Easy to build projects for everyone

Everyday ELECTRONICS

NOV 78
40p

extra SPECIAL SUPPLEMENT CONSTRUCTORS GUIDE

COMBINATION LOCK

AUDIO EFFECTS OSCILLATOR

Ideal for Beginners

GOOD GAME?

Australia 75c South Africa 70c New Zealand 85c Malaysia $2·25

Iron out the little problems...

Model X25 - 25 watts **(illustrated)**

A general purpose iron also with a ceramic and steel shaft to give you toughness combined with near-perfect insulation. Fitted with 1/8" bit and priced at **£4.15** inclusive of VAT and P.&P. Range of 4 other bits available.

Model CX - 17 watts

a miniature iron with the element enclosed first in a ceramic shaft, then in a stainless steel. Virtually leak-free. Only 7½" long. Fitted with a 3/32" bit. **£4.15** inclusive of VAT and P.&P. Range of 5 other bits available from ¼" down to 3/64"

Model SK3 Kit

Contains both the model CX230 soldering iron and the stand ST3. Priced at **£5.99** inclusive of VAT and P.&P. It makes an excellent present for the radio amateur, modelmaker or hobbyist.

Model SK4 Kit

With the model X25/240 general purpose iron and the ST3 stand, this kit is a must for every toolkit in the home. Priced at **£5.99** inclusive of VAT and P.&P.

Model SK1 Kit

This kit contains a 15 watt miniature soldering iron, complete with 2 spare bits, a coil of solder, a heat sink and a booklet, How to solder. Priced at **£6.48** inclusive of VAT and P.&P.

Model MLX Kit

The soldering iron in this kit can be operated from any ordinary car battery. It is fitted with 15 feet flexible cable and battery clips. Packed in a strong plastic envelope it can be left in a car, a boat or a caravan, ready for soldering in the field.

Price **£4.83** inclusive of VAT and P.&P.

Model TCSU1 Soldering Station

The TCSU1 soldering station with either the XTC 50 watt – 24/26 volt soldering iron or the CTC 35 watt soldering iron for pin point precision and exceptionally fast recovery time.
We have put at least twice as much power into irons which are already well known for good recovery time. The temperature control stops them from over-heating; the "fail-safe" electronic circuit provides protection even if the thermocouple fails.
TCSU1 soldering station **£52.65**. XTC and CTC irons **£14.85** inclusive of VAT and P.&P.

...with Antex

The ANTEX multi purpose range of soldering equipment is fast becoming a must for every home. Built with precision for long life, each iron is fully tested and guaranteed.
ANTEX soldering irons are made in England to strict local and international standards of safety.
Our name for reliability is spreading from all over Europe to U.S.A. to Japan and to many other countries.

Stocked by many wholesalers and retailers or direct from us if you are desperate.

ANTEX

Mayflower House, Armada Way,
Plymouth, Devon.
Tel: 0752 67377/8
Telex: 45296

Please send me the Antex colour brochure ☐ I enclose cheque/P.O./Giro No. 258 1000 ☐

Please send the following

Name

Address

Antex Ltd. Freepost, Plymouth PL1 1BR Tel. 0752 67377 EE II

WATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 30p* TO ALL ORDERS UNDER £10·00. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE.

VAT Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 8% to devices marked *. To the rest add 12½%.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday 9.00 am–6.00 pm. Ample Free Car Parking space available.

POLYESTER CAPACITORS: Axial lead type (Values are in μF)
400V: 0·001, 0·0015, 0·0022, 0·0033 7p; 0·0047, 0·0068, 0·01, 0·015, 0·018 9p; 0·022, 0·033, 10p; 0·047, 0·068 14p; 0·10 15p; 0·15, 0·22 22p; 0·33, 0·47 39p; 0·68 45p. 100V: 0·039, 0·15, 0·22, 11p; 0·33, 0·47 19p; 0·68, 1·0 22p; 1·5 29p; 2·2 32p;
DUBILIER: 1000V: 0·01, 0·015 20p; 0·022 22p; 0·047 26p; 0·1 38p; 0·47 48p.

POLYESTER RADIAL LEAD (Values in μF) 250V:
0·01, 0·015, 0·022, 0·027 8p; 0·033, 0·047, 0·068, 0·1 7p; 0·15 11p; 0·22, 0·33 13p; 0·47 15p; 0·68 18p; 1·0 24p; 1·5 27p; 2·2 31p.

FEED THROUGH CAPACITORS
100μF 350V 8p

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μF) 500V: 10 40p; 47 68p; 250V: 100 65p; 63V 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8, 8, 10, 15, 22 8p; 47, 32, 50 11p; 63, 100 27p; 50; 1·0 7p; 50, 100, 220 25p; 470 50p; 1000, 2200 68p; 40V: 22, 33 7p; 100 11p; 3300 62p; 4700 94p; 35V: 10, 33 7p; 330, 470 32p; 1000 49p; 25V: 10, 22, 47 6p; 80, 100, 160 8p; 220, 250 13p; 470, 640 25p; 1000 27p; 1500 30p; 2200 41p; 3300 52p; 4700 94p; 16V: 10, 40, 47, 68 7p; 100, 125 8p; 330, 470 16p; 1000, 1500 20p; 2200 34p; 10V: 4, 100 6p; 640 10; 1000 14p.
TAG-END TYPE: 70V: 2000 88p; 4700 121p; 50V: 3000 75p; 40V: 4000 70p; 2500 65p; 25V: 4700 48p; 2000 37p; 40V: 2000 + 2000 95p; 325V: 200 + 100 + 50 + 100 190p.

TANTALUM BEAD CAPACITORS 35V: 0·1μF, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2μF, 3·3, 4·7, 6·8 25V: 1·5, 10 20V: 1·5 16V: 10μF 13p each 47, 100 40p. 10V: 22μF, 33, 47 6V: 47, 68, 100, 3V: 68, 100μF. 20p each

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01μF 6p
0·015, 0·02, 0·04, 0·05, 0·056μF 7p
0·1μF, 0·15, 0·2 8p 50V: 0·47 11p

CERAMIC CAPACITORS: 50V
0·5pF to 10nF 3p each
15nF, 22nF, 33nF, 47nF 4p each
0·1μF 6p

POLYSTYRENE CAPACITORS
10pF to 1nF 8p; 1·5nF to 47nF 10p.

SILVER MICA (Values in pF) 3-3, 4-7, 6-8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220 9p each 250, 300, 330, 360, 390, 600, 820 10p each
1000, 1800, 2000, 2200 20p each

CERAMIC TRIMMER CAPACITORS
2-7pF, 4-15pF, 6-25pF, 8-30pF 20p

MINIATURE TYPE TRIMMERS
2·5-6pF, 3-10pF, 10-40pF 22p
5-25pF, 5-45pF, 60pF, 88pF 30p

COMPRESSION TRIMMERS
3-40pF, 10-80pF, 25-190pF 25p
100-500pF 38p

POTENTIOMETERS
(AB or EGEN)
Carbon Track. ¼W Log & ½W Linear values
500 Ω. 1K & 2K (lin only) Single 27p
5K Ω-2MΩ single gang 27p
5KΩ-2MΩ single gang D/P switch 60p
5K Ω-2MΩ dual gang stereo 70p

SLIDER POTENTIOMETER
0·25W log and linear values 60mm
5K Ω-500K Ω single gang 70p
10K Ω-500K Ω dual gang 80p
Self Stick Graduated Bezels 22p

PRESET POTENTIOMETERS
Vertical & Horizontal
0-1W 50 Ω—5MΩ Miniature 8p
0-25W 100 Ω—3·3M Ω Horiz 16p
0-25W 200 Ω—4·7M Ω Vert 10p

RESISTORS—Erie make 5% Carbon Miniature High Stability, Low noise

RANGE	VAL	1 99	100
¼W 2-2 Ω- 4·7M	E24	1·5p	1p
¼W 2-2Ω- 4·7M	E12	2p	1·5p
¼W 2-2 Ω 10M	E12	5p	4p
2% Metal Film 10 Ω-1MΩ	8p		4p
1% Metal Film 51 Ω-1M	10p		6p

100 + price applies to Resistors of each type not mixed values.

DO IT DIGITALLY
TTL Test-Bed £20·95 prices incl. Additional Comp. £2·75 VAT & p&p

DPTO ELECTRONICS★
LEDs plus clip
TIL209 Red 13
TIL211 Grn 18
TIL212 Yellow 22
2" Red 15
2" Yellow Green 18
Spare Clips 2
LS400 255
TIL307 695
ORP12 63
2N5777 45
7 Seg Displays
TIL312 C An 3" 105
TIL313 C Cth 3" 105
TIL321 C An 5" 115
TIL322 C Cth 5" 115
D1704 C Cth ·3" 99
DL707 C.A. ·3" 99
FND357 120
MAN3640 175
LCD 3½ digit 915

SWITCHES★
TOGGLE 2A 250V
SPST 28p
DPDT 38p
4 pole on/off 54p
SUB-MIN TOGGLE
SP changeover 59p
SPST on/off 54p
DPDT 6 tags 70p
DPDT c/off 79p
DPDT Biased 115p
SLIDE 250V:
1A DPDT 14p
1A DP c/over 15p
½A DPDT 13p
4 pole c/over 24p
PUSH BUTTON
Spring Loaded
SPST on/off 60p
SPDT c/over 65p
DPDT 6 Tag 85p

JACK PLUGS

	Screened chrome	Plastic body
2·5mm	12p	8p
3·5mm	15p	10p
MONO	23p	15p
STEREO	31p	18p

SOCKETS

	open metal	moulded with break contacts	in line couplers
	8p	20p	11p
	8p	20p	12p
	13p	20p	18p
	15p	24p	22p

	Plugs	Sockets	In Line
DIN			
2 PIN Loudspkr.	11p	7p	18p
3 4 5 Pin Audio	13p	8p	20p
CO-AXIAL (TV)	14p	14p	14p
PHONO		5p single	15p
assorted colours	9p	6p double	20p
Metal Screened	12p	10p 3-way	—
BANANA 4mm	11p	12p	—
2mm	10p	10p	—
1mm	7p	7p	—
WANDER 3mm	9p	9p	—

SWITCHES ★ Miniature Non-Locking
Push to Make 15p Push to Break 25p
ROCKER (white) 10A 250V
SP changeover centre off 30p
ROCKER: (black) on/off 10A 250V 23p
ROCKER: Illuminated (white)
Lights when on: 3A 240V 52p
ROTARY: (ADJUSTABLE STOP) 1 pole/2-12 way 2p/2-6W 3p/2-4W 4p/2-3W 41p
ROTARY: Mains 250V AC, 4 Amp 45p

DIL SOCKETS ★ (Low Profile – Texas)
8 pin 10p; 14 pin 12p; 16 pin 13p; 18 pin 20p; 20 pin 27p; 24 pin 30p; 28 pin42p; 40 pin 55p.

JACKSONS VARIABLE CAPACITORS

Dielectric		0 2 365pF	with
100/300pF	140p	slow motion	
500pF	165p	Drive	325p
6 1 Ball Drive		00 208/176	285p
4511/DAF	115p*	,, ,, with slow	
Dial Drive 4103		motion drive	325p
6 1/36 1	650p*	C804-5pF 10 15	
Drum 54mm	30p*	25 50 pF	175p*
0-1·365pF	245p	100, 150pF	215p*
00 2 365pF	275p	'L' 3 x 310pF	495p
		00·3 x 25pF	430p

DENCO COILS

'DP' VALVE TYPE		RDT2	92p
Range 1 to 5 Bl.,		RFC 5 chokes	91p
Rd., Yl. Wht.	95p	RFC 7 (19mH)	96p
6-7 G.Y.R.	75p	1 FT 13; 14; 15;	
1·5 Green	92p	16; 17	99p
FT' 1 to 5 Bl., Yl.		1 FT 18/1·6	99p
Rd., Wht.	93p	1 FT 18/465	105p
B9A Valve Holder		TOC 1	86p
	25p	MW5FR	82p
		MW/LW 5FR	103p

VERDBOARD★ 0·1 (copper clad) 0·15 (plain) 0·15

2½ × 3½	41p	33p	22p
2½ × 5	49p	45p	28p
3½ × 3½	49p	45p	—
3½ × 5	58p	60p	39p
2½ × 17	152p	121p	75p
3½ × 17	195p	163p	107p
4½ × 17	252p	—	165p
Pkt of 35 pins			30p
Spot face cutter			85p
Pin insertion tool			99p

DIODES

AA119	15
AA15	15
CRO33	157
BY100	24
BY126	14
BY127	14
OA9	75
OA47	12
OA70	12
OA79	12
OA81	15
OA85	12
OA90	6
OA91	6
OA95	8
OA200	9
OA202	8
IN914	4
IN916	5
IN4001/2★	5
IN4003★	6
IN4004/5★	6
IN4006/7★	7
IN4148	4
IS44	20
3A/100V★	18
3A/400V★	20
3A/600V★	27
3A/1000V★	30
6A/600V	50

ZENERS
Range 2V7 to 39V 400mW 9p each
Range 3V3 to 33V. 1·3W 17p each

NOISE
25J 150

★BRIDGE RECTIFIERS
(plastic case)

1A/50V	20
1A/100V	22
1A/200V	25
1A/400V	29
1A/600V	34
2A/50V	35
2A/100V	44
2A/200V	46
2A/400V	53
2A/600V	65
4A,100V	72
4A/200V	75
4A/400V	79
4A/600V	105
4A/800V	120
6A/100V	73
6A/200V	78
6A/400V	85
BY164	56
VM18 DIL	40

SCRs★ Thyristors

1A50V	38
1A100V	42
1A200V	47
1A400V	52
1A600V	70
3A50V	38
3A100V	43
3A200V	60
3A400V	110
3A600V	120
8A400V	120
7A400V	125
8A400V	150
BT106	150
C106D	55
TIC44	25
TIC45	45
2N4444	140

TRIACS★

3A200V	49
3A400V	55
6A400V	70
6A500V	85
8A200V	80
8A400V	73
8A500V	92
10A500V	97
15A400V	105
16A400V	165
16A500V	210
40669	95

DIAC★

ST2	25

TTL 74★

7400	13	7494	78	74193	105	4056	134
7401	13	7495	85	74194	105	4057	2570
7402	14	7496	87	74195	95	4059	480
7403	14	7497	189	74196	99	4060	99
7404	14	74100	119	74197	85	4061	2380
7405	18	74105	82	74198	150	4062	999
7406	38	74107	29	75150	110	4063	110
7407	38	74109	54	75491	75	4066	58
7408	17	74110	54	75492	80	4067	380
7409	17	74111	68	**CMOS★**		4068	22
7410	15	74112	85	4000	15	4069BE	20
7411	20	74116	198	4001	17	4070	32
7412	17	74118	83	4002	17	4071	21
7413	30	74119	119	4006	105	4072	21
7414	51	74120	115	4007	18	4073	21
7416	30	74121	25	4008	87	0475	23
7417	30	74122	46	4009	50	4076	85
7420	16	74123	48	4010	50	4077	40
7421	29	74125	38	4011	18	4078	21
7422	24	74126	57	4012	18	4081	20
7423	27	74128	74	4013	42	4082	21
7425	27	74132	73	4014	86	4085	74
7426	27	74136	73	4015	89	4086	73
7427	27	74141	98	4016	45	4089	150
7428	35	74142	289	4017	85	4093	85
7430	17	74143	314	4018	89	4094	190
7432	25	74145	85	4020	99	4095	105
7433	40	74147	175	4021	91	4096	105
7437	36	74148	109	4022	88	4097	372
7438	33	74150	99	4023	20	4098	110
7440	17	74151	64	4024	66	4099	145
7441	74	74153	64	4026	19	4160	109
7442	68	74154	98	4026	180	4161	109
7443	115	74155	53	4027	45	4162	109
7444	112	74156	80	4028	81	4163	109
7445	94	74157	67	4029	99	4174	110
7446	94	74159	210	4030	50	4175	99
7447	82	74160	82	4031	205	4194	168
7448	56	74161	92	4032	100	4408	720
7450	17	74162	92	4033	145	4409	720
7451	17	74163	92	4034	198	4410	720
7453	17	74164	105	4035	111	4411	995
7454	17	74165	105	4036	325	4412F	1850
7460	17	74166	161	4037	105	4415F	795
7470	28	74167	198	4038	198	4415V	795
7472	25	74170	230	4039	320	4422	545
7473	32	74172	625	4040	105	4433	1180
7474	27	74173	170	4041	80	4435	825
7475	38	74174	87	4042	75	4440	1275
7476	36	74175	87	4043	94	4450	295
7480	48	74176	75	4044	88	4451	295
7481	86	74177	78	4045	145	4490F	695
7482	69	74178	102	4046	128	4490V	525
7483	72	74180	85	4047	87	4501	17
7484	95	74181	165	4048	58	4502	120
7485	106	74182	90	4049	48	4503	69
7486	31	74184	135	4050	48	4506	51
7489	210	74185	135	4051	72	4507	55
7490	33	74188	275	4052	72	4508	298
7491	75	74190	115	4053	72	4510	99
7492	38	74191	105	4054	110	4511	150
7493	32	74192	105	4055	128	4512	98

LINEAR IC's

702	75
709C 14 pin	35
710★	48
723★	45
733★	99
741C★ 8 pin	22
747C★	70
748C★	36
753	150
810	159
8038CC★	335
AY-1-0212	580
AY-1-1313	660
AY-1-1320	305
AY-1-5050	208
AY-1-5051	145
AY-1-6721/6	195
AY-3-8500★	385
AY-3-8710★	850
AY-5-1224A★	295
AY-5-1230★	450
CA3011★	82
CA3018★	68
CA3020	170
CA3023	170
CA3028A★	80
CA3035	240
CA3043	190
CA3046	71
CA3048	280
CA3075	175
CA3080E★	70
CA3081	190
CA3089E	210
CA3090AQ	375
CA3123E	200
CA3130★	85
CA3140★	70
ICL7106E★	950
ICM7206★	1150
LD130★	452
LM3001H	170
LM301A★	30
LM304★	240
LM308	110
LM318★	195
LM324★	79
LM339★	80
LM348★	95
LM379★	375
LM380	95
LM381	145
LM381AN	241
LM382	125
LM1458★	50
LM3900★	60
LM3909N★	70
LM3911★	125
M252AA★	750
M253AA★	795
MC1303	88
MC1304P	260
MC1310	149
MC1312P	195
MC1488★	85
MC1489★	85
MC1495★	395
MC1496	92
MC1710	79
MC3401	88
MC3340P★	150
MC3360P	120
MC724★	175
MFC4000B	85
MFC6040★	97
MK50398★	635
MK50362★	850
MM2102-2★	170
MM2112★	310
MM2112-2★	295
MM5760★	620
NE518A★	260
NE555★	29
NE556DB★	80
NE560★	325
NE561★	395
NE562★	410
NE565A★	185
NE566★	160
NE567★	170
NE571★	450
RAM2102-2★	170
RC4136D★	120
ROM2513★	700
SFF96364E★	1150
SG3402	295
SN76003N	175
SN76013N	140
SN6023N	140
SN76033N	175
SN76115N	215
SN76227	115
SN76477★	225
TAA621AX1	228
TAA960	300
TBA120S	70
TBA540Q	220
TBA550Q	330
TBA841BX11	250
TBA651	180
TBA800	90
TBA810S	99
TBA820	70
TBA920	260
TCA270	220
TDA1022★	575
TDA2020	320
TL071CP★	60
TL081CP★	52
TL082CP★	96
TL084CP★	130
UAA170	198
ZN414	90
ZN424	130

