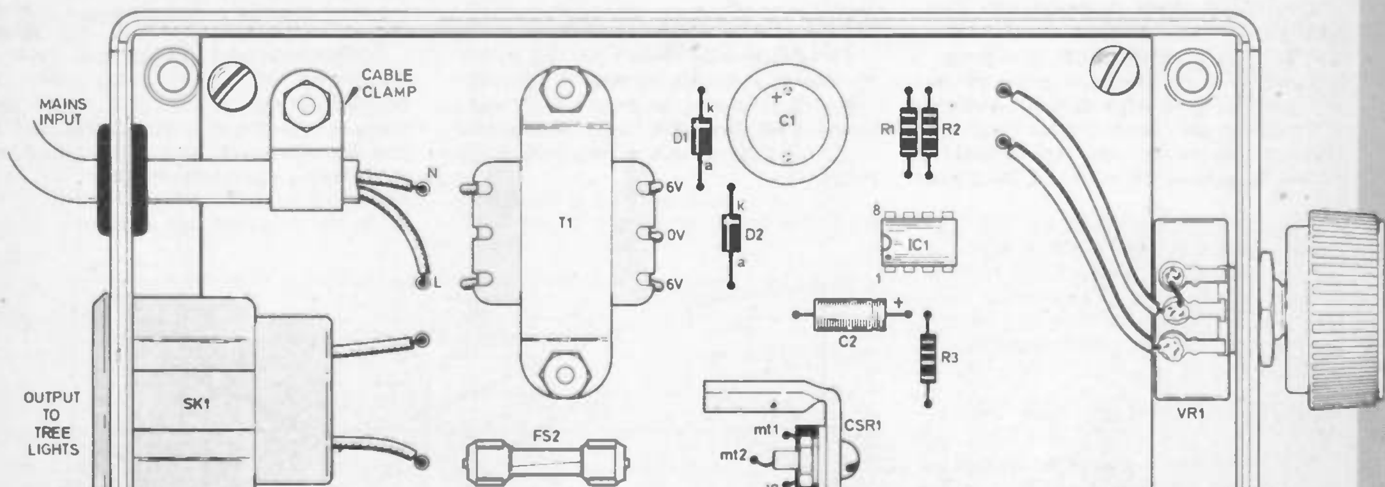


Fig. 3. Component layout of the p.c.b. shown mounted in the case with all interwiring shown.

BY R. A. PENFOLD

FOR the electric guitar player who has a hi fi system it would seem to be logical to use the hi fi system as a guitar practice amplifier rather than buying a guitar amplifier. However, there is the problem of matching the guitar to the hi fi amplifier since the latter is unlikely to have a guitar input.

One way is to feed the output of the guitar to the "Tuner", "Tape", or "Aux" input via a preamplifier. The additional amplification of the preamplifier is needed because the output signal of a guitar is only about one-tenth of that from a tuner or tape deck, and inputs intended for use with this type of equipment are therefore far too insensitive to give good results.

The obvious drawback of this system is that the preamplifier needs a power source of some kind, which means either buying expensive batteries or incurring the cost and inconvenience of a mains power supply.

MAGNETIC CARTRIDGE INPUT

The input for a magnetic cartridge has an input sensitivity which is more than adequate for use with an electric guitar, but it is also equalised.

This equalisation substantially boosts the bass response and attenuates the treble response of the amplifier, and is needed to counteract the treble boost and bass cut applied to signals during the recording process (which is done to give an improved signal to noise ratio and to avoid excessive low frequency groove modulations).

Fig. 1 shows the equalisation used during recording and playback. Connecting a guitar to a magnetic cartridge input would obviously give disappointing treble output and excessive bass.

DE-EQUALISING FILTER

By adding a filter having the RIAA recording response ahead of the amplifier it is of course possible to compensate for the bass boost and treble cut, and thus obtain a flat frequency response.

The input sensitivity of a magnetic cartridge input is usually about 3mV for maximum output at 1kHz, but the sensitivity is only about one-tenth of this at the highest audio frequencies, so about 30mV is needed for full output at these frequencies. In effect, the input filter reduces the sensitivity of the amplifier to this level at all frequencies, and in practice there will be small losses through the filter even at high audio frequencies. This gives an input sensitivity of typically about 40 to 50mV r.m.s. for maximum output, and this is adequate to give good results with the majority of guitar pick-ups.

CIRCUIT DESCRIPTION

The circuit diagram of a filter for use in this application is shown in Fig. 2.

The reduction in sensitivity from 20kHz down to 1kHz of about 20dB is provided by R1 and C1, plus the impedance across the output of the filter which is governed mainly by R3 (although the input impedance of the amplifier shunts R3 slightly).

At these frequencies C2 has a very low impedance and effectively short circuits R2. Thus we have a potential divider with one element comprised of the combined impedance of C1 and R1, and the other formed by R3 and the input impedance of the amplifier.

The finished prototype Adaptor.

At frequencies of 20kHz and above, the impedance of C1 is very low in comparison to that of R3, and only small losses are produced through C1 and R1. At lower frequencies the impedance of C1 rises steadily so that increased losses and the required roll-off in the response are obtained.

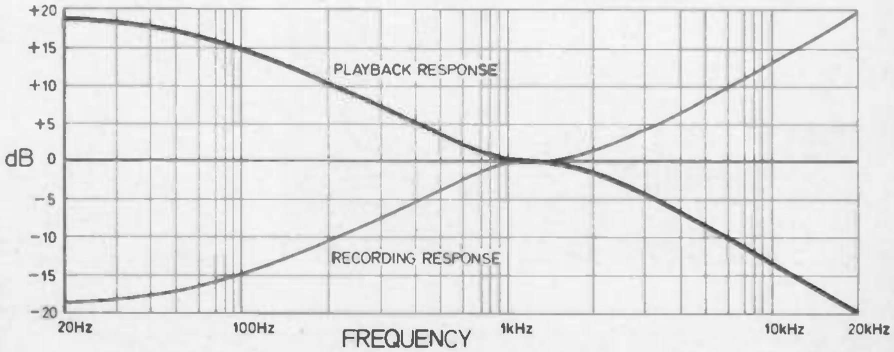


Fig. 1. Playback and recording responses for a hi fi magnetic cartridge input (RIAA).

The roll-off diminishes considerably at frequencies of around 1 or 2kHz since the impedance of R1 is less than that of C1 at these frequencies, and R1 limits the amount of attenuation produced and flattens the response.

At frequencies below about 1kHz the impedance of C2 adds significantly to the impedance of C1 and R1 so that the roll-off is re-introduced. This continues down to frequencies of a few tens of hertz where the impedance of R2 becomes low in comparison to that of C2, and the required flattening out of the response is obtained.

It must be admitted that this method of adapting a hi fi amplifier for use with a guitar is not without faults. The response of the filter will vary somewhat according to the input impedance of the particular amplifier with which the unit is used, and it will not give an absolutely flat overall frequency response anyway.

The input impedance of the filter also reduces considerably with increases in input frequency. However, despite these limitations this system seems to give perfectly acceptable results in use, which is what really counts! It also has the advantage of needing no battery or other power source as it is purely passive.

ASSEMBLY DETAILS

The filter is housed in a diecast box measuring about 100×50×25mm externally. The input jack is mounted at one end of the case, and the output sockets are fitted on top of the case towards the opposite end. C1, C2, R1 and R2 are mounted on a small 0·1in matrix stripboard which measures 8 holes by 15 strips. Once completed and wired into circuit the component panel is mounted in the central portion of the case. R3 is wired across the output sockets, and this is shown in the wiring diagram of Fig. 3.

The earth connection between the two output sockets and the input socket is carried via the case. Phono sockets are used at the output of the prototype as these match the input sockets on the amplifier with which the unit is employed. Other types of socket can of course be used, and chosen for convenience and to suit the system.

The finished unit is connected to the magnetic cartridge input of the amplifier by way of a twin screened lead fitted with the appropriate plugs, and the guitar lead is plugged into SK1. Both channels of the amplifier (which will presumably be a stereo type) are driven in parallel, as is standard practice when driving a stereo amplifier from a mono source. ☐

COMPONENTS

Resistors
R1 180kΩ
R2 1MΩ
R3 13kΩ
All ¼W carbon ± 5%

Capacitors
C1 1nF polystyrene
C2 3·3nF polystyrene

Sockets
SK1 standard (¼ inch) open jack
SK2 twin-phono (see text)

Miscellaneous
Stripboard, 0·1in matrix size 15 strips × 8 holes; aluminium diecast box size 100 × 50 × 25mm approx., 6BA or M3 nuts, bolts and 5mm long spacers; wire and solder.

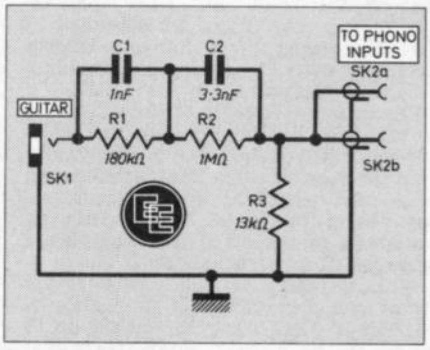


Fig. 2. Circuit diagram of the Guitar Adaptor.

COMPONENTS approximate cost £2·50

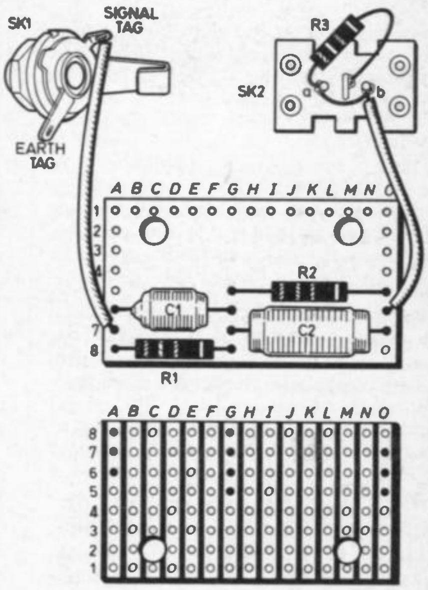
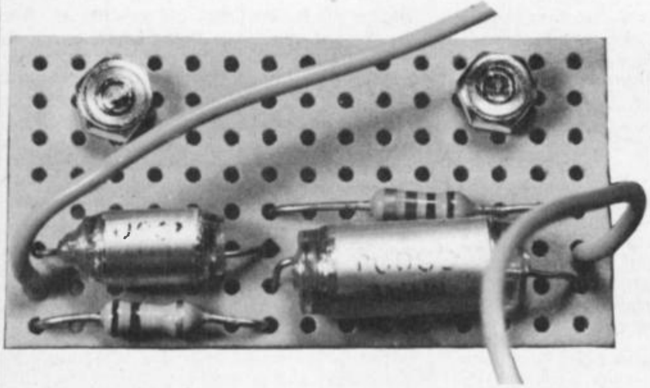
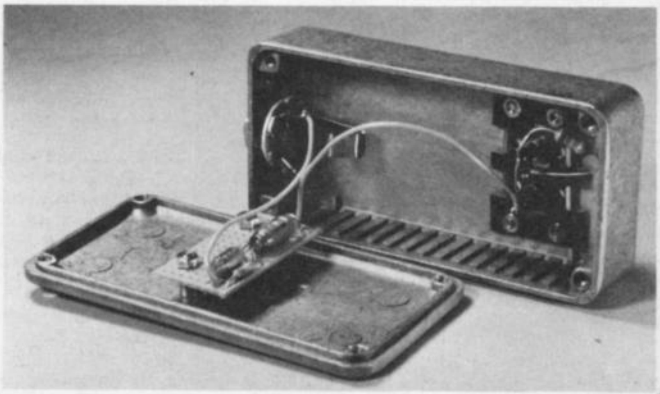


Fig. 3. Layout of the components on the stripboard and wiring up to input and output sockets. In and out earth link is made through the metal box.



Close up view of the completed prototype circuit board.



For your ENTERTAINMENT

By BARRY FOX

Inside Story

One of the few science correspondents in Fleet Street to have his ear really close to the ground, indeed the *first* real science correspondent with a news sense, is Chapman Pincher. Although it's now become fashionable to "put down" Chapman Pincher's more sensational revelations as innaccurate those in Fleet Street who know his work are always more inclined to believe Pincher, than those who deny what he says!

Publicity for Chapman Pincher's most recent book has made it easy to forget that his previous biography *Inside Story* was first published in 1978 and is now available in paperback (Sidgwick and Jackson £1·25). There are some fascinating electronic titbits to be found in its four hundred pages. For instance there's a fuller version of the story (previously touched on in this column) on how the Russians managed to bug the supposedly bug-proof American Embassy in Moscow, and in the process succeeded in dosing the Embassy staff with a dangerous level of microwave radiation.

The book reveals that a plaque was presented to the Embassy by the Kremlin. Years later it was discovered that the plaque had been hollowed out to contain a small metal drum with a needle. The drum acted as the diaphragm of a microphone, and vibrated in sympathy with any speech soundwaves in the room.

The Russians beamed microwaves into the building from across the street and picked up radar reflections off the drum. These were modulated with the speech, so demodulation provided a direct eavesdrop of everything said in the room. There was subsequently a flap that 10 Downing Street might have been bugged in a similar fashion.

Laser Bugs

Pincher also confirms what many people have long suspected, namely that laser window bugging is widespread. When people speak in a room the windows vibrate in sympathy with the speech soundwaves.

If a laser beam, from anything up to miles away, is beamed onto the window the reflection of that beam will be modulated with the speech soundwave form. Again de-modulation provides an invisible eavesdrop.

The answer, of course, is to pull the curtains or put a portable radio alongside any vulnerable window. The book also explains how metal tags, of the type now used to trap shop lifters, are now used to alert the security forces if anyone takes a secret file out of a government building without authorization.

Particularly interesting is the full story, probably for the first time, of the cable-vetting scandal of 1967. To cut a long story short the news leaked to Fleet Street that all cables and telegrams, however personal, were being monitored by the security authorities in the hope of establishing a "pattern" of spy-style messages.

When this story was published there was uproar and a committee under the chairmanship of Lord Radcliffe was set up to set the matter straight. Pincher feels that the authorities tried to make him a scapegoat and that the Post Office had "submitted an untruthful memorandum" to cover up unpalatable facts.

Science and Politics

Anyone with an interest in how science can play a part in politics or become a political pawn, should read *Inside Story*. It has much in common with the previously mentioned *Most Secret War* in which Professor R. V. Jones tells how science often conflicts with political expediency in time of war or international crisis.

Significantly Chapman Pincher's book deplores the fact that "the outstanding talents of some scientists like Professor R. V. Jones, so valuable in helping to win the war against Germany, were largely wasted after it because of Civil Service jealousy".

In Confidence

The book also gives an interesting insight into how the press handles difficult stories. Journalists must always remember that the most attractive and sensational story may have been leaked and slanted by someone with an axe to grind. Official pressure not to publish a story, supposedly "in the national interest", may well be motivated by nothing more than the self-seeking interest of an anonymous person trying to save his own skin.

I particularly liked Pincher's reference to my own particular bug bear, the "confidence" trick. It works like this. A journalist, by dint of hard research and leg work, unearths a good story. And by definition a good story will almost inevitably embarrass someone.

Suddenly the party likely to be embarrassed wants to talk. After telling the journalist everything he already knew the informant blurts out "Of course I am telling you this in absolute confidence".

The journalist is then in a cleft stick; either print the story and appear to have breached confidence or suppress it and see someone else print it. It's why most hardened journalists will only accept information in confidence, if a clear agreement to do so is reached in advance.

Incidentally, exactly the same situation occurs in industry. Most firms won't talk to inventors in confidence. They are afraid that the inventor will tell them about an idea that is already on the company drawing board.

Any reader who has been rebuffed by a journalist or manufacturing firm after offering them information in confidence should bear these very reasonable reasons in mind and not feel personally offended.

Times are changing

Every year now sees a new crop of calculators that tell the time and wake you up. We've had clocks and watches that play musical tunes and electronic note pads that keep a running tally on the owner's bank balance. Now we are seeing calculators that can memorise musical tunes and others that challenge their owner to a game.

The next batch of electronics wizardry planned will be speech-receptive. Already there are prototype calculators and video recorders in Japan that operate under spoken words of control. So within a few years we shall quite literally be asking the time from a speaking clock.

Almost everything these days seems to have a built in digital clock whether it's needed or not. Telephones, televisions, radios, hi fi systems, you name it, it tells the time.

So our homes are becoming full of digital clocks of one type or another. And what happens? Every year when Summertime comes in, or goes out, it becomes an ever-more infuriating business to re-set all the clocks. I for one yearn for the good old days when changing to or from Summertime simply meant moving the hands of an old-fashioned wristwatch.

The really astonishing thing is that the Japanese designers, while searching each year for new and often pointless gimmickry to incorporate in their electronics, have so far overlooked the obvious selling feature for a digital clock; an "hour advance-hour retard" button. This would enable Summertime re-setting without the need to clear all the clock memories and re-set the time from scratch.

Who will be the first calculator or clock manufacturer to offer a Summertime setting switch?

SCHOOLS
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COMPETITION

over £1,000 IN PRIZES

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The competition will be conducted in two stages.

STAGE 1
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Papers will be judged for novelty, ingenuity and viability. Particular attention will be given to originality and good circuit design technique.
Schools whose designs are adjudged to be the most promising will be asked to produce a working model of their designs.

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FIRST PRIZE	**£150**	**plus a selection of components valued at £100**
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Science teachers of Secondary Schools are invited to apply for a Registration Form which contains full details of this competition.

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Secondary School Pupils—make sure your school accepts this challenge and enters this inaugural contest. So bring this announcement to the attention of your science teacher or the head of your school.

Closing date for Registration: December 31 1981

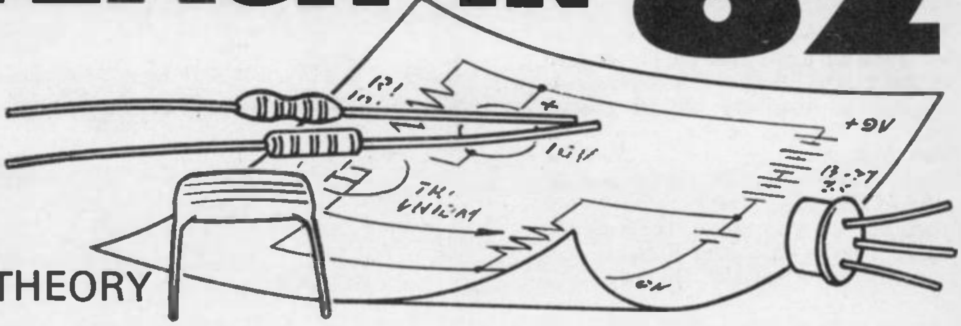
Closing date for submission of Papers: February 16 1982

SCHOOLS ELECTRONIC DESIGN AWARD COMPETITION (SEDAC) SPONSORED BY MULLARD LTD AND EVERYDAY ELECTRONICS

EE TEACH-IN 82

PART 3

BY O.N. BISHOP



BASIC ELECTRONIC THEORY WITH EXPERIMENTS

SEMICONDUCTOR JUNCTIONS

LAST month we saw that the conductivity of a material such as silicon can be increased by doping it with a small quantity of a certain other element such as phosphorus or boron.

The electrons of the atoms of phosphorus are not all needed to take part in the structure of the doped crystal. Each atom has an extra electron which is free to leave the atom and wander in the crystal as a carrier of negative charge. This gives *n*-type silicon.

We saw how the atoms of boron have one fewer outer electron than the atoms of silicon, so that there is a vacancy or hole. This hole attracts an electron from a neighbouring silicon atom, causing a hole to be created there. Holes act as if they are mobile carriers of positive charge in *p*-type silicon.

THE PN-JUNCTION

Fig. 3.1 shows a close-up view of a silicon crystal which has been partly doped with phosphorous atoms and partly doped with boron. The proportion of doping atoms shown in the diagram is much higher than would really be the case.

The boundary between the *n*-type region and the *p*-type region is called the **pn-junction**. On one side of the junction are atoms of phosphorous with an extra or "spare" electron; on the other side are boron atoms with holes. The electrons cross the junction, attracted by the positive charge of the holes, and fill them.

It is important to realize that the extra electron of a phosphorous atom is part of its normal complement of electrons. The positive charge on its nucleus is exactly balanced by the negative charge of its electrons—including the extra one—and the atom has zero overall charge. When the spare electron is taken away, the atom is left with a positive charge on its nucleus which is no longer completely balanced. The atom becomes a positively charged ion. Similarly, the atoms of boron gain a negative charge and become negatively charged ions (Fig. 3.2).

On either side of the *pn*-junction there is a region of ions. There are no electrons and no holes in this region. It is depleted of of charge carriers. We call it the **depletion region.**

Since there are no charge carriers, no current can flow across this region—it acts as an insulator. The charged ions do not flow because they are firmly fixed in their positions in the crystal.

Once the depletion region has formed, further flow of electrons and holes across the junction is prevented. Fig. 3.3 shows the situation on a smaller scale so that we can see the overall effect more clearly.

There is a potential difference across the junction, due to the two zones of ions on either side of it. In silicon the p.d. is about

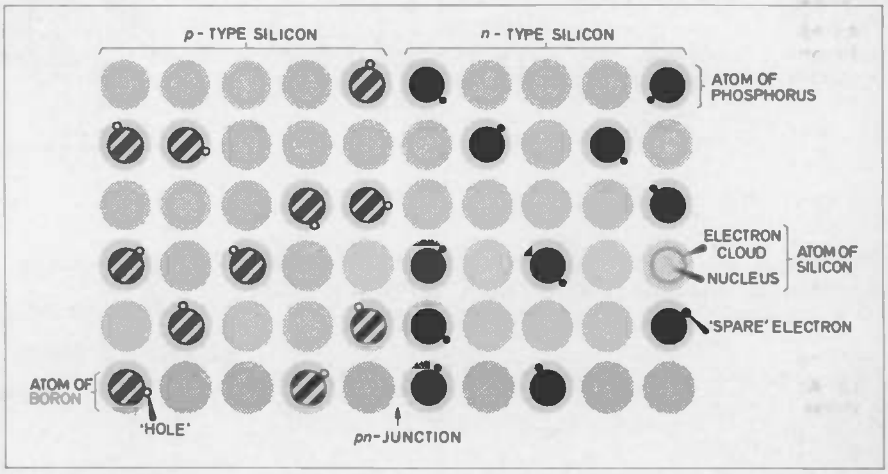


Fig. 3.1. Part of a crystal of silicon doped as *p*-type on the left and as *n*-type on the right (very diagramatic).

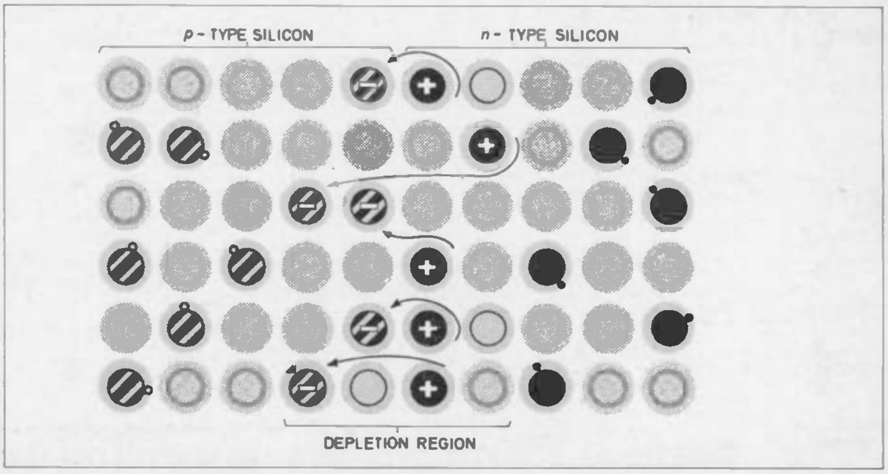


Fig. 3.2. A depletion region forms at a *pn*-junction.

0·6V. It has the same effect as a 0·6V cell connected across the junction. We sometimes refer to this as the **imaginary cell.**

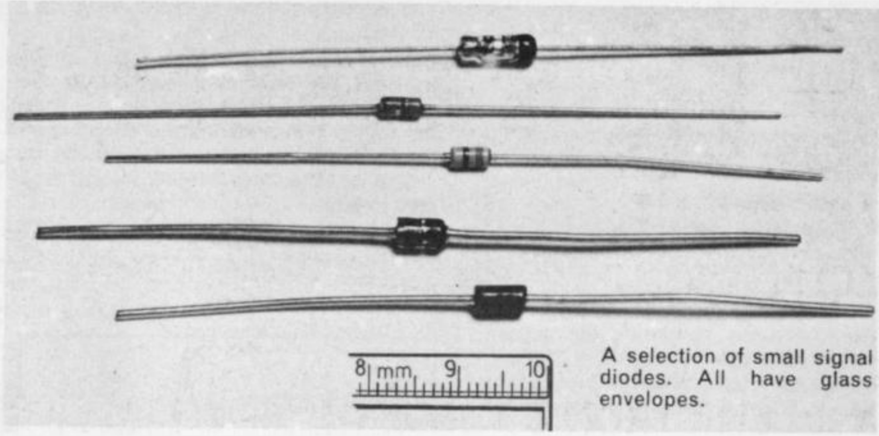
BIASING THE JUNCTION

Fig. 3.4 shows what happens if we connect a real cell to the silicon. It is connected so that its p.d. is in the same direction as that of the imaginary cell. It attracts electrons from the *n*-type and removes holes from the *p*-type (electrons from the negative wire enter the *p*-type and fill some of the holes). There are now fewer charge carriers than before. The depletion region is wider than before. No current flows across the junction. The junction is said to be **reversed biased.**

If an external cell is connected as in Fig. 3.5, its p.d. opposes that of the imaginary cell. Indeed, if a 1·5 volt dry cell is used, it will more than counteract the effect of the imaginary cell. Now the depletion region becomes very narrow. The field due to the external cell is strong enough to carry electrons and holes across the region freely. Current flows across the junction. The junction is now said to be **forward biased.**

ONE-WAY CONDUCTION

The *pn*-junction has the interesting and useful property of allowing current to pass in one direction, but not in the other.