TRANSISTORS

AC117★	35	BC169C	10	BF182★	30	OC28★	99	ZTX109	11	2N3108	39
AC125★	20	BC170	17	BF183★	30	OC29★	160	ZTX300	13	2N3121	40
AC126★	20	BC171	11	BF184★	30	OC35★	80	ZTX301	16	2N3133	43
AC127★	20	BC172	10	BF194	10	OC36★	99	ZTX302	18	2N3135	53
AC128★	20	BC177★	17	BF195	10	OC41★	48	ZTX303	21	2N3250	30
AC141★	24	BC178★	17	BF196	10	OC42★	32	ZTX304	24	2N3252	38
AC141K★	34	BC179★	17	BF197	10	OC43★	55	ZTX311	17	2N3302	35
AC142★	24	BC182	9	BF198	18	OC44★	31	ZTX314	24	2N3442★	131
AC142K★	38	BC182L	10	BF200★	28	OC45★	20	ZTX326	40	2N3563	20
AC176★	18	BC183	9	BF224A	18	OC46★	28	ZTX341	20	2N3614★	169
AC187★	20	BC183L	10	BF244	24	OC70★	19	ZTX500	13	2N3618★	135
AC188★	20	BC184	9	BF256★	50	OC71★	25	ZTX501	14	2N3663	24
ACY17	35	BC184L	10	BF257★	26	OC72★	30	ZTX502	19	2N3702	10
ACY18★	40	BC186	21	BF258★	26	OC76★	36	ZTX503	15	2N3703	11
ACY19★	40	BC187★	28	BF259★	30	OC77★	70	ZTX504	25	2N3704	10
ACY20★	40	BC212	9	BF394	22	OC79★	76	ZTX531	25	2N3705	11
ACY21	35	BC212L	10	BF594	40	OC81★	28	ZTX550	25	2N3706	10
ACY22★	40	BC213	9	BF595	38	OC82★	45	2N526★	58	2N3707	10
ACY28★	40	BC213L	11	BFR39	25	OC83★	43	2N696★	36	2N3708	10
ACY39	78	BC214	9	BFR40	25	OC84★	44	2N697★	21	2N3709	10
ACY40★	48	BC214L	10	BFR79	28	OC122★	48	2N698★	39	2N3710	10
ACY44	39	BC307B	14	BFR80	28	OC123★	48	2N699★	39	2N3711	10
AD140★	70	BC308	13	BFX29★	26	OC139★	85	2N706A★	19	2N3715★	250
AD149★	60	BC328	13	BFX81★	130	OC140★	85	2N707★	50	2N3772★	170
AD161★	42	BC338	12	BFX84★	24	OC141★	85	2N708★	19	2N3773★	288
AD162★	42	BC441★	30	BFX85★	24	OC170★	40	2N914★	32	2N3819	22
AF114★	25	BC461★	30	BFX86★	28	OC171★	40	2N916★	27	2N3820	32
AF115★	25	BC477★	18	BFX87★	23	OC201★	75	2N918★	30	2N3823★	65
AF116★	25	BC547	11	BFX88★	24	OC202★	85	2N920★	51	2N3824★	70
AF117★	25	BC548	11	BFY18★	50	OC203★	85	2N930★	18	2N3866★	90
AF118★	55	BC549	11	BFY50★	20	OC204★	85	2N961★	61	2N3903	18
AF121★	48	BC557	13	BFY51★	20	TIP29	43	2N1131★	22	2N3904	18
AF124★	55	BC558	12	BFY52★	20	TIP29A	44	2N1132★	22	2N3905	18
AF125★	35	BCY30★	57	BFY71★	20	TIP29C	60	2N1302★	35	2N3906	17
AF127★	35	BCY34★	75	BSX20★	18	TIP30	47	2N1303★	50	2N4037★	52
AF139★	35	BCY39★	80	BSY65★	30	TIP30A	47	2N1304★	50	2N4058	17
AF178★	70	BCY40★	78	BSY95★	25	TIP30B	64	2N1305★	28	2N4061	17
AF180★	70	BCY43	75	BSY95A★	25	TIP30C	65	2N1306★	35	2N4064★	120
AF186★	50	BCY58★	22	BU105	140	TIP31★	40	2N1307★	60	2N4236★	145
AF239★	42	BCY59★	22	BU205★	190	TIP31A★	40	2N1308★	48	2N4289	20
ASY26★	40	BCY70★	15	BU208★	225	TIP31B★	40	2N1613★	23	2N4359	85
ASY27★	49	BCY71★	21	E5567	65	TIP31C★	46	2N1671A★	190	2N5135	42
BC107★	9	BCY72★	21	ME4102	18	TIP32★	49	2N1671B★	195	2N5136	42
BC107B★	10	BCY78★	20	ME6002	14	TIP32A★	49	2N1893★	28	2N5138	20
BC108★	9	BD115★	62	MJ400★	90	TIP32B★	70	2N1986★	60	2N5179★	60
BC108B★	12	BD121★	95	MJ491	160	TIP32C★	70	2N2160★	105	2N5180★	60
BC108C★	12	BD123★	98	MJ2955★	95	TIP33★	80	2N2217★	48	2N5191★	65
BC109★	9	BD124★	115	MJE340★	45	TIP33A★	80	2N2218A★	31	2N5305★	24
BC109B★	12	BD131★	38	MJE370★	55	TIP33B★	100	2N2219A★	22	2N5457	32
BC109C★	12	BD132★	38	MJE371★	60	TIP33C★	105	2N2220A★	26	2N5458	32
BC113	17	BD133★	43	MJE520★	45	TIP34★	85	2N2221★	23	2N5459	32
BC114	19	BD135★	36	MJE521★	65	TIP34A★	85	2N2222★	20	2N5485	32
BC115	19	BD136★	37	MJE2955★	95	TIP34B★	110	2N2297	45	2N5777★	45
BC116	19	BD137★	36	MJE3055★	70	TIP34C★	110	2N2303★	45	2N6027	40
BC117	15	BD138★	36	MPF102	38	TIP35★	219	2N2368★	21	40311★	50
BC118	19	BD139★	45	MPF103	36	TIP35A★	225	2N2369★	15	40313★	125
BC119★	20	BD140★	38	MPF104	36	TIP35C★	270	2N2476★	125	40316★	86
BC134	19	BD142★	58	MPF105	36	TIP36A★	265	2N2483★	38	40317★	52
BC135	20	BD145★	198	MPF106	50	TIP36C★	325	2N2484★	30	40324	85
BC136	18	BD222★	60	MPF107	50	TIP41A★	83	2N2646★	48	40326★	52
BC137	20	BD659A★	75	MPSA05★	24	TIP42A★	64	2N2894★	30	40327★	82
BC140★	28	BD696A★	75	MPSA06★	24	TIP42B★	82	2N2904★	22	40347★	80
BC142★	25	BDY17★	195	MPSA12	40	TIP2955★	83	2N2905A★	22	40348★	101
BC143★	25	BDY60★	110	MPSA55	24	TIP3055★	65	2N2906★	18	40360★	43
BC147	7	BDY61★	165	MPSA56	24	TIS43	36	2N2907★	20	40361★	45
BC148	7	BF115★	22	MPSA70	34	TIS44	45	2N2907A★	22	40362★	48
BC149	8	BF154★	25	MPSU02★	58	TIS46	45	2N2926G	10	40407★	50
BC153	14	BF156★	29	MPSU05	48	TIS50	47	2N2926R	8	40412★	83
BC154	14	BF167	25	MPSU06	54	TIS60	45	2N2960	8	40467	95
BC157	10	BF173★	25	MPSU52★	65	TIS62	45	2N2926Y	8	40576★	190
BC158	11	BF177★	24	MPSU55★	53	TIS74	47	2N2926Y	8	40594★	80
BC159	11	BF178★	25	MPSU56★	56	TIS90	18	2N3011★	24	Matched pair add 10p per pair	
BC160	27	BF179★	30	MPU131★	39	TIS91	22	2N3053★	20		
BC167A	11	BF180★	20	OC25★	120	ZTX107	11	2N3054★	49		
BC168C	12	BF181★	30	OC26★	150	ZTX108	11	2N3055★	55		

ROOM THERMOSTAT

Famous Satchwell, elegant design. Intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30 C. Special snip this month £3·25.
ROD THERMOSTAT—£3·00.

WINDSCREEN WIPER CONTROL

Vary speed of your wiper to suit conditions. All parts and instructions to make £3·75.

MICRO SWITCH BARGAINS

Rated at 5 amps 250V. Ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 (two types) for £1·25.

RADIO STETHOSCOPE

Easiest way to fault find, traces, signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Kit comprises transistors and parts including probe tube and twin stetho-set. £3·95.

MULTISPEED MOTORS

Six speeds are available 500, 800 and 1,000 r.p.m. and 7,000, 9,000 and 11,000 r.p.m. Shaft is ¼ in. diameter and approximately 1 in. long. 230/240V. Its speed may be further controlled with the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. × 5 in. long. Price £2.

12V MINIATURE RELAY

dc operated with two sets of change over contacts. The unique feature of this relay is its heavy lead out wires; these provide adequate support and therefore the relay needs no fixing; on the other hand there is a fixing bolt protruding through one side so if you wish you can fix the relay and use its very strong lead outs to secure circuit components—an expensive relay; but we are offering it for only 87p each. Don't miss this exceptional bargain!

EXTRACTOR FAN

Ex computers—made by Woods of Colchester. Ideal for fixing through panel—reasonably quiet running—very powerful 2500 rpm. Choice of two sizes 5" or 6½" dia. £4·43.

MAINS RELAYS

With triple 10 amp changeover contacts—operating coil wound for 230V a.c. Chassis mounting one screw fixing. Price £1·25

MICRO AMPLIFIER

Ex behind the ear hearing aid complete with volume control. £2·10. Case not supplied.

MERCURY BATTERIES

Bank of 7 Mercury cells type 625 which are approx. ⅝in. diameter by ½in. thick in plastic tube giving a total of 10·7V.
Being in a plastic tube it is very easy to break up the battery into separate cells and use these for radio control and similar equipment. Carton of 25 batteries £1·60.

PP3/PP9 REPLACEMENT

Japanese made in plastic container with leads size 2in. × 1½in. × 1½in., this is ideal to power a calculator or radio. It has a full wave rectifier and smoothed output of 9V suitable for loading of up to 100mA. £2·53.

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in. × 18in. £2·50. 13in. × 10in. £1·95.

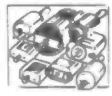
MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer, rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1·95.

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £3·45
Made up model £1·00 extra

8 POWERFUL BATTERY MOTORS



For models, Meccanos, drills, remote control planes, boats, etc. £2.

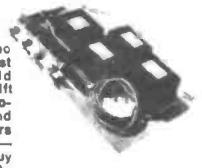
ROTARY PUMP

Self priming, portable, fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertiliser, chemicals, anything liquid. Hose connectors each end. £2.

SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 10, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts £1·94—crystal earphone 35p including VAT and postage.

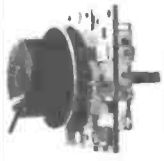
MULLARD UNILEX



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 and complete with a pair of speakers 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 £15 including VAT and postage. 10 watt amps to upgrade unilex £3·50 each.

HUMIDITY SWITCH

American made by Ranco, their type No. J11. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive micro-switch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp. at 250V a.c. Overall size of the device approx. 3⅜ in. long. 1 in. wide and 1⅜ in. deep 75p.

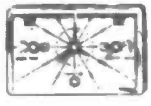


DELAY SWITCH

Mains operated—delay can be accurately set with pointers knob for periods of up to 2½ hrs. 2 contacts suitable to switch 10 amps—second contact opens few minutes after 1st contact 95p.

25A ELECTRIC PROGRAMMER

Learn in your sleep. Have radio playing and kettle boiling as you wake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours independent 60 minute memory jogger. A beautiful unit. £3·50.



MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied Model 1153 500mW, power, output £1·69
Model 1172—10 watts power output £3·94
Model 1172 1W, power output £2·25
Model EP9000 4 watt power output £2·90
EP 9001 twin channel or stereo pre-amp £2·90

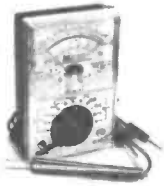
Combination lock
Hot-line game
Water level alarm
Audio effects oscillator

To quickly receive parts for this month projects send the estimated cost as shown in the article and any cost adjustments can be made later.

SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. £9·95.

MINI-MULTI TESTER



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AC volts 10, 50, 250, 1000
DC amps 0-1 mA and 0-100 mA
Continuity and resistance 0-150K ohms.
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IT'S FREE

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—it's an interesting list and it's free—just send S.A.E. Below are a few of the Bargains still available from previous lines.

Pot Cores. These are ex-unused equipment. They contain the bobbins. Three sizes available.

	Diameter	Thickness	Price
FX 2243	4·5 cm	3·0 cm	81p }
FX 2242	3·5 cm	2·3 cm	70p } per pair
FX 2240	2·5 cm	1·6 cm	60p }

Quantity Discounts apply.

Component Panel Ref. 3655. Taken from unused P.S.U.'s, these contain 4 × 2N 3055 power transistors with mica insulators all on heat sink and 4 × 3W type variable pots, preset type with spindle locks. Real bargain at £1·00.

Component Board 421. Again from unused equipment, major items on these are two power silicon transistors, Motor Rola ref. SJ 5433 mounted on a heat sink with mica insulators, also behind the panel are two power rectifiers ST NS 1008. Price 90p.

Heavy Duty 3 Core Appliances Lead. 15 Amp wire 6ft long, conventional yellow green, brown and blue cores, grey pvc outer, prepared ends, this flex normally sells at 30p per metre. 10 leads for £2·50 + 20p. Post £1·00. Good quantity available.

E.H.T. Mains Transformer. With inductance control, normal primary and output voltage 3·5kv. The core, however, is made of a very good quality grain oriented transformer steel, and its flux can be varied by applying a DC voltage to the lower bobbin. We are not sure how much the output voltage may be increased or decreased but using a 9 volt battery we seem to get a rise or fall of about 50 volts. These transformers are unused ex-P.S.U.'s which we are breaking down. Price £4·35.

Music Centre Dust Cover. Size 12" × 10½" × 1½" with attachments for hinging. Price £3·95. Callers only.

Hi Fi Console. This is a pleasingly designed shelving arrangement which could tidy up your equipment, sorry but it's another callers only item but a real bargain at £6·50.

Battery Charger Kit. Soon the dark nights will be with us and chances are your battery will become gradually discharged. Keep it topped up at low cost from the mains. Our kit consists of transformer, full wave rectifier, charging meter and battery clips. Bargain price £4·60.

Electrical Wiring Cables. 2·5mm twin and earth, flat p.v.c. covered grey outer, 100 metre coils, price £15·00. This is the cable you need for ring main circuits but for lighting a smaller 1mm cable will do. We can supply this at £9·00.

Power Packs for the Telephone Answering Machines have just arrived, these isolate the machine from the mains and provide the correct voltages for driving the record and playback motors, etc. On metal chassis with voltage selector and fuse, these have a plastic cover to make them safe. Not new of course but fully guaranteed. Price £5·88.

Telephone Answering Machines. We have sold all last month's delivery and the new lot we find rather varied. There are some without cases, some with slightly broken cases and some which look perfect. The description we gave in last month's newsletter cannot apply to this new lot. So we now restate this as follows:— "Telephone Answering Machine, used, but so far as we can see complete and quite possibly in working order. However, we are allowed to supply these only for breaking up, they should be very suitable for conversion to open reel tape recorder, background music machine, echo chamber, etc. The list of parts contained in the machine are as in our August newsletter (copy on request). They are all untested but we guarantee to replace any major item in the machine should this item be faulty. We are repricing these as follows. Machines less outer case £7·50 with outer case slightly broken but substantially whole £10·50. Machines with unbroken outer cases £12·50 and finally machines with very good, new looking outer cases £14·50. Post £2·00 per machine less case, others £2·50."

Wall Mounting Thermostat. The Satchwell room stat. This will handle mains heaters up to a total of 20 amp and is settable for normal air temperatures between 30-80°F. Suitable also for greenhouse control. Nicely finished in white enamel. Also has a cover to prevent interference with control setting. Price £3·00.

10 r.p.m. Motor with 230v mains coil, not like the usual of these geared motors, this has a good length of ½" shaft price. £3·00 + 20p.

Can Anyone Help US? We are looking for fairly large quantities of the items listed below. If you have any stock yourself or can put us on to a reasonably priced supplier we would be obliged.
7-Segment displays common anode red or green.
BZY88C5V6 Zener.
TIL209 red l.e.d.s.
Soldercon pins.
0·1 inch matrix Veroboard 52 holes × 46 strips.
0·1 inch matrix Veroboard size 34 holes × 34 strips.
CA3130 IC. Operational amplifier 1C.
MPF102. Transistor.
We are also looking for VDU's, oscilloscopes, computers and most instruments. If you know of any surplus please send details or 'phone Mr. J. Bull, 01-688 1833.

Charge Discharge Indication meter. This is a heavy panel mounting instrument made originally for the GPO, rather old design but still we feel will fill an urgent need. Basically the operation of this depends upon a Mercury motor which revolves clockwise or anti-clockwise depending upon whether the batteries are charging or discharging. A pointer shows the state of charge of the batteries at any time. Also fitted within the instrument are auxilliary contacts which could be used to set off alarms like lamps, etc. Price £5·95.

Resettable Fuses (thermal trips). Two new types have come in, one made by ETA is a 6 amp model which is mounted through a single hole rather like a volume control. This is suitable for 250 volts AC or 24 volts DC. Price 54p. 4·5 Amp Model made by AEG is held by two screws thus a bank of these could be mounted between metal straps. Price 54p.

Disc Motor, mains operated. This is very thin in fact less than ½" thick and only approx. 2" dia. Spindle revolves at 250 rpm and the spindle which is approx. 1/32" dia. pushes through so motor could be used to drive clockwise or anti-clockwise. The spindle being a friction fit can be pushed completely out and replaced by your own spindle, a knitting needle for instance. Price only 38p.

75 rpm Mains Induction Motor with gearbox. This motor is quite powerful and has 1⅛" stack and the final 75 rpm drive shaft is 1½" long by ¼" dia. The motor also has a spindle coming from the opposite end to which could be fitted another pulley. Overall size approx. 3" × 5" × 2½" + spindles. Price £3·35.

24 Hour Motor, beautifully made by Sangamo. This is 200-240v mains driven motor with gearbox together in one housing, size approx. 1½" dia. by 1⅛" deep. If you are contemplating making a 24 hour switch with a lot of on/offs, then this is obviously the motor. Price £1·89.

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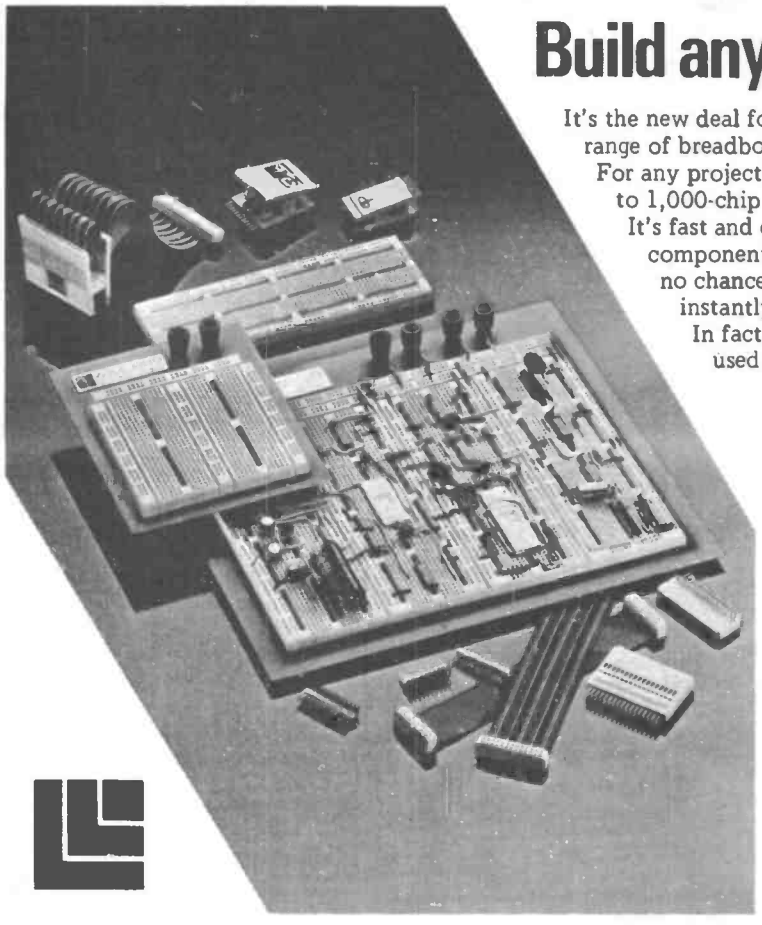

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Goodmans 5" 8 ohm long throw H/D loudspeaker.
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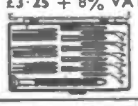

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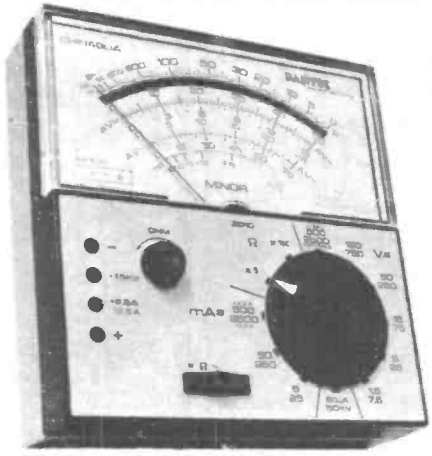

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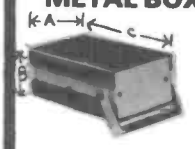

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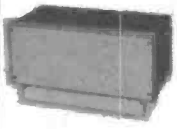

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QT-8S	(1.4 x 1.1 in., 16 terminals)	£1.90
QT-7S	(1.3 x 1 in., 14 terminals)	£1.75
QT-59B	(6.5 x 6.2 in., 20 terminals)	£1.45
AT-47B	(5.3 x 5 in., 16 terminals)	£1.30
QT-35B	(4.1 x 3.8 in., 12 terminals)	£1.15

Protoboard Series

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PB-103	(2250 tie points, 4 binding posts, 24 x 14 DIL capacity)	£34.45
PB-104	(3060 tie points, 4 binding posts, 32 x 14 DIL capacity)	£45.95
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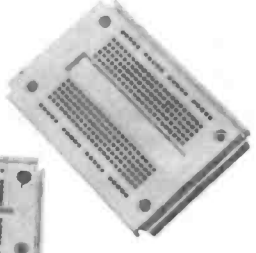

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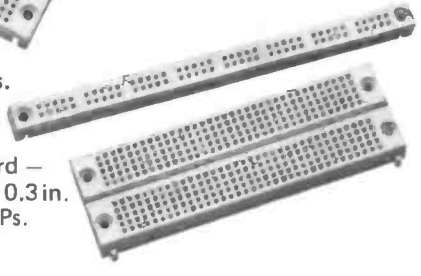

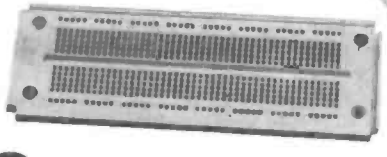

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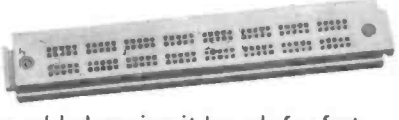

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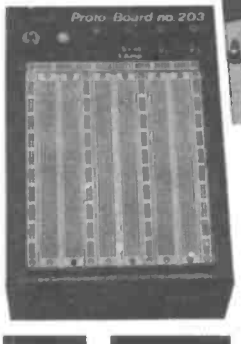

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Projects... Theory...

and Popular Features...

Sitting Pretty might be an apt title for this month's front cover picture of a keen constructor relaxing and enjoying the evidence of his own handiwork.

But as we all know building useful gadgets and instruments is more than a self-satisfying exercise. The end-product is usually of benefit and service to others, as well. The electronics enthusiast is likely to have around his home a variety of working models that substantiate this. And some of these fruits of his own handiwork will be unique, since they were not otherwise available when he built them from published designs.

The *Tele-Tel* is the current example of this. It is right up-to-date, applying modern circuit devices to give an answer to that everyday problem faced by all telephone subscribers—how to keep a check on those mounting costs. *Tele-Tel* shows you just what is building up on your account every time you use the phone. With this evidence it should not be too difficult to instil a sense of brevity (and cost consciousness) into every member of the family, and better still make them contribute their proper share to the quarterly phone bill!

Also in the picture is an *Electronically Controlled Air Freshener* This is something unusual and many readers will seize upon this as a novel and welcome Christmas gift for mum.

If you have a weakness for intricate gadgets or puzzles, our *Combination Lock* will keep you happy for quite a while. This is one of those projects which has to be left open-ended, application-wise. So it offers a challenge to the innovator. Projects such as this add that bit of extra zest to the hobby of electronics.

Those newcomers to electronics who have just joined us and are still in the process of wetting their toes at the shallow end will find more facts about home construction explained in simple terms in *Square One*. Projects recommended for the novice are the *Audio Effects Oscillator* and the *Hot Line*. When completed, these simple designs should supply hours of amusement. And in the making of these projects the newcomer to electronics will gain valuable experience in handling components and assembling them to form complete working models.

There are many approaches to circuit construction and some highly sophisticated methods are employed in industry. The hardware involved is generally available to the home constructor and a wide range of typical commercial aids to building are described and illustrated in this month's special supplement.

Fred Bennett.

Our December issue will be published on Friday, November 17. See page 813 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.

Telephone enquiries should be limited to those requiring only a brief reply. We cannot undertake to engage in discussions on the telephone, technical or otherwise.

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. 7 NO. 15 NOVEMBER 1978

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

SPECIAL SUPPLEMENT

Back issues of EVERYDAY ELECTRONICS June 1977 onwards (October to December 1977, January to March 1978 NOT available) are available worldwide at a cost of 60p per copy inclusive of postage and packing. Orders and remittance should be sent to: Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF.

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tele-tel

SUBSCRIBERS PHONE CALL CHARGE METER

By F. G. Rayer

IN VIEW of the various rates, anyone can be excused from not being able to calculate even the approximate cost of a phone call. The Subscribers Tele-Tel Meter described here overcomes this. It displays the number of units charged on a call for each of the nine inland rates and is readily readjusted if the rates are revised.

A continuous display indicates how the unit charge is mounting.

Dialled calls are provided for at the rates shown in Table 1 where the time periods refer to time bought for one unit (at present 3p). This table was abbreviated and appears on the Tele-Tel front panel.

Table 1. Time bought for one unit (3p) as a function of Rate and Charge Letter.

Rate	Charge Letter *L*	*a*	*b*
Peak Mon–Fri 9 a.m.–1 p.m.	1 min	30 sec	10 sec
Standard Mon–Fri 8 a.m.–9 a.m. 1 p.m.–6 p.m.	3 min	45 sec	15 sec
Cheap All other times	12 min	3 min	1 min

No account has been taken of V.A.T. which should be added at the appropriate rate once the final costing has been carried out.

OPERATION

Operation of the Tele-Tel requires several actions which should be carried out in the following order:

(1) Select RATE
(2) Switch ON
(3) Press RESET
(4) When reply heard switch to START
(5) When receiver is replaced switch to STOP—note charge
(6) Switch OFF.

It is recommended that this be reproduced and placed on the front panel for ease of operation.

If further calls at the same rate are to be made immediately after, return to (3) after (5).

POWER SUPPLY

The current consumption of the Tele-Tel is quite high in the order of 300mA making a battery version out of the question.

The power supply section as seen in Fig. 1 is a conventional regulated type. Mains enters this stage via FS1 and the main on/off switch and appears across the primary of T1, resulting in 6 volt a.c. across the secondary. Half-wave rectification is accomplished by D1 and smoothing by C1 producing a d.c. level of about 7·8 volts across the latter.

Resistor R1 and Zener diode D2 clamps the base of TR1 at 5·6 volts; a 0·6 volt drop across the base/emitter junction of TR1 makes 5 volts available at the emitter, across C2, for powering the remainder of the circuitry.

RATE TIMER

The circuit of the rate timer is shown in Fig. 1 and consists of IC1, a 555 timer i.c. connected as an astable multivibrator. The frequency of oscillation (*f*) is determined by the setting of VR1 to

COMPONENTS approximate cost £15

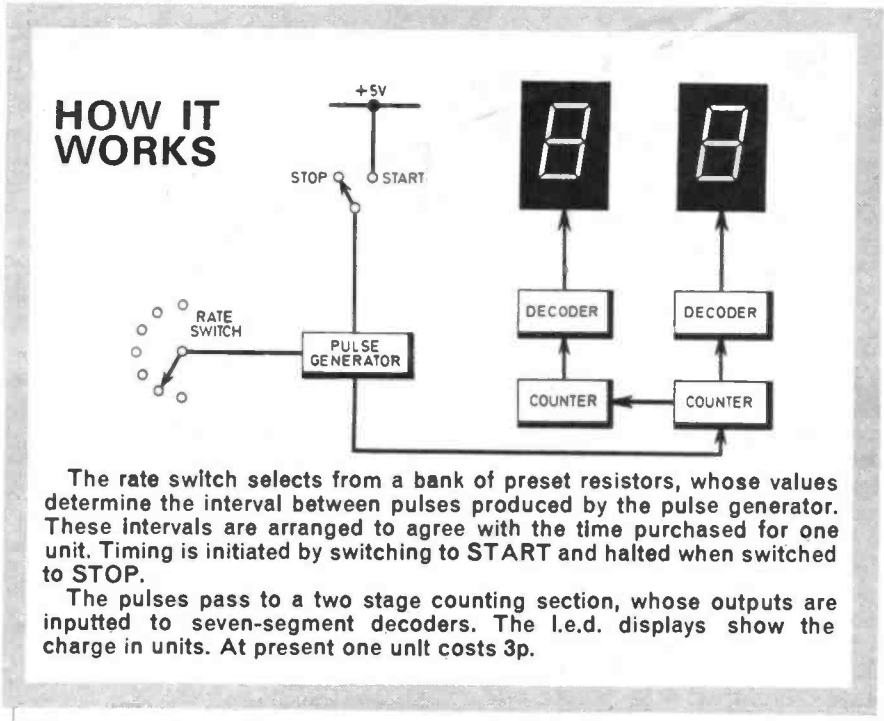
VR8 selected by S2. These values are chosen so that the periodic times of the oscillations ($1/f$) can be trimmed to agree with Table 1 for the nine positions of S2.

Timing commences when S3 is closed, a pulse passing from pin 3 of IC1 to the input (pin 14) of IC2 in the counting section. Further pulses are passed to the counter section at regular intervals, the latter dependent on the setting of S2.

COUNTER AND DISPLAY

The counter/display section is capable of displaying two digits with a maximum count show of 99. If it is expected that a further digit (hundreds) is required, another identical counter/display element similar to IC4/IC5/X2 can be added and its input connected to IC3.

The counting section is composed of IC3 and IC5 series cascaded and counts the number of pulses from the rate timer. One of the outputs from IC5 (this is the units counter), the *D* output, provides a divide-by-ten and this is connected to the input of IC3 which acts as a "tens" counter.



The rate switch selects from a bank of preset resistors, whose values determine the interval between pulses produced by the pulse generator. These intervals are arranged to agree with the time purchased for one unit. Timing is initiated by switching to START and halted when switched to STOP.

The pulses pass to a two stage counting section, whose outputs are inputted to seven-segment decoders. The l.e.d. displays show the charge in units. At present one unit costs 3p.

The output from these counters is in the form of BCD (binary coded decimal) and each is fed to seven-segment decoders / drivers IC2, IC4 wired to seven segment l.e.d. displays X1 and X2 via current limit resistors R6 to R19.

Switch S4 resets the counter to zero when operated. This switch is normally closed and when pressed disconnects the reset pins of IC3 and IC5 causing them to assume a logic 1 (high) level required to reset the devices.

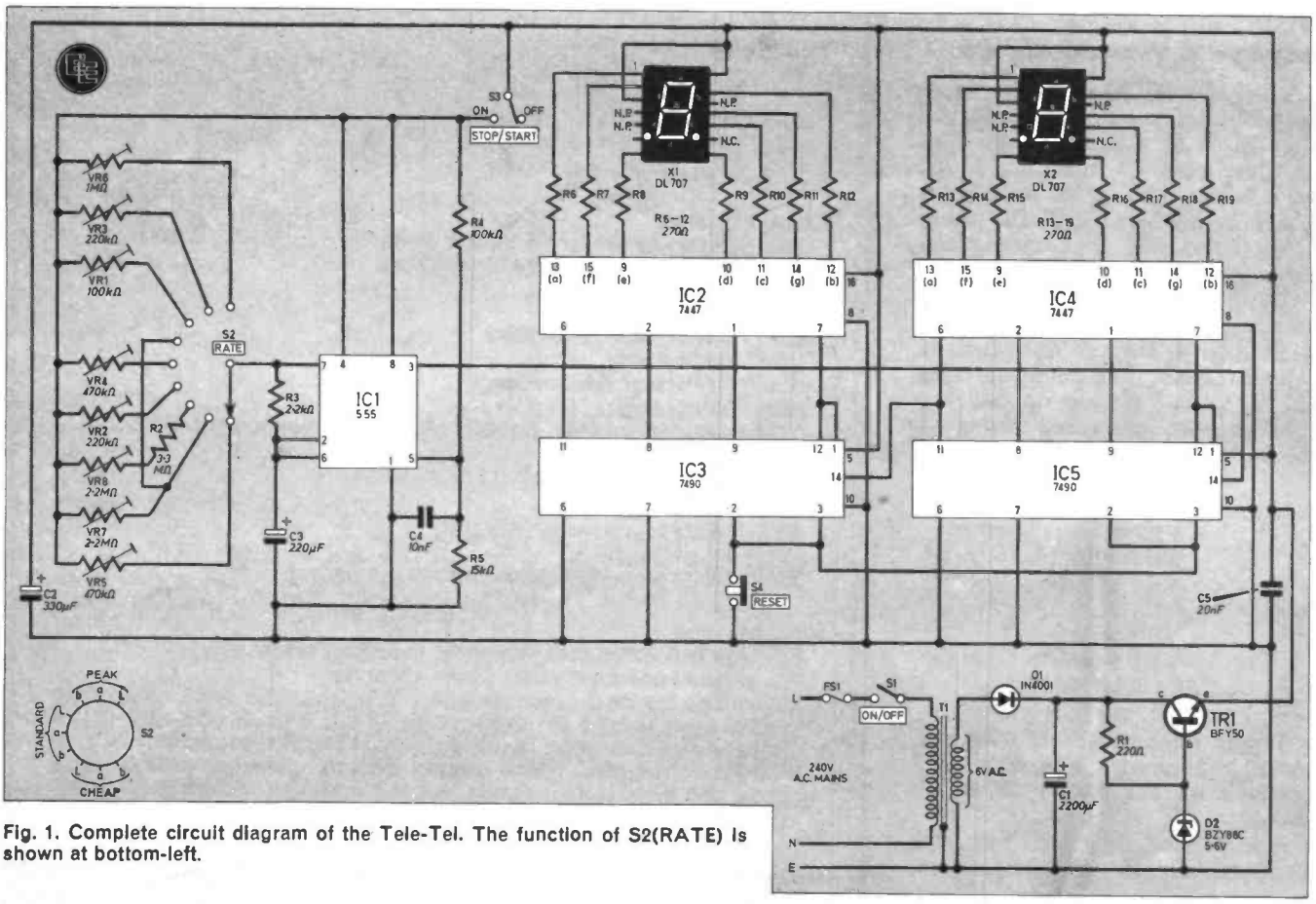


Fig. 1. Complete circuit diagram of the Tele-Tel. The function of S2(RATE) is shown at bottom-left.

CONSTRUCTION starts here

CIRCUIT BOARD

All components except the switches and power supply section are fitted to a piece of 0·1 inch matrix board size 37×33 holes and fitted to the underside of the top panel of a Bimbox type BIM1006, a sloping top case. The layout of the components on the top side of the board and the interwiring on the underside is shown in Fig. 2.

Dual-in-line holders are used for all the i.c.s. and for the l.e.d. displays. The latter have longer pins, (connecting leads), bringing them up through openings in the top panel. When first inserting the i.c.s and displays into their holders, take care that all pins engage correctly and fully, and that the i.c.s and displays are the correct way round.

PRESET POTENTIOMETERS

The holes for locating the preset potentiometers need to be enlarged slightly to accommodate the legs of these controls but should still be a fairly tight fit to hold them firmly in position. Drill the three fixing holes and then mount the presets and i.c. holders.

The presets should be set at the values below, which have been calculated to be close to the required values. These adjustments are an aid for initial setting up and are subsequently corrected using a stopwatch later.

VR1 60kΩ;
VR2 90kΩ;
VR3 180kΩ;
VR4 270kΩ;
VR5 360kΩ;
VR6 750kΩ;
VR7 1·2MΩ;
VR8+R2 4·5MΩ;

Supply lines use 24 to 22 s.w.g. tinned copper wire, and other connections on the board 32 to 30 s.w.g.

A few connections to the i.c. and displays holders will hold them initially. Wiring can then proceed with tinned copper wire. For example, solder the wire to pin 9 of IC2, bring up through the board as shown, pass down through the board close to IC3 to reach pin 1 of IC3, pull the wire taut and solder.

When fitting the tinned copper wire and components, shape the connections with pliers. In many places component leads will reach the i.c. and display pins. Elsewhere, extend them with wire.

Some wires pass very close to others and will require some sleeving to prevent shorting. These are shown on the layout. Do not attach any flying leads at this stage.

POWER SUPPLY

The power supply section is mounted on a separate board, a piece of 0·1 inch matrix perforated board. The layout of the components on the topside of the board and the interconnection on the underside are shown in Fig. 3. Prepare the case to accept the mains cable grommet and fuse holder and fit the completed board with flying leads to the base of the case. The prototype used a self adhesive board holder.

The power supply should be tested before proceeding. The voltage at the emitter of TR1 should be about 5 volts.