A selection of small signal diodes. All have glass envelopes.

This property is put to use in the semiconductor component known as the **diode,** see Fig. 3.6. It is named after the two-electrode valve, which has the same one-way properties and was widely used in the days before semiconductors.

The terminal wires of the semiconductor diode are named after the electrodes of the diode valve. In Fig. 3.6 the arrow of the symbol points in the direction in which the flow of current is allowed. This refers to **conventional current,** which is *assumed* for

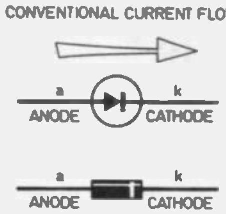


Fig. 3.6. The symbol used for a diode in circuit diagrams and the way diodes are marked (in EE projects) to show their polarity.

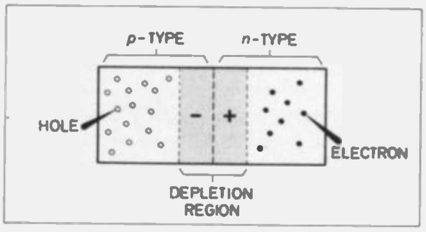


Fig. 3.3. As Fig. 3.2 but to reduced scale. The atoms are not shown.

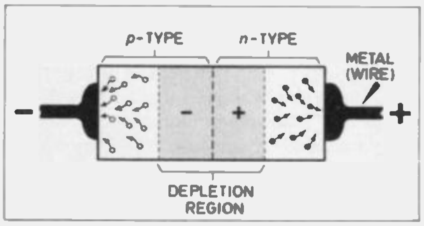


Fig. 3.4. A *pn*-junction with a potential applied from outside. This is reverse bias.

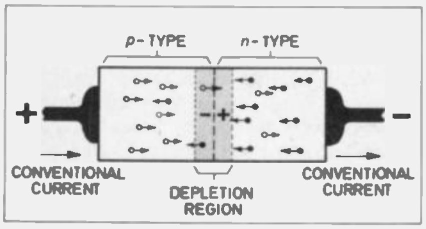


Fig. 3.5. A *pn*-junction with forward bias.

EXPERIMENT 3.1

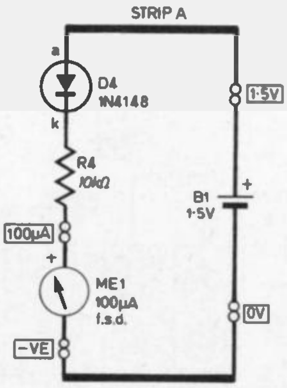


Fig. 3.7. The circuit diagram for measuring the current flowing through a forward biased diode.

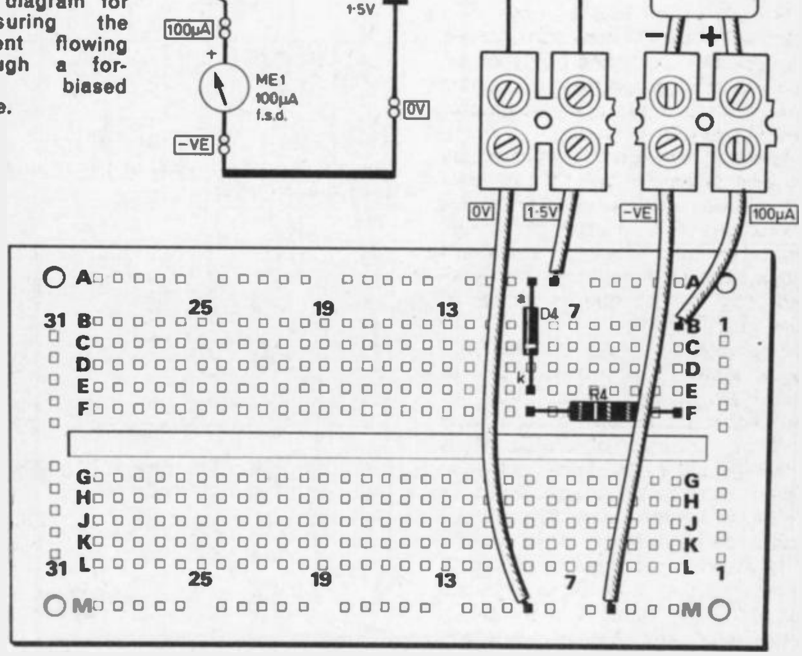


Fig. 3.8. The layout on the breadboard for the circuit in Fig. 3.7.

convenience to flow from positive to negative (Fig. 3.5), even though we know that it consists of a flow of electrons in the opposite direction.

EXPERIMENT 3.1
Measuring the current flowing through a diode

The circuit for measuring the current flow through a diode is shown in Fig. 3.7. The suggested layout on the breadboard is seen in Fig. 3.8. Resistor R4 is needed to limit the current to a safe value.

Measure the current and keep a note of its value, for later. This is the current through the diode when it is forward-biased (as in Fig. 3.5). Now turn the diode around, so that its banded end (k) goes to hole *A9* on the breadboard. This makes it reverse-biased, as in Fig. 3.4. Can you detect current now? Increase the voltage to 3V, 6V, 9V and 12V. Measure the current (if any) each time.

We can use Ohm's Law to find the voltage of the imaginary cell in D4. When the diode is forward biased the current is about 80μA. Is this the value you obtained?

If the current through R4 is 80μA, and its resistance is 10kΩ, the p.d. across its end is $V = IR = 80 \times 10^{-6} \times 10 \times 10^{3} = 0{\cdot}8$V. If the drop in voltage across the resistor is 0·8V and the total voltage from the cell is 1·5V, the voltage drop across the diode must be (1·5 − 0·8) = 0·7V.

This is called the **forward voltage drop** and is largely due to the imaginary cell. This result is close to the value 0·6V already quoted. Try working out your result too.

EXPERIMENT 3.2
Measuring the forward voltage drop at a pn-junction

In this experiment the meter is used as a *voltmeter* to measure forward voltage drop directly, Figs. 3.9 and 3.10.

Connect the battery and take the meter reading. Increase the applied voltage from 1·5V to 3V and then to 6V. Does this have any marked effect on the forward voltage drop? It should not, for the voltage drop is due to the imaginary cell at the junction, and is solely a property of the junction.

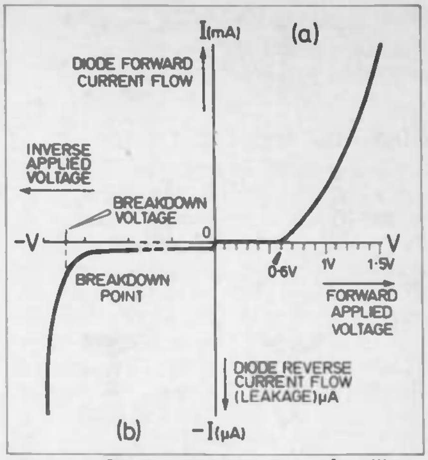


Fig. 3.11. Characteristic curves of a silicon diode (a) forward biased quadrant (b) reverse biased quadrant. Note the different scale of the horizontal and vertical axis in this quadrant.

DIODE CHARACTERISTICS

If we measure the current through a forward-biased diode at various applied voltages, we obtain a curve like that shown in Fig. 3.11a. For voltages below 0·6V there is no current, because the depletion region acts as an insulator. Above 0·6V there is a steady increase of current. The current is several *milliamps*, even with a p.d. of only a few volts.

A reverse-biased diode passes virtually no current, even when the reverse p.d. is several tens of volts, see Fig. 3.11b. The small leakage current (a few *microamps*) is due to the relatively few electrons being set free from silicon atoms by warm conditions.

When the reverse p.d. reaches a certain value (anything up to 1000V or more, depending on how the diode is constructed) there is a breakdown in the usual mechanism and conduction begins. Unless special precautions are taken, a large current may flow and destroy the diode. There is more about this later in the series.

Since the reverse leakage current depends on electrons set free from the silicon, the amount of such conduction depends on temperature. The higher the temperature, the more free electrons and the greater the leakage current. For this reason a reverse-biased diode is often used as the sensor in circuits for measuring temperature. Germanium diodes are used because they have greater leakage current.

A similar effect was used last month in the light triggered circuit. The sensor was a reverse-biased photodiode. When light falls on this, the light energy sets free electrons which increase the reverse leakage current through the diode. The increased current causes the circuit to change state.

A **light-emitting diode** is made from a special type of semiconducting material, often from gallium arsenide or gallium phosphide. When it is forward biased, electrons combine with holes at the junction and the excess energy is liberated as visible light.

Last month it was stated that an *n*-channel MOSFET cannot conduct when there is no charge on its gate. This is because of

EXPERIMENT 3.2

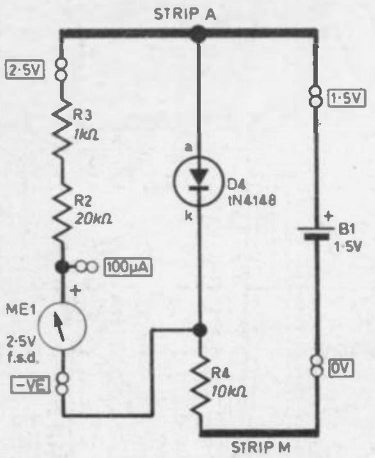


Fig. 3.9. Circuit diagram for measuring the forward voltage drop at a *pn*-junction.

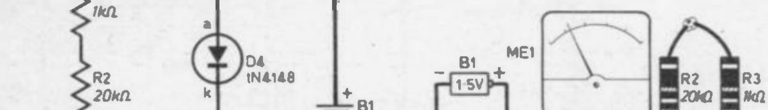


Fig. 3.10. The layout of Fig. 3.9 on the breadboard.

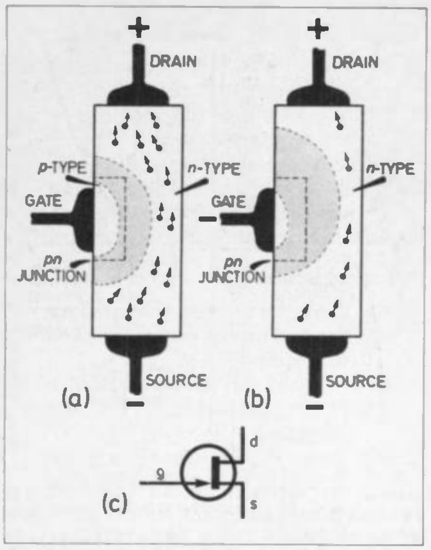


Fig. 3.12. Schematic diagram of an *n*-channel junction field effect transistor (f.e.t.) (a) gate at 0V (b) gate at −ve potential (c) circuit symbol.

the *pn*-junctions between the *p*-type material and the *n*-type regions at both ends of the transistor. Whichever way round the transistor is connected, one of these junctions becomes reverse-biased and no current can flow.

However, when the gate has a positive charge, a continuous band of *n*-type material is created to join the two *n*-type doped regions together and current can flow.

ANOTHER KIND OF F.E.T.

The *pn*-junction is used in the junction f.e.t. (j.f.e.t. for short). The transistor consists mainly of *n*-type material, see Fig. 3.12, but its gate is a small region of *p*-type material. The depletion region at the *pn*-junction acts as an insulator, as described above. It functions in the same way as the silicon dioxide layer in a MOSFET.

In use, the gate is made negative of both source and drain so the *pn*-junction is always reverse-biased. No appreciable current flows into or out of the gate which therefore has high impedance, just like the gate of the MOSFET.

If the gate is left unconnected, the depletion region is relatively small and does little to interfere with the flow of electrons from source to drain, Fig. 3.12a. However, when the gate is made negative with respect to the source, the width of the depletion region increases (compare Fig. 3.4 and Fig. 3.12b). Conduction through the transistor is restricted.

The lower the gate potential, the wider the depletion region, and the smaller the current. If the gate is made about 3V negative of the source, the depletion region extends across the transistor and cuts off the current altogether.

Thus the j.f.e.t. can be used as a switch or as an amplifier in a similar way to the MOSFET. One point of difference is that the *n*-channel MOSFET works with its gate *positive* with respect to its source, which is generally a more convenient feature; j.f.e.t.s can also be made from *p*-type material with an *n*-type gate, but these *p*-channel j.f.e.t.s are less commonly used.

PLEASE TAKE NOTE

VN10KM

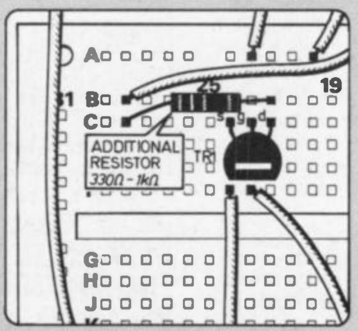


FIG. 2.7 PAGE 745

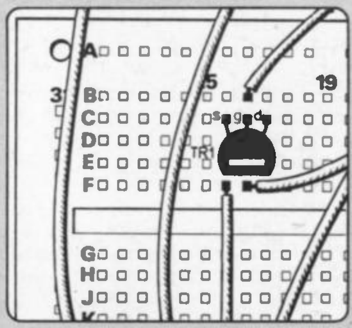


FIG. 2.9 PAGE 746

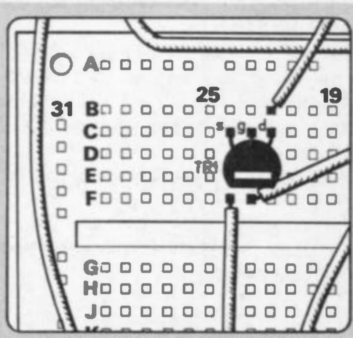


FIG. 2.11 PAGE 746

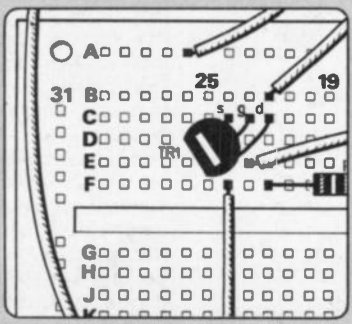


FIG. 2.13 PAGE 747

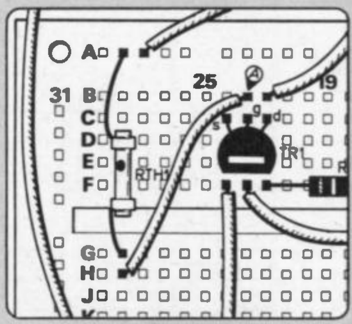


FIG. 2.15 PAGE 748

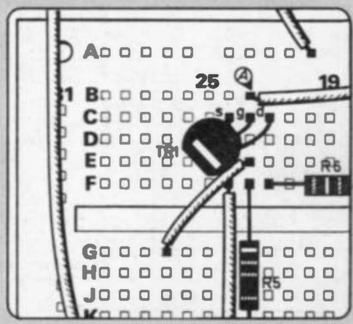


FIG. 2.17 PAGE 748

ERRATA

In Experiment 2·5, diode D2 has been drawn inverted in the Verobloc layout, Fig. 2.17. The circuit diagram Fig. 2.16 is correct.

In all Experiments in Part 2, the VMOS transistor has been drawn with its flat face on the wrong side. If this is placed in the Verobloc layouts as shown, the Experiments will fail to work. Of particular importance is Expt. 2.1, Fig. 2.7. If wired as shown the l.e.d. will be destroyed. Modifications for the appropriate section of each Verobloc layout for Part 2 Experiments appears above. All circuit diagrams are correct.

The pinning details for the VN10KM are also shown and this should be used to correct that appearing in TEACH-IN 82 COMPONENTS IDENTIFIED on page 663.

Closer inspection of the circuit for Expt. 2.1 shows that even with TR1 connected the right way round the current passing through the l.e.d. could, in certain circumstances still exceed the maximum permissible, although this has not been experienced by the author when conducting this experiment on several occasions. Therefore, with this potential danger in mind, we advise that a resistor (330 ohms to 1 kilohm) be connected in series with the l.e.d. to limit current flow to a safe level. The modified layout above has this resistor (R4) connected. It is available from your List 2 kit.

In Fig. 1.3, labels *X* and *Y* should be transposed to agree with Fig. 1.2.

On p660, column 2, line 15, delete "ten".

On p661, column 3, line 18, "1000" should be changed to read "100".

On p662, column 3, first equation should read:

$$\frac{V_{IN}}{R4 + R5} = \frac{V_{OUT}}{R5}$$

On p747, column 2, the equation should read:

$$gm = \frac{\text{change in output current}}{\text{change in input voltage}}$$

The wiring between the potentiometers and terminal block in Experiments in Parts 1 and 2 does not agree with the same wiring in the *Minilab*, although this in no way affects results. However, to provide agreement and intended operation (clockwise rotation of pot. shaft moves wiper from Yellow to Blue) potentiometer extreme connections need to be transposed in Verobloc layout diagrams.

EXPERIMENT 3.3.

Making a very simple high impedance voltmeter

The circuit diagram for this experiment is shown in Fig. 3.13. It contains three separate sections (i) Minilab voltmeter (left) (ii) VMOS buffer transistor (centre) and (iii) the voltage producing circuit—a potential divider composed of R5 to R8.

The total resistance between point *A* and the 0V line is 1420kΩ and the total for the whole chain is 1890kΩ. We can calculate that the voltage at point *A* is 12 × (1420/1890) = 9V. This is the voltage we are trying to measure.

First let us see what result we get when we use the *Minilab* voltmeter directly. To do this place wire end *X* into breadboard location *B24* (Fig. 3.14). The result is enough to make one wonder if the meter is in working order. It reads only about 2V, which is 7V below what it should be! An error of 78 per cent!

This is not really so surprising. The voltmeter requires 100μA to give full-scale deflection, corresponding to a 10V reading. To read 9V it would need 90μA. Yet the current flowing down the chain of resistors is only 12V/1890000Ω = 6μA.

Look at it in another way. The resistance of meter and its series resistor is about 100kΩ. In trying to measure the voltage at *A* we have in effect placed a 100kΩ resistor in parallel with the 1420kΩ of R6 to R8. Their combined resistance is only 93·42kΩ (for calculations, see Part 1).

QUESTION TIME

3.1. Which side of the *pn*-junction is at positive potential?
3.2. Which wire of a diode goes to the *n*-type material?
3.3. Which kind of charge carrier flows in the same direction as conventional current?
3.4. How much is the forward voltage drop of a silicon diode?
3.5. Does the forward voltage drop depend on the voltage applied to the diode?
3.6. In what way is the gate of a j.f.e.t. insulated from the channel?
3.7. Does conventional current flow into or out of the banded end of all common types of diode?
3.8. What is the advantage of using an f.e.t. at the input of a voltage measuring circuit?
3.9. What would be the voltage between R7 and R8 in Fig. 3.13?
3.10. What reading would be obtained at R7 and R8 junction in Fig. 3.13, using a 10V f.s.d. meter, resistance 100kΩ?

Answers in Part 4

EXPERIMENT 3.3

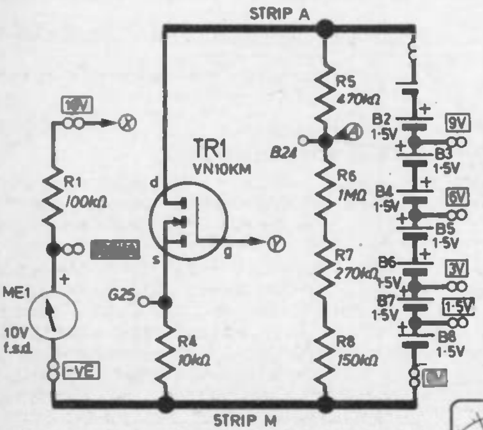


Fig. 3.13. Circuit for making a high impedance voltmeter.

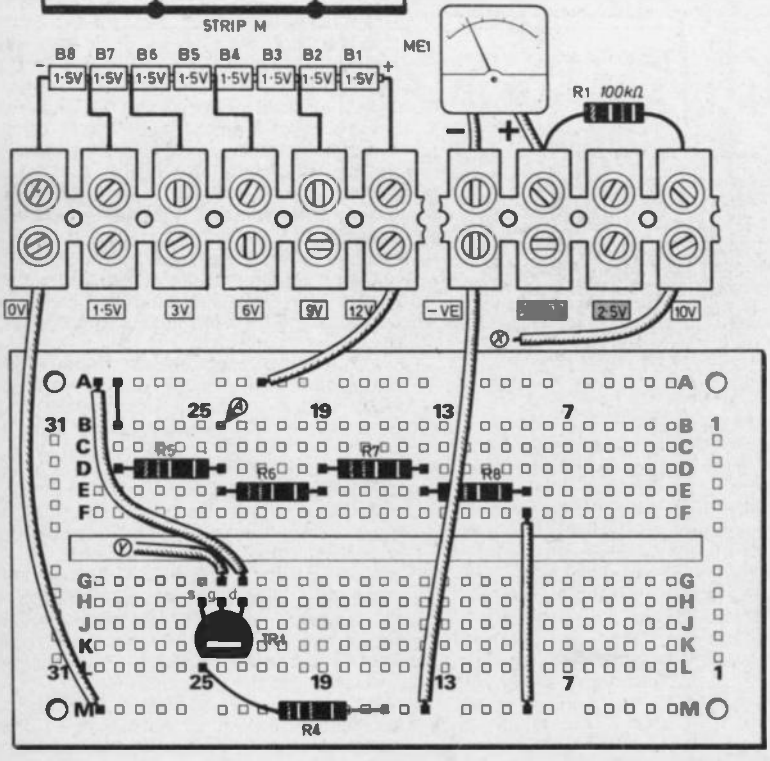
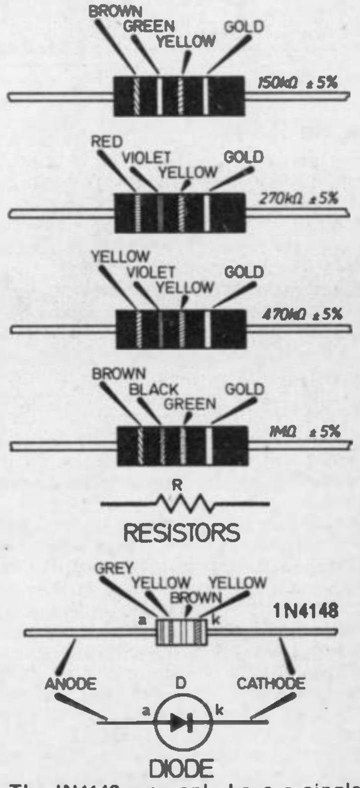


Fig. 3.14. Layout of the components on the breadboard at one stage in the experiment.

TEACH-IN 82 COMPONENTS IDENTIFIED



The IN4148 may only have a single band at its cathode end (k).

PART 2 ANSWERS

2.1. n-type.
2.2. Away from positive toward negative.
2.3. Metal-oxide silicon.
2.4. 22V.
2.5. Increase by 3V.
2.6. Source, gate, drain.
2.7. Source.
2.8. Exchange the photodiode with R1 and VR1.
2.9. All pens the author tried were negatively charged; there was a decrease in current through the meter. The duster showed positive charge.
2.10. Increase in voltage $= 1{\cdot}2 - 1{\cdot}0 = 0{\cdot}2\text{V}$*. Increase in current* $= 70 - 10 = 60\mu\text{A} = 6 \times 10^{-5}\text{A}$*. So* $g_m = 6 \times 10^{-5}/0{\cdot}2 = 3 \times 10^{-4}$ *siemens, or* $300\mu\text{S}$*.*

With 470kΩ above *A* and 93·42kΩ below it, the voltage at *A* should be $12 \times (93{\cdot}42/563{\cdot}42) = 2\text{V}$, which is exactly what we found. The meter is giving the *correct* reading, but joining the meter to point *A* has upset the voltage we are trying to measure.

The meter needs so much current to make it work that we cannot use it when the current obtainable from the circuit is very small.

The gate of a MOSFET requires virtually no current to make it work. It has **high input impedance**, so we can use it to sense the voltage at *A*. Yet a large current can flow through the MOSFET and go to the meter so the meter can have as much current as it needs. The MOSFET has **low output impedance** to match the meter.

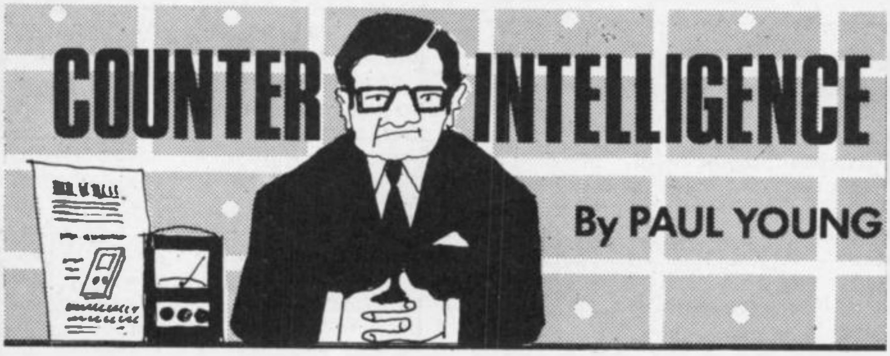
The MOSFET is connected as an amplifier with voltage gain a little less than unity. Now connect wire end *X* to breadboard location *G25*. The meter is now across resistor R4.

Try touching the flying lead from TR1 gate, wire end *Y* to battery terminals 0V, 3V, 6V, and 9V. Note the meter reading for each voltage. The meter should show a range of readings from 0V up to about 9V (gain is less than unity). We now know what reading corresponds to 9V, the supposed voltage at point *A*.