COMPONENTS

Resistors

R1	120Ω
R2	3·3MΩ
R3	2·2kΩ
R4	100kΩ
R5	15kΩ
R6-R19	270Ω (14 off)

All ¼ watt carbon ±5%

Potentiometers

VR1	100kΩ
VR2	220kΩ
VR3	220kΩ
VR4	470kΩ
VR5	470kΩ
VR6	1MΩ
VR7	2·2MΩ
VR8	2·2MΩ

All sub-miniature horizontal presets

Capacitors

C1	2200μF 10V elect.
C2	330μF 6V elect.
C3	220μF elect.
C4	10nF plastic or ceramic
C5	20nF plastic or ceramic

See Shop Talk page 790

Semiconductors

D1	1N4001 or similar 1A silicon diode
D2	BZY88C5V6 5·6 volt 400mW Zener
TR1	BFY51 silicon *npn*
IC1	555 timer i.c.
IC2	7447 7-segment decoder
IC3	7490 counter
IC4	7447 7-segment decoder
IC5	7490 counter
X1, X2	7-segment l.e.d. displays type DL707 common anode (2 off)

Switches

S1	mains on/off toggle
S2	1-pole 9-way rotary (see text)
S3	s.p.s.t. toggle
S4	push-to-break, release-to-make button type

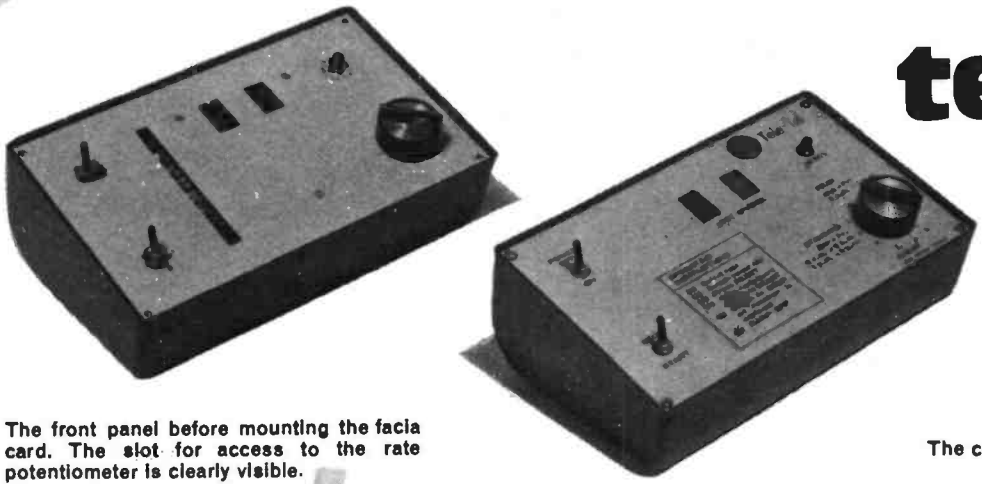
Miscellaneous

FS1	500mA 20mm fuse and panel mounting holder
T1	mains primary/6 volt 0·5 amp secondary

Plain matrix board: 0·1 inch pitch 37 × 33 holes and 27 × 20 holes; dual-in-line i.c. sockets; 16 pin (2 off), 14 pin (4 off), 8 pin (1 off); knob to suit S2; tinned copper wire; insulated connecting wire; case, Bimbox type BIM1006; three-core mains cable; sleeved grommet; mains cable gripper; 6BA countersunk bolts, nut and washers (board fixings).

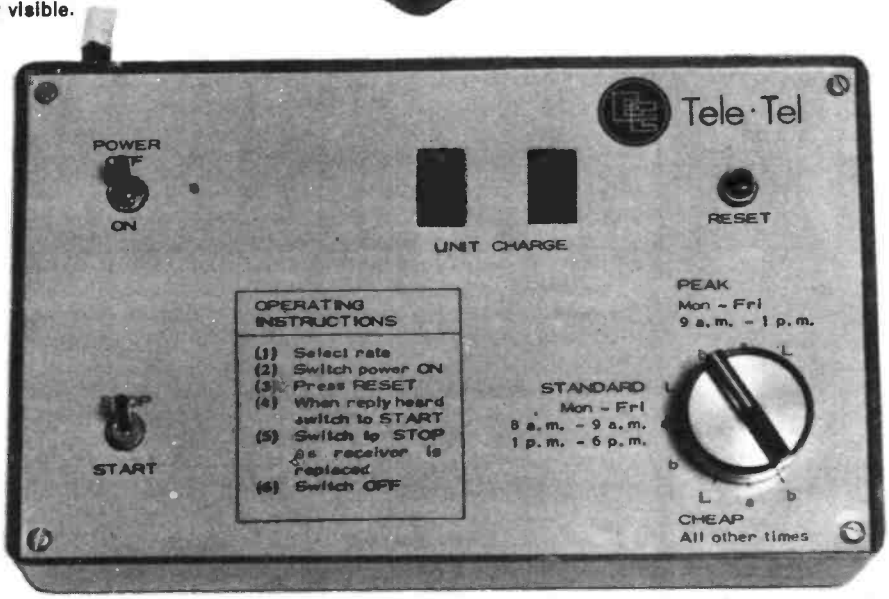
tele·tel

SUBSCRIBERS PHONE CALL CHARGE METER



The front panel before mounting the facia card. The slot for access to the rate potentiometer is clearly visible.

The completed unit ready for use.



Close-up of the front facia showing the front panel lettering and all the important instructions for use.

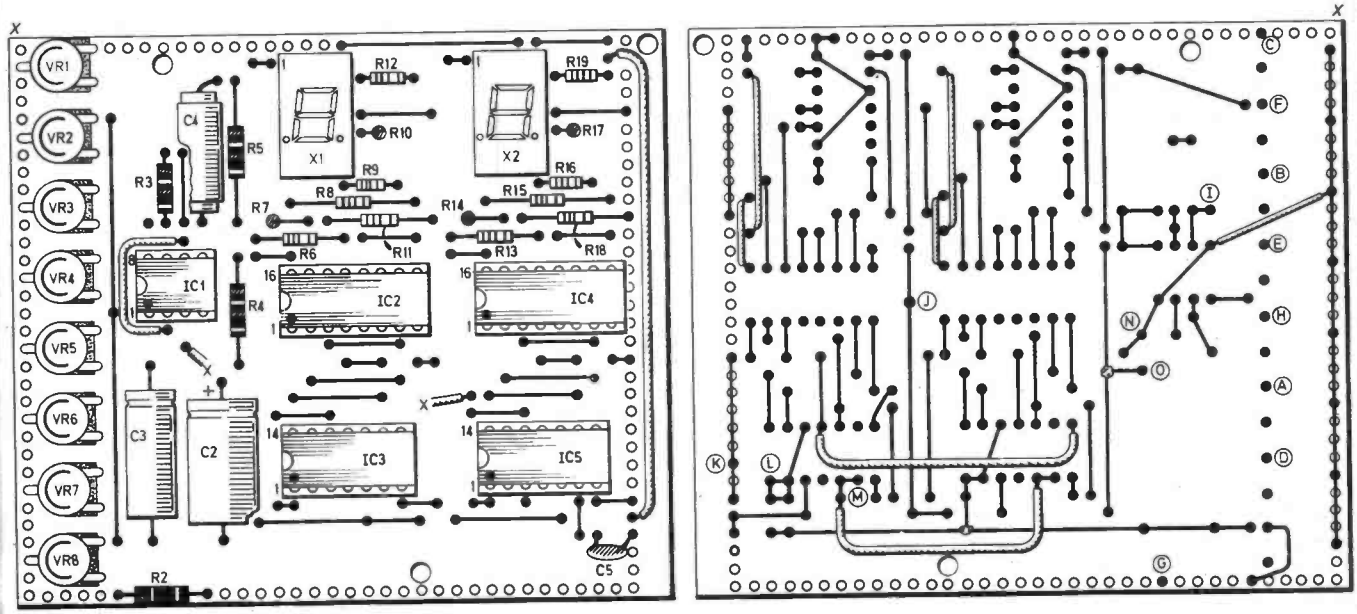
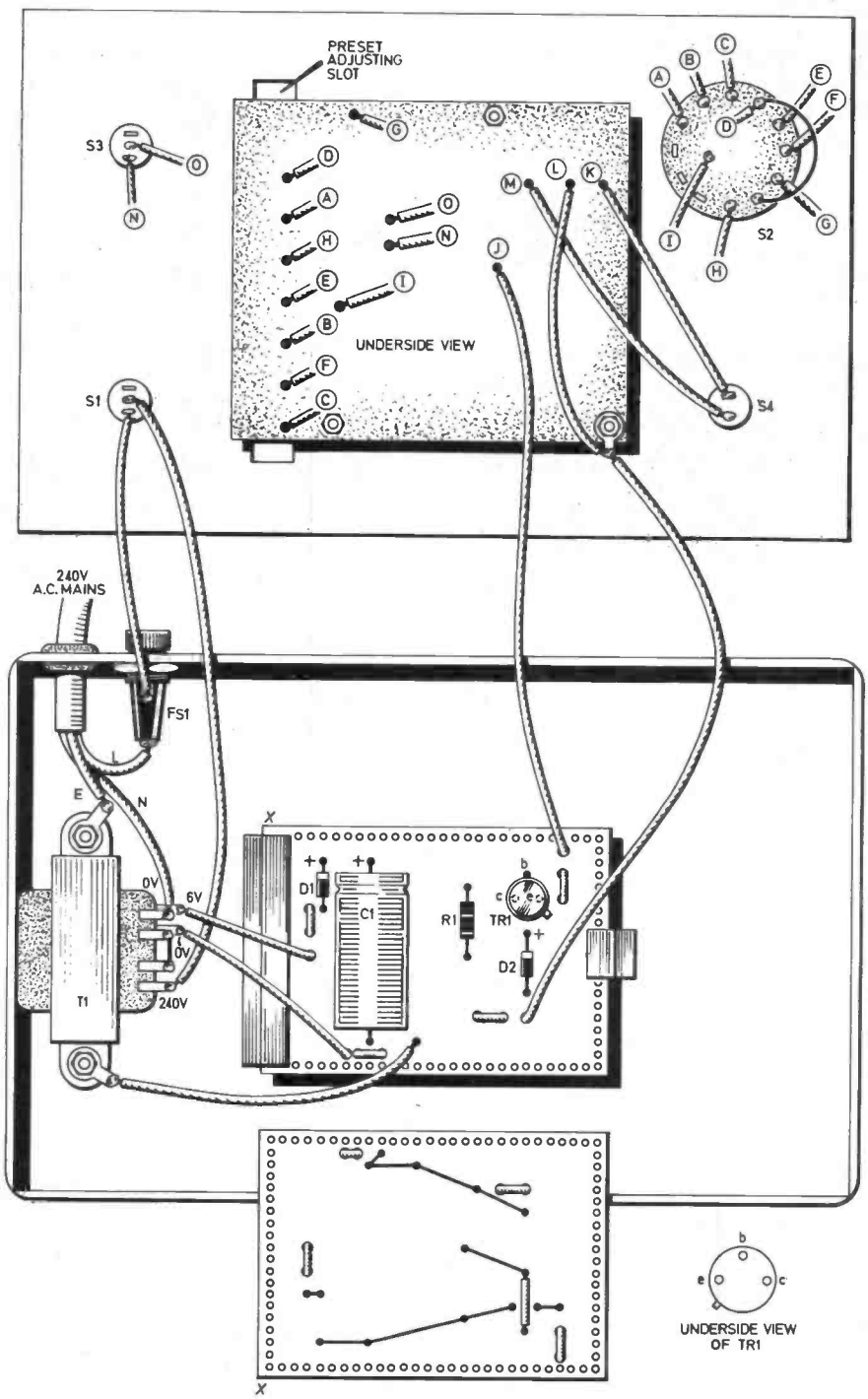


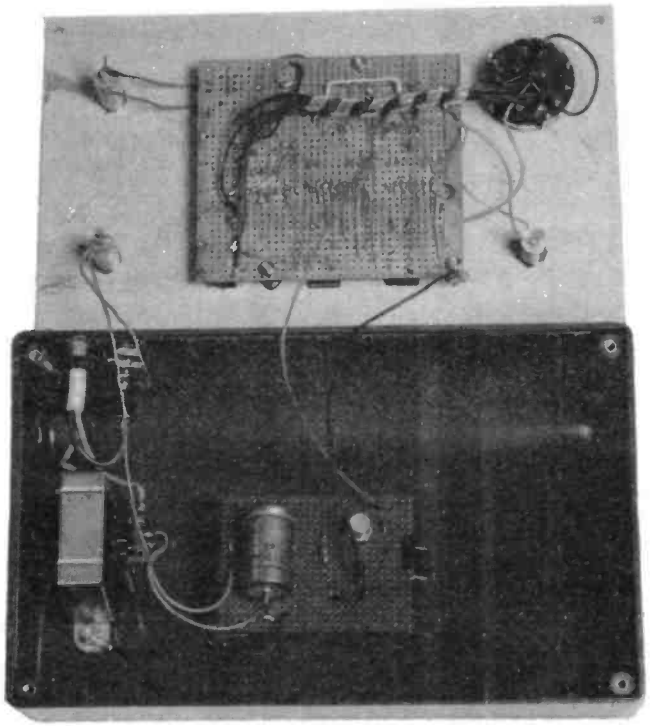
Fig. 2. Top and underside wiring details of the main circuit board. Note that all wiring to the rate switch S2 is made to the underside.

tele-tel

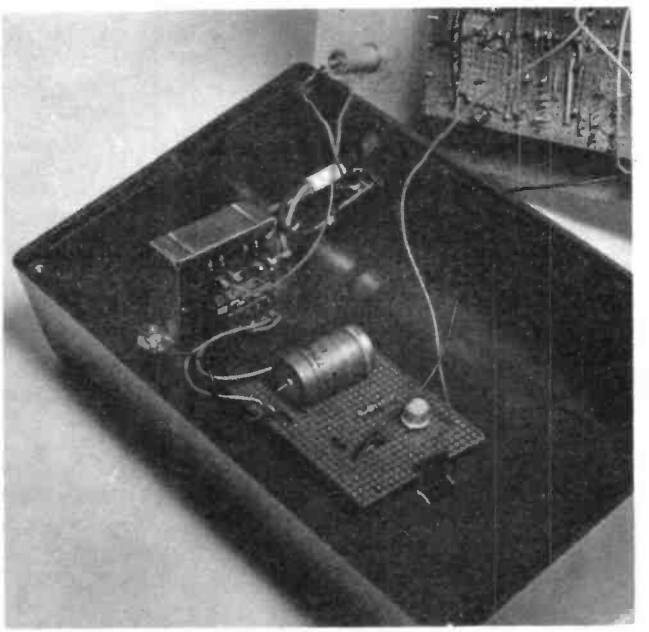
SUBSCRIBERS PHONE CALL CHARGE METER



Figs 3 and 4. Power supply board wiring and interconnection details to the main circuit board. The circuit board is mounted on 12mm spacer to the front panel and the power supply board by self-adhesive clips. The underside of the power supply board is also shown.



The completed Tele-Tel showing the interwiring to the main circuit board and power supply.



Details of the power supply showing fixing of the board and wiring to the mains transformer.

FRONT PANEL

The front panel should next be prepared to accept the panel mounted components including windows for X1 and X2 and board fixings. The long narrow slot has been included to allow access to the presets on the board when setting up and for when the rates are changed by the Post Office.

Next carry out the interwiring according to Fig. 4. and then secure the component board to the underside of the top panel by means of countersunk bolts, nuts and washers to hold the board about 12mm from the panel, as shown in Fig. 4. Alternatively 12mm long spacers can be used.

When the wiring is complete the front panel may be screwed in place and the final timing periods set.

TESTING AND SETTING UP

The displays should light when the power is turned on and indicate "01". Pressing S4 should set both numerals to zero. Counting commences when S3 is closed, the speed of the count depending on the setting of S2.

For timing, individually set VR1 to VR8 in conjunction with S2 according to Table 2.

Table 2. Timing periods as a function of rate and charge letter and presets requiring adjustment to accomplish these times.

Rate	Charge Letter *L*	*a*	*b*
Peak	VR6 (2 min)	VR3 (30 sec)	VR1 (10 sec)
Standard	VR7 (3 min)	VR4 (45 sec)	VR2 (14 sec)
Cheap	VR8 (12 min)	VR7 (3 min)	VR5 (1 min)

For example, with S2, set for a "Standard *a*" call, adjust VR4 so that the display advances one count every 45 seconds.

Pulses from IC1 could be set for other rates e.g. overseas telephone calls making an international Tele-Tel if required. The three remaining positions on S2 should be used, for this or made to cater for operator-connected calls if necessary. Details of these rates and others are found in the booklet entitled Telephone Dialling Codes issued to all telephone subscribers.

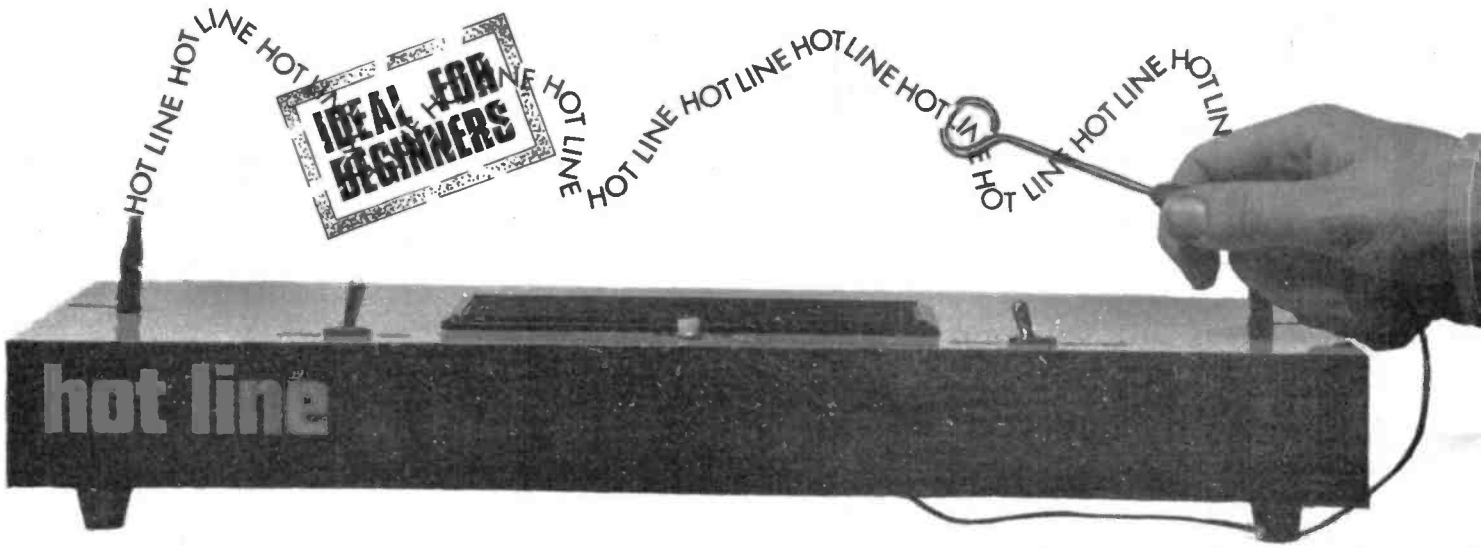
An "opening-out" of adjustments is possible by having a combination of fixed and adjustable resistors in place of VR1 to VR8. This would prove worthwhile on overseas calls where timing is calculated to within 1/100th of a second.

FACIA

A facia needs to be prepared to cover the front panel to mask the adjustment slot. This can be achieved with Letraset on a piece of coloured card, of same dimensions as top panel, and cut-outs made for the displays and switches. These holes should be large enough to fit around the switch fixing nut. The facia is held in place by means of the four fixing screws for the top panel.

To remove the facia when the rates require alteration, remove the panel fixing screws and the knob, and the top panel adjustment slot is exposed. Replace the knobs and re-setting can be carried out without dismantling the unit.

In the prototype a photographic process was used to produce the markings on clear film. This produces a hard glossy finish protecting the markings and allows the colour of the facia to be readily changed when desired. The markings around the switches and operating instruction panel can be seen in the photographs. ⌑



Prove to your friends (and yourself!) that you have a steady hand.

By. P. J. Homer

THIS is a simple and easy project to build which once constructed will bring hours of fun to young and old alike. A wooden case is used thereby keeping the cost of the game down to a minimum.

The object of the game is to get the ring from one end of the line to the other without touching it. If the line is touched an audible tone will be heard—it will linger on for a few seconds and then die out. The player will then have to start over again.

The game also has a light which can be switched in as an alternative to the tone generator when playing, so as not to annoy others who do not wish to join in.

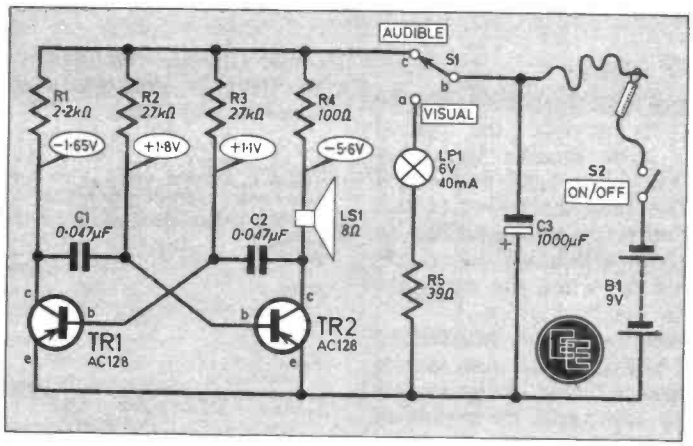


Fig. 1. Circuit diagram of the Hot Line. Voltages are as shown with the ring touching the line, and switched to the AUDIBLE mode.

CIRCUIT DESCRIPTION

The circuit of the Hot Line appears in Fig. 1 and consists of a multivibrator comprising TR1 and TR2. In the normal state no power is applied to this part of the circuit, however, if the ring happens to touch the line, power is momentarily applied to the multivibrator and C3.

For the moment we shall leave the purpose of C3 to later, but first the action of the multivibrator will be described.

Assume that power is applied to the circuit, both transistors will begin to turn on. Due to component tolerances one transistor will turn on faster than the other. For the sake of this explanation we will assume that it is TR1 that turns on the faster. As it does so a current will be sent to the base of TR2 via C1, this effectively turning TR2 off. Thus TR1 turns hard on while TR2 is held in the off state.

When the collector potential of TR1 falls, obviously no further signal can be sent to the base of TR2. Capacitor C1 therefore charges by way of R3 until about 0·6V is present at the base of TR2. This transistor thus begins to turn on supplying a current via C2 to the base of TR1. This action has the effect of turning TR1 hard off, the voltage developed across R1 being used to turn TR2 hard on via capacitor C1. Capacitor C2 then begins to charge through R2 and when about 0·6V is present at the base, TR1 begins to turn on.

A regenerative action similar to that which just occurred will now take place, except that it is TR1

which ends up being turned hard on, and TR2 hard off. The entire action takes place in less time than it does to describe it.

DECAYING VOLTAGE

As we have just said the action of the multivibrator is very rapid, power need only be applied for a few brief seconds. When the ring briefly touches the line, power is applied to the multivibrator, an audible warning is thus given immediately. At the same time C3 charges up according to how long the voltage was applied.

Now when the ring is removed, thus removing power, C3 starts to discharge into the multivibrator, which sets it operating.

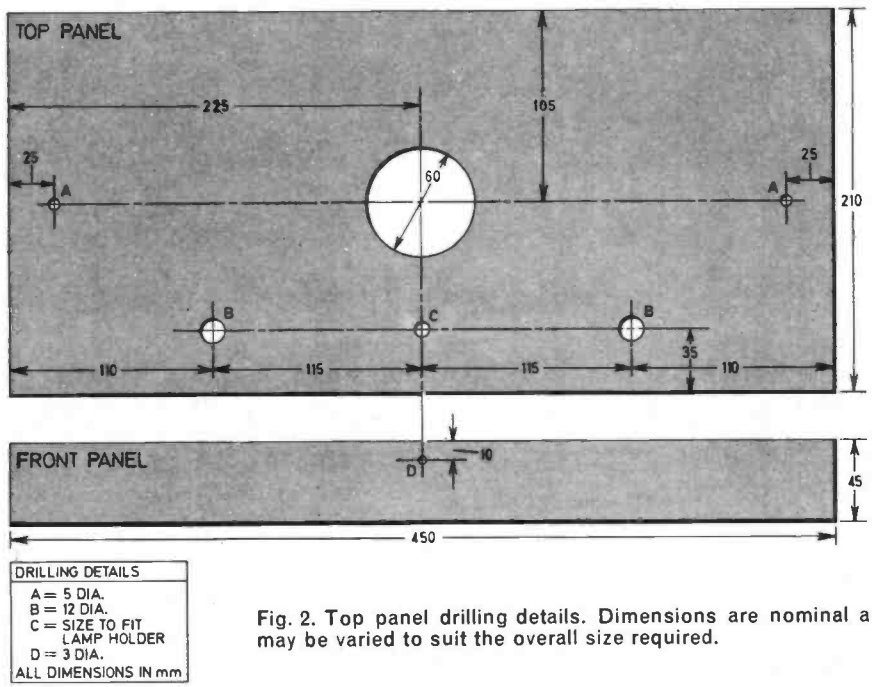


Fig. 2. Top panel drilling details. Dimensions are nominal and may be varied to suit the overall size required.

COMPONENTS

Resistors

R1	2·2k Ω
R2	27k Ω
R3	27k Ω
R4	100 Ω
R5	39 Ω

All ¼W carbon ±10%

See Shop Talk page 790

Capacitors

C1	0·047μF polyester
C2	0·047μF polyester
C3	1000μF 10V elect.

Semiconductors

TR1	AC128 *pnp* germanium
TR2	AC128 *pnp* germanium

Miscellaneous

LS1	8 ohm 75mm diameter speaker
LP1	6V 40mA MES lamp and holder
S1	single pole two-way toggle switch
S2	single pole on/off toggle
B1	9V PP3 battery

Matrix board 0·15 inch matrix 12 × 11 holes; plywood for case, sizes as required; Fablon or similar material; aluminium rod 3mm diameter (an old clothes hanger will suffice); wooden dowl 13 × 90mm; battery clip to suit B1; plastic speaker grille 170 × 85mm; connecting wire: 4BA and 2BA hardware as required; "Terry" clip for mounting B1.

However this time a slowly decaying voltage, due to C3 discharging produces an alarm which decays in volume.

The result is a loud tone to begin with, slowly dying away, this results in a far more pleasing alarm, indicating that the player has failed.

Almost any general purpose transistor can be used for TR1 and TR2, providing they can pass a current of about 100mA. If more suitable, *npn* transistors can be used in which case the polarity of C3 and the battery must be reversed.

CONSTRUCTION starts here

CASE

The prototype case was made from 10mm plywood for the sides and 3mm plywood for the top and bottom. The case has an overall size of 450×210×45mm, although the finished size is up to the constructor, it can be made smaller or larger as required.

The top panel drilling details are shown in Fig. 2. The dimensions are nominal and could be changed to suit the components available. They will also need to be altered if the case is made a different size.

When all the holes have been drilled the entire case may be painted to suit. If you are not too handy with a paint brush then sticky backed paper, Fablon or similar material can be used.

A plastic speaker grill is then fixed in position with 4BA bolts. The speaker can either be bolted using small brackets or can be glued, as in the prototype.

The line was made from 3mm diameter rod, about 750mm long. An old clothes hanger can be used for this purpose. A 2BA screw was soldered on each end, the finished line being bolted in place. The ring was made from the same rod, and had an internal diameter of 15mm Fig. 3. The diameter can be changed to suit the individual, the smaller it is, the harder the game and vice versa. The length used was 200mm. A 13mm diameter dowl was fitted onto the end, a 3mm hole being drilled through the middle to accommodate the rod. The dowl was shaped to look like a handle. The rod may then be glued in place, a length of connecting wire soldered to one end.

An amusing game for young and old alike.

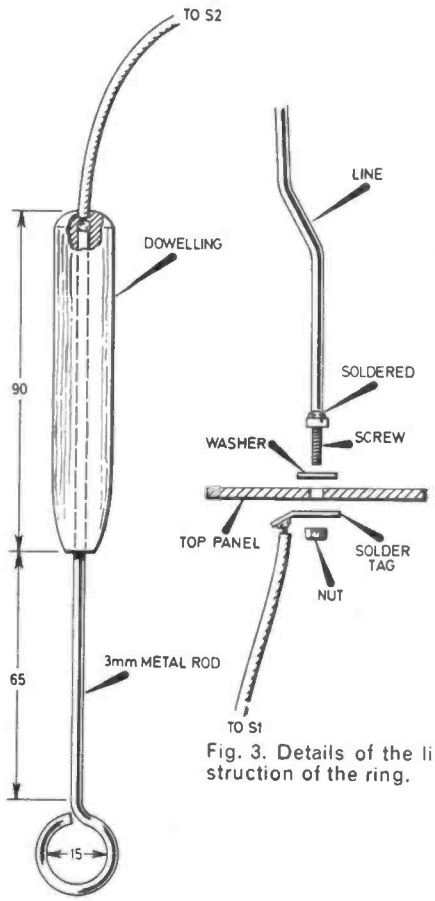
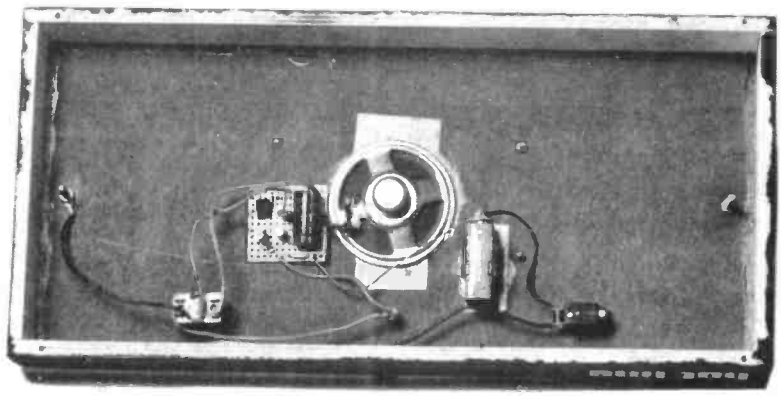


Fig. 3. Details of the line fixing and construction of the ring.



COMPONENTS approximate cost £4.50 excluding case

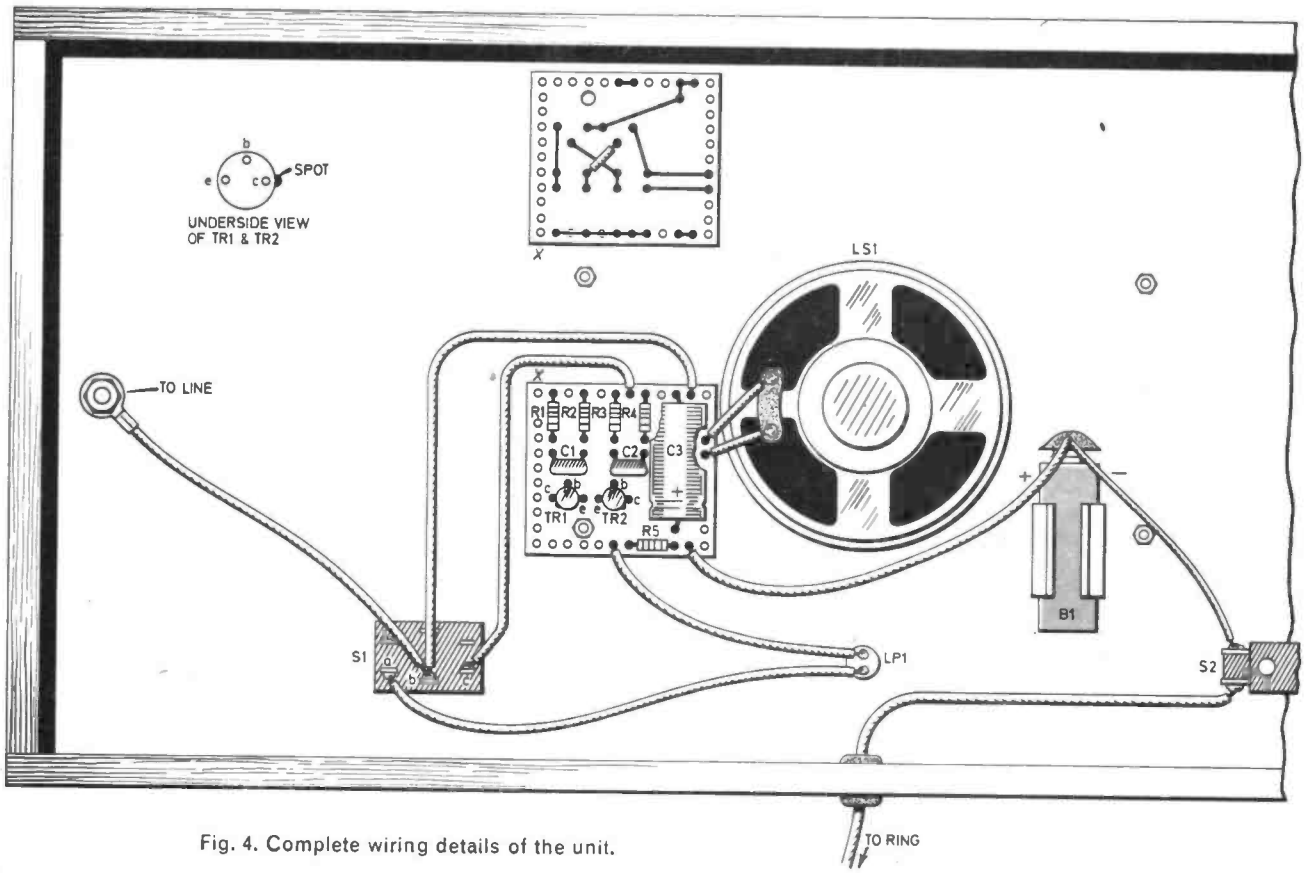
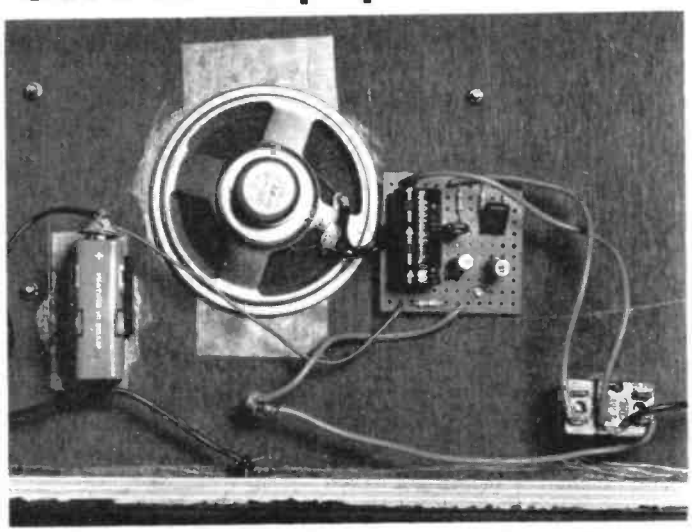


Fig. 4. Complete wiring details of the unit.

Sure to be popular at fund raising activities.



Close up view of circuit board, speaker, and interwiring.

CIRCUIT BOARD

The wiring details for the unit are shown in Fig. 4. This also shows the wiring to the loudspeakers, switches and bulb. The circuit board is fixed in place under one of the screws which hold the speaker grill in place.

Finally the line is bent to any desired shape and fitted using the two screws at each end, one fitted with a solder tag. Do not forget to place the ring over the line before fitting. The wire from the ring is then passed through a hole in the front of the case, a knot being tied to prevent it from being pulled out.

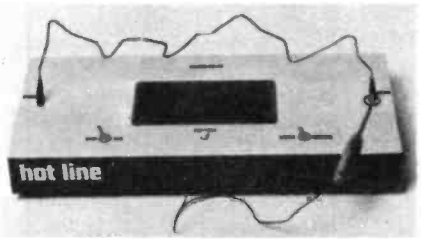
At the start and finish of the line some insulating tape can be wrapped around the line, so the ring can be left at either end without the alarm operating. This also provides a starting and finishing point for the players.

IN USE

At the start of the game the AUDIBLE or VISUAL alarm can be selected depending on the household situation. The unit is then switched on and the game commences.

The only rules which can be applied to this game regards the number of touches allowed before the player loses. This should be decided at the start of the game, not half way through!

To keep it in good working order, the line should be cleaned frequently, either with some proprietary cleaner or steel wool. ⌑



SQUARE one FOR BEGINNERS

THE circuit diagram tells all. As was suggested last month, it is possible to build an electronic project from the information given in a circuit diagram alone. But only if you have some experience: if you can correctly interpret the circuit diagram in terms of real actual components.

So what do the symbols used in circuit diagrams stand for? And just what are the most important components commonly found represented in these diagrams?

TRANSISTORS

Please refer to page 818 and Fig. 1. This is the circuit diagram of a simple audio oscillator.

The active parts are two transistors, designated TR1 and TR2, according to normal practice.

These transistors are the semiconductor or solid state equivalents of the triode thermionic valve of yesterday. They are referred to as active devices because they cause changes to be made in the current flow and also in the voltages appearing in certain parts of the circuit.

Transistors such as these are the essential working parts of all truly electronic circuits.

The type indicated, BC108, is a very common "general purpose" transistor. It is also cheap, as a study of our advertisers announcements will show.

This transistor functions as an amplifier. If an input signal is applied between the emitter (e) and the base (b) the "transfer-resistance" action of the TRANSISTOR causes a magnified or amplified version of that signal to appear across the collector and the emitter.

This is the essence of all electronic circuit operation.

It is vital that this particular transistor be connected with its collector (c) to the positive (+) side of the supply, and the emitter (e) to the negative side. Refer to the circuit again, and it will be seen that the arrow in the TR1 and TR2 symbol points in the direction of conventional current flow—from positive to negative. This symbol indicates an *npn* type transistor (the BC108 for example).