Touch the flying lead (wire end *Y*) to point *A* (breadboard location *B24*). The meter should give the same reading as it gave with the 9V battery terminal. It has measured the voltage *without* changing it.

This simple circuit demonstrates the importance of a high-impedance input in a voltage-measuring circuit. The input circuits of many types of electronic test-meter and of oscilloscopes are based on similar f.e.t. inputs.

To be continued



Bargain Parcel

In a previous article I touched on the problem of buying components, but with costs rising continually, I would like to enlarge on this with suggestions on how you can save money. My first suggestion is to look out for bargain parcels.

In the ordinary way, bargain parcels are apt to be very suspect, and one always thinks of the phrase, "Caveat Emptor", but with electronic components, this is a different matter. For example, a retailer who offers you resistors at five pence each, may well offer you four hundred for five pounds. Not only are these the same resistors, but while on the first transaction he loses money, he makes a profit on the second.

The answer lies in the cost of overheads. These might be ten pence a minute (probably a great deal more) and the time taken to sell you one resistor is the same as it takes to sell you four hundred.

The same argument would apply to capacitors and many other items, so keep your eyes open for the bargains, and if you have time, go to one or two of these Exhibitions where selling takes place. There is a good one in Leicester, usually held in November. I have been to it many times and it is fun to see amateur constructors arriving from all over the country, with voluminous shopping bags, which they proceed to fill with a variety of parts at really modest prices.

In the last year or two there has been one held in May at Alexandra Palace in North London, and I was pleased to see at the last Breadboard Exhibition in London, quite an mount of selling was taking place. In addition, many of the Amateur Radio Clubs hold rallies during the year at which there are stalls selling components. The Radio Society of Great Britain would, I am sure, give you details. A little time spent in this way could save you pounds.

Computer Call

I see two months have gone by and I haven't given computers a single knock and now for once I intend to say something in their favour.

I have often pondered on the use of the home computer. I know it will tell you the weather, but it's just as easy to look out of the window. What won the 4.30? I know for certain that it wont be the "gee gee" I put my shirt on. Stocks and Shares? All mine went long ago. My bank balance? Please, I'd rather not know.

Now the French have come along with a really sensible use for them. They are going to give one to each of their telephone subscribers in place of Directories, and although the initial outlay will be astronomical they reckon in the long run it will save them money, and in matters of tha kind you can trust the French.

Electronic Gremlins

During World War II, those of us who were unfortunate enough to be aircrew had our lives made even more miserable by a type of airborne poltergeist. We called them Gremlins. Their mischiefs were infinite, from crossing control wires, putting water in the petrol and deflating tyres.

You might have thought that with the end of hostilities they would have disappeared but no such luck, a new and more terrible breed has sprung up, the Electronic Gremlins. Don't scoff dear reader or you may be their next victim. The scope of their activities are enormous and if they happen to get out of bed on the wrong side they could easily start a global war. Undoubtedly I am in their black books, probably because of my frequent remarks on the fallibility of computers and failing to give them the credit for it.

Let me tell you about the latest trick they played on me. My watch started to lose time, so I asked my watch repairer for an estimate. He telephoned me a few days later and said £24. I told him that as I could buy four digital watches for that sum, to forget it.

I duly purchased one of these digital contraptions and next day I was idly watching the figures approach five o'clock. Four fifty eight, four fifty nine, then six o'clock!! I couldn't believe my eyes. I phoned the "talking clock", no, it was definitely five o'clock.

Twice the next day it again jumped an hour. I then returned it to the shop that supplied it, they kindly replaced it.

Now you are not going to believe this, but midday next day I was again watching the figures, eleven fifty eight, eleven fifty nine, one o'clock! I telephoned the suppliers and asked if they had had any similar cases they replied, "No!".

Have any of my readers had an experience like this? If they haven't, then undoubtedly the little men have it in for me, either that or its a bad case of Phsyco kinetics!

EE SPECIAL REPORT

ELECTRONIZE DESIGN ELECTRONIC IGNITION KIT

A RECENT but familiar name on the electronic kit scene with their "TOTAL ENERGY DISCHARGE" Electronic Ignition is the Midlands-based company, Electronize Design.

This very comprehensive kit, currently retailing at under £15, is supplied complete with all components and hardware to build and install an ingeniously designed ignition system. All you need is a soldering iron, pliers, sidecutters and a couple of hours to complete what promises to be a welcome addition to any car. (It is well worth noting that a similar system for motorcycles and cars with twin ignition is also available at a fraction under £23).

ASSEMBLY

The construction of the kit was a pleasure, being based around a single glass fibre printed circuit board on which *all* components are mounted, thus eliminating the need for any internal wiring and the potential errors that could accompany it.

Another nice finishing touch was to find all the holes in the p.c.b. of the correct size and the components requiring to stand off the board have had their legs preformed and just drop into place, as in fact do all components.

The board assembly then mounts on to an aluminium base plate which doubles up as a heatsink for the power transistor, this being mounted on the copper side of p.c.b. The unit is completed with a neat black and gold case through which the switch and timing light protrude all resulting in a compact, easy to build and quite advanced electronic ignition unit.

CONNECTORS

A selection of automotive type push-on connectors are supplied to install the system as indeed are screws to fix it under the bonnet. While mentioning the attention to small details you might like to know that the kit is also supplied with ample solder and even a small tube of silicon grease heatsink compound for the power transistor!

The illustrated instruction leaflet covers all aspects of assembly from basic soldering techniques to the final installation and all components are identified in the text by their colour or numeric codes.

HIGH ENERGY SPARK

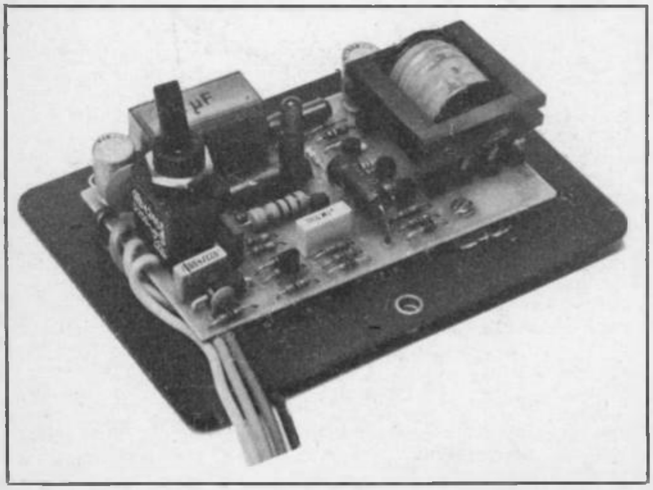
The "TOTAL ENERGY DISCHARGE" system, a new development of the familiar capacitive discharge electronic ignition, produces a high power spark of medium duration (that is "burn time") compared with the relatively short duration of the capacitive discharge systems. This enables the "TOTAL ENERGY DISCHARGE" unit to ignite weaker fuel mixtures.

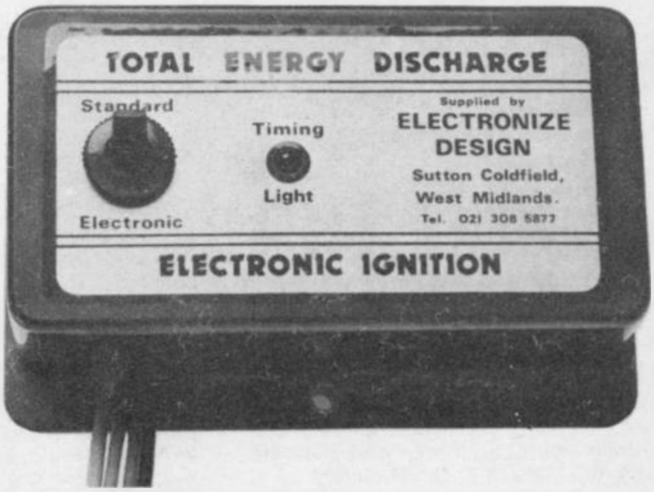
The circuit techniques employed prevent energy being reflected back into the storage capacitor (as the name would suggest) thus enabling the unit to generate the high energy spark without the ignition delay inherent in the low power, "long burn" inductive systems.

The unit can, incidentally, be switched out of the circuit to convert back to the original ignition as all existing components are retained.

AVAILABILITY

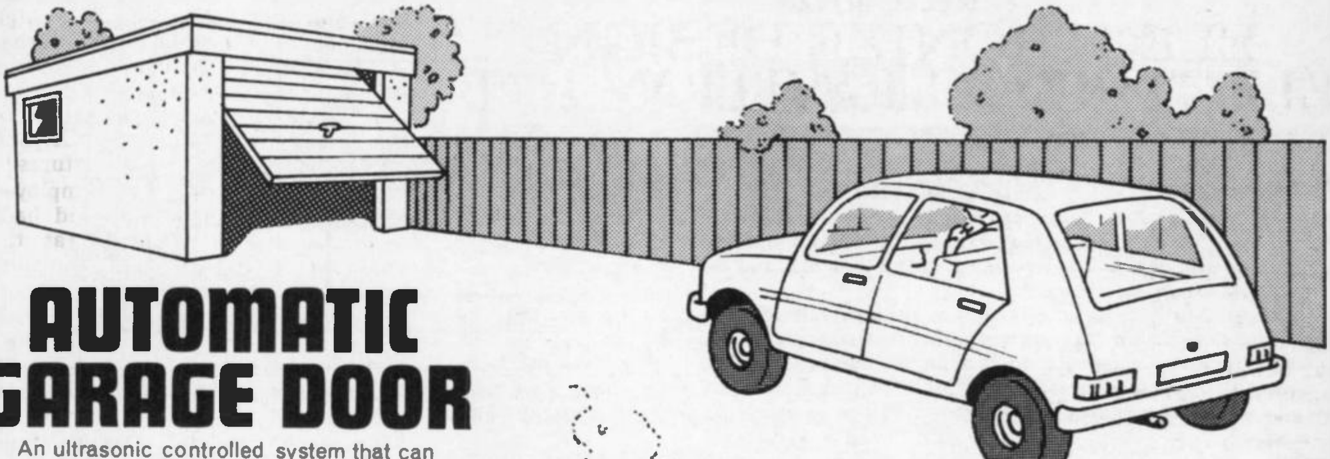
The "TOTAL ENERGY DISCHARGE" kits are available by mail order directly from Electronize Design, Dept EE, Magnus Road, Wilnecote, Tamworth, B77 5BY.





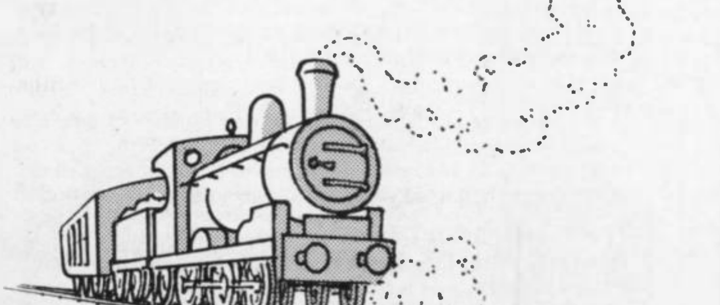
Everyday ELECTRONICS

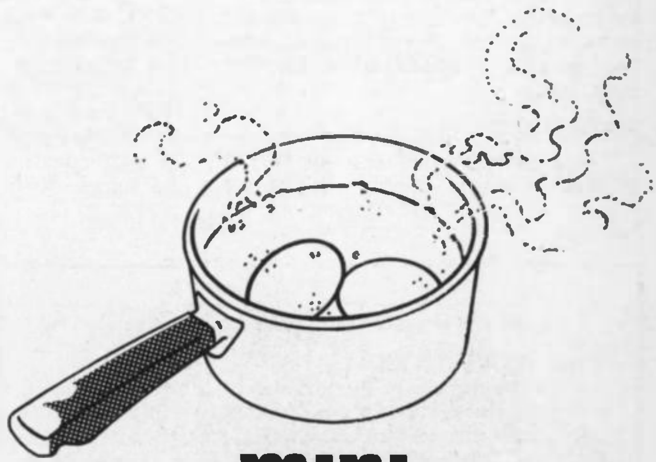
LOW-COST LUXURY FOR THE MOTORIST IN NEXT MONTHS ISSUE



AUTOMATIC GARAGE DOOR

An ultrasonic controlled system that can be used with existing up-and-over doors. The luxury provided by this device will be especially appreciated in the wet and dismal days of winter.





MODEL TRAIN CHUFFER

Realistic sound effect for the model railway enthusiast: "hissing" simulating steam escaping from stationary locomotive and "chuffing" sounds when the train starts to move, with the rate of "chuff" related to speed of train.

JANUARY 1982 ISSUE
ON SALE
FRIDAY, DECEMBER 18

MINI EGG TIMER

Bleeps at the end of preset timing period. Contained in a small case this useful instrument could be used for other purposes, such as timing phone calls or turns at Scrabble.

INTRODUCTION TO LOGIC

PART 8 BY J. CROWTHER

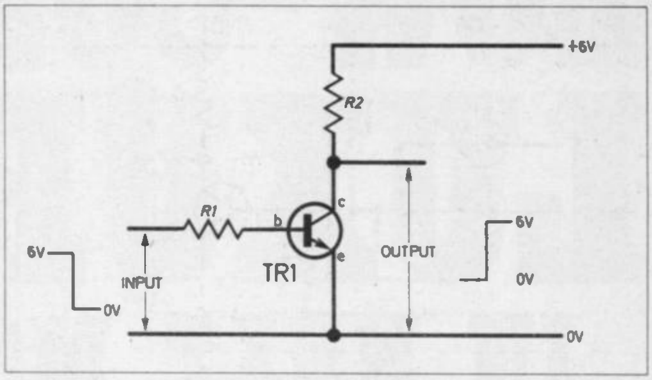


Fig. 8.2 A transistor in the grounded emitter mode will produce a NOT gate.

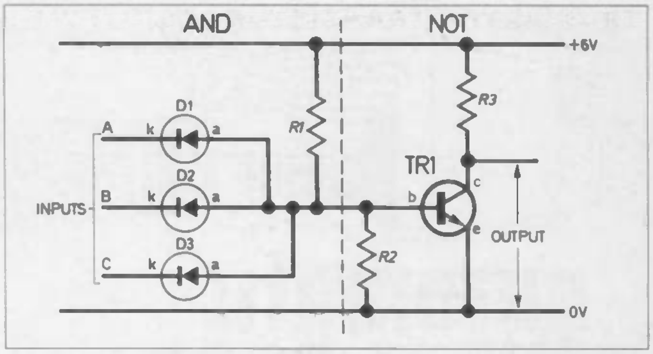


Fig. 8.3 A 3-input NAND consisting of a 3-input AND followed by a NOT gate.

THE "OR" GATE USING DIODE LOGIC

An OR gate using diodes may be constructed as shown in Fig. 8.1. If all the inputs were at 0V (logic 0), no current would flow through resistor R1, no voltage drop across R1, and the output would be zero (logic 0).

If logic 1 (6V) were applied to any of the inputs the diode in that input would conduct, current would flow through R1 and the voltage drop across R1 would cause the output to rise. As before if the ohmic value of R1 was a lot larger than the forward resistance of the diodes, the output would rise to nearly 6V (logic 1).

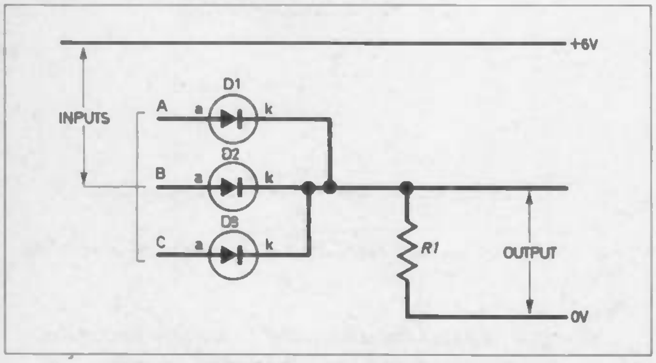


Fig. 8.1 A 3-input OR gate constructed using diodes.

THE NOT GATE

Since the purpose of the NOT gate is to invert the input, a transistor must be used for this gate. Since a transistor amplifier, connected in grounded emitter (see Fig. 8.2), gives a 180 degrees phase shift, it follows that a transistor amplifier biased to cut-off, that is acting as a switch, would produce a NOT gate.

THE NAND GATE USING DIODE-TRANSISTOR LOGIC (DTL)

Since the NAND gate is the inverse of AND, the NAND gate is an AND gate followed by a NOT gate. That is to say it is a combination of the circuits in Fig. 7.6 and Fig. 8.2 as shown in Fig. 8.3.

If all the inputs were at logic 1 (6V), the diodes would be reverse biased and would not conduct. The transistor would then be biased to the "on" position by the bias network of R1 and R2, it would conduct and the resulting voltage drop across R3 would cause the output to fall to logic 0.

If any of the inputs went to logic 0 (0V), that particular diode would conduct, virtually shorting the base of the transistor to ground turning it "off". If the transistor was "off" no current would flow through R3, no voltage drop would result across R3, and the output would rise to 6V (logic 1).

Note

If the diodes are followed by an even number of amplifier stages there would be 360 degrees of phase shift and the circuit would act as an AND gate with gain. An odd number of stages after the diodes would cause the circuit to act as a NAND gate.

THE NOR GATE USING DIODE-TRANSISTOR LOGIC

Since the NOR gate is the inverse of OR, the NOR gate is an OR gate followed by a NOT gate. It is a combination of the circuits in Fig. 8.1 and Fig. 8.2 and this is shown in Fig. 8.4.

If all the inputs were at logic 0 (0V), the diodes would not conduct and the transistor would be biased to cut-off by the bias network R1 and R2. Since the transistor is "off" no current will flow through resistor R3, there is no voltage drop across R3 and the output will be at 6V (logic 1).

If any of the inputs went to logic 1 (6V), that diode would conduct causing an increase of current through R2. This increase of current would cause a large volts drop across R2 making the base of the transistor more positive and switching it on. The transistor would now conduct, current would flow through R3, and the voltage drop across R3 would cause the output to fall to logic 0.

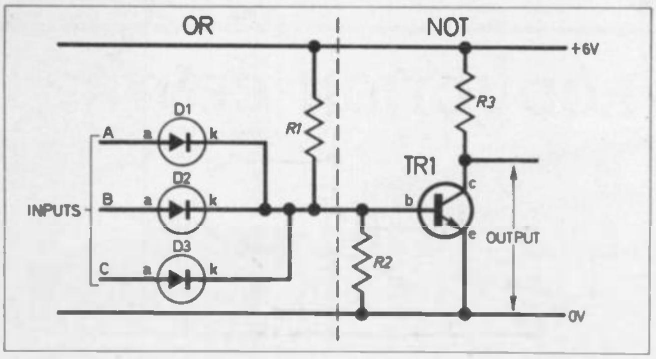


Fig. 8.4 An OR gate followed by a NOT produces a NOR gate.

TRANSISTOR-TRANSISTOR LOGIC (TTL)

In order to obtain TTL a special transistor must be used with more than one emitter, see Fig. 8.5.

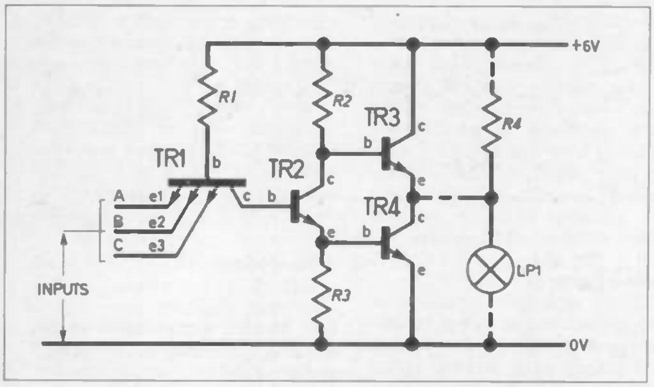


Fig. 8.5 A TTL 3-input NAND gate. This requires a special type of transistor having in this case three emitters.

Using positive logic this acts as a NAND gate, so the output should be logic 0 if all the inputs are logic 1, and 1 if all the inputs are not at logic 1.

If all the inputs are logic 1 (6V) the base and emitter of TR1 are at the same potential and TR1 is cut-off, that is no current flows between the emitter and the collector. As the transistor is an *npn* the base is *p*-material and the collector *n*-material, this will act as a diode which is forward biased (low resistance) and virtually straps the base of TR2 to positive. Since the base of TR2 is positive it will conduct heavily and the large voltage drop across resistors R2 and R3 will cause the base of TR3 to go more negative cutting it "off", and the base of TR4 to go more positive switching it "on". If TR4 is conducting it provides a low resistance path across the lamp and current will flow from +6V via R4 and TR4 to ground, by-passing the lamp, so the lamp will not light giving no output (logic 0).

If any one input was logic 0, TR1 would conduct providing a low resistance path between the base of TR2 and ground. This would virtually strap the base of TR2 to ground cutting it "off", there would now be no voltage drop across resistors R2 and R3 so the base of TR3 would be high switching it "on", and the base on TR4 low cutting it "off". Current would now flow from +6V via TR3 and the lamp to ground, the lamp would light thus giving an output (logic 1).

LOGIC MODULES

A logic module contains a combination of gates from the five basic gates available, and Boolean expressions can be written to show the combinations of switches that the module represents.

example

To derive the Boolean expression and switching circuit diagram for the logic circuit in Fig. 8.6.

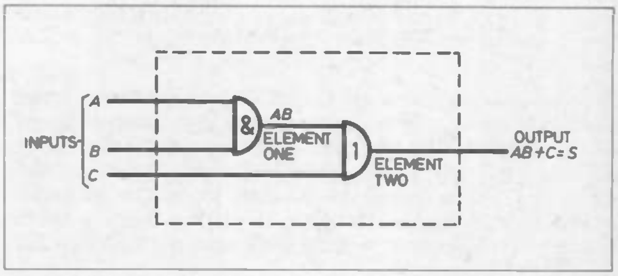


Fig. 8.6 The gate arrangement in the dotted box is known as a "logic module".

The output from the AND gate is of the form AB, this is fed to the input of an OR gate, with C to the other input. As the output of an OR gate is the sum of the two inputs, the output from the OR gate will be:

$$AB + C = S$$

This equation represents the switching circuit in Fig. 8.7:

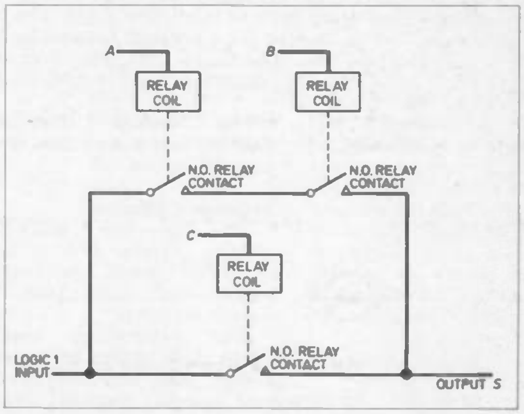


Fig. 8.7 A relay (switch) realisation of the logic module in Fig. 8.6.

Truth Table

The truth table for the module in Fig. 8.6 is shown below:

Input to element 1		Input to element 2		Output
A	*B*	*C*	*AB*	*AB+C=S*
0	0	0	0	0
0	0	1	0	1
0	1	0	0	0
0	1	1	0	1
1	0	0	0	0
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

Answers

7.1 (*a*) 1, (*b*) 1, (*c*) 0, (*d*) 0, (*e*) 1, (*f*) 1, (*g*) 1.

TO BE CONTINUED

Everyday News

NEW OPEN UNIVERSITY PRODUCTION CENTRE

"The new building will give students the benefit of some of the most advanced audio-visual teaching techniques available."—Dr John Horlock, OU Vice-Chancellor.

"The BBC is very glad to take part in this educational partnership because it knows how important a part broadcasting can play in education at all levels."—George Howard, BBC Chairman.

With a success rate of over 45,000 degree students, more than 43,000 short course passes and the production of more than 6,000 TV and radio programmes, the Open University/BBC move from the historical home of television at Alexandra Palace to the new £8 million purpose-built Production Centre complex at Milton Keynes takes with it a record second to none and sets a challenge for future educationalists.

With the lease on "Ally-Pally" expiring in 1977, the story goes back over ten years ago with the formation, in December 1970, of the Alexandra Palace Replacement Study Group. This was followed by the BBC/OU Joint Study Group, which reported in May 1972 with an outline brief for the Centre at Milton Keynes.

A working party comprising representatives from the OU, BBC, architects and quantity surveyors was appointed to progress the initial design work. Although its terms of reference and title were modified from time to time, the group saw the implementation of this £8 million plus project, funded by the Department of Education and Seience, to a successful conclusion with the first production in September 1981—spot-on the schedule set in 1976.

Claimed as Europe's biggest purpose-built educational broadcasting complex, the new Production Centre consists of an Office Block and a Technical Block joined together at a Main Reception area. The centre is capable of making up to 400 radio and television programmes each year.

Technical Block

In the Technical Block there are two television studios, two sound studios, a Central Technical Area, film dubbing / review / editing areas, outside broadcast vehicle areas and the usual support areas.

Television Studios

Of the two television studios, Studio 1 is a fully equipped small production studio with four Link 110 colour cameras.

The production control suite has separate control, vision and lighting control and sound control rooms. The desks and monitor stacks are positioned so as to allow direct line-of-sight between the Director and staff in the production control room and those in the other two rooms.

Studio 2 has been equipped initially for operation on a "drive-in" basis with the colour mobile control room. The installation has thus been confined to production lighting and cabling to a connection point in the nearby outside broadcast base where the vehicle will be parked when used in this mode.

Sound Suite

There are two studios in the sound suite. The larger studio is equipped for drama and music with a 19-channel general purpose stereo control desk, four Studer A80 tape machines and four disk reproducers of BBC design.

The adjacent talks studio also serves as a quality check room.

Central Technical Area

The central technical area is divided into a number of rooms for video tape recorders, a video rostrum camera or episcope room, telecine, a television quality checking room, maintenance room and television apparatus room.

The video rostrum had been in use at Alexandra Palace for five years and consists of a standard Link 110 colour camera mounted vertically above a graphics table.

Film Areas

All the film areas are on the first floor of the technical block. There are seven cutting rooms, a "sync-up" room, three viewing rooms, listening room, sound transfer room, film rostrum camera, dubbing suite and two review theatres.

As Open University programmes demand extensive use of graphics and still photography, a large area of the first floor is devoted to a photographic studio and film processing facilities.

Studio One production control room.

One of the new videotape editing areas.

At long last and after much controversy the new UK Citizens Band radio service was finally inaugurated on November 2.

Licences to use CB are obtainable over the counter at Post Offices for the sum of £10. Licence application forms are also being packaged by some manufacturers and distributors with new legal equipment.

Prospective CB users are able to license the use of up to three sets using the 27MHz or 934MHz FM bands. Each additional payment of £10 will cover up to three more sets.

The licence also carries examples of the mark of compliance that sets sold for the new legal service must carry on the front panel. The symbol of compliance is a circle containing the legend CB27/81 or CB934/81.

The 27MHz AM sets being used illicitly at present will remain illegal because of the harm they cause to television, radio and the emergency services. They may, however, be modified to meet the specification of the new legal service. The HM Customs and Excise are to announce the arrangements under which this will be possible.

There is no bar on business use, so if firms want to use CB for office-to-site or shop-to-van communication, for example, they are free to do so.

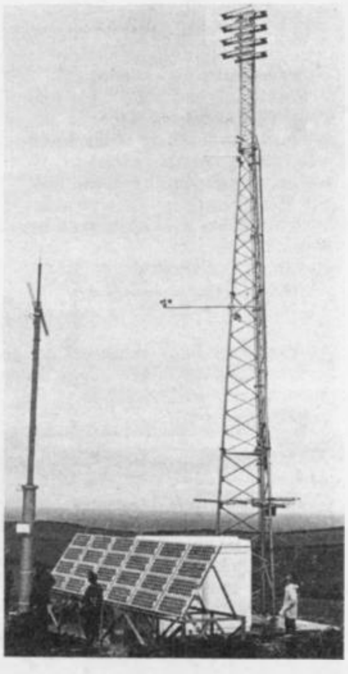
A five-year contract initially worth £2million has been awarded to Thorn Consumer Electronics for the supply of its Ferguson TX colour television technology in kit form to EURO-TV Ltd of Athens, Greece.

Six small-dish aerials worth nearly £¾million have been ordered from Ferranti Electronics by British Telecom, for use by customers of the new business satellite service with Europe.

SUN and WIND TV

The first television transmitting station in the UK to be powered by the wind and sun has been built by the IBA at Bossiney in Cornwall. This experimental station will provide ITV, BBC and later Channel Four programmes to just under 300 people. It also marks an important development in the design of low-cost relay stations capable of bringing 625-line colour television to communities of less than 500 people.

All power for the Bossiney station will normally come either directly from the wind or solar generators or from a bank of 36 large lead-acid batteries (about 1,000Ah) that will be kept charged by excess power from the generators.



EARTH STATION LONDON

Early in October in the ostentatious surroundings of a Kensington nightclub, an assorted crowd of pressmen and video personalities were invited to a preview of Satellite television beamed directly from the Russian *Molniya* satellite somewhere 22,300 miles away from London, W8.

All this was courtesy of an American made dish aerial of some 2m diameter, Swedish developed amplification equipment and an Englishman, namely Nik Powell (Video Palace), who is currently importing this ensemble, collectively known as an Earth Station, for sale at around £4,000. The unit comprises a receiver, antenna, low noise amplifier and feedhorn and weighing about 40kg, should stand no higher than three metres when in position.

Although satellite broadcasting is not a new concept, this is the first time it has been made commercially available to the public in the UK.

Already a boom industry in the United States, Earth Stations are still in their embrionic stages in Europe with only a few satellites transmitting, amongst them a couple of French satellites and the aforementioned Soviet stations positioned in geo-stationary orbit above the equator, their "footprints" covering northern Europe and all of the Eastern bloc countries. However, some of the French signals are scrambled test programmes and therefore cannot be received but with a suitable triple standard TV set to decode the SECAM broadcasts (at an additional £600) the Russian programmes can be viewed with surprising clarity.

The live ice hockey match and news programmes presented at the demonstration displayed remarkable colour quality and the sound reception is acceptable (to those with an ear for such languages!). But will there be any customers wanting to tune-in to Soviet TV and perhaps a few European language stations for the best part of £5,000? It may seem a little extravagant at present, but the future certainly looks promising with the possibility of Indian and Saudi Arabian TV in the near future, further European stations (including UK) by 1986 and even a mid-atlantic based satellite to allow access to a myriad of US channels before the end of the decade.

Everyday News

CIVIL ENGINEERING INNOVATION WINNERS

INCLUDE AN ELECTRONICS-BASED DEVICE

A high-speed profilometer for measuring road surface characteristics at normal traffic speeds developed by a team at the Transport and Road Research Laboratory won a £650 runners up prize in the Civil Engineering Innovation Competition.

The device, installed in a two-wheeled trailer, depends upon four laser sensors mounted on a rigid beam and attached to a power supply and computer in the towing vehicle. Light signals reflected from the road surface are detected and measured and their analysis provides accurate assessment of the road surface characteristics, such as longitudinal road profile, rut depths and surface macro-texture depth.

On October 13 the Duke of Kent presented prizes to winners of this competition which was sponsored by the National Research Development Corporation and New Civil Engineer, the magazine of the Institution of Civil Engineers. The first prize of £10,000 was awarded to Mr M. A. Richard of Marcon International Ltd for his Unitunnel method of tunnelling which uses a process similar to the way the common earthworm moves.

AMERICAN AWARD

The American Institute of Electrical and Electronic Engineers have presented their 1981 First Prize paper to Dr C. D. Schauder and Mr R. Caddy, project system engineers with GEC Rugby.

Fibre Link

Laying the world's longest optical fibre link, running the 125 miles from London to Birmingham, has just got under way.

The link will form part of Britain's growing optical fibre network, over which telephone calls, computer data and telex messages are sent as rapid on-off pulses (digital) of light in hair-thin strands of ultra-pure glass. It is hoped that the service will come on line in the summer of 1982.

SPACE CALL

Phone calls and TV pictures to Australia and the Far East now zoom through space from the Madley 3 satellite communications aerial.

This new £7·5 million aerial will help British Telecom keep abreast of rapid growth in intercontinental phone calls, which double every four to five years. The new aerial can handle 2,000 phone calls and two TV programmes simultaneously. Its dish aerial is 32m (105ft) diameter.

EVERYDAY ELECTRONICS QUESTIONNAIRE

Five thousand questionnaire forms were randomly inserted in Home distribution copies of September issue of EVERYDAY ELECTRONICS. By the end of September a total of 1,129 completed questionnaires had been sent back to us.

The nearest estimate in the competition to judge how many replies we would receive came from Mr S. W. T. James of Cardiff, whose estimate was 1,121. Mr James has therefore been awarded the prize of £50, in accordance with the conditions set out on the questionnaire.

We would like to thank all those readers who completed and returned this questionnaire. The information provided will be carefully analysed and should prove invaluable when planning future issues.—Editor.

£50 WINNER

The Department of Industry is to increase the maximum amount of grant available to manufacturing industry for feasibility studies into the use of microelectronics, from £2,000 to £3,000.

The increase is to enable firms to obtain the same amount of consultancy as when the grant was introduced in 1978.

The Bristol University's Chair of Microelectronics has gone to Dr Erik Dagless.

The "Chair" is not affected by the recently announced cuts in University expenditure. It is financed by the Imperial Group and it is to be known as the "Imperial Group Chair of Microelectronics".

Evidence of the growth rate in sales of teletext receivers is further increased with the announcement of an order worth around £2million for the supply of 120,000 teletext modules and chip sets by Mullard to the Thorn Consumer Electronics.

SCOTELEX '82

The 13th annual Scottish Electronics Exhibition and Convention, organised by the Institution of Electronics, will be held on June 8 to 10, 1982, at the Royal Highland Exhibition Hall, Ingliston, Edinburgh, EH28 8NF.

Admission is free of charge via tickets from Exhibitors and The Institution of Electronics.

Teaching BASIC

Help for the first-time business user struggling with his new microcomputer is now available as a self-teach training aid.

A new audio-training package called "Business Basic" has been produced by the National Computing Centre. The self-instruction package is designed to teach people with a small business microcomputer to program simple business applications in BASIC.

Electronic Mail

A $31 million contract to provide an electronic computer originated mail (E-COM) system to the US Postal Service has been awarded to RCA Government Communications Systems.

RCA will provide the complete "turnkey" system. It will install equipment, develop computer programs, train postal employees and provide initial maintenance.

The system will accept inputs from a customer's computer-generated magnetic tape or from a computer via private telecommunications carriers. Information will be printed at the electronic mail centre designated by the customer, then entered into the first class mailstream.

It is claimed that the system will deliver a letter anywhere in the US within two days of its transmission to the appropriate E-COM post office.

RADIO WORLD

By Pat Hawker, G3VA

Legal at last

Legal CB in the UK at last—but will the licence conditions be respected? For those who have waited they seem reasonable enough, and one cannot feel much sympathy for those who claim that amplitude modulation (AM) should have been permitted.

The Home Office have stated that interference complaints, arising from the illegal use of a.m. have been coming in at the extremely high rate of 1,000 a week. There are also many reports floating around of over-eager types using far more powerful transmitters than have ever been authorised for CB operation anywhere in the world. There is no doubt that some people are using amateur radio h.f. transceivers on 27MHz (and sometimes within the amateur bands); others are using linear amplifiers to boost the output from CB rigs.

It is much to be hoped that the many local CB clubs and associations will encourage their members to stick by the rules, including the use only of the authorised channels; the use of f.m. and not a.m. or s.s.b.; and to keep the power low. Agreed, the CB licences have been unduly long coming and many will agree with an editorial writer who summed it all up as: "From beginning to end the CB saga has been an outstanding example of confusion, indecision and downright stupidity".

A Brighter Future?

Let us hope this can be now put behind us and that our CBers will prove that 27MHz can provide a useful, enjoyable, well-conducted communications facility, well worth the £10 licence fee—and show that CB need not degenerate into a shambles as in some countries.

Although legal f.m. CB is far less likely to cause interference to neighbours' television, radio and hi-fi than a.m., undoubtedly some CBers, keeping carefully to the terms of their licence, will come up against this problem. Often this is not through any fault on their part but because many TV sets are far too susceptible to any strong local signals.

Radio amateurs have long struggled with this problem and the Radio Society of Great Britain has recently published a useful information sheet "Domestic Entertainment Equipment and the Radio Amateur" that provides guidance on this problem. It indicates briefly how and why interference can arise, how viewers and radio listeners can obtain advice from the Post Office, although this does not include audio and similar equipment where it is officially recognised that, to quote the leaflet, "the problem is wholly due to deficiencies in the equipment suffering the breakthrough".

When interference is traced to an amateur station a distinction is made between those cases where the transmitter is at fault and the nowadays more frequent cases where the domestic equipment is at fault. In the latter case the amateur is asked not to transmit on bands causing the interference for 28 days to give the complainant time to fit any necessary filters, etc—but afterwards the amateur is free to resume operation.

The information sheet is available, on receipt of a stamped addressed envelope, from RSGB, 35 Doughty Street, London WC1N 2AE.

First Radio Club

One of the enduring aspects of radio as a hobby has been the continued existence of several hundred local societies and clubs. Recently I had the opportunity of visiting the Derby and District Amateur Radio Society—successors to the original Derby Wireless Club formed in 1911 and believed to have been the very first club devoted entirely to "wireless telegraphy" in the UK. It was formed two years before the Wireless Society of London (which for almost 60 years has been called the Radio Society of Great Britain). Sale, Birmingham, Liverpool and Northampton were also in advance of London.

In those days British amateur stations had three-letter callsigns, one letter always being "X" to denote experimental. Among those active were local units of the Territorial Army, Cadet Corps, Boy Scouts (who shared the callsign "XBS") and Church Lads' Brigades.

The Derby club met weekly, had a library and carried out experiments. They even made a variable capacitor consisting of two buckets arranged so one could be lowered into the other. They came rapidly to the conclusion that the secret of successful reception was "a high aerial and a good pair of headphones"—not bad advice even today.

Derby now has a flourishing membership still with its own club room and with record numbers of enthusiasts studying for their amateur radio technical and morse examinations. Many of these come from the ranks of those who jumped the gun on CB but now realise that amateur radio has more to offer to those with a technical interest in radio. In fact in all parts of the country there seems to be more, rather than less, interest in amateur radio.

Come Wind Come Sun

A small IBA experimental relay station designed to serve 300 people at Bossiney on the north coast of Cornwall has become the first TV station in the UK to derive its electrical power from the sun and the wind. The equipment needs about 150 watts or about 2·5kWh per day.

This can all come from the wind generator provided the wind speed is more than about 15mph. The 24 solar panels, with 864 photovoltaic diode cells, can provide 780 watts in peak sunlight. Excess power can be used to charge the large capacity batteries that are needed in still nights or during fog, which is the enemy of both wind and solar generators.

It is more than an experiment in energy conservation since TV relay stations often have to be built some distance from mains supplies and it is costly to have cables specially installed. Come wind, come shine, Bossiney's doing fine!

New Bands in January

The Home Office has agreed that UK amateurs may use (on a secondary, non-interference basis) the three new h.f. bands allocated for amateur use at the World Administrative Radio Conference in 1979. This is earlier than had been expected for 18 and 24MHz.

The new bands are: 10,100—10,150kHz (expected to be used only for morse and radio teleprinters); 18,068—18,168kHz; and 24,890—24,990kHz. All should prove excellent bands for long-distance working.

Goose Therapy

A few years back, in Autumn 1977, I was fascinated to hear how a British radio amateur, Reg Patrick, G2BBX, acting on the advice of an American medical-electronics specialist, was able with the aid of his 14MHz transmitter to effect the complete cure of a pet goose that had developed a malignant tumour on its left foot that seemed certain to prove terminal.

With the aid of a pair of suitable home-made electrodes and using only a little transmitter power, Reg Patrick, after a short series of 30 minute treatments that were clearly painless to the goose, had his bird walking again and helping to keep the lawn trim.

This was, in fact, the first time I had come across some of the important recent developments in r.f. diathermy, a relatively ancient technique, that have shown great promise of extending its usefulness in the treatment of some cancers, basically by using electrodes that improve the coupling between transmitter and patient.

Much of the experimental work in the USA has been on frequencies around 13·56, 27·12, 40·68, 915 and 2450MHz (scientific, medical and industrial allocations). There has also been work going on in this country.

The principle is very simple. It has been found that the r.f. power tends to heat up a tumour more than it does the surrounding healthy tissue; the tumour liquefies, and may be removed with the aid of a syringe, though it remains difficult to ensure that all the malignant cells are killed.

This form of hyperthermia by r.f. radiation is gradually being recognised as a valuable new tool in the fight against cancer, though of course one must stress that it is only one of an arsenal of weapons, and that I am not advocating do-it-yourself diathermy treatment of pets or people using 14MHz amateur transmitters!

Race Track Speedo

BY A. P. DONLEAVY

MODEL racetracks nowadays have a proliferation of accessories and this project describes the construction of one more, a two digit speedometer, to measure the average lap-speed of the car. A phototransistor buried in the track detects the car racing overhead, by interrupting the ambient light falling on the cell. The unit works on the principle that the time between two successive passes depend on the speed of the car.

The unit can also measure the lap time up to a count of 9·9 seconds.

OPERATING MODES

The unit has two modes of operation, one to give the average speed of the car and the other to display the lap time. The rate at which the circuit "counts" is determined by the speed and timer oscillators, the former causing the counter to run down from 99 to zero thus representing the average speed of the car and the latter counting up from zero to 99 to approximate the lap time.

CIRCUIT DESCRIPTION

A block diagram of the system is given in Fig. 1.

Fig. 2 shows the circuit diagram. TR1 is a phototransistor, connected as shown to the one input of a NAND gate, IC1a. With normal ambient lighting, the transistor will pass enough collector current to bring the emitter to near the supply voltage. Interrupting the light will cause the transistor current to fall, and hence the emitter voltage drops. The phototransistor therefore sends a negative going signal to the pulse shaper when the light is interrupted by the racing car. See Fig. 3, waveform 1 and 2.

This pulse shaper circuit consists of two Schmitt trigger NAND gates, IC1a and IC1b, wired as a monostable multivibrator which produces a negative pulse of approximately one second duration (determined by C1 and R3). The point of this is to eliminate any jitter in the signal from the photocell as the car passes over it.

For the duration of this pulse, TR2 (and hence l.e.d. D1) is held on by the output of gate IC1a. Also if the ambient light level falls too low, then the emitter of TR1 will again be below the gate threshold value causing the output of IC1a to be high, indicated by D1 staying on.

IC2 contains two monostables, *A* and *B*, which generate the latch and reset pulses and each monostable has two inputs and two outputs for positive and negative signals. The first of these, monostable *A*, is triggered by the falling edge (that is the start) of the pulse from the shaper circuit and produces a negative going latch pulse which is fed to the counter/latch/driver system. The latch pulse then triggers monostable *B* which produces a positive going reset pulse to reset the counter. See waveforms 3 and 4 in Fig. 3.

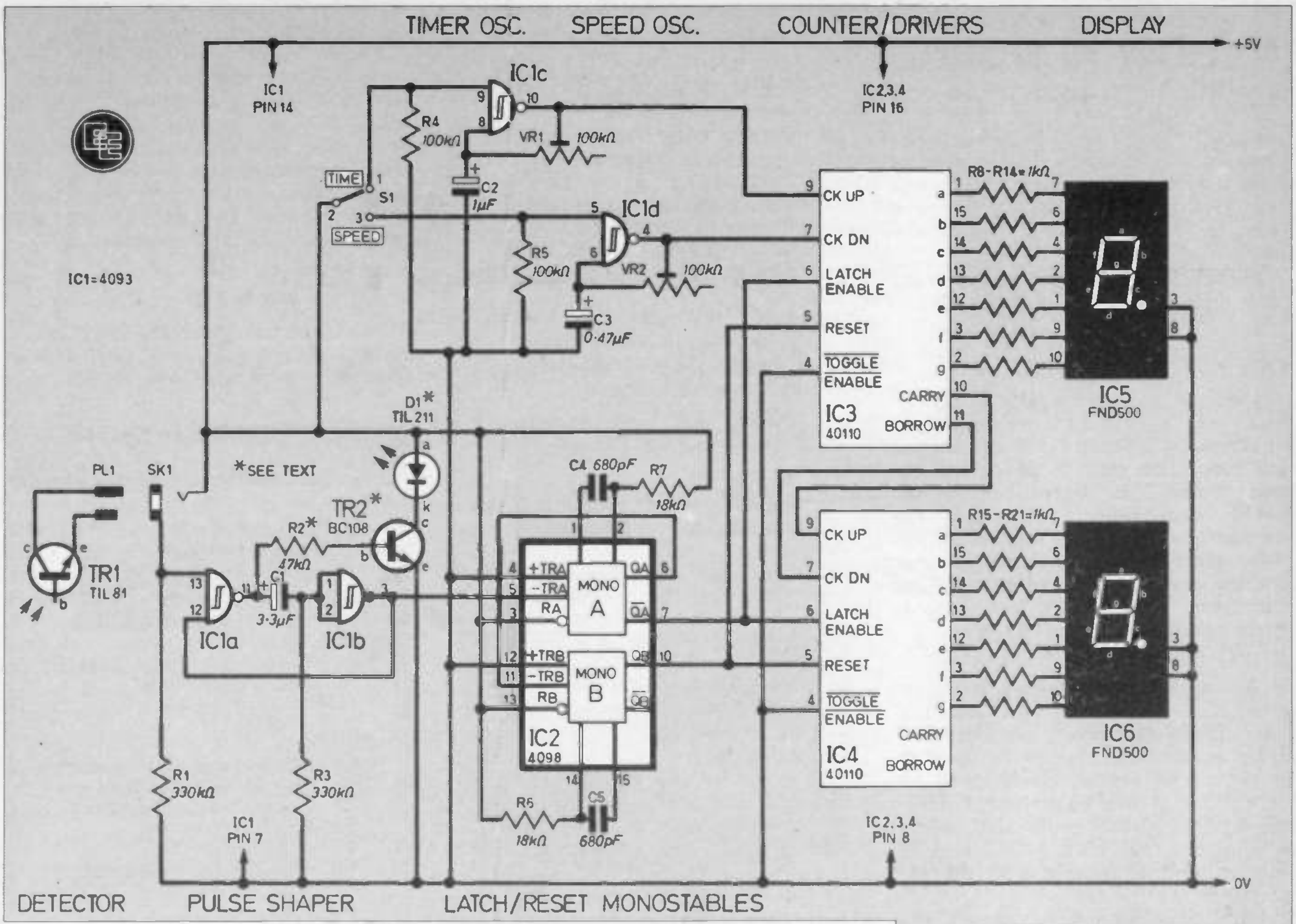
In order to achieve the delay between the latch pulse and the reset pulse, the reset monostable (*B*) must be triggered after the latch monostable (*A*). To do this, monostable *B* is activated by triggering it on the negative edge of the positive output pulse of monostable *A*, waveform 5, Fig. 3 (remembering that each monostable in IC2 has both positive and negative outputs).

The duration of the latch and reset pulses are governed by the time constants of C4-R7 and C5-R6 respectively.

COUNTER

The counter consists of two 40110 decade counter/driver i.c.s cascaded in series to permit a maximum count of 99.

When the car first passes the detector, the latch pulse causes the number in the counter to be displayed, which for the first pass will be a random number, and the reset pulse sets the counter running again from zero.



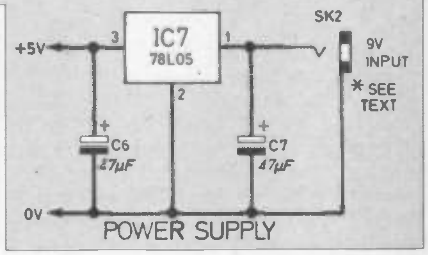


Fig. 2. Complete circuit diagram for the Race Track Speedo.

After the car completes the lap and passes the detector again, the latch pulse causes the new count to be transferred to the display and the counter is once more zeroed ready to measure the next lap.

The counter circuit is able to count upwards from zero to 99 or downwards from 99 to zero depending upon which clock input is selected (IC3 pin 9 or 7).

In order to use the unit to measure average speed, the "count-down" input is clocked by the speed oscillator consisting of IC1d, VR2 and C3.

For the timing mode, the "count-up" input is clocked by the timer oscillator, made up from IC1c, VR1 and C2. Switch S1 is used to select the mode of operation by enabling either the timer oscillator or the speed oscillator.

The numerical readouts, IC5 and 6, are seven segment common cathode displays and are driven directly from the counters via the current limiting resistors R8 to R21. Almost all the current used by the circuit is consumed by the display and in the prototype this was in the order of 80mA.

The unit is intended to be powered by the 9V calculator adaptor via SK1 with IC7 being used to provide a stabilised 5 volt supply. If the track has its own power supply between 9 and 15 volts d.c., then this could be used instead.

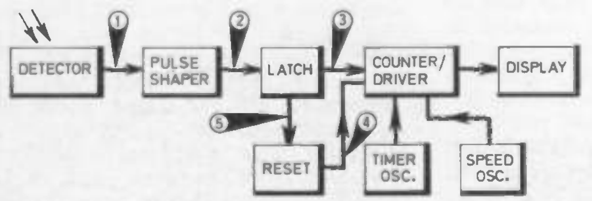


Fig. 1. Block diagram of the system.

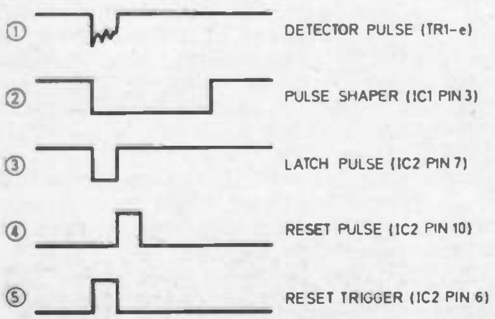
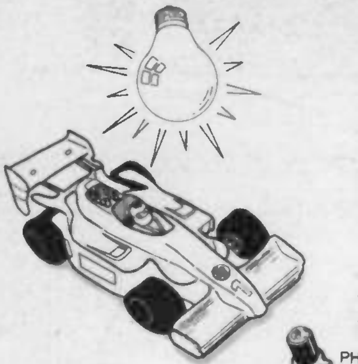


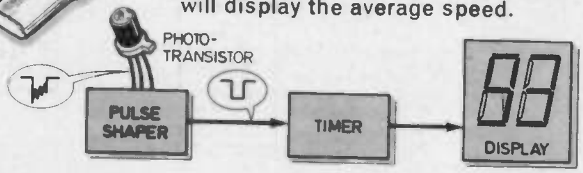
Fig. 3. Typical waveforms to be expected at the various stages that make up the circuit for the Race Track Speedo.

HOW IT WORKS



The speedo unit "detects" when the car passes over the photo-transistor by the blocking of the ambient light falling on it, thus generating a pulse. By measuring the period between two successive pulses, that is the time taken for one lap, the unit can determine the lap time.

Alternatively the unit can be used as a speedo, in which case the timer counts downwards and will display the average speed.