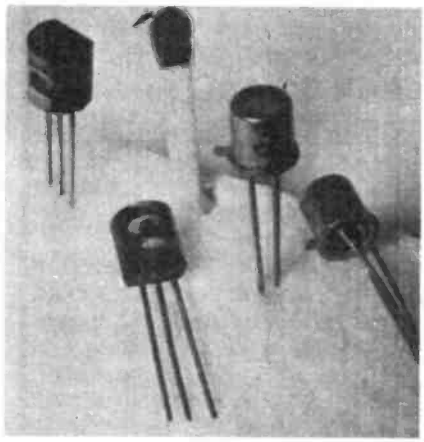
There are *pnp* transistors which have the *opposite* polarity, but we can ignore them for the moment.

RESISTORS

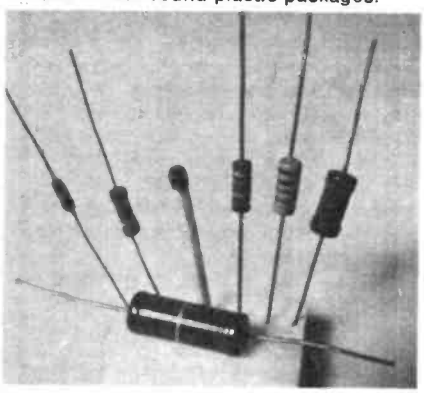
The resistor is the most commonplace of all electronic circuit components. It is depicted by a zig-zag, which clearly indicates the resistance property of this device. (All straight lines in the diagram are considered to have negligible resistance). All resistors are given the reference R, followed by a serial number.

Resistors are made of a compound of carbon or metal oxide, and have a small tubular form with connecting wires or "leads" emerging from either end. The physical size varies according to the power handling capability of the resistor. Resistors with ratings of $^1/_8$, $^1/_4$, $^1/_2$ and 1 watt are commonly used.

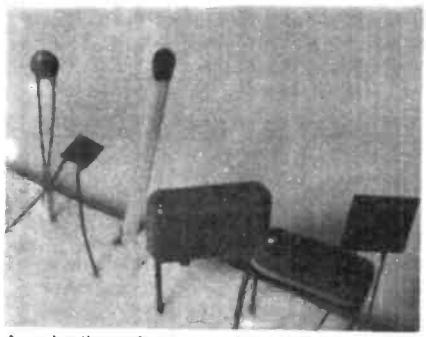
The resistance value in Ohms is marked on each resistor, usually in the form of a well known colour code.



Small Signal transistors. The right hand pair are type BC108. These are encapsulated in small metal cans. On the left are a pair of a different type of transistors encapsulated in half-round plastic packages.



A representative collection of metal film and carbon composition resistors, ranging from (left) $\frac{1}{8}$ Watt to $\frac{1}{2}$ Watt and 2 Watt in foreground.



A selection of small-value capacitors: (left to right) bead ceramic, plate ceramic, polyester (2) and plate ceramic. These components are described by the kind of insulating material used between the plates. The match gives scale.

Coloured bands on the body of the component indicate (1) first figure (2) second figure and (3) number of noughts in the overall number which is the resistance in ohms.

Additional bands indicate the tolerance of the nominal value. Silver for 10 per cent, and gold for 5 per cent (see Handy Guide given with last month's issue).

CAPACITORS

The capacitor (or "condenser" of old) is almost as commonplace as the resistor in typical electronic circuits. The circuit symbol is composed of two "plates", which precisely depict the essential physical construction of the capacitor. The reference for this component is C.

C3 in our example is a normal capacitor, although its actual composition and overall size and shape may take one of several forms, depending upon the particular type. This symbol indicates a non-polarised capacitor; this means it may be connected either way round in the circuit.

C1 and C2 are shown differently, with one of the two "plates" in the symbol left "open". This indicates an electrolytic-type capacitor, Most important of all, this means that the capacitor is polarised, and must always be used with its positive (+) marked terminal or lead connected to the positive side of the circuit.

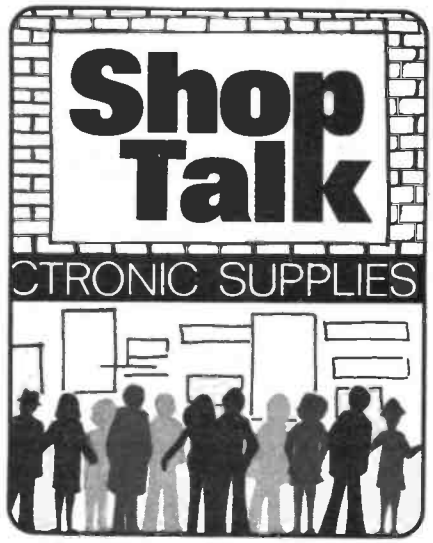
VARIABLE RESISTORS

Two components remain in the circuit: VR1 and VR2. These are variable resistors, hence the reference letters. Commonly found as volume controls and tone controls in radios and amplifiers, these components have a rotating arm which "wipes" a carbon track as the control spindle is turned.

It is by means of such variable components as these that the user is able to control the functions of an electronic circuit.

We have now met the most important members of the electronic components family. Now look at other circuit diagrams in this issue and try to pick them out. Don't worry about the strangers that often accompany them. Get your eye in to identify these principle performers in electronics. Then locate them in the practical layout diagrams and so get familiar with their physical outlines and other characteristics. Finally, take a look at the Components list and note just how each of these components is described. This is important, for it shows you how to "specify" components when sending away an order to any of the retail suppliers.

Transistors, resistors and capacitors. Concentrate on these alone for now. Don't worry about their many associates and relatives—these can be sorted out later.



By Dave Barrington

Over the last few months we have published two very popular constructional projects for the home and motorist, namely the *Mains Tester* and *Car Battery State Indicator*. Since publication it has been brought to our attention that two similar products are available commercially.

Car Battery Charge Monitor

With the great proportion of car breakdowns being attributed to electrical faults, the C-More car battery charge indicator from Harvelec should be a good purposeful addition to the car dashboard.

The C-More uses two l.e.d.s to monitor the battery condition. Between 11·5 and 15·1 volts both l.e.d.s are illuminated. This reassures the driver that all is well, and that the unit is functioning correctly. Below 11·5V the Red l.e.d. alone will light up, indicating a poor battery condition.

The C-More Battery Condition Display from Harvelec.

Above 15·1V the Yellow l.e.d. only will light up, indicating an overcharge condition.

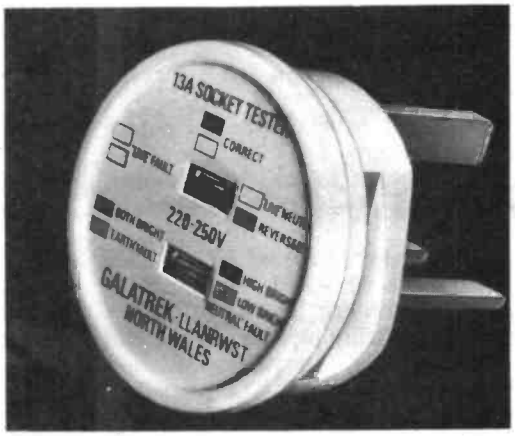
Within this "safe band", an ideal voltage lies between 12·4 and 14·2 volts, the red and yellow brilliances being about equal. Digressions from this ideal voltage range are shown by an increase in red or yellow brilliance.

It is claimed that by using coloured l.e.d.s, the driver does not need to know if a particular voltage is good or bad. He only has to glance to see that both colours are present.

Retailing at £6·20 the C-More Battery Condition Display is available direct by mail order from Harvelec, Dept EE, 1 Formby Avenue, Thatto Heath, St Helens, Merseyside, WA10 3NW.

Mains Tester

The 13A Socket Tester from Galatrek Engineering is a five-function 220-250V mains wiring tester.



The five-function 13A Socket Tester from Galatrek Engineering.

Mounted in a modified 13A plug, neons on the front face indicate the following condition of the mains wiring to the 13A outlet socket: 1, Correct socket wiring; 2, Danger reverse polarity; 3, Danger no earth connection; 4, Danger live fault and 5, Danger neutral fault.

Available direct from the manufacturers, the recommended retail price of the 13A Socket Tester is £4·15 including VAT and postage/packing. For further information readers should write to Galatrek Engineering, Dept EE, Scotland Street, Llanrwst, Gwynedd, North Wales, LL26 0AL.

Component News

Some sad news for readers this month comes with the announcement that Doram, stockists of RS Components parts, are no longer handling component supplies.

However, they are continuing to market their own complete microprocessor based and other electronic kits.

Feedback from the *Chronostop* article, which appeared in our August 1978 issue, shows that some readers are still experiencing difficulty in obtaining the displays for this stopclock.

Our latest information is that one of our advertisers, Tamtronik, have redesigned the project, including the circuit board, to accept several displays. They are also able to supply complete kits of parts for this project.

It is interesting to note that this firm translates most of our constructional projects to printed circuit board versions.

CONSTRUCTIONAL PROJECTS

This month, like the farmers, we again have a bumper harvest of constructional projects and over the next few months we hope to bring you many more popular projects that were only seeds of ideas this time last year. So you've been warned, order your future copies now before its too late!

Tele-Tel

The main theme for this issue could be called "Everyday Electronics Around the Home". The *Tele-Tel*, Subscribers Phone Call Charge Meter, will certainly pay for its outlay in most households.

There should be no problems with components for this project as they are available from most of our advertisers. The high value preset potentiometers may be difficult to obtain but you can use the highest value "pots" you can obtain, say one megohm, and make up the correct value with standard resistors in series with the potentiometers.

The case used in our model is the Bim Box type 1006. The transformer specified is a tight fit in the case and if another transformer is used a larger case may be required.

Other types of readout display can be used but the wiring may have to be altered.

Air Freshener

For the kitchen we have the *Electronically Controlled Air Freshener*. Apart from the fan motor, the special tubs of air freshener gel and printed circuit board, most of the other components should be generally available.

The printed circuit board, fan motor and the air freshner gel are all available from Greenweld Electronics. They are also producing complete kits of parts for this project.

Combination Lock

The security conscious householder is catered for by the *Combination Lock*. This is a special project in that it has been built on a new product called Wonderboard, a subject of a report on page 820 in this issue.

Those readers who do not wish to use this type of board can use plain perforated board and still keep to the original wiring, However, if Veroboard or printed circuit board is to be used then readers will have to formulate their own wiring layouts.

The reed relay specified is obtainable from Maplin Electronics and most of the other components are available from RS Components stockists, such as Ace Mailtronics.

The solenoid which forms part of the door bolt can be any 12V type with a minimum coil resistance of 100 ohms. The switches used for the keyboard are miniature printed circuit board mounting types and the "flip top" box used for housing the finished keyboard is a Vero 75 13018C type.

Those readers who use the Wonderboard should note that components must be of small physical size. The mechanical arrangements for the door or window bolts is left to each individual constructor.

Hot Line

The *Hot Line* game should provide many hours of fun and entertainment for the family at party time.

Components for this project should not prove troublesome. Any 8 ohm speaker with suitable grille can be used as the case housing the rest of the components can be any size to suit requirements, ours is only a typical example.

Beginners

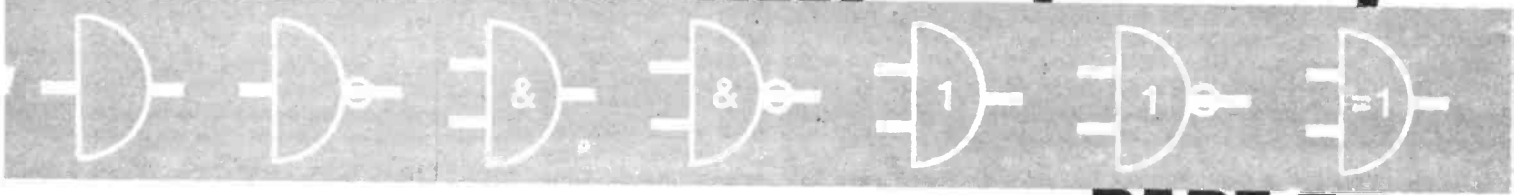
The beginner has not been overlooked and the *Sound Effects Oscillator* in our *Mini Module* Series should not create any problems regarding components. Specially designed to familiarise the newcomer with various methods of construction readers should be able to find most components from their own spares as tolerances are not critical.

The *Hot Line* game also falls into the beginners category and for component availability see comments above.

Regarding our major new series *Doing it Digitally*, components for this months and the first six parts are readily available from many of our advertisers.

Finally, we strongly recommend the newcomer to electronics to read this month's special 8-page supplement. Covering hardware, it should help readers to select the correct approach in trying to obtain that professional finish to their constructional projects.

DOING IT DIGITALLY



By O. N. Bishop PART 2

IN PART 1 last month we saw the action of AND and NOT gates. What do you think will happen if the output from an AND gate is fed into a NOT gate?

You can build the gates, as shown in Fig. 1.2 and 1.6, omitting the l.e.d. (D10) at the output of the AND gate and connect its output directly to the input of the NOT gate.

This is shown in symbolic form in Fig. 2.1a; an AND gate followed by a NOT gate is known as a NAND gate and has its own symbol, Fig. 2.1b.

If you connect up the two circuits from last month you will obtain the truth of Table 2.1.

Table 2.1. Truth for a NAND gate (tinted panels) made from an AND gate followed by a NOT gate.

Inputs A	Inputs B	AND output C	NOT output D
1	1	1	0
1	0	0	1
0	1	0	1
0	0	0	1

A NAND gate is used in logical statements of the form:

If *A* AND *B*, NOT *D*

For example, if I have a headache AND I have a sore throat, I will NOT go to work today.

THE 7400 I.C.

Four ready made NAND gates are contained in the 7400 i.c., input/output pinning details appear in Fig. 2.2. To provide current for operating the gates, pin 7 is connected to ground (0V) and pin 14 is connected to +5V.

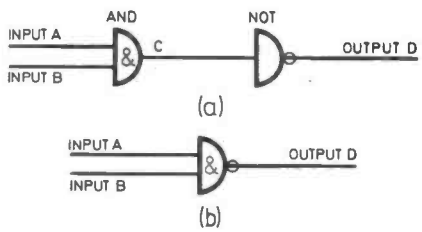


Fig. 2.1a. Symbolic form for an AND gate followed by a NOT gate. (b) Symbol for a NAND gate.

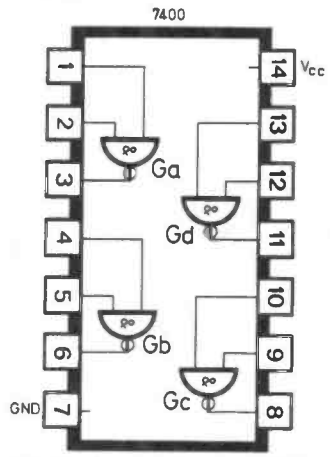


Fig. 2.2. Pinning details of a 7400 i.c.

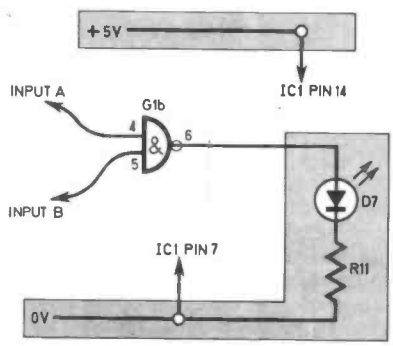


Fig. 2.3. Circuit for investigating the actions of a NAND gate.

For convenience the gates have been numbered Ga, Gb, Gc and Gd. When these gates, appear on a circuit diagram, a further digit is added to identify the i.c. containing them. For example G1a refers to Ga in IC1; G3c, Gc in IC3. This is the system adopted in EVERYDAY ELECTRONICS.

We shall investigate the action of one NAND gate in the 7400 using Gb, see the circuit diagram of Fig. 2.3. Insert a 7400 in the 14-pin d.i.l. socket on the Test-Bed and wire up according to Fig. 2.4.

The ends of the wires to inputs *A* and *B* are left free so that they may be readily connected to the +5V and 0V lines. Try all the possible combinations of high and low inputs and record your results in Table 2.2 below.

The l.e.d. indicates the state of the output, on for high (H) and off for low (L).

Table 2.2. Truth table for a 2-Input NAND gate

Inputs A	Inputs B	Output D
H	H	...
H	L	...
L	H	...
L	L	...

The same results will be obtained with each of the other three gates. Compare these results with those of Table 2.1.

NAND FOR OTHER LOGIC ELEMENTS

Now connect one or more gates of the 7400 in the various ways shown in Fig. 2.5a,b,c. Investigate their actions by completing the

truth tables and try to give a name to the logic action of each of these circuits.

Answers given later.

Wiring details on the Test-Bed for these three circuits are shown in Fig. 2.6a,b, and c.

A SIMPLE MEMORY

Our next experiment involves the use of two of the gates in a 7400 connected as shown in Fig. 2.7 where their inputs and outputs are cross-coupled. The l.e.d.s on the Test-Bed will allow you to observe the state of the outputs. The wiring up of this circuit on the Test-Bed is shown in Fig. 2.8.

To find out what this circuit will do, run through the programme in Table 2.3 and note what happens at each step.

This circuit can "remember" which of the two inputs was the

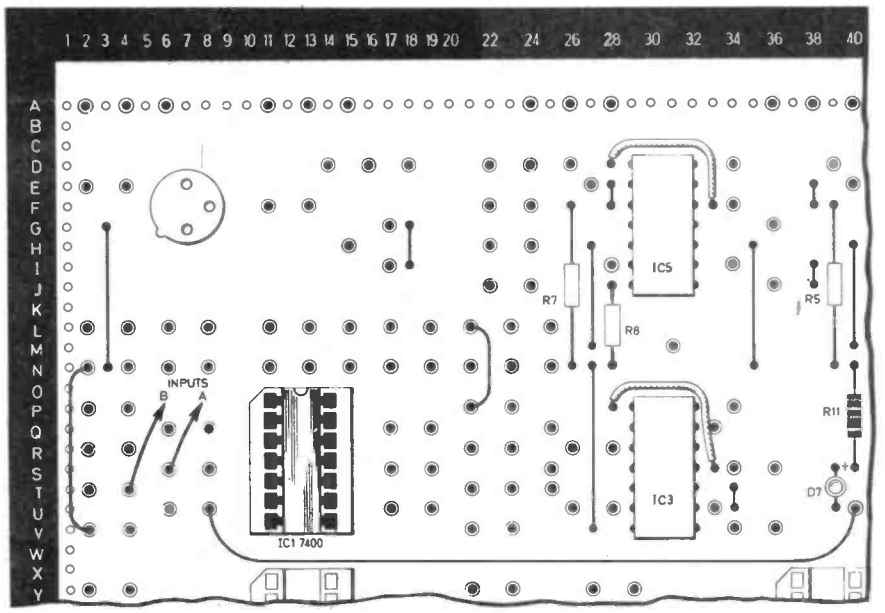


Fig. 2.4. The circuit of Fig. 2.3. wired on the Test-Bed.