CIRCUIT OPTIONS AND COMPONENTS

Should either the timing mode or speed mode not be required, then the relevant potentiometer, capacitor, resistor and switch S1 may be omitted provided the unused clock input on the counter is tied to ground. For example if the unit is to be used purely as a speedo then VR1, R4, C2 and S1 may be left out and pin 9 of IC3 connected to the 0V rail.

Another alternative is to use the same oscillator for both modes of operation and use S1 to feed the signal to the appropriate input of the counter. In this case a 1MΩ resistor connected to 0V must be added to each clock input to prevent it from floating when unused. This system however, gives no flexibility when calibrating the speedo if the timer mode is to be accurately adjusted.

The lap/low light indicator D1, along with TR2 and R2 may also be omitted as they are not essential to the working of the circuit but it is recommended that they are included as they do perform a useful function. TR1 is specified as a TIL81 but other phototransistors can be used though it may be necessary to adjust the value of R1.

DISPLAYS

The FND500 displays were selected because they do not require an additional contrast filter but again, a suitable seven segment common cathode display with the same pin-out (see Fig 4) will work quite adequately.

Should a decimal point be desired, although this was not thought to be necessary on the prototype, a 1KΩ resistor from pin 5 of IC6 connected to the +5V rail will provide one.

CONSTRUCTION starts here

CIRCUIT BOARD

A piece of stripboard measuring 40 strips by 33 holes is required as shown in Fig. 4. Due to the fairly complex nature of the circuit, a large amount of track breaks are necessary and these must be very carefully made in the foil strips in the positions shown (65 in total).

Dual-in-line i.e. sockets are recommended for all integrated circuits (with the exception of IC7, a TO-92 package) and the displays, IC5 and IC6 share one 24-pin d.i.l. socket. These should be soldered in first followed by the wire links, resistors, capacitors, IC7, TR2 and finally the two potentiometers.

Please note that any wire links spanning more than four holes should be either insulated wire or be covered with p.v.c. sleeving, thus eliminating the likelihood of a short circuit due to the links flexing. A total of 38 links are required; carefully check their positions in relation to the i.c. sockets as mistakes are easily made at this stage.

As most of the capacitors are tantalum bead types and therefore polarity sensitive, ensure that they are fitted correctly.

Now the flying leads of flexible insulated wire can be inserted into the positions indicated, these being long enough to reach their respective destinations.

Finally insert the i.c.s into their sockets, observing the correct orientation and taking great care not to touch the pins as they are CMOS devices and therefore static sensitive. The board can now be turned over and examined for dry joints and solder bridges and put to one side ready for the final assembly stage.

CASE

The case used for the Race Track Speedo unit is a console type with a sloping aluminium top panel size

COMPONENTS

See Shop Talk page 804

Resistors
- R1 330kΩ
- R2 47kΩ
- R3 330kΩ
- R4 100kΩ
- R5 100kΩ
- R6 18kΩ
- R7 18kΩ
- R8 to R21 1kΩ (14 off)

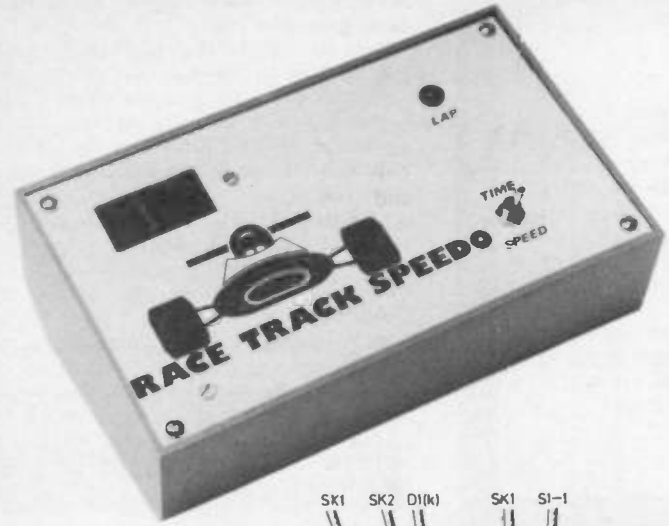
All $\frac{1}{4}$W carbon $\pm$ 5%

Capacitors
- C1 3·3μF 16V tantalum bead
- C2 1μF 16V tantalum bead
- C3 0·47μF 16V tantalum bead
- C4 680pF polystyrene
- C5 680pF polystyrene
- C6 47μF 16V tantalum bead
- C7 47μF 25V elect. or tantalum bead

Semiconductors
- D1 TIL211 or similar 0·125in green l.e.d.
- TR1 TIL81 phototransistor
- TR2 BC108 silicon *npn*
- IC1 4093 CMOS quad 2-input NAND Schmitt trigger
- IC2 4098 CMOS dual monostable
- IC3, 4 40110 CMOS counter/driver (2 off)
- IC5, 6 FND500 0·5in common cathode 7-segment display (2 off)
- IC7 78L05 +5V regulator TO-92 case

Miscellaneous
- VR1, 2 100kΩ $\frac{3}{4}$in multiturn preset (2 off)
- S1 s.p.d.t. miniature toggle
- SK1 3·5mm jack socket
- SK2 2·5mm jack socket
- PL1 3·5mm jack plug

Stripboards: 0·1 inch matrix 40 strips by 33 holes and 7 strips by 7 holes (for phototransistor); console type case 160 × 95 × 60 (rear) × 40 (front) with aluminium lid; 24-pin d.i.l. i.c. socket; 16-pin d.i.l. i.c. socket (3 off); 14-pin d.i.l. i.c. socket; l.e.d. mounting clip; p.v.c. sleeved wire; tinned copper wire (for links); Veropins (7 off); tapped M3 spacers 12mm long (2 off); M3 × 6mm long screws (4 off).



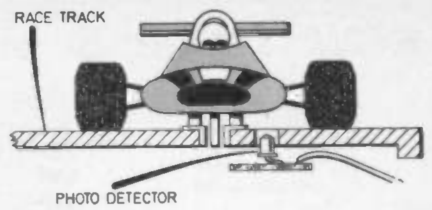
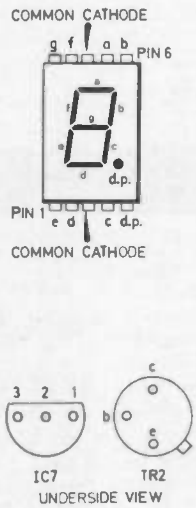
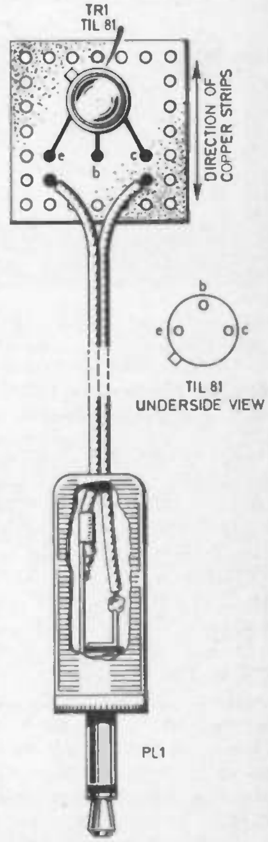
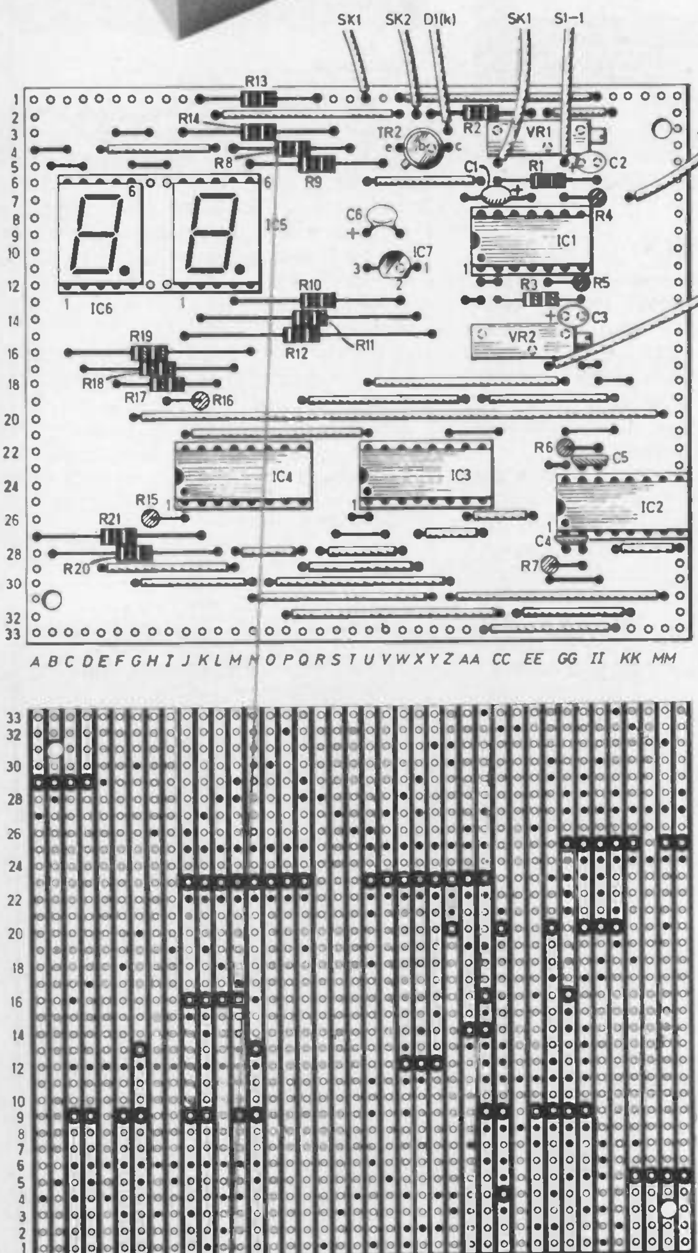


Fig. 8. Mounting the detector board beneath the track.







COMPONENTS approximate cost £20·50

Fig. 7. Component layout and wiring to the photo-cell.

Fig. 4. Component layout and details of breaks to be made on the underside of the circuit board.

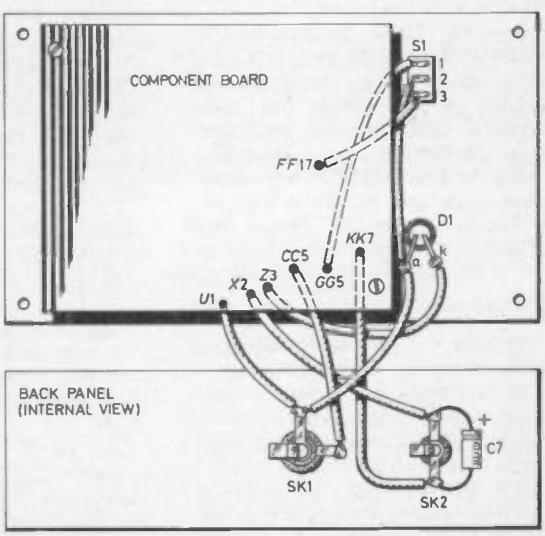


Fig. 6. Interwiring details from the board to the front and back panels.

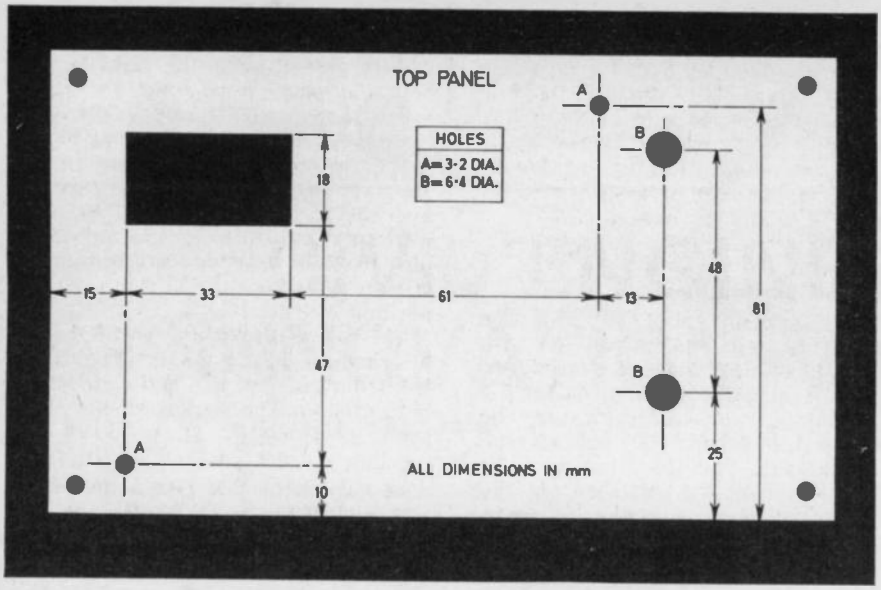
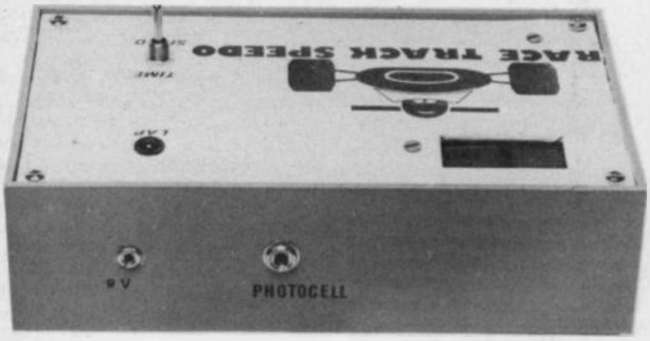


Fig. 5. Front panel drilling and display cut-out details.

156×91mm. The component board is mounted below this panel on spacers and the drilling details and display window cut-out dimensions are shown in Fig. 5. To make the display window, drill a small hole in each corner and cut out the centre portion with a coping saw or a hacksaw with an "Abrafile" blade fitted, finally filing the edges flush.

Two further holes are required, both in the back panel of the plastic case, for SK1 and SK2, and the approximate positions of these are shown in the wiring diagram Fig. 6.



(above) Rear of the case showing the supply and photocell jack sockets.

These holes are to suit the 3·5mm and the 2·5mm jack sockets and are 6mm and 4mm diameter respectively.

PHOTOTRANSISTOR

The TIL81 phototransistor is mounted on the 7 strips by 7 holes piece of stripboard in the manner shown in Fig. 7. This device does in fact have a "base" lead although in the speedo circuit it is unused but it is still soldered down to the board to aid mechanical strength. The collector and emitter terminals are wired, via a suitable length of twin-core cable (two wires twisted together will suffice), to the 3·5mm jack plug PL1 with the collector being soldered to the tip of the plug.

FINAL ASSEMBLY

The component board assembly is to be mounted beneath the top panel with the two 12mm long M3 spacers secured top and bottom with the 6mm long M3 screws, (half inch long 6BA spacers with quarter inch long 6BA screws may be used instead, depending on what is available.

The layout of the board is such that the displays will fall neatly behind the window cut-out when secured in position and should it be found to raise the height of the display so that it protrudes through the panel, one suggestion is to insert another 24-pin socket under the display i.c.s in the original socket; in effect to "stack" them to achieve the extra few millimetres.

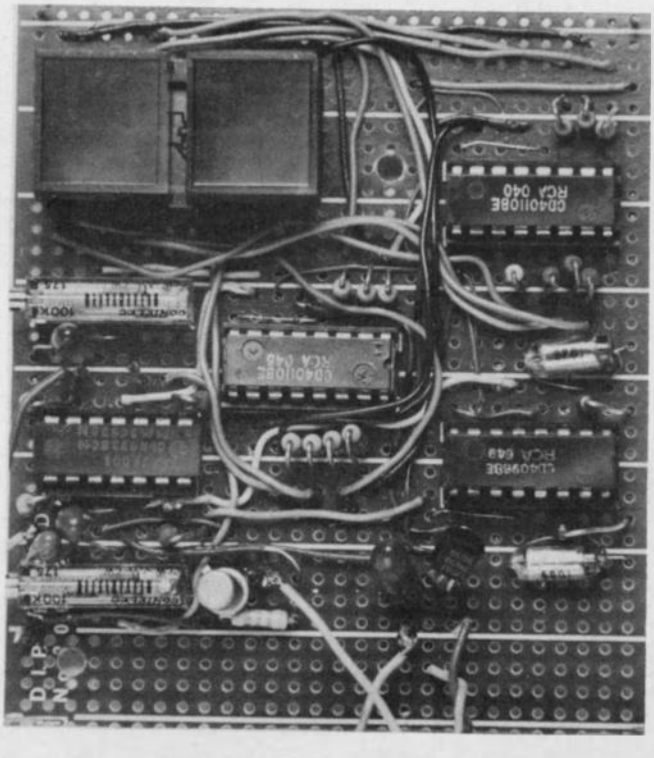
The l.e.d. D1, the switch and the two jack sockets can now be fitted into their relevant positions in the case and top panel and the wiring completed as shown in Fig. 6, capacitor C7 being soldered directly across SK2.

It can be noticed that the wiring acts as a kind of "hinge" along the back edge of the case and when completed the top panel can be folded down into position.

DETECTOR LOCATION

The phototransistor should ideally be set into the track near the start of the circuit and to mount it, a small hole must be drilled into a section of the track. This hole must be in a position where the racing car will pass over it hence interrupt the light to the cell but not so as to interfere with the guiding "slot" or to obstruct the wheels.

The detector board assembly is then to be mounted from the underside as shown in Fig. 8 and secured with double sided sticky foam pads or "Blu Tack" type adhesive. The wires can be brought out through a small notch in the side of the track moulding.



(right) The completed prototype circuit board. The two multiturn potentiometers and the displays can be seen on the right and top right respectively. Note that this layout is very different from that in Fig. 4 as it was constructed on Vero type VQ board.

CALIBRATION

Having set up a suitable track and connected both the detector and a compatible power supply to SK2 (tip of the plug must be positive) the unit is ready to test.

If when switched on, the l.e.d. D1 stays on, then the ambient light falling on the detector is too low and the level of room lighting must be increased. However the author did not experience any problem of this nature with normal room light levels.

Passing your hand over the cell will cause a new reading to be displayed simultaneously with D1 turning on for about a second.

To calibrate the timer set S1 to the TIME position, momentarily interrupt the light to the cell twice at an interval of nine seconds, and adjust VR1 until the display reads 9·0. A more accurate calibration can be made using a longer time interval, for example interrupting the light every 29 seconds, and adjust the display to read 9·0, the counter having already gone twice "round the clock".

Calibration of speed is done by setting S1 to SPEED and adjusting VR2, The constructor may wish to use real units like cm/sec, so, if for example, the track is 400cm long, calibrate the speedo by manually interrupting the light every ten seconds and adjusting VR2 until the display reads 40, which represents 40cm/sec. Alternatively one may adjust VR2 to give a reading of about 80 for the average lap time of the car so as to simulate a scale speed of 80m.p.h. to add to realism.

TROUBLE SHOOTING

Any problems occuring with the completed unit may be isolated with the help of the following procedures.

Before actually switching on for the first time, it is as well to measure the resistance between +5V and ground, to make sure that there are no short circuits. When first switched on, the display will show a random number, however, if nothing appears on the display the problem is almost certainly a power supply problem. Check for 5 volts at pin 16 of IC3 and IC4, and 0 volts at pins 8 of IC3 and IC4 and pins 8, 3 of the displays.

Problems of missing segments may be identified by transposing first IC3 with IC4, then transposing the displays. If the fault does not move with the display or the i.c, then a wiring error should be suspected.

If the display never changes, check the correct functioning of the photocell by interrupting the light to the cell and observe whether D1 lights for a short time. If this is the case then check that the voltage at pin 5, IC2 drops from 5 volts to 0 volts, while D1 stays on. Should an oscilloscope be available check that the oscillators are working by examining the signal at pin 10, IC1 with S1 in position 1 (TIME), and pin 4, IC1 with S1 in position 3 (SPEED).

The functioning of IC3 and IC4 may be checked by disconnecting pin 6, IC3 from pin 7 of IC2 and connecting it to ground. The display should then count continuously up or down depending on the position of S1. If it does not, check that pins 5 and 4, of IC3 and IC4 are at 0 volts. If the display does count but the unit does not work with IC2 connected, then this indicates the absence of the latch pulse, which could be due to a wiring error or IC2 being faulty.

Finally if the unit appears to give completely random speed and time readings, then the problem is almost certainly a missing reset pulse, which again is due to a wiring error or IC2. ⌘

LETTERS

Circuit Code

I have found a way of simplifying the quick reading of circuits and layout diagrams.

In some cases there are quite a few leadouts or long connecting (black lines) wires running all over the diagram. I get coloured pencils and line in the topmost line of the layout (usually the positive line with a *npn* transistors) with a Red pen or pencil. Then the Earth or negative line is marked with Black pen or pencil, then the middle line in Green. If another lead line is needed it can be coloured in with say Brown or Yellow pencil. Thus all component junctions are shown on each line.

I find this a great help when checking over a circuit. I just run along the positive line (+V) on the circuit diagram and check that all connections to this Red line are the same as on the layout diagram. Then the same with the negative line (Black) and the same with the middle line (Green). This makes it easy and quick to check that all connections are made to each coloured line.

Other parts of the circuit, such as leads to coils or variable capacitors, can be seen to stand out clearly if in different colours. I am sure that the colour system should be used with coloured print in Radio and Electronic circuits given in magazines etc, although it may make printing a little more expensive.

When I look at an old black and white diagram, I find it diffiicult to trace long lead lines and spot where they go to before my eyes get tired.

T. S. Hambly,
Hove,
Sussex.

Products Found

With reference to a letter from Mr. C. F. Hartley, of Willington, Crook, Co. Durham, in your *Letters* page in EVERYDAY ELECTRONICS October issue.

I am writing to inform you that we have taken over the manufacturing of all the various products from Proops Brothers Ltd, London, which includes the electronic speed control.

Hoping this will be of help to Mr. Hartley and your readers.

C. J. Roe,
Proops Manufacturing,
10-11 Wharf Lane,
Burton-on-Trent, Staffs.

Logical Time

Why do digital watch manufacturers offer the public stopwatch specifications to 100th of a second when there is no possible way that human reaction time could ever attain such an accuracy?

Surely it would be more logical to provide a miniature socket on the side of the watch into which could be plugged various electronic timing devices.

Not only would this make timing of events far more accurate, it would also enable a lucrative market to be established in selling such devices to the general public.

However, I do have one very strong point to make. Please, please, manufacturers, make your sockets compatible!

David E. Smith,
Sale, Cheshire.

Display Time

A number of years ago, January 1976 to be exact, EE published an article for a *Digital Clock* featuring a phosphor diode display, Futaba 5LT 01.

This clock has given excellent service until a week ago when it was knocked to the floor and the display was broken. I have tried the original suppliers for the display, but unfortunately they no longer seem to be in business.

I have tried a number of advertisers in your magazine without success. Could any of your readers offer advice as to where I may be able to obtain the above display or failing that a suitable alternative.

A. J. Prior,
Wigan,
Lancs.

Before the Chip

The article "Before the Chip" (Nov. '81) is very interesting but Mr. R. D. Railton is in error when he states that the crystal used in a crystal set was germanium! If my memory serves me correctly it was usually galena, i.e. lead ore or lead sulphide, PbS.

I always think of the students who read EE and who, perhaps, may use information like this in an exam.

T. R. de Vaux-Balbirnie,
Huntingdon,
Cambs.

Would Clifford Irwin Mundul please send his full address to the Editor.

HEADS or TAILS GAME

BY F.G.RAYER

A TRUE flip of a coin has a 50-50 chance of being a head or a tail. That is to say there are two possible results, each one equally likely to occur.

As there are only two possible outcomes, the head or the tail, this is known as a binary decision and as each successive "flip" of the coin is entirely independent of the preceding result we can say that it is a purely random process.

This project is for an electronic binary decision maker with the head and tail states being represented by two indicator lamps and the "spinning" of the coin is achieved by very rapidly clocking the circuit so that the output switches between heads and tails and then stopping at one or the other of these states.

This can also be considered a random process since the high clock frequency makes it impossible to predetermine the result.

CIRCUIT DESCRIPTION

The circuit consists of a clock oscillator and a counter i.c. with two indicator lamps to indicate the result. See circuit diagram in Fig. 1.

The oscillator, IC1, is a 555 timer i.c. and when both the DISPLAY switch, S2, and the SPIN switch, S1, are depressed it generates an output signal at pin 3, the frequency of which is determined by R1 and C1.

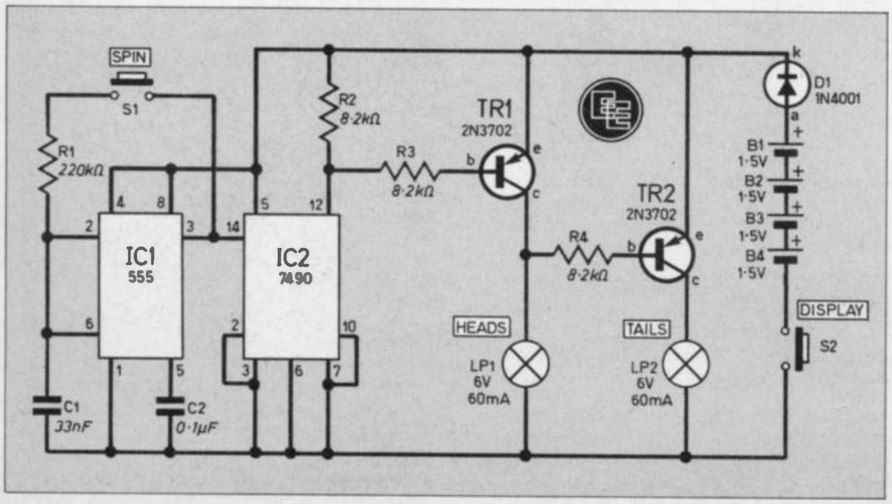
This signal is fed to IC2 which is wired as a divide-by-two counter so that the output at pin 12 is high for one input pulse and low for the next pulse. So when S1 is released (though S2 is kept depressed) the output of IC2 (pin 12) will either be high or low.

When it is high the base of TR1 is positively biased via R2 and R3, so the collector current is negligible. Therefore the potential difference across the HEADS indicator LP1 is very low and TR2 base will be negatively biased. This transistor will conduct and the TAILS indicator LP2 will light up.

If pin 12 of IC2 is low when the S1 is released, TR1 base will now be negatively biased via R3 and IC2 and it will turn on, lighting up LP1, the HEADS indicator. The volts drop across LP1 holds the base of TR2 high so that it cannot conduct.

The DISPLAY switch, S2, which is the on-off switch for the circuit, is a push-button type on the original model as this prevents the unit from being left on and draining the batteries but any switch can be used here quite satisfactorily.

Fig. 1. Circuit diagram of the Heads or Tails Game.



COMPONENTS

Resistors
- R1 220kΩ
- R2, 3, 4 8·2kΩ (3 off)
- All ¼W carbon ± 5%

Capacitors
- C1 33nF plastic or ceramic
- C2 0·1µF plastic or ceramic

Semiconductors
- TR1, 2 2N3702 silicon *pnp* (2 off)
- D1 1N4001 silicon
- IC1 555 timer
- IC2 7490 TTL decade counter

Miscellaneous
- B1-B4 4 × 1·5V size AA (HP7)
- S1, 2 push-to-make (2 off)
- LP1, 2 6V 60mA filament lamps and holders (2 off)

Stripboard: 0·1 inch matrix 17 holes by 21 strips; 14-pin d.i.l. i.c. socket; 8-pin d.i.l. i.c. socket; p.v.c. sleeved wire; 6BA or M3 board mounting hardware; battery holder for B1-B4; battery connector; case to suit.

Approx. cost Guidance only **£5·50** excluding case

The power for the circuit is supplied by four 1·5V batteries, diode D1 being included to drop the six volts from the batteries down to suit the 7490 TTL i.c.

CIRCUIT BOARD

Fig. 2 shows the layout of the components on the stripboard and the wiring to the switches and lamps.

The underside view of the board gives the positions of the breaks to be made in the copper strips and these must be carefully checked.

The components should be soldered into the board as shown and flying leads of flexible p.v.c. sleeved wire added for the switches and lamps. These are to be long enough to suit the layout of components in the case, and finally S1, S2, LP1 and LP2 can be soldered on to these leads and the battery connector wires added.

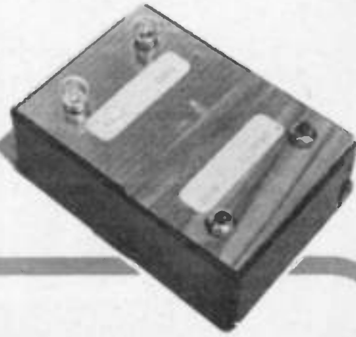
When selecting a case for this project, bear in mind the size of the battery holder for the four AA size batteries. The actual panel layout is left to the constructor but the photograph shows a typical design.

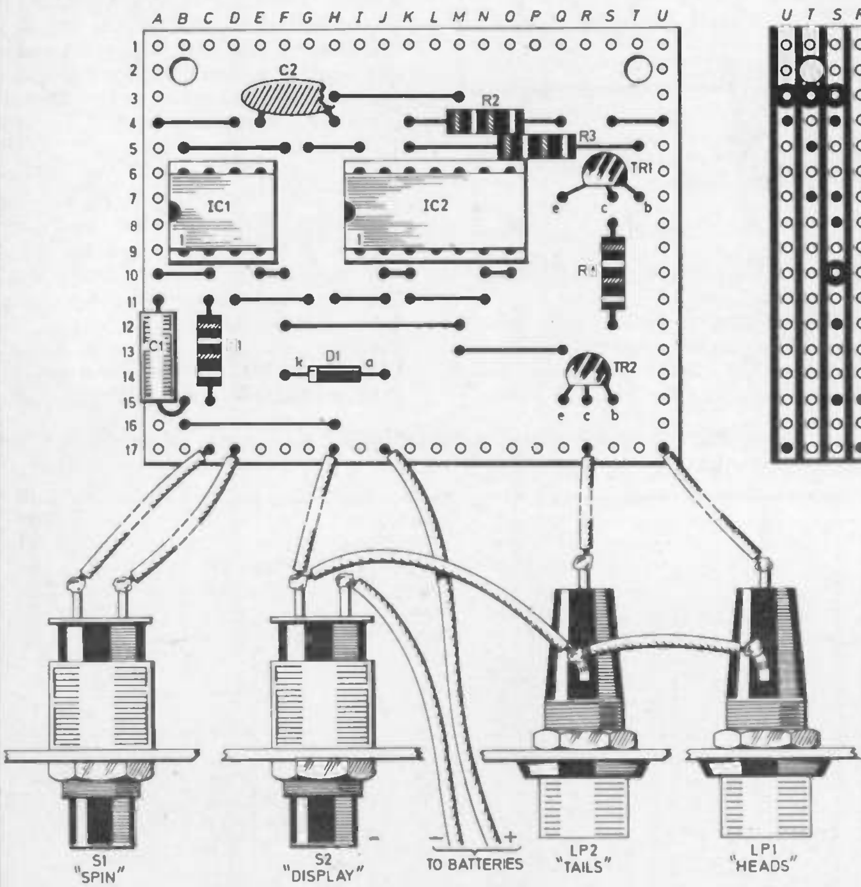
TESTING

Having completed the assembly and inserted the batteries, the unit is ready for checking. On depressing the DISPLAY switch, S2, only one lamp will be illuminated and when the SPIN switch, S1, is activated, both lamps will have the appearance of being on but at reduced brightness. This is because they are being rapidly turned on and off in succession but at a rate faster than the eye can detect, making it impossible to choose the outcome. When S1 is released the unit will display either a head or a tail, the chances of each occurring being exactly equal.

Should the unit fail to operate, check to see if there is a signal present at pin 14 of IC2 with S1 depressed. This can be done with a high impedance earpiece coupled through a 10nF capacitor. A "buzzing" sound should be heard. Test also pin 12 of IC2 where a buzz should also be detectable but at half the frequency of that at pin 14.

If the signal is absent look for short circuits around IC1 and check the power supply. If a signal is present and the unit still fails, examine TR1, TR2 and the filaments of the lamps LP1 and LP2. ⌑





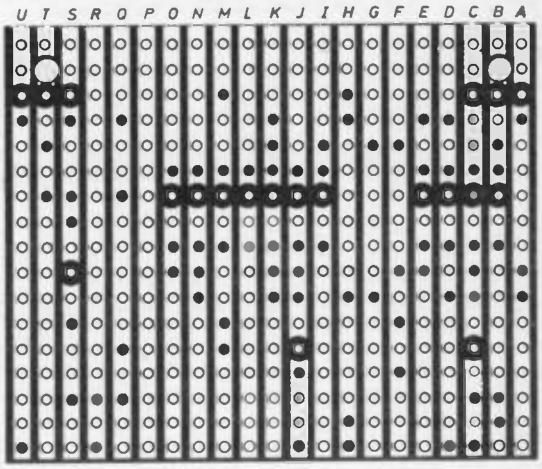
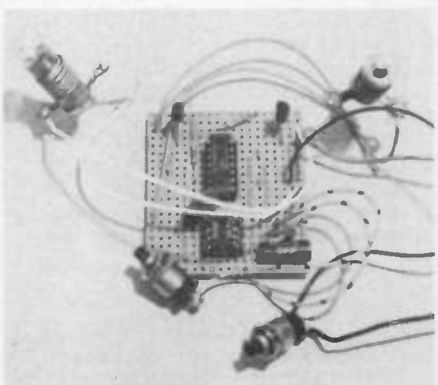


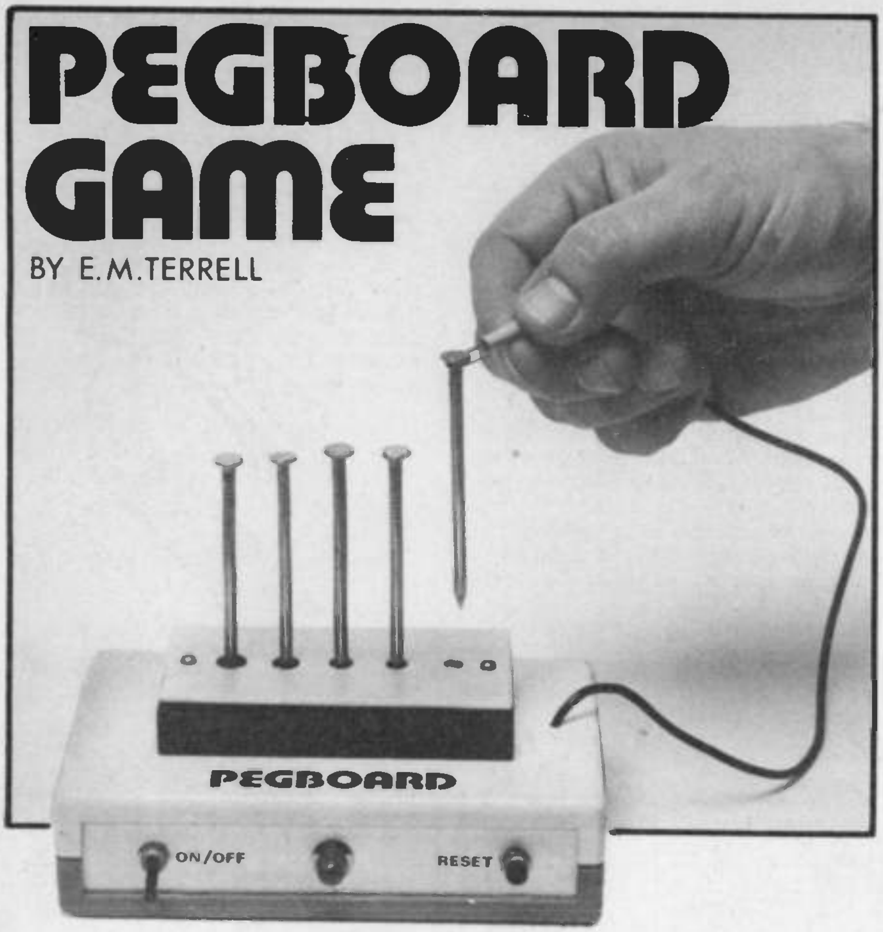
Fig. 2. Stripboard component layout and interwiring diagram. The track breaks on the underside of the board are also shown.



The board assembly of the prototype unit. Note that it differs slightly from the layout given in Fig. 2.

PEGBOARD GAME

BY E.M.TERRELL



THE game to be described in this article will provide amusement for one player or a group of players. The basic requirements for successfully completing the game are a steady hand and a sharp eye and good coordination between the two.

The Pegboard Game consists of placing five metal pegs, one in each of five locating holes on the "board". Surrounding the peg locating holes is a metal plate ("mask") drilled so that the locating holes are each encircled by a raised concentric metal cut-out. The object of the game is to place the five pegs in their holes without them at any time touching the metal surround.

The task is made increasingly more difficult in working from one end to the other because the drilled holes in the mask are made progressively smaller as one proceeds along the array.

PRINCIPLE OF OPERATION

The metal peg, in fact a six-inch wire nail, is picked up using a metal hook which forms one of the two contacts to the circuitry. The other contact is the metal plate. If the two contacts touch, through the metal peg, then the alarm is activated which is indicated by a flashing light on the front panel.

The difficulty factor can be increased by further increasing the distance of the metal plate above the board containing the locating holes.

CIRCUIT DESCRIPTION

The circuit diagram for the Pegboard Game is seen in Fig. 1. It is based on the cheapest digital i.c. available, the 7400, a TTL quad 2-input NAND gate.

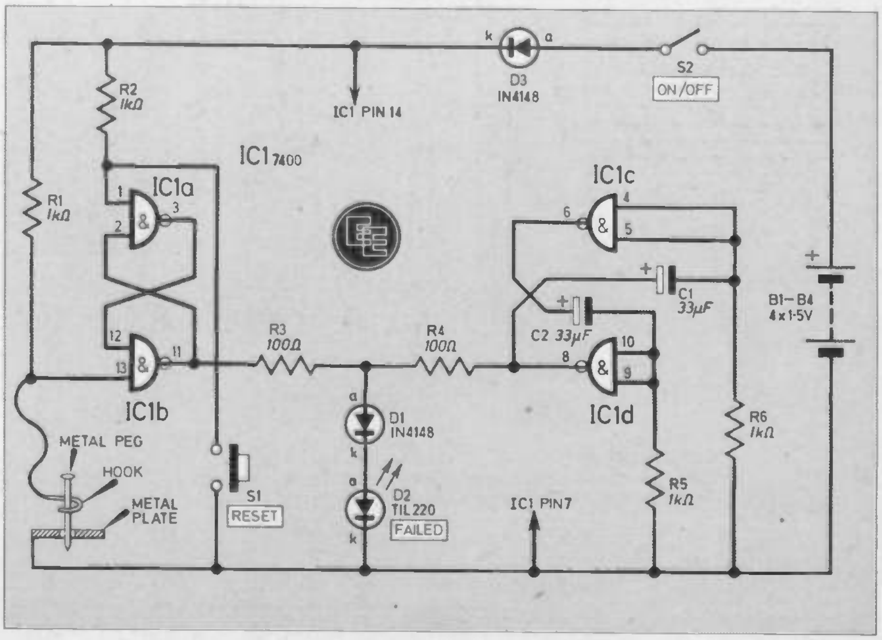
Two of the gates, IC1a and IC1b, are cross-wired to form a bistable latch. This arrangement has two stable states as suggested by its name. Either IC1a output, pin 3 is at logic "high" with IC1b output (pin 11) at logic "low", or vice versa. The states may be transposed by (1) grounding pin 13 when IC1b output is low and (2) grounding pin 1 when IC1b output pin 3 is high. Assuming IC1a output is high, it can be seen that contact between the hook/peg/mask will cause the flip-flop to change state. The output of IC1b is connected to one input of a resistor-diode 2-input AND gate composed of R3, R4 and D1.

PULSE GENERATOR

The remaining two gates of IC1 are capacitively cross-coupled to form an astable multivibrator, that is a pulse generator. The output of this is connected to the second input of the discrete AND gate. Therefore, when the contact is made between peg and plate, a high output is fed to one AND input and the pulses from IC1c and IC1d to the other. The result of this is to cause the l.e.d. D2 to flash on and off at the rate of the astable. This condition indicates that your attempt has failed.

Pressing the RESET switch causes the bistable output, pin 11 to change from high to low which disenables the discrete AND gate and the flashing l.e.d. extinguishes, indicating that the unit is ready for your next attempt.

Fig. 1. The complete circuit diagram of the Pegboard Game.



COMPONENTS

Resistors
R1 1kΩ
R2 1kΩ
R3 100Ω
R4 100Ω
R5 1kΩ
R6 1kΩ
All ¼W carbon ± 5%

See **Shop Talk** page 804

Capacitors
C1, C2 33µF 6V elect. radial (see text)

Semicontors
D1 1N4148 small signal silicon
D2 TIL209 or TIL 220 red l.e.d.
D3 1N4148 small signal silicon
IC1 7400 TTL Quad 2-input NAND gate

Miscellaneous
S1 momentary action push-to-make
S2 single-pole miniature on/off toggle
B1-B4 6V type HP11 4 × 1·5V cells (Duracell preferred)
Stripboard: 0·1 inch matrix size 26 strips × 15 holes; battery holder and clip to suit B1; panel mounting lens for D2; case: size 150 × 80 × 35mm approx., Verobox type 202-21040F, or similar; aluminium for hole "mask", size 100 × 45mm; softwood size 100 × 45 × 15mm (block for locating holes); 6-inch long wire nails (5 off); 6BA fixings (metal) and solder tag; paper clip; extra flexible cable for "hook" lead.

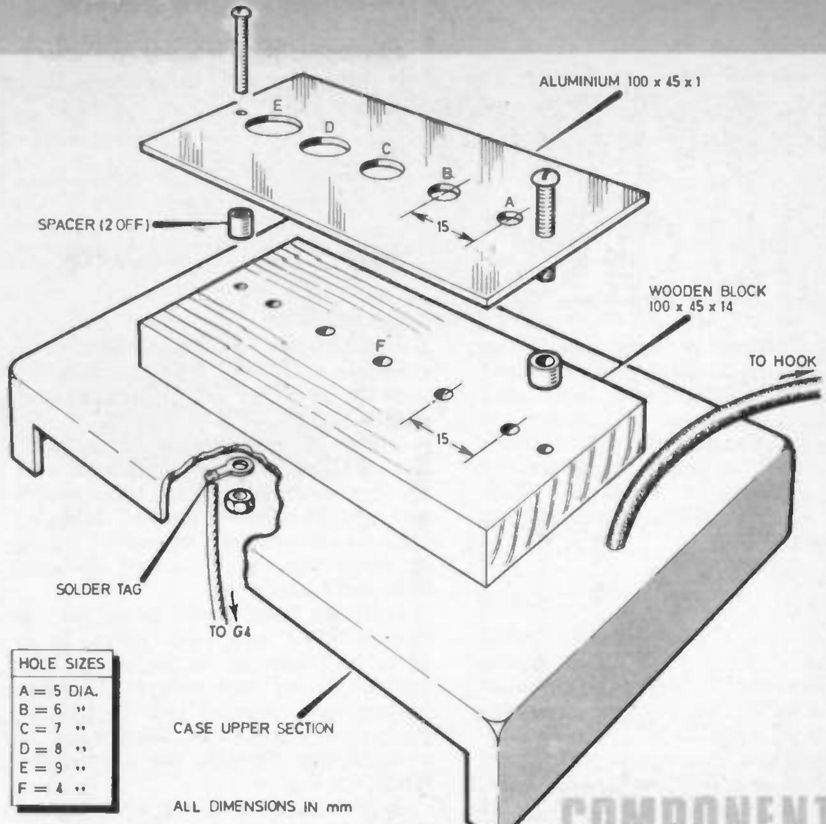


Fig. 3. Construction and mounting details of the locating block and metal mask on the case lid. Increasing the length of the spacers increases the difficulty factor.

COMPONENTS approximate cost £5

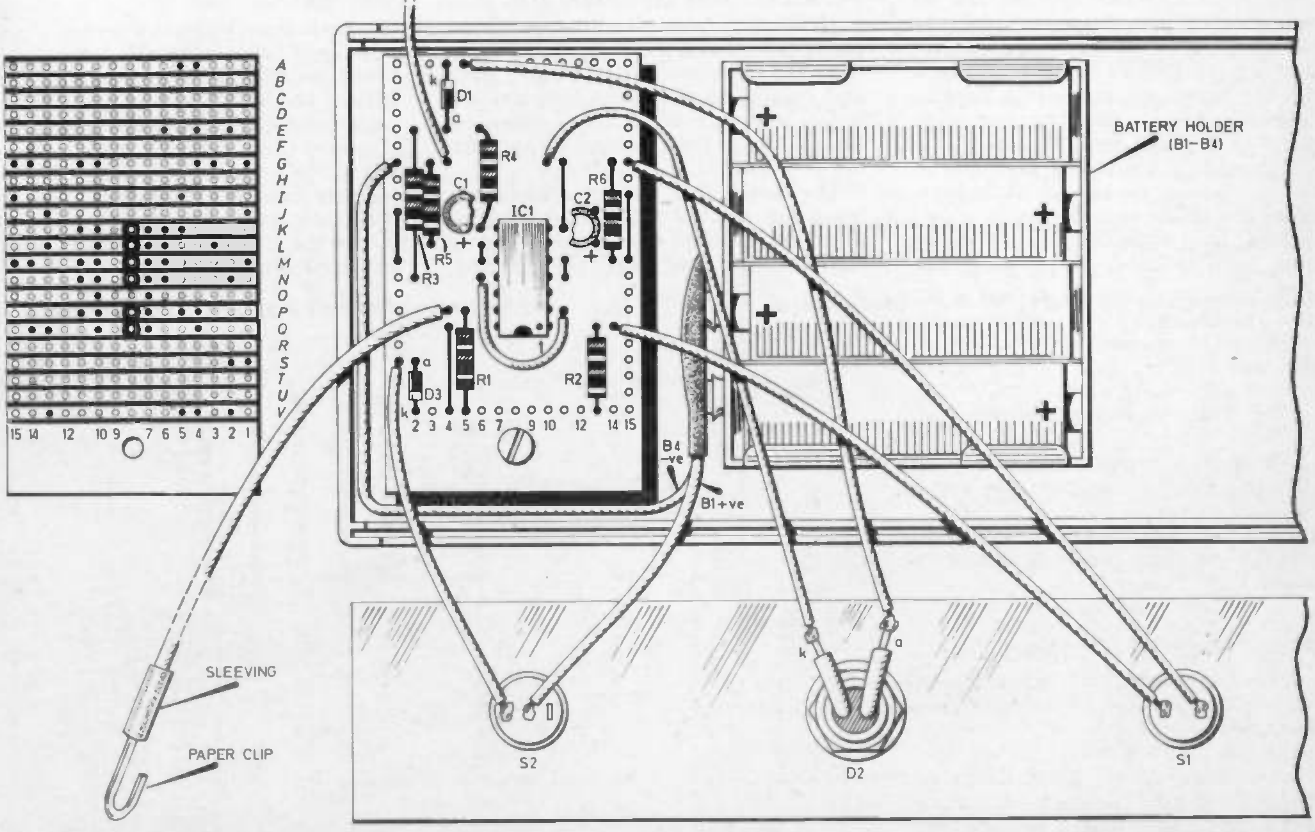
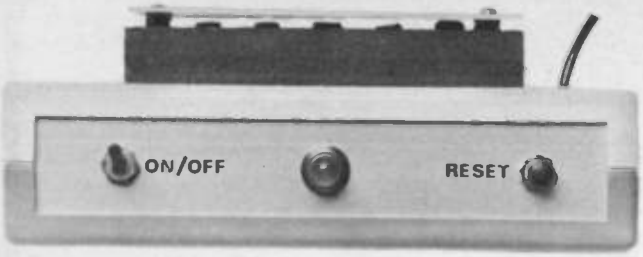


Fig. 2. The layout of the components on the topside of the stripboard, the breaks to be made on the underside and full interwiring details.



Face view of the completed prototype. You can see the metal mask panel sitting above the wooden locating block on the case top.

Battery power in the shape of four HP11 type cells (Duracell version) was found to be suitable and lasted for a long time even with heavy use such as at an exhibition or fête. Diode D3 has been included to reduce the battery voltage to about 5·3 volts which is then within the operating range of the 7400.

ASSEMBLY

The prototype unit was constructed on a small piece of 0·1inch matrix stripboard, size 26 strips × 15 holes. A Verobox Series II type case was found most suitable to house the circuit board and controls since this case easily comes apart, lower and upper sections clip together, and the metal front and rear panels slide out of their retaining slots, as can be seen in the photograph.

The inclusion of an i.c. socket was not thought necessary but room does exist on the board for a low profile type to be fitted if preferred. Incidentally, this may cost more than the i.c. from some suppliers.

The layout of the components on the topside of the stripboard and the breaks required to be made on the underside are shown together in Fig. 2 with the complete interwiring details. Make the breaks using a spot face cutter or a small twist drill bit and drill two fixing holes. The positions of the latter correspond to the mounting pillars in the specified case.

Radial lead capacitors were used as these were to hand at the time, but adequate space exists for the more common axial lead types to be fitted with the required link wires that may result.

Order of construction is unimportant. Follow Fig. 2 for placement of the components to your convenience and attach suitable lengths of flying lead—p.v.c covered stranded wire—to reach the case mounted components and battery clip.

Drill the front panel to accept the two switches and l.e.d. bezel, fit in place and wire up to the board. The board can be now secured in place in the case, leaving two as yet unconnected leads. The next stage of construction concerns the "pegboard" itself, see Fig. 3.

A 100mm long piece of softwood 45×15mm was used in the prototype. A piece of aluminium size 45×100mm should be prepared next and its fixing holes drilled (6BA clearance). These holes should be used as a template to drill the same through the wooden block, and then the two screwed together.

Mark out the peg holes and drill all the way through the combination with a drill size just large enough to allow the chosen nails to slide in unhindered. Remove the metal plate and enlarge each hole in this, getting larger as you work down the line. In the prototype the enlarged holes were 5, 6, 7, 8 and 9mm in diameter.

The wood was stained with black wood dye and the polished aluminium fitted on top but spaced above by a full 6BA nut. The larger this spacing, the more difficult it will be to successfully complete the task. Use metal fixings for this, long enough to pass through to the underside of the case lid to which the assembly should now be fitted. A solder tag is fitted under one nut to provide the required contact to the metal plate.

Feed the appropriate lead through a hole in the case lid and solder to a section of a paper clip to form the hook for the pegs. Fit the remaining lead to the solder tag to complete.

IN USE

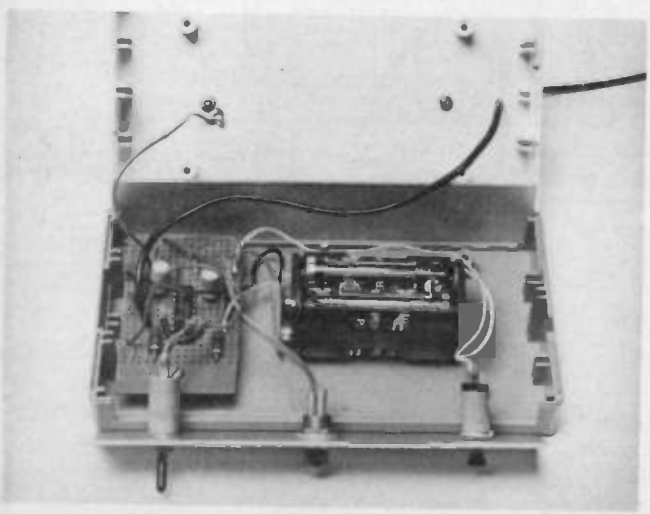
The loaded battery holder can be attached to the case using self-adhesive foam. Push on the battery clip and snap the two sections of the case together. Five 6-inch wire nails were used for the pegs, their tips being filed down for reasons of safety.