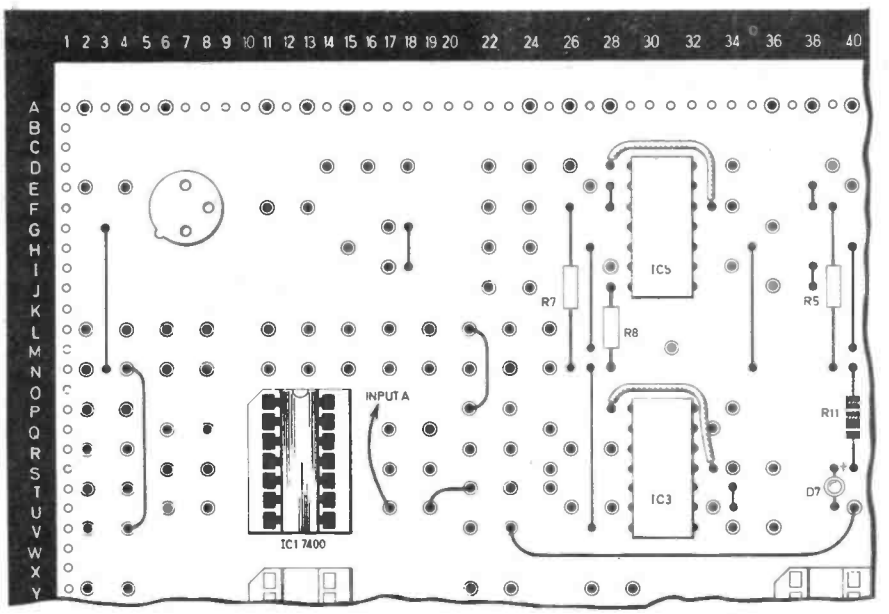
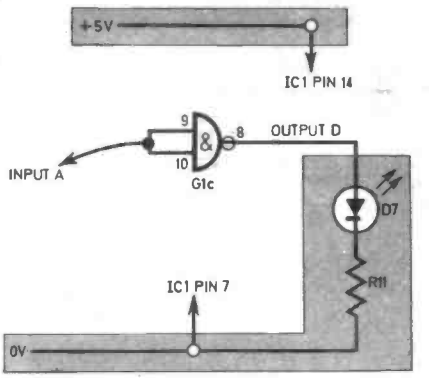


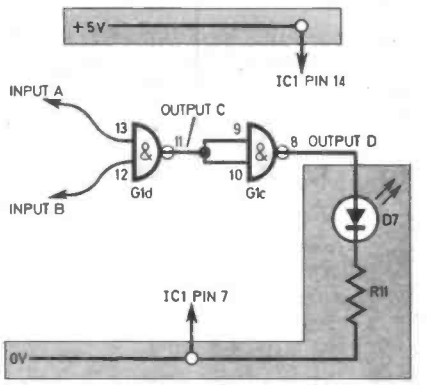
Fig. 2.6a. Circuit of Fig. 2.5.a wired up on the Test-Bed.

Fig. 2.5. (Right). Connect one or more NAND gates as shown in each case, and try to determine what type of gate you are experimenting with.



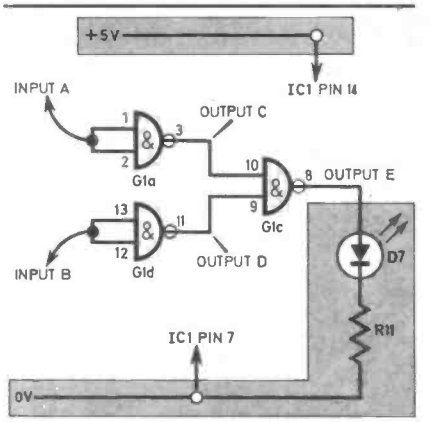
Truth table for (a)

Input A	Output D
...	...
...	...
...	...
...	...



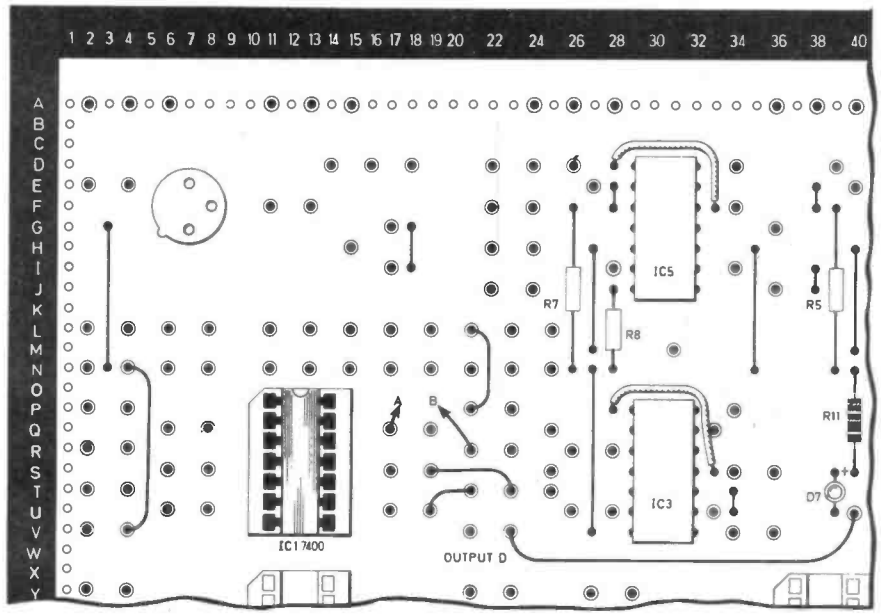
Truth table for (b)

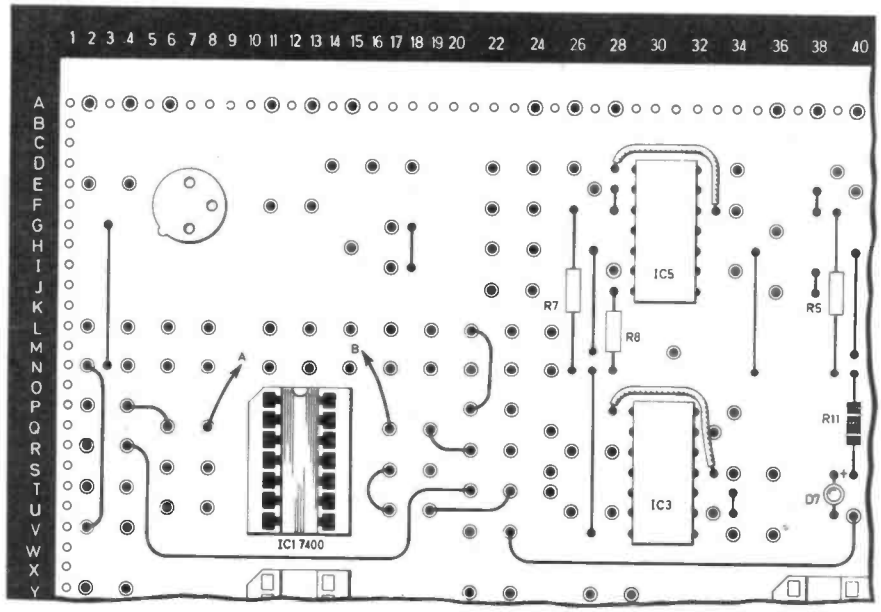
Inputs A	Inputs B	Output D
...	...	...
...	...	...
...	...	...
...	...	...



Truth table for (c)

Inputs A	Inputs B	Output E
...	...	...
...	...	...
...	...	...
...	...	...





COMPONENTS REQUIRED FOR FIRST SIX PARTS OF DOING IT DIGITALLY

Resistors

27Ω (1 off)
100Ω (2 off)
1kΩ (1 off)

All ¼ watt carbon ±10%

Semiconductors

1N4148 silicon signal diode (15 off)
BC107 silicon *npn* (1 off)
7400 Quad 2-input NAND (1 off)
7473 Dual J-K flip-flop (1 off)
7490 Decade up counter (1 off)
7402 Quad 2-input NOR (1 off)

Miscellaneous

Stripboard 0·1 inch matrix 34 strips × 34 holes (1 piece)
crystal earpiece (1 off)
crocodile clips (4 off)

Capacitors

0·47μF polyester (2 off)
1000μF 10V elect. (2 off)

The capacitors were omitted from the list sent to advertisers and need to be ordered separately if you have already purchased the additional component pack. These capacitors will be required in Part 3 next month.

Fig. 2.6b. (Top left). Circuit of Fig. 2.5b. wired on the Test-Bed.
Fig. 2.6c. (Left). Circuit of Fig. 2.5c. wired up on the Test-Bed.

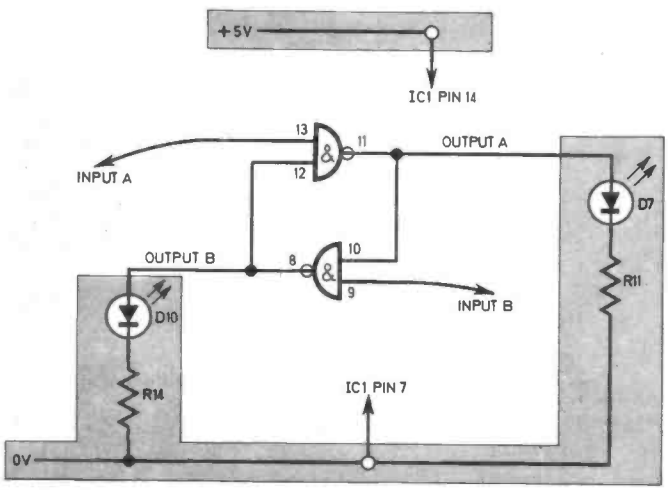
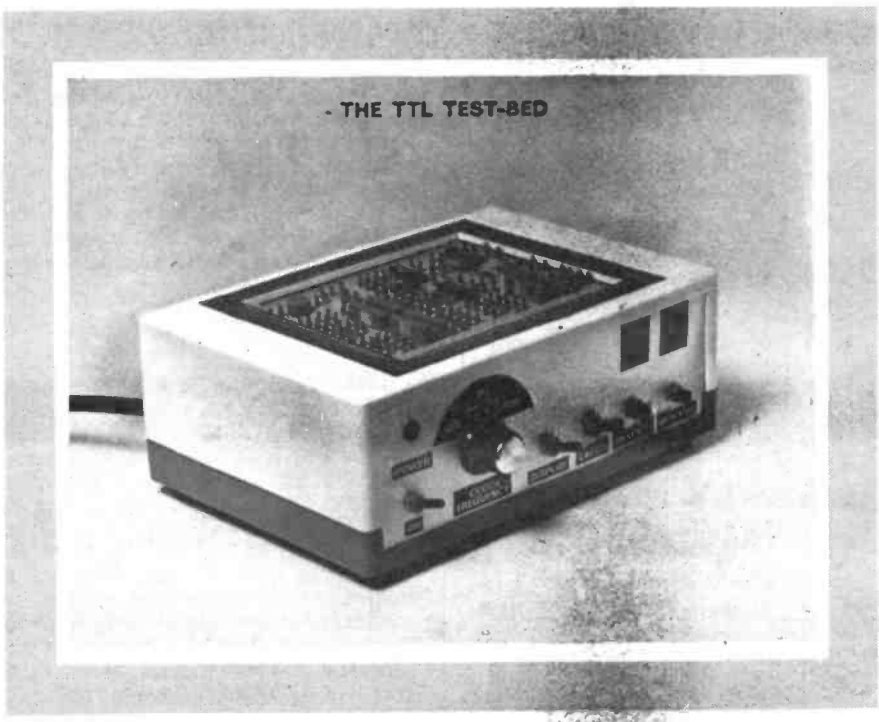


Fig. 2.7. Circuit of a "Bistable", composed of two NAND gates.

Table 2.3. Investigation Programme

Step	Action
1	Touch input *A* wire to 0V
2	Remove input *A* wire from 0V
3	Touch input *A* wire to 0V again
4	Touch input *B* wire to 0V
5	Remove input *B* wire from 0V
6	Touch input *B* wire to 0V again
7	Touch input *B* wire to +5V
8	Touch input *A* wire to 0V
9	Continue as above until you have found out what to do to make the circuit change state.



last to be grounded (touched on the 0V rail).

Such a memory has several applications as we shall see later in the series. This circuit is called a bistable because it is stable in either one of its two states.

Readers will notice that a bistable is permanently wired into the Test-Bed at IC3 using gates G3a and G3d.

Also in IC3 we have a NOT gate with two outputs and the NAND at G3b fitted with two outputs.

Answers

The logic circuits of Fig. 2.6: (a) gives a NOT (b) gives an AND gate (NAND followed by NOT is equivalent to NOT NOT AND which reduces simply to AND (c) gives an OR gate.

In the bistable circuit of Fig. 2.7 the following observations will have been noticed:

(1) either D7 or D10 are lit (not both). When input *A* is grounded, D7 lights and D10 goes out (if not already in that state)

(2) no change

(3) no change

(4) D7 goes out and D10 lights

(5) no change

(6) no change

(7) no change; with NAND gates, unconnected inputs are effectively "high" so touching to +5V rail makes no difference

(8) D7 lights, D10 goes out

(9) To make D7 light and extinguish D10, ground input *A*. To change to the other state ground input *B*. Repeatedly grounding the same input has no effect.

To be continued

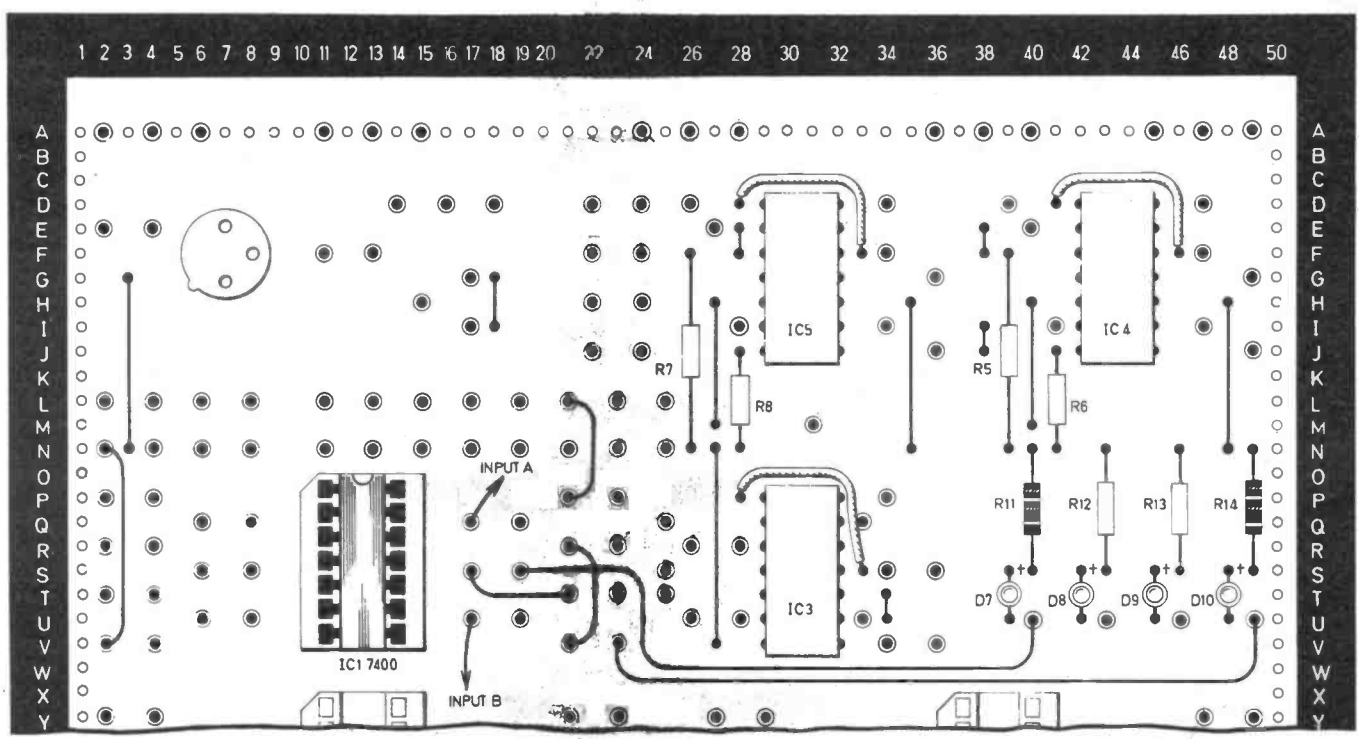


Fig. 2.8. Wiring details on the Test-Bed for the circuit of Fig. 2.7.

By ADRIAN HOPE

Radio Paging

It's amusing to watch how a room full of business or medical men in the London area react when there is a sudden electronic bleeping noise.

A fair number of them will go for their pocket paging receivers like cowboys going for a gun. It's hardly surprising because apart from numerous internal or on-site systems there are now ten thousand people in the London area who subscribe to the British Post Office Radiopaging scheme.

The scheme has proved so successful that it is already being expanded, from ten thousand subscribers on upwards towards the current hundred thousand maximum. It is also likely that public paging will move into other cities. Thames Valley is already covered, probably Birmingham is next.

One reason for the success of the schemes is their surprisingly low cost, only £7 a month and free phone calls to the Post Office computer which transmits the bleep calls over London on receiving a dialled code instruction.

Most people have only a very sketchy idea of what radio paging is all about. Here then is some of the background. Much of the pioneering work in the UK was done by the British firm Multitone which was founded in 1931 by the Russian engineer Joseph Poliakoff. Poliakoff was a prolific inventor years ahead of his time. For instance in 1900, while still a student in Moscow, he patented an optical sound film system, based on the use of selenium cells, which was very similar to that used in your local cinema to this very day.

In the early 20's he fled for his life to England and in 1925 worked with GEC on what was effectively a point contact transistor. In 1929 he devised a transformer which served as a tone control but, failed (hardly surprisingly) to persuade Plessey to hand over a third share of their company in return for the transformer patent!

He founded Multitone to exploit the invention himself and his son Alexander took over the company in 1938. In 1955 St. Thomas's Hospital in London asked the firm to develop a personal paging system so that doctors could be called to the telephone by bleeping from a central control. The St. Thomas's Hospital system went into operation in 1956. Bleep signals were transmitted by an inductive loop laid round the hospital walls.

It's interesting to note that St. Thomas's Hospital was not only first in the field but is now equipped with one of the most modern staff paging systems in the world. Virtually everyone, from consultants to foreman plumber carry bleepers. The inductive loop has been replaced by a radio transmitter and a microprocessor is used in the main control console.

When a doctor is bleeped the microprocessor transmits a replica of human speech which tells what extension number to call. This saves the hospital switchboard operators an immense amount of work each day.

Interrogation

Whereas the St. Thomas's Hospital system, and other internal or on-site systems can convey speech as well as bleep tones, the Post Office Public Radiopaging system is bleep-only. This isn't half the disadvantage that you might imagine. Verbal messages are often quite unnecessary, and because they take up more time are a terrible waste of spectrum.

It is far cheaper for all concerned, if a public paging system simply sends out a bleep to a subscriber who then goes to the nearest telephone and calls home or the office. It makes far better sense to automate the system further, rather than introduce speech. One line of automation already being investigated is the use by subscribers of their own bleepers to interrogate their own telephone answering machines over the telephone.

There is already in existence a working prototype system where the answering machine records a message in the normal way and then automatically instructs the Post Office radio paging service to bleep the owner. He then 'phones his own answering machine and uses his bleeper to command it to rewind and replay the recorded message.

Digital Bleeper

It turns out that some answering machines are ideally suited to conversion along these lines. They are already designed to phone TIM automatically after every call has been recorded and it is a simple matter to modify the machine so that it dials the Post Office Radiopaging computer, rather than TIM, and so send out a bleep call for the machine owner.