They should also be cleaned with a file or some emery paper to make their shafts smooth. Similarly clean the paper clip (hook) to ensure good electrical contact when playing.

If the l.e.d. flashes when the unit is switched on, press RESET to extinguish it. Touch the clip on the metal plate and the l.e.d. should start flashing again, and remain so even after the clip has been removed. Press RESET to begin the game.

With the hook, pick up a peg and try and place it in the hole masked by the largest cut-out, and if successful repeat with another peg in the next position and so on trying to place all pegs without turning on the l.e.d. and also *without* use of the RESET switch. If the l.e.d. comes on before the fifth peg is in place, all pegs successfully placed must be removed before pressing RESET to try again. Numerous other rules for playing this game could be concocted and variations on those outlined above are left to the user to define to suit needs and application at the time ⌑

The prototype with the top section of the case removed.



The finished unit with all pegs successfully placed.

NEW KITS

COMBINATION SWITCH
Battery operated, would control solenoid lock or any electrical device, virtually impossible to decode. Uses no power when in the off position. Complete kit £4.50.

A SECRET SWITCH
Can be hidden behind a panel, door, wallpaper, etc. Will light the lamp or whatever device is secretly controlled and it will also latch itself on. Complete kit £1.95.

3 - 30v VARIABLE VOLTAGE POWER SUPPLY UNIT
With 1 amp DC output, for use on the bench, students, inventors, service engineers, etc. Automatic short circuit and overload protection. In case with a volt meter on the front panel. Complete kit £13.80

IONISER KIT
Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder — complete mains operated kit, case £11.95. post £1.50.

40 WATT AMPLIFIER
Module form. Complete kit (no case) £9.50.

T.V. AERIAL FILTER
Designed to eliminate C.B. and other interference complete

MORSE TRAINER
Complete kit £2.99.

DRILL SPEED CONTROLLER
Complete kit £3.95.

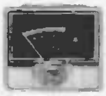
MAINS POWER SUPPLY
Gives any voltage from 3v to 16v at up to 300mA. Complete kit less case £1.95. Case 90p.

SUPER HI -FI SPEAKER CABINETS

Made for an expensive Hi- Fi outfit — will suit any decor. Resonance free. Cut-outs for 6½" woofer and 2½" tweeter. The front material is Dacron. The completed unit is most pleasing. Supplied in pairs, price £6.90 per pair (this is probably less than the original cost of one cabinet) carriage £3.00 the pair.

GOODMAN SPEAKERS
6½" 8 25watt. £4.50. 2½" 8 tweet. £2.50. No extra for postage if ordered with cabinets. Xover £1.50.

Vu METER SNIP.

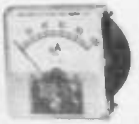


Approximately 1 5/8" square, suitable for use as a recording level meter power output indicator or many similar applications. Full vision front, cover easily removable if you wish to alter the scale. Special snip price £1.00, or 10 for £9.00.

MOTORISED DISCO SWITCH

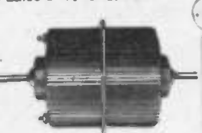
With 10 amp changeover switches. Multi-adjustable switches all rated at 10 amps, this would provide a magnificent display. For mains operated 8 switch model £6.25, 10 switch model £6.75, 12 switch model £7.25.

100uA PANEL METER



Japanese made (Shinohara Electrical) so very good quality, these have a full vision front, are approx. 2" square and come complete with mounting studs and nuts. A thoroughly reliable instrument usually retailed at over £4, offered at a snip price this month of £2.85 or 10 for £25.00.

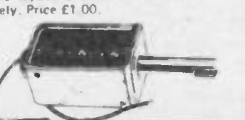
12v MOTOR BY SMITHS



Made for use in cars, these are series wound and they become more powerful as load increases. Size 3¼" long by 3" dia. These have a good length of ¼" spindle — price £3.45. Ditto, but double ended £4.25.

EXTRA POWERFUL 12v MOTOR
Made to work battery lawnmower, this probably develops up to ¼ h.p., so it could be used to power a go-kart or to drive a compressor, etc. etc. £6.90 + £1.50 post.

UNIVAC KEYBOARD BARGAIN
50 computer type keys, together with 5 miniture toggle switches all mounted on a p.c.b. together with 12 i.c.'s many transistors and other parts. £13.50 + £2.00 post. This is far less than the value of the switches alone. Diagram of this keyboard is available seperately. Price £1.00.

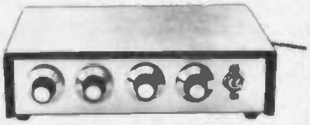


SOLENOID WITH PLUNGER
Mains operated £1.99
10 — 12 volts DC operated £1.50.

MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost anyone. In easy to assemble modular form this should sell at about £30 — but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £16.75 including VAT and post.
FREE GIFT — buy this month and you will receive a pair of Goodman's eliptical 8"x 5" speakers to match this amplifier.

3 CHANNEL SOUND TO LIGHT KIT



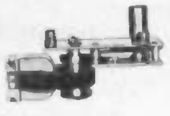
Complete kit of parts for a three-channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four-pin plug and socket facilitate ease of connecting lamps. Special snip price is £14.95 in kit form or £25.00 assembled and tested.

THIS MONTH'S SNIP

YOUR LAST CHANCE TO BUY THIS COMPUTER PRINTER FOR ONLY £4.95

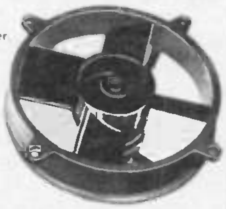
Japanese made Epson 310 — has a self starting, brushless, transistorised d.c. motor to drive the print hammers, print drum — tape forward/reverse and paper feed.
Complete, ready-built with electronics. Brand new still in maker's wrapping - price £4.95 + £1.25. Technical and practical data £1 extra.

SPIT MOTORS



These are powerful mains operated induction motors with gear box attached. The final shaft is a ⅜" rod with square hole, so you have alternative couplingmethods — final speed is approx. 5 revs/min, price £5.50. — Similar motors with final speeds of 80, 100, 160 & 200r.p.m. same price.

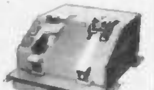
EXTRACTOR FAN



Mains operated — ex. computer
5" Woods extractor £5.75 Post £1.25
6" Woods extractor £6.90 Post £1.50
5" Plannair extractor £6.50 Post £1.25
4" x 4" Muffun 115v. £4.50 Post 50p.
4" x 4" Muffin 230v. £5.75 Post 50p

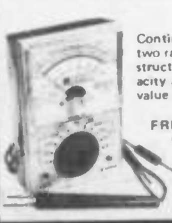
8 POWERFUL BATTERY MOTORS
For models, meccanos, drills, remote control planes, boats, etc. £2.50.

TAPE PUNCH & READER



For controlling machine tools, etc, motorised 8 bit punch with matching tape reader. Ex-computers, believed in good working order, any not so would be exchanged. £17.50 pair. Post £3.00.

MINI-MULTI TESTER
Deluxe pocket size precision moving coil instrument, Jewelled bearings - 2000 o.p.v. mirrored scale.
11 instant range measures: DC volts 10, 50, 250, 1000.
AC volts 10, 50, 250, 1000.
DC amps 0 — 100 mA.



Continuity and resistance 0 - 1 meg ohms in two ranges. Complete with test prods and instruction book showing how to measure capacity and inductance as well. Unbelievable value at only £6.75 + 50p post and insurance.

FREE Amps range kit to enble you to read DC current from 0 - 10 amps, directly on the 0 - 10 scale. It's free if you purchase quickly, but of you already own a Mini-Tester and would like one, send £2.50.

FREE OUR CURRENT BARGAIN LIST WILL BE ENCLOSED WITH ALL ORDERS.

TRANSMITTER SURVEILLANCE
Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox — all electronic parts and circuit. £2.30. (Not licenceable in the U.K.).

RADIO MIKE
Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6.90 comp. kit. (Not licenceable in the U.K.).

FM RECEIVER
Made up and working, complete with scale and pointer needs only a speaker, ideal for use with our surveillance transmitter or radio mike. £5.85.

CB RADIO —
Listen in with our 40-channel monitor. Unique design ensures that you do not miss sender or caller. Complete kit with case, speaker and instructions only £5.99.

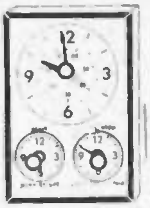
NEW ADDRESS FOR CALLERS:—
2, Bentham Road, Off Elm Grove, Brighton.
Tel: Brighton 671457. Please phone before making a special journey for any advertised item.

VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95. These are new but without case, but we can supply plastic cases (base and cover) £1.75 or metal case with window £2.95. Also available is adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.

STEREO HEADPHONES

Japanese made so very good quality. 8 ohm impedance, padded, terminating with standard ¼" jack-plug. £2.99 Post 60p.



TIME SWITCH BARGAIN
Large clear mains frequency controlled clock, which will always show you the correct time + start and stop switches with the dials. Comes complete with knobs. £2.50.

SAFE BLOCK
Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit. £1.95.

6 WAVEBAND SHORTWAVE RADIO KIT
Bandspread covering 13.5 to 32 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy if you have an amplifier to connect it to or a pair of high resistance headphones. Price £11.95.

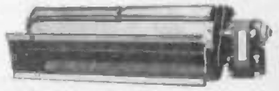
SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginner's model. Price £2.30. Crystal earpiece 65p. High resistance headphones (gives best results) £3.75. Kit includes chassis and front but not case.

RADIO STETHOSCOPE
Easy to fault find — start at the arial and work towards the speaker — when signal stops you have found the fault. Complete kit £4.95.

INTERRUPTED BEAM
This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components — relay, photo transistor, resistors and caps etc. Circuit diagram but no case. Price £2.30

MUGGER DETERRENT
A high-note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2.50 complete kit.

TANGENTIAL BLOW HEATER



2.5 Kw quiet, efficient instant heating from 230/240 volt mains. Kit consists of blower as illustrated, 2.5 Kw element, control switch and data all for £4.95. post £1.50.

12V SUBMERSIBLE PUMP
Just join it to your car battery, drop it into the liquid to be moved and up it comes, no messing about, no priming, etc. and you get a very good head. Suitable for water, paraffin and any non-explosive non-corrosive liquid. One use if you are a camper, make yourself a shower. Price: £8.50.

MINI MONO AMP
On p.c.b., size 4" x 2". Three transistors and we estimate the output to be 3 watt rms. Brand new perfect condition, offered at the very low price of £1.15 each or 10 for £10.00.

J. BULL (Electrical) Ltd.
(Dept. EE), 34 - 36 AMERICA LANE, HAYWARDS HEATH, SUSSEX RH16 3QU.
Established 30 YEARS

MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £10.00, add 60p service charge. Monthly account orders accepted from schools and public companies.
ACCESS & BARCLAYCARD orders phone Haywards Heath (0444) 54563.
CALLERS: to Haywards Heath or 2, Bentham Road, Off Elm Grove, Brighton.
BULK ORDERS: Please write for special quotation.

SQUARE one FOR BEGINNERS

ABBREVIATIONS

Abbreviations are an indispensable "shorthand" and are widely used in text and diagrams.

Some will be very familiar, even to those new to electronics: for example, h.t., d.c., m.w., and f.m.

Others will be completely strange and so the following list will be valuable for reference purposes when reading articles in this and other electronics publications. *Excluded from the present list are those abbreviations that relate specifically to the microcomputing area of electronics.*

COMMON ABBREVIATIONS

It will be noted that the majority of common abbreviations are formed from the initial letter of each word in the term. Small letters separated by full stops are generally used—but capitals if the punctuation demands, as at the commencement of a sentence.

Some abbreviations depart from this general rule, and appear as capitals without full stops. For example, BA, CMOS, DIN and TTL.

UNIT SYMBOLS

"Single-capital" abbreviations are used as symbols for electrical quantities: V (volt), A (ampere) and F (farad), for example.

Prefixes are commonly used with such symbols to divide or to multiply the standard unit, as required:

mV—millivolt (one thousandth of a volt)
kΩ—kilohm (one thousand ohms)
MHz—megahertz (one million hertz)

Note that submultiple indicators are in small letters:

c (centi)
m (milli)
μ (micro)
p (pico)

Multiples use capitals:

T (tera)
M (mega)
but small k is used for kilo.

CAPACITANCE

It will be discovered that there are alternative ways of expressing a particular value or quantity. This applies particularly with capacitance, which is measured in farads (F).

This is much too big a quantity for practical purposes, and the actual values used in practice are submultiples of the farad: pico-farad (10^{-12}F), nanofarad (10^{-9}F) and microfarad (10^{-6}F).

One of the larger values of capacitor frequently encountered in electronics is 100μF. This could also be expressed as 100,000nF or as 100,000,000pF. Clearly the first method is the most sensible.

An intermediate value of capacitance such as 0·01μF equals 10nF or 10,000pF.

The very small value of capacitance of 1pF equals 0·001nF or 0·000001μF.

From all this it will be deduced that smallest values are best expressed in pF's, intermediate values can be in any of the three forms, and larger values in μF. The following table offers general guidance in this respect.

It would be a useful exercise to calculate the equivalents in nanofarads and microfarads for each capacitance range given in Table 1.

TABLE 1

CAPACITANCE RANGE			EXPRESS IN
1pF	to	999pF	pF
1,000pF	to	99,999pF	pF, nF or μF
100,000pF	to	999,999pF	nF or μF
1,000,000pF	and above		μF

ABBREVIATIONS GENERAL LIST

A	ampere (amp)
a.c.	alternating current
a.f.	audio frequency
a.f.c.	automatic frequency control
a.g.c.	automatic gain control
a.m.	amplitude modulation
BA	British Association (nut and bolt sizes)
b.f.o.	beat frequency oscillator
bit	binary digit
C	coulomb
c	centi (÷100)
cm	centimetre
CMOS	complimentary metal oxide silicon
c.r.o.	cathode-ray oscilloscope
c.r.t.	cathode-ray tube
c.w.	continuous wave
d	deci (÷10)
dB	decibel
d.c.	direct current
d.i.l.	dual-in-line
DIN	Deutsche Industrie Nummer
d.p.d.t.	double-pole double-throw
elect.	electrolytic
e.h.t.	extra high tension
e.m.f.	electromotive force
e.m.u.	electromagnetic unit
e.s.u.	electrostatic unit
eV	electron volt
F	farad
f.e.t.	field effect transistor
f.s.d.	full scale deflection
f.m.	frequency modulation
G	giga (x1,000,000,000)
g	gram
H	henry
Hz	hertz (cycles per second)
h.f.	high frequency
h.t.	high tension
i.c.	integrated circuit
i.f.	intermediate frequency
k	kilo (x1,000)
l.e.d.	light emitting diode
l.d.r.	light dependent resistor
l.f.	low frequency
lin.	linear
l.t.	low tension
log.	logarithmic
l.w.	long wave
M	mega (x1,000,000)
m	metre (measurement of length)
m	milli (÷1,000)
mm	millimetre
MOS	metal oxide silicon
m.w.	medium wave
n	nano (÷1,000,000,000)
npn	transistor structure
pnp	transistor structure
op-amp	operational amplifier
p	pico (÷1,000,000,000,000)
p.d.	potential difference
p.i.v.	peak inverse voltage
p-p	peak-to-peak
p.t.f.e.	polytetraflouroethylene
p.v.c.	polyvinyl chloride
r.f.	radio frequency
r.m.s.	root-mean-square
s.p.c.o.	single-pole changeover
s.p.s.t.	single-pole single-throw
s.r.b.p.	synthetic resin bonded paper
s.s.b.	single sideband
s.h.f.	super high frequency
s.w.g.	standard wire gauge
T	tera (x1,000,000,000,000)
t.r.f.	tuned radio frequency
TTL	transistor transistor logic
u.h.f.	ultra high frequency
u.j.t.	unijunction transistor
V	volt
v.c.o.	voltage controlled oscillator
v.h.f.	very high frequency
v.l.f.	very low frequency
W	watt
w.w.	wire wound
X	reactance
Z	impedance
%	per cent
μ	micro (÷1,000,000)
Ω	ohm

MEMOREX CASSETTE TAPES

PRIVILEGED OFFER TO READERS OF EVERYDAY ELECTRONICS

Dear Reader,

OVER 200,000 MEMOREX CASSETTE TAPES AT UP TO HALF LIST PRICE.

We have recently made an exclusive purchase from Memorex of an abnormally large quantity of Memorex Hi Intensity, low noise cassette tapes. In order to reduce our stocks we are, for a short time, offering these to the public at dramatically low prices.

You and your colleagues can buy these cassettes at the following prices:

Playing Time.	List Price.	☆ YOUR PRICE ☆ (incl. VAT)
C60 (30 minutes each side)	£1.29	79p
C90 (45 minutes each side)	£1.79	89p

Wide Dynamic Range.

There is almost certainly someone you know who would be glad to take advantage of this offer. All these cassettes are of extremely high quality, have a wide dynamic range and are designed to be used with all radio recorders, car players and stereo systems. Memorex cassettes are justly famous for their superb hi-fidelity reproduction and it is only by making an exceptionally large purchase that we are able to offer them at these incredibly low prices.

Privileged Prices.

It is possible to buy cheap 'LN' cassettes almost anywhere but cheap cassettes may damage your equipment by shedding oxide and making the delicate record/replay head dirty. They may even let you down by jamming or snapping. The studio quality low noise cassettes we are offering are not cheap, but they are a bargain. They are branded Memorex products and the reputation of this world famous magnetic tape manufacturer is your guarantee of superb quality.

Leda Tapes have been supplying recording tapes to industry, education and the trade since 1964. We are wholesalers and our prices are almost unbelievably low.

Special Quantity Bonus!

If it is possible for you and your friends to make a collective order we will give you a FREE C90 Memorex HI when you spend £10 or more (limited to one FREE cassette per order).

Any quantity may be ordered while stocks last, so why not pass this letter around your colleagues at work or pin it on your staff notice board?

Free Headphones!!

Enhance your listening pleasure with a pair of these dynamic stereo headphones. Elegantly designed they have luxuriously padded ear cushions, and a fully adjustable headband for exceptionally comfortable listening. Their extreme sensitivity and wide frequency range (50-15,000Hz) ensure 'Concert Hall' enjoyment. Ideal for Mono or Stereo they are supplied with a 3 conductor jack plug. Our normal shop price for these dynamic stereo headphones is £11.95 but we will send you one pair absolutely FREE with every 20 MEMOREX cassettes that you pay for.

P.T.O.

OUR REF. LG/A73

Money Back Undertaking.

If delivery takes 1 day longer than you would like - if the cassettes or headphones do not make your hi fi equipment sound better than ever - if you are not entirely satisfied in every respect - then send the items back to us within 30 days of receipt and your money will be refunded, cheerfully and immediately. You and your colleagues can order with confidence.

Reliable, Fast Delivery.

We will not keep you waiting 4 or 5 weeks. Your order will be despatched promptly and will be sent to you by Recorded Delivery. Under normal circumstances you should receive your order within 14 working days, but please allow 21 working days before querying non-delivery.

Please remember - all cassettes are backed by a 5 YEAR REPLACEMENT GUARANTEE and by our 30 DAY MONEY BACK undertaking. But supplies are limited so it's "first come, first served". For your convenience an order form is attached to the foot of this letter.

Yours faithfully,

Peter Rogers

Peter Rogers
Marketing Co-ordinator.

P.S. Remember, we will give you a FREE C90 MEMOREX HI if you spend £10 or more.

P.P.S. Don't forget to claim one set of de-luxe stereo headphones FREE with every 20 MEMOREX HI that you pay for.

Credit Card mail order service
01-607 4420 (Day or Night)

LEDA TAPES

1 HIGHBURY STN., HIGHBURY CORNER, LONDON N5.

Personal shoppers (cash only) may collect from the following pick-up points:

• LONDON W1 – PICCADILLY STATION ARCADE, (HAYMARKET ENTRANCE) • LONDON EC2 – CASSETTE SHOP, MASONS AVENUE, 30 COLEMAN STREET • LONDON EC2 – 137 BISHOPSGATE, (BY LIVERPOOL STREET STATION) • LONDON WC2 – CASSETTE SHOP, LEICESTER SQUARE STATION (TICKET HALL – CRANBOURN STREET EXIT) • LONDON SW1 – 330 VAUXHALL BRIDGE ROAD, (BY VICTORIA STATION) • LONDON EC4 – MANSION HOUSE, STATION (THE BOOKING HALL) • LONDON N5 – CASSETTE SHOP, HIGHBURY & ISLINGTON, (STATION FORECOURT) • LONDON SE14 – CASSETTE SHOP, NEW CROSS GATE STATION • BIRMINGHAM – BULL RING, 20 ST. MARTIN'S HOUSE PARADE (MOOR STREET STATION ENTRANCE) • LEEDS – 62 WELLINGTON STREET • MANCHESTER – 6 VICTORIA STATION APPROACH • BRISTOL – 29 DENMARK STREET • SHEFFIELD – 206 LONDON ROAD • LEIGH-ON-SEA – 113 RECTORY GROVE •

TO: LEDA TAPES, 1 Highbury Station, London N5.

Date: ....

Please provide the following cassettes on 30 day Money Back approval - only orders from U.K. mainland accepted (please read order form carefully before ordering).

Qty.	Size	Type	Price	Total
	C60	MEMOREX HI	79p	
	C90	MEMOREX HI	89p	
	HEADPHONES 1 set FREE with every 20 cassettes paid for.		11.95	

Plus Post & Insurance 95p

TOTAL: ______

I claim the following FREE cassette - 1 C90 MEMOREX HI when I spend £10 or more (limited to 1 FREE per order).

Tick box ☐

I enclose official requisition for invoice (orders of 50+ from Local Authorities/Govt. Depts. only ☐

I enclose Cheque/P.O. ☐

Debit my ACCESS/VISA/TRUSTCARD/BARCLAYCARD NO.

Credit cards not accepted for other products or from personal shoppers. Please give Cardholders home address if using credit card.

....

Address to which goods are to be sent:

NAME: ______________________________

ADDRESS: ______________________________

TOWN: ______________________________

COUNTY: ______________ POST CODE: __________

SIGNATURE: ______________________________

☆LEDA VIDEO LIBRARY☆

Please send me details of the Leda Video Library. No deposit - only £3 hiring - no time limit - over 1200 titles - Beta or VHS. Please print your Name and Address above and tick box ☐

(Please send stamped addressed envelope)

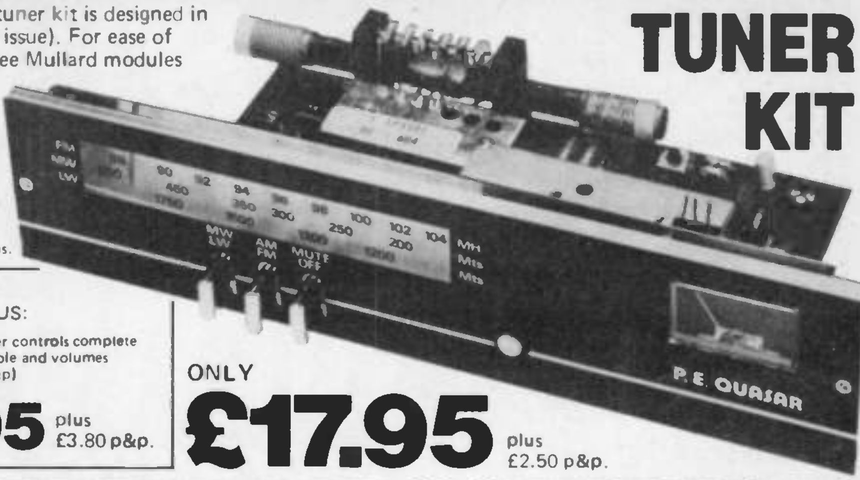
A part of the David Cavalier Limited Organisation. Registered in England No. 1310501

NEW

PRACTICAL ELECTRONICS - STEREO TUNER KIT

This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.

FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabilised power supply with 'C' core mains transformer. All components supplied are to P.E. strict specification. Front scale size 10½"x 2½" approx. Complete with diagrams and instructions.

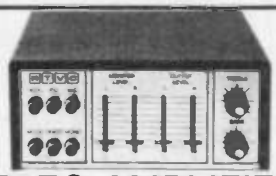


SPECIAL OFFER! TUNER KIT PLUS:

- Matching I.C. 10+10 Stereo Power amplifier kit (usually £3.95 + £1.15 p&p)
- Mullard LP1183 built preamp. suitable for ceramic and auxiliary inputs (usually £1.95 + 70p p&p)
- Matching power supply-kit with transformer (usually £3.00 + £1.95 p&p)
- Matching set of 4 slider controls complete with knobs for bass, treble and volumes (usually £1.70 + 80p p&p)

£21.95 plus £3.80 p&p.

ONLY **£17.95** plus £2.50 p&p.



STEREO AMPLIFIER KIT

- Featuring latest SGS/ATES TDA 2006 10 watt output IC's with in-built thermal and short circuit protection.
- Mullard Stereo Preamplifier Module.
- Attractive black vinyl finish cabinet, 9"x 8¾"x 3⅜" (approx)
- 10+10 Stereo converts to a 20 watt Disco amplifier.

To complete you just supply connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs - tape, speakers and headphones. By the press of a button it transforms into a 20 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus power amp assembly kit and mains power supply. Also features 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia with matching knobs and contrasting cabinet. Instructions available, price 50p. Supplied FREE with the kit.

£14.95 Plus £2.90 p&p.

SPECIFICATIONS: Suitable for 4 to 8 ohm speakers.

Frequency response	40Hz - 20KHz.
Input sensitivity	P.U. 150mV. Aux. 200mV. Mic. 1.5mV.
Tone controls	Bass ±12db @ 60Hz Treble ±12db @ 10KHz
Distortion	0.1% typically @ 8 watts
Mains supply	220 - 250 volts 50Hz.

STEREO MAGNETIC PRE-AMP CONVERSION KIT Includes FREE Magnetic cartridge with diamond styli. All components including p.c.b. to convert your ceramic input on the 10+10 to magnetic. Only available with 10+10 amp. £2.00 includes p&p.

8" SPEAKER KIT Two 8" twin cone domestic speakers. £4.75 per stereo pair plus £1.70 p&p. when purchased with amplifier. Available separately £6.75 plus £1.70 p&p.

PRACTICAL ELECTRONICS CAR RADIO KIT SERIES II

2 WAVE BAND MW — LW

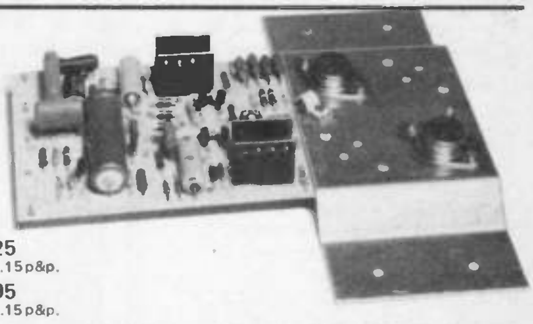
- Easy to build
- 5 push button tuning
- Modern design
- 6 watt output
- Ready etched and punched PCB
- Incorporates suppression circuits.

All the electronic components to build the radio, you supply only the wire and the solder, featured in Practical Electronics March issue. Features: pre-set tuning with 5 push button options, black illuminated tuning scale. The P.E. Traveller has a 6 watt output neg. ground and incorporates an Integrated circuit output stage, a Mullard IF Module LP1181 ceramic filter type pre-aligned and assembled, and a Bird pre-aligned push button tuning unit.

£10.50 Plus £2.00 p&p.

Suitable stainless steel fully retractable aerial (locking) and speaker (6"x 4" app.). available as a kit complete. **£1.95** /pack. Plus £1.15 p&p.

HIGH POWER AMPLIFIER MODULES



READY BUILT OR IN KIT FORM

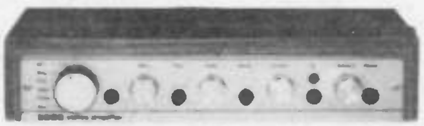
	KIT	BUILT
125 WATT MODEL	£10.50 Plus £1.15 p&p	£14.25 Plus £1.15 p&p.
200 WATT MODEL	£14.95 Plus £1.15 p&p	£18.95 Plus £1.15 p&p.

SPECIFICATIONS:	125 W Model	200 W Model
Max. output power (RMS)	125 watts	200 watts
Operating voltage (DC)	50 - 80 max.	70 - 95 max.
Loads	4 - 16 ohms	4 - 16 ohms
Frequency response measured @ 100 watts	25Hz - 20KHz	25Hz - 20KHz
Sensitivity for 100 watts	400mV @ 47K	400mV @ 47K
Typical T.H.D. @ 50 watts, 4 ohms	0.1%	0.1%
Dimensions (both models)	205 x 90 and 190 x 36mm.	

The power amp kit is a module for high power applications — disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC Board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions.

ACCESSORIES:

Suitable LS coupling electrolytic for 125W model	£1.00 plus 25p p&p.
Suitable LS coupling electrolytic for 200W model	£1.25 plus 25p p&p.
Suitable mains power supply unit for 125W model	£7.50 plus £3.15 p&p.
Suitable Twin transformer power supply for 200W model	£13.95 plus £4.00 p&p.



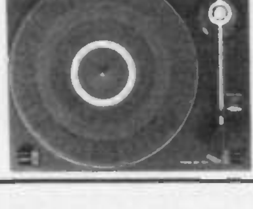
30+30 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet, silver finished rotary controls and pushbuttons with matching fascia, mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30+30 watts RMS, 60+60 watts peak. For use with 4 to 8 ohm speakers.
Size 14¾"x 10" approx.
BUILT AND TESTED.

£32.90 Plus £3.80 p&p.

PHILIPS BELT DRIVE RECORD PLAYER DECK GC037 (Size: 15¼"x 12¼" approx.)

HiFi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge



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COMPLETE
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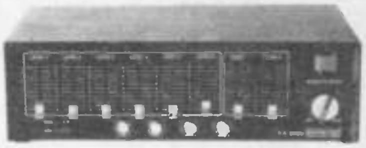
MONO MIXER AMPLIFIERS



50 WATT Six individually mixed inputs for two pick ups (Cer. or Mag.), two moving coil microphones and two auxiliary for tape, tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic and aux inputs. Size: 13¼"x 6½"x 3⅜" app. Power output 50 watts R.M.S. (continuous) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.

£39.95 Plus £3.70 p&p.

100 WATT

Brushed Aluminium fascia and rotary controls.
Size: approx. 14"x 4"x 10¼".

Five vertical slider controls, master volume, tape level, mic level, deck level, PLUS INTERDECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PFL) lets YOU hear the next disc before fading it in.
VU meter monitors output.
100w RMS output (200w peak).

£76.00 Plus £4.60 p&p.

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BOOK REVIEWS

OSCILLOSCOPES—HOW TO USE THEM, HOW THEY WORK

Author Ian Hickman, BSc, CEng, MIEE, MIEEE
Price £3·45 soft covers
Size 220 × 140mm, 122 pages, many illustrated with photographs and two-colour line drawings
Publisher Butterworth & Co Ltd—"Newnes Technical Books"
ISBN 0-408-00472-X

THIS book is just as the title suggests, a guide for all those likely to come into contact with oscilloscopes, working on the principle that the best drivers know a little of what goes on under the bonnet.

It is definitely not a textbook, avoiding complicated mathematics and formulae and caters for varying degrees of technical competence from rank beginners through student technicians to even the graduate engineer.

The book takes the reader through the realms of cathode ray oscillography from the most basic of 'scopes to advanced modular "plug-in" systems and special purpose equipment such as spectrum and logic analysers and storage 'scopes and along the way uses equipment from the major manufacturers as examples to illustrate the features and techniques described. There are also chapters on accessories, probes and cameras, and so on, and the theory of how oscilloscopes actually work.

In conclusion, I would also recommend this book as a buyers' guide to show the potential purchaser just what kind of facilities are available and how to best match these to his individual requirements.

G.P.H.

ELECTRONICS POCKET BOOK (Fourth edition)

Author E. A. Parr
Price £5·60
Size 186 × 122 350 pages
Publisher Newnes Technical Books
ISBN 0 408 00481 9

IN YEARS to come an historian, seeking to trace the history of electronics and the micro-electronics revolution in particular, would do well to study the various editions of this pocket book. First compiled in 1963 when the mainstay of the industry was the simple germanium transistor.

With each succeeding edition, the latest developments appear and are introduced whilst, at the same time, not losing sight of the earlier technology with its "old fashioned image". To read with understanding the details of a new technology usually involves going back-to-basics.

From the basic building blocks of molecules and atoms, through semiconductors—valves, transistors and integrated circuits—the component story, circuits and some of the many applications; it's all here and many a student will be indebted to Mr Parr for his explanations.

To read and understand such things as the digital computer, optoelectronics, servosystems and transducers whilst also getting to grips with the basics of communications—including line transmissions, disc recording, digital and video techniques and broadcasting—together with an all important section on test equipment, power supplies and the associated safety aspects involved. All this will, I am sure, keep this edition off the bookshelf for quite some time, at least until a more detailed reference source is required.

D.J.G.

VIDEO HANDBOOK

Author Ru Van Wezel (UK edition edited by Gordon J. King)
Price £19·90 hard covers
Size 240 × 170mm, 403 pages, many with photographs and line drawings
Publisher Butterworth & Co Ltd—"Newnes Technical Books"
ISBN 0-408-00490-8

THE book covers a very wide spectrum indeed to cater for both the enthusiastic video amateur and advanced studio technician alike and is written in an interesting manner with a mild sprinkling of amusing anecdotes.

It is a book strictly for the dedicated or the professional, however, as all basic theory has been omitted to concentrate on the more serious aspects of broadcasting and creative video.

Amongst the subjects covered are TV standards, cameras, control consoles, recording and production techniques as well as construction advice and circuits for those who wish to enter this field by building their own equipment. Notable absences are Teletext, but strictly speaking this doesn't fall within the scope of the work, and commercially available domestic VCR machines, but again one feels that details on such would rapidly become obselete.

The book was originally published in Dutch and would appear to have lost nothing in translation with all necessary amendments due to differences between Dutch and UK standards having been made.

Not quite the definitive work but nevertheless a comprehensive handbook for those involved in and associated with the growing world of video entertainment.

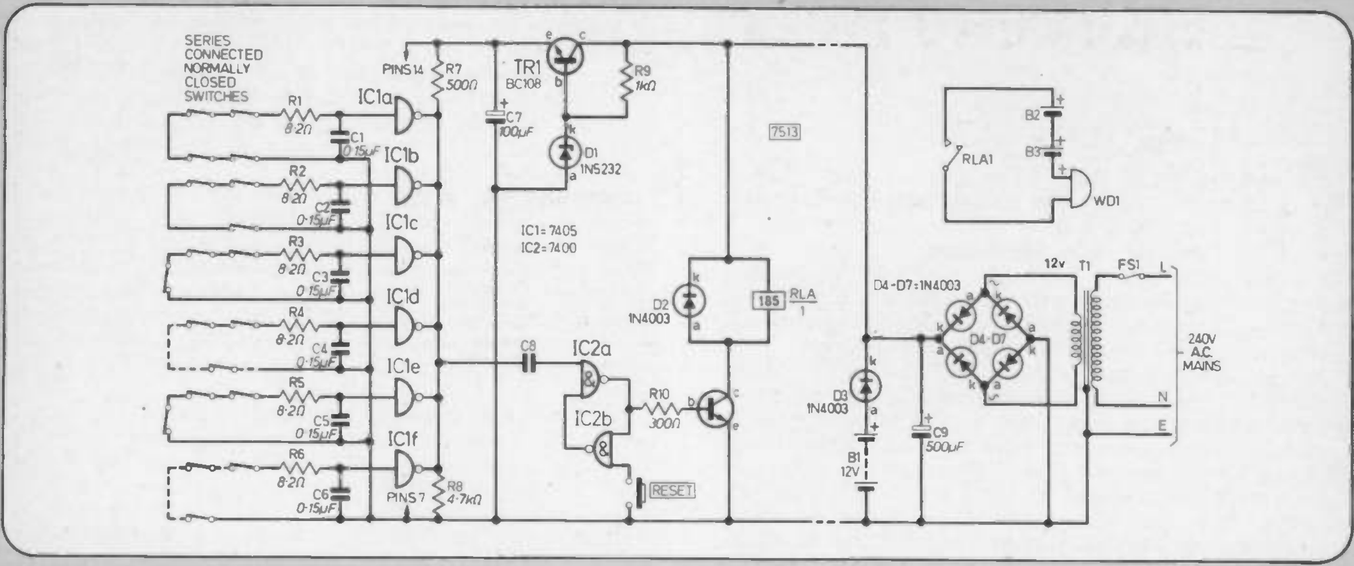
G.P.H.

CIRCUIT EXCHANGE

ECONOMICAL BURGLAR ALARM

I have designed a burglar alarm circuit which is very economical to build. The input is inverted so the high input (due to the closed circuit) give a low output. All the outputs are combined and is fed into a latching circuit comprising of two NAND gates from a 7400. The reset switch can then interrupt the latching circuit by altering the logic state. The alarm is operated by the output of the NAND gates switching a transistor so the connection between the 0V supply and the relay is closed. This operates the relay and in turn the bell or siren.

Gary Partis,
Bedlington, Northumberland.

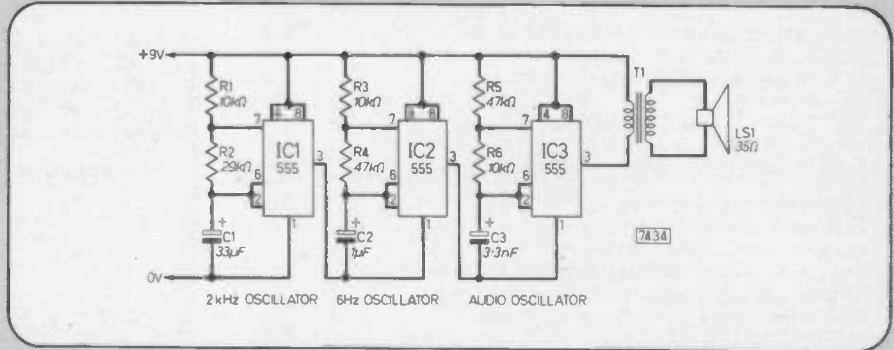


CHIRPING CRICKET

I have been designing audio effects circuitry on breadboard and have come up with this circuit which, with an output transformer to accentuate the output, simulates the sound of a chirping cricket quite accurately.

The values chosen for the components are recommended for best results. Without the output transformer it sounds a bit like a conventional watch alarm.

Michael Vincent,
Feilding, New Zealand.



JACK PLUG & FAMILY...

BY DOUG BAKER

Everyday

ELECTRONICS

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FM Transmitter tuneable 88-108MHz (not licenceable in U.K.)
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KS200
Mini FM Transmitter 88-108MHz 9V DC (not licenceable in U.K.)
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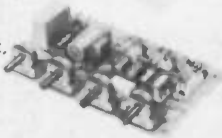
3 Channel Microphone operated sound to light, 300W per channel 240V AC.
£14.43 inc VAT

KS240
3 Channel sound to light, output 3 x 1kW 240V.
£13.70 inc VAT



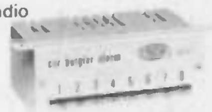
KS260
3 Channel chase light, 1KW per channel, 240V AC.
£11.27 inc VAT

KS262
10 Channel chase light, 300W per channel, 240V AC.
£18.72 inc VAT

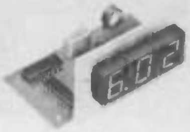
KS452
Car light indicator, audio & visual warning, activated by removal of ignition key, 12V DC.
£8.71 inc VAT

UK380
Digital tuning indicator LW, through to VHF, variable offsets, FM 10.6-10.7-10.8MHz, 262.5-460-455KHz, 240V AC.
£43.47 inc VAT

UK823
Car anti-theft alarm, protects doors, boot, bonnet & radio 12V DC.
£11.70 inc VAT



KS420
Digital DC voltmeter, 999MV-999V .5V DC.
£19.47 inc VAT



KS272
6 channel high power VU display, 300W per channel, 240V AC.
£21.29 inc VAT

UK716
3 channel stereo mixer, inputs, microphone-phono-aux, 240V AC.
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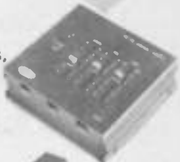
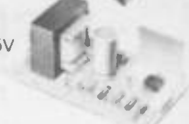


KS490
Nicad battery charger, 10-20-45-100-150mA, 15V DC max, 240V AC.
£9.06 inc VAT



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Stereo pre-amp, treb-bass-midd loudness & volume control 16-25V DC.
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Sound operated switch, 9-12V DC.
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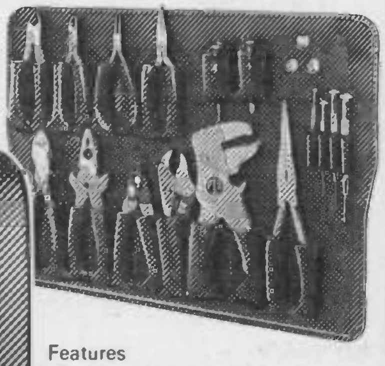

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EE 12

DIY MUSIC & EFFECTS KITS

128—NOTE SEQUENCER
Enables a voltage controlled synthesiser, such as the P.E. Minisonic, to automatically play pre-programmed tunes of up to 32 pitches and 128 notes long. Programs are initiated from the 4-octave keyboard and note length and rhythmic pattern are externally variable.
Kit plus keyboard & contacts SET 76 £114·00

16—NOTE SEQUENCER
Sequences of up to 16 notes long may be pre-programmed by the panel controls and fed into most voltage controlled synthesisers. The notes and rhythms may be changed whilst playing, making it more versatile than the name would suggest.
Kit order code SET 86 £80·95

3—CHANNEL STEREO MIXER
Full level control on left and right of each channel, and with master output control and headphone monitor.
Kit order code SET 107 £19·42

3—MICROPHONE STEREO MIXER
Enables stereo live recordings to be made without the 'hole in the middle' effect. Independent control of each microphone.
Kit order code SET 108 £12·54

6—CHANNEL MIXER
A high specification stereo mixer with variable input impedances. Specs given in our lists. The kit excludes some SW's—see lists for selection. The extension gives two extra channels.
Main kit code SET 90 £39·87
Extension kit ADN 90 £11·74

AUDIO EFFECTS UNIT
A variable siren generator that can produce British & American police sirens, star-trek red alert, heart beat monitor sounds, etc.
Kit order code SET 106 £13·00

AUTOWAH UNIT
Automatically gives wah or swell sounds with each guitar note played.
Kit order code SET 58 £16·89

CHOROSYNTH
A standard keyboard version of the published Elektor 30-note chorus synthesiser with an amazing variety of sounds ranging from violin to cello and flute to clarinet amongst many others.
Kit plus keyboard & contacts SET 100 £114·79

COMPRESSOR
Operates as an automatic gain control, with little distortion and a compression range of about 30db. Has compression level and decay rate controls, and additionally has line and microphone inputs complete with mixing controls.
Kit order code SET 120 £21·98

DRUM SYNTHESISER
Synthesises conventional and extraordinary drum sounds ranging from bass drum through bongos woodblocks & snare drums and way on to sea, thunder & jet-plane whooshes. Can be triggered via a microphone (not incl.), by hitting an existing drum, or by handclaps and shouts. Requires a +12V/0V—12V PSU at approx 40mA.
Kit order code SET 110 £45·30

DYNAMIC NOISE LIMITER
Very effective stereo circuit for reducing noise found in most tape recordings.
Kit order code SET 97 £14·57

EXPOSURE TIMER
Controls up to 750 watts in 0·5sec steps up to 10 minutes, with built-in audio alarm.
Kit order code SET 93 £38·03

FUNNY TALKER
Incorporates a ring modulator, chopper & frequency modulator to produce fascinating sounds when used with speech & music.
Kit order code SET 99 £16·98

GUITAR EFFECTS UNIT
Modulates the attack, decay and filter characteristics of a signal from most audio sources, producing 9 different switchable sounds that can be further modified by manual controls.
Kit order code SET 42 £14·76

GUITAR FREQUENCY DOUBLER
Produces an output one octave higher than the input. Inputs and outputs may be mixed to give greater depth.
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BASIC COMPONENT SETS
Include specially designed drilled & tinned fibreglass printed circuit boards with layout charts, all necessary resistors, capacitors, semiconductors and potentiometers. Most kits include their own power supplies or will operate from 9 volt batteries. They also contain basic hardware such as knobs, sockets, switches, a nominal amount of wire and solder, a photocopy of the original published text, and unless otherwise stated, an aluminium box. Most parts may be bought separately. For fuller kit and component details see our current lists. Kits originate from projects published in Practical Electronics, Everyday Electronics & Elektor.

GUITAR MULTIPROCESSOR
An extremely versatile sound processing unit capable of producing, for example, flanging, vibrato, reverb, fuzz and tremolo as well as other fascinating sounds. May be used with most electronic instruments. Meter & some SW's not included in kit—see list for selection.
Kit order code SET 85 £74·03

GUITAR OVERDRIVE
Sophisticated versatile fuzz unit incl. variable controls affecting the fuzz quality whilst retaining the attack and decay, and also providing filtering.
Kit order code SET 56 £19·75

GUITAR PRACTISE AMPLIFIER
A 3 watt mains powered amplifier suitable for instrument practise or as a test gear monitor. Drives 8 or 15 ohm speakers (not incl. in kit).
Kit order code SET 108 £20·56

GUITAR SUSTAIN
Maintains the natural attack whilst extending note duration.
Kit order code SET 75 £13·30

HEADPHONE AMPLIFIER
For use with magnetic, ceramic or crystal pickups, tapedeck or tuner, and for most headphones. Designed with RIAA equalisation.
Kit order code SET 104 £19·29

METRONOME
Has a 'tick' rate that can be varied between approximately 40 & 240 beats per minute.
Kit order code SET 118 £9·51

P.E. MINISONIC SYNTHESISER
A very versatile 3-octave portable mains operated synthesiser with 2 oscillators, voltage controlled filter, 2 envelope shapers, ring modulator, noise generator, mixer, power supply and sub-min toggle switches to select the functions. A case is excluded, but the text gives comprehensive constructional details.
Kit plus keyboard & contacts SET 38 £100·00

PHASER
An automatically controlled 6 stage phasing unit with internal oscillator. Depth can be increased with extension.
Main kit code SET 88 £18·98
Extension kit ADN 88 £7·68

PHASING UNIT
A manually controlled unit for introducing the phasing effect at the precise moment required.
Kit order code SET 25 £9·56

PULSE GENERATOR
Produces controllable pulse widths from 100NS to 2Sec. Variable frequency range of 0·1Hz to 100KHz.
Kit order code SET 115 £22·29

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RHYTHM GENERATORS
Two different kits—the control units are designed around the M252 and M253 rhythm-gen chips wihch produce pre-programmed switch-selectable rhythms driving 10 effects instrument generators feeding into a mixer.
12-Rhythm Unit SET 103-253 £65·65
15-Rhythm Unit SET 103-252 £58·37

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Compatible with the formant and most other synthesisers.
Kit order code SET 87 £11·98

SIGNAL TRACER & GENERATOR
Allows audio signals to be injected into circuits under test, and for tracing their continuity. Includes frequency & level controls.
Kit order code SET 109 £19·28

SIMPLE WAVEFORM CONVERTER
Modifies a sawtooth waveform to produce triangle and sine outputs.
Kit order code SET 96 £8·25

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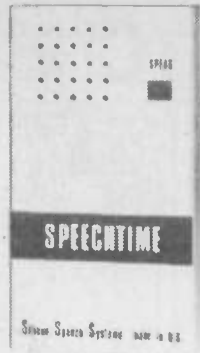

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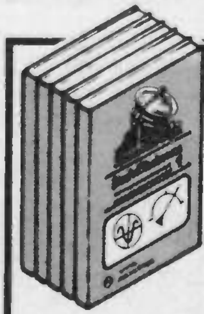

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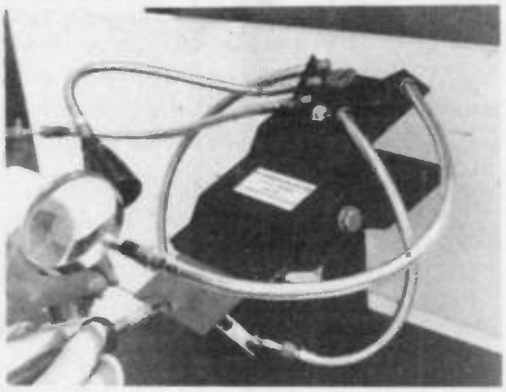

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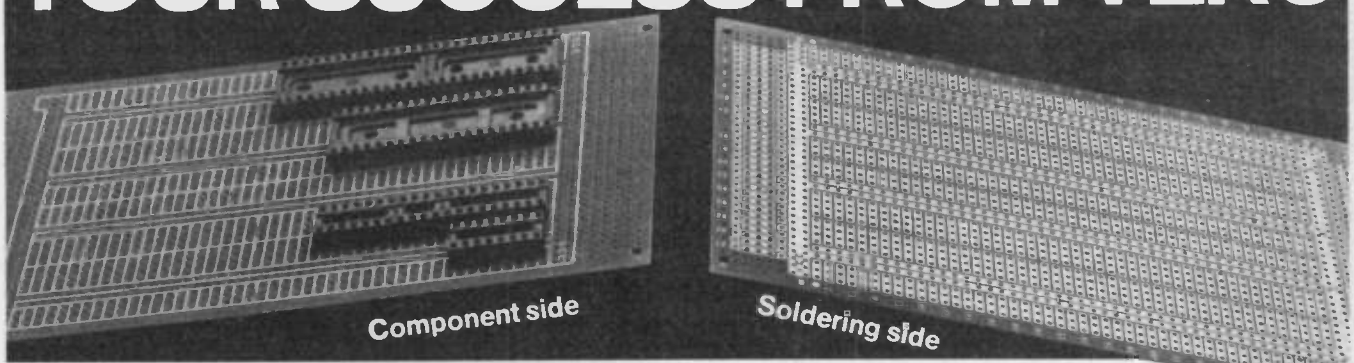

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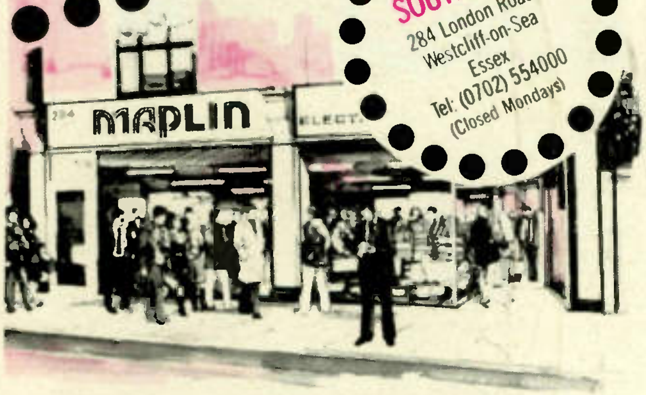

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