Another automated system, soon to be installed by Multitone at the American Stock Exchange in New York, is a digital display bleeper. Already all the modern radio paging bleep systems rely on digital transmissions. The present Post Office Radiopaging system has the facility built in to send out eight different coded signals to each of one hundred thousand subscribers, although in fact only two codes (two bleeps or three bleeps) are used and there are so far nowhere near that number of subscribers.

Currently, agreement in Europe is being reached on a new code which will enable an almost infinite number of messages to be sent out to eight million subscribers. This will involve a string of 32-bit message and address blocks, limited in complexity only by available air-time. Because it becomes impractical to register a large number of different messages simply in bleep fashion (unless every subscriber is prepared to learn morse code!) the new generation of bleepers will have a calculator style four digit display.

This can give direct readout of telephone extension numbers or, with a code book, can convey all manner of messages, e.g. readout "1234" means "phone home", readout "4321" means "phone the office" and so on. This is exactly the system now being installed in the American Stock Exchange.

Alexander Poliakoff believes we are only just now beginning to scrape the surface of paging potential. He envisages us all one day carrying a receiver and using it for electronic identification like a bank card. Although he's biased, it's easy to subscribe to the view and wonder about becoming a Post Office paging subscriber.

Next month we will look at the frequencies used for paging, and why they are interesting.

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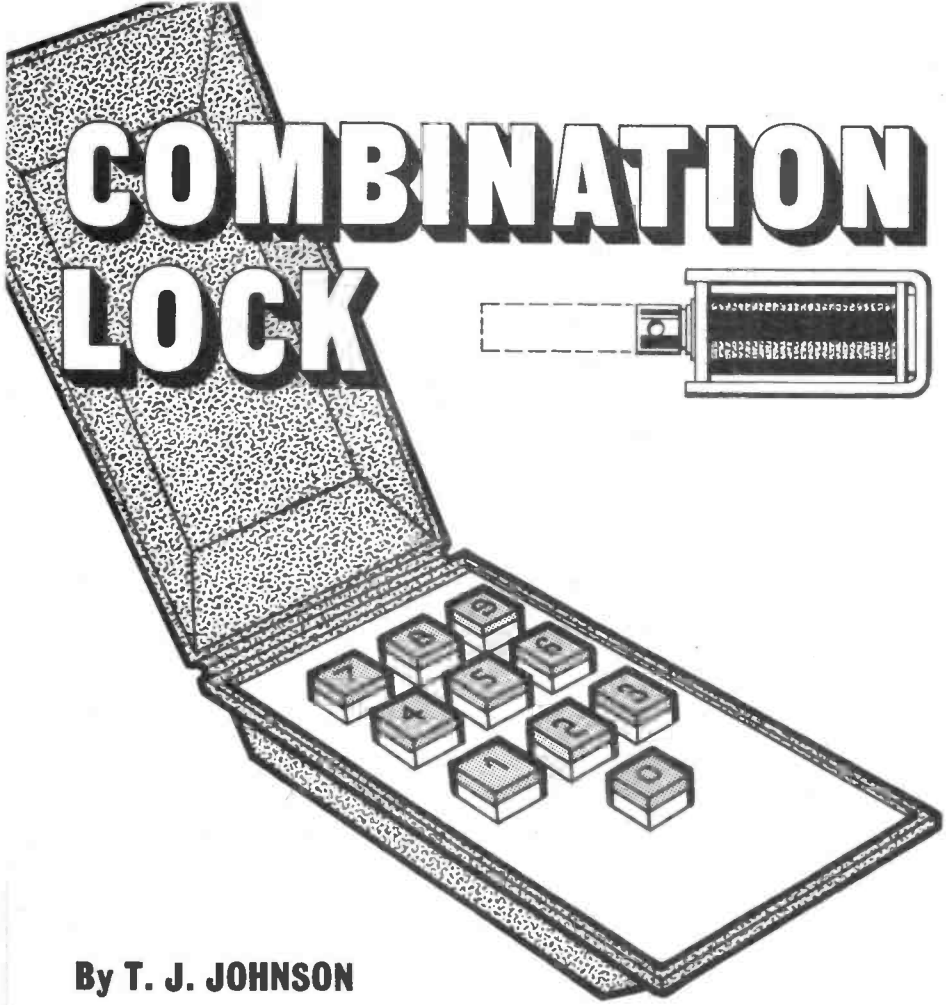
COMBINATION LOCK



By T. J. JOHNSON

A HOME security system is not complete without an electronic combination lock. A lock which requires a certain combination to release the front door is a luxury indeed. But for a small initial outlay, you can add a combination lock easily and simply, as this article explains.

Of course you need not use the lock in this situation, it is equally suited for any other type of enclosure; desk drawers, cupboards and so on. It can also be used for its novelty value, say at a féte where a contestant has to solve the right combination before he wins a prize. No doubt other uses will come to mind.

WONDERBOARD

The more observant readers will have noticed the rather unusual layout in the diagrams. We are using, we believe for the first time in this country, a new wiring board. This is a low cost Elastomeric Contact Circuit Card. Quite a mouthful! So we shall call it by its trade name "Wonderboard". (See Special Report elsewhere in this issue.)

CIRCUIT DESCRIPTION

The circuit of the Combination Lock is shown in Fig. 2. It consists of three distinct sections: keyboard and bistables, timer, and switch. Each will now be described in turn.

KEYBOARD AND BISTABLES

Four switches of a ten-switch keyboard are connected individually to one or other of four bistables. The choice of which switches are connected decide the overall combination. In our design the switches are wired for 9621, in that order. There is of course no reason why this should not be changed, details will be given later.

7400
NAND GATE

INPUTS		OUTPUT
A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

7402
NOR GATE

INPUTS		OUTPUT
A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

Fig. 1. Truth tables for a NAND and NOR gate.

Each of the four bistables is formed by two gates, half of a 7400 NAND i.c. In the normal rest state the outputs, pins 11 and 3, of each i.c. are high.

Consider the bistable formed by G1a and G1b. The inputs, pins 9 and 13 are high as they are connected via "pull-up" resistors to the positive supply. In order for the output to be high at pin 11, the other input, pin 12, must be low.

This low condition is obtained from pin 8 of G1b. This low output at pin 8 is obtained from the output at pin 11. The two inputs, pins 9 and 10 both being high.

TRUTH TABLE

This sounds complicated but reference to the Truth Table Fig. 1 for this gate should make it clear.

The above is also true for the remaining three bistables, each output being high. The four outputs are taken to G3a and G3b. The Truth Table for this NOR gate Fig. 1 shows that when both inputs are high the output is low. The two outputs pins 4 and 10 are connected to G3c which is wired as an inverter. The resultant output of this gate being high.

COMBINATION

The action of a bistable is to remain in one state until it is caused to flip over to the opposite state. In this circuit the bistables are arranged to be high until set to the low condition.

Consider the first bistable G1a and G1b. As was said previously the input, pin 9, is high. When switch S3 is pressed, the input is taken low, the effect of the pull-up resistor being overidden.

We now have a situation where the two inputs to G1b are low and high respectively, according to the Truth Table the output will now go high.

This high condition presented to the other input of G1a, is sufficient to cause the output to go low. Once again reference to the Truth Table will make this clear.

For the remaining three bistables the action is precisely the same, each in turn flips over to the low state. However, one important point should be noted. Whereas in the first bistable the low was derived from the ground 0V line, the low for each successive switch

is derived from the low output of the previous bistable.

It should now be apparent that providing the keys are pressed in the correct order, all the bistables will change state. However, even if the correct keys have been found, this does not mean the bistables will operate. Only if the *first* key is correct, will the low condition be available for the next bistable and so on.

Once the four keys have been pressed in their correct sequence, we now have a situation where all the outputs are low. The two gates G3a and G3b, because of the low input conditions at all inputs will produce a high output, this is then inverted by G3c, and passed to the trigger input of IC4.

RESET KEYS

Assuming the first key has been selected correctly and the bistable has been set, to reverse the condition a low needs to be applied to the opposite input. In our case this will be pin 13 of IC1.

Now when an incorrect key is pressed, say for example S4, a low will be placed on the reset line. The reset line is common to the opposite inputs of the bistables. Referring to the Truth Table it will now be seen that the bistable will flip over to its original state. This is true for all the reset keys and for each bistable.

TIMER

An automatic re-locking facility is included in the form of IC4, wired as a monostable. The values chosen for R8 and C4 produce an output pulse of 20 seconds duration when a trigger pulse is received at pin 2 via G3c.

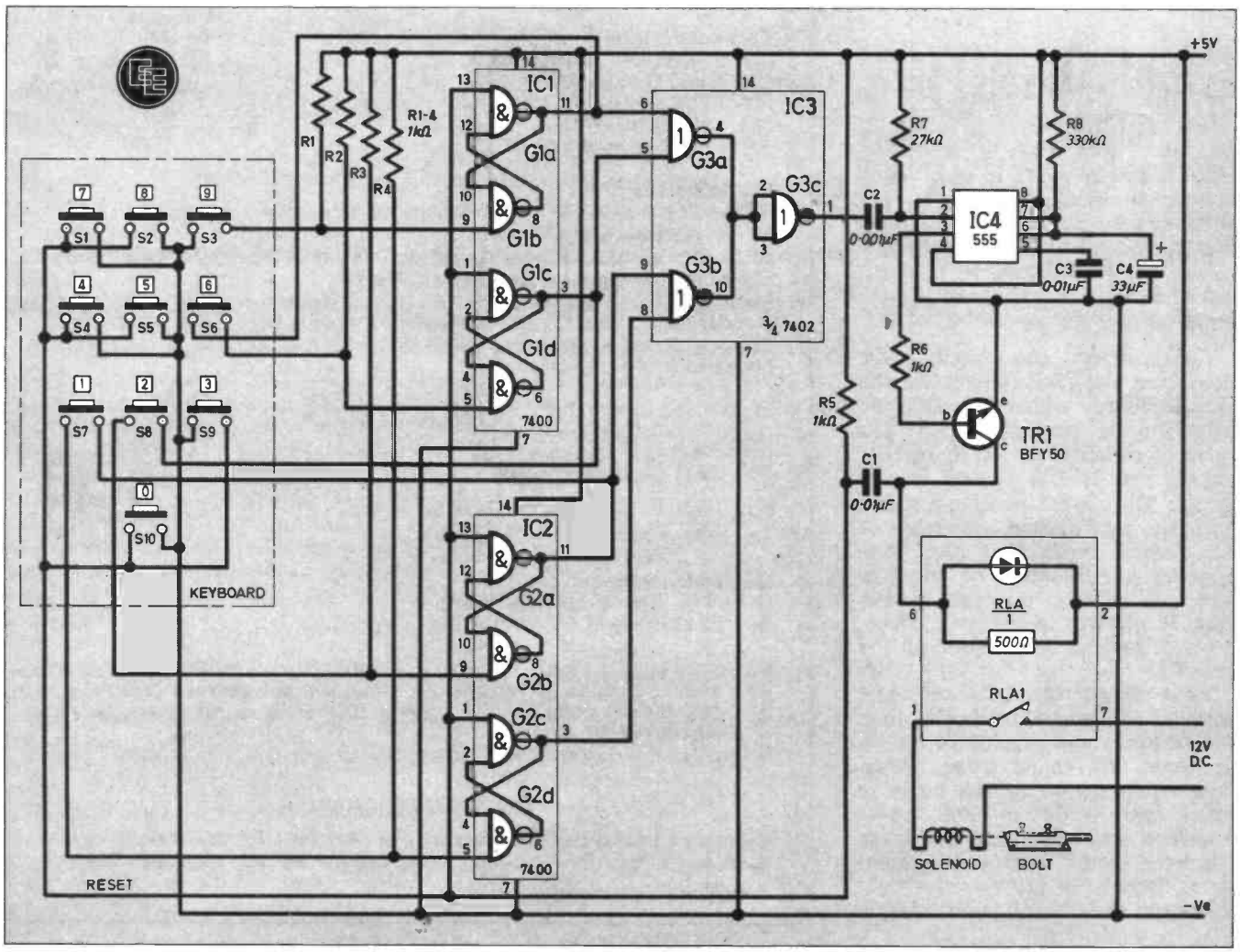
Having this auto-relock will enable the user to enter, within the delay period, and having the door locked automatically behind. This period may be increased by increasing the values of R8 and/or C4.

The timing period is started via the transition of the output from high to low of G3c. As soon as the timer has been triggered, pin 2, the switch operates and connects power to the solenoid.

COMPONENTS approximate cost £16·5

Lock: £10 excluding cases and switches
Power Supply: £4·50 excluding batteries
Mechanics: £2 depending on arrangement used.

Fig. 2. Circuit diagram of the Combination Lock. The unmarked diode is integral with the relay, which is a d.i.l. type. Although a solenoid is shown as the controlled device, other devices may be used.



After the period has elapsed the monostable will reset, the switch turns off and the bolt is then locked once more.

SWITCH

The switch consists simply of a transistor and reed relay. The contacts of the relay operating the external device. In this design the device is solenoid, for other purposes other devices may be used. A bell and light could be used for example, for say, at a féte. For each device the supply must be chosen to suit.

The transistor is turned on via the pulse from the output of IC4, pin 3. As the transistor is turned hard on the collector voltage will fall to zero volts thus connecting the reed relay between the positive supply and ground. The relay thus operates, and through its contacts the solenoid will operate. This fall in collector voltage is transmitted via C1 to the bistable reset line setting the outputs of each bistable high, ready for the next operation.

CONSTRUCTION starts here

CONSTRUCTION

Construction can begin with mounting the components on the Wonderboard, remember that no soldering is required with this form of construction! (For further details see Special Report in this issue.) The layout of Fig. 3 shows both the topside and underside of the board. Note that the components are mounted on the top, and all wiring on the underside. If the wiring becomes tricky, a few wires can be mounted on the topside.

First mount the i.c.s and d.i.l. relay in the positions shown, then the resistors and capacitors can be mounted. We found it an advantage when trimming the leads to bend the leads at the angle required and then cut the leads from the bottom of the component to a length of 3mm. This will allow the component to sit snuggly on the board without the leads coming through the other side.

The only component to which this cannot be done is the transistor. Here the leads are left long, the transistor being positioned slightly over to one side. This will allow sufficient space for the other components to fit.

Once all the components have been mounted the wiring can then be carried out. To prevent any mistakes it is advisable to mark each lead as it is wired in.

The best way we found when connecting the link wires is to insert one end in the appropriate hole, carefully position the wire as shown, cut the wire a few millimetres past the hole, bend the end at rightangles and insert it into the hole. Final "dressing" of the wire can then be done.

Where wires cross, either insulating sleeving can be used, or insulated wire. Remember, however, that the wire needs to be thin. We found that 26 s.w.g.

COMPONENTS

COMBINATION LOCK

Resistors

R1 1kΩ	R3 1kΩ	R5 1kΩ	R7 27kΩ
R2 1kΩ	R4 1kΩ	R6 1kΩ	R8 330kΩ

All ¼W carbon ±10%

Capacitors

C1 0·01μF miniature polyester
C2 0·001μF miniature polyester
C3 0·01μF miniature polyester
C4 33μF 10V Tantulam

Semiconductors

IC1 7400 Quad NAND gate
IC2 7400 Quad NAND gate
IC3 7402 Quad NOR gate
IC4 NE555 timer
TR1 BFY50 *npn* silicon

Miscellaneous

RLA 14 pin d.i.l reed relay with one set of normally open contacts. Coil resistance of 500 ohms.
S1 to S10 single pole push on, release off switch (10 off) (RS type 337 611)
Solenoid 12 volt d.c. type (RS type 349 709)
Matrix board 0·1 inch 28 × 49 holes (125 × 70mm); one "Small Wonder" Wonderboard; Vero flip top case; length of nine core cable as required; 26 s.w.g. tinned copper wire; solid connecting wire; case as required to house lock and power supply.

POWER SUPPLY

See Shop Talk page 790

Resistors

R1 120Ω 1W carbon ±10%

Capacitors

C1 2200μF 25V elect.

Semiconductors

D1 to D5 IN4001 rectifiers (5 off)
D6 BZY88C5V6 5·6V 400mW Zener diode

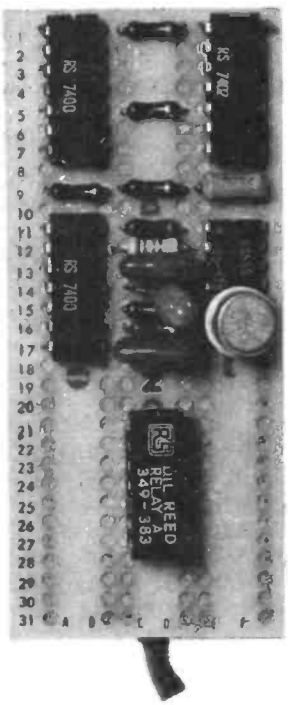
Miscellaneous

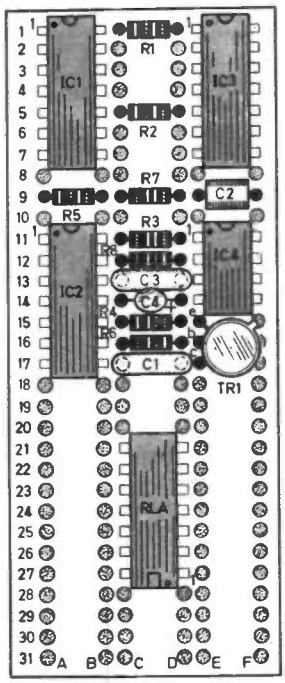
T1 standard mains transformer 9V secondary at 1 amp
B1 12V battery capable of supplying 800mA for a few seconds. For example: HP1, 8 × U2.
Matrix board 0·1 inch 42 × 37 holes; connecting wire; mains cable.

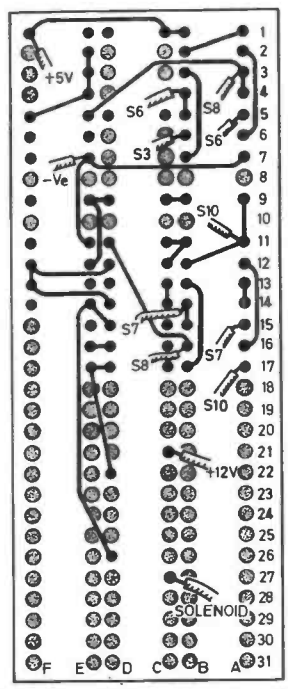
DOOR MECHANICS

Solenoid as described; "T" shaped flat steel for bolt; low tension return springs (2 off); cover if required to enclose mechanics; two steel "keeps".

COMBINATION LOCK







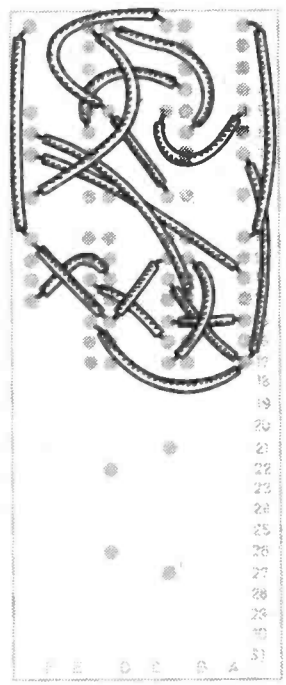


Fig. 3. Wiring diagram for the circuit. The underside wiring is shown as two processes for clarity. Mark each lead on the diagram as it is wired in—this will avoid any errors. Also ensure that the components you have are small enough to fit in the positions indicated.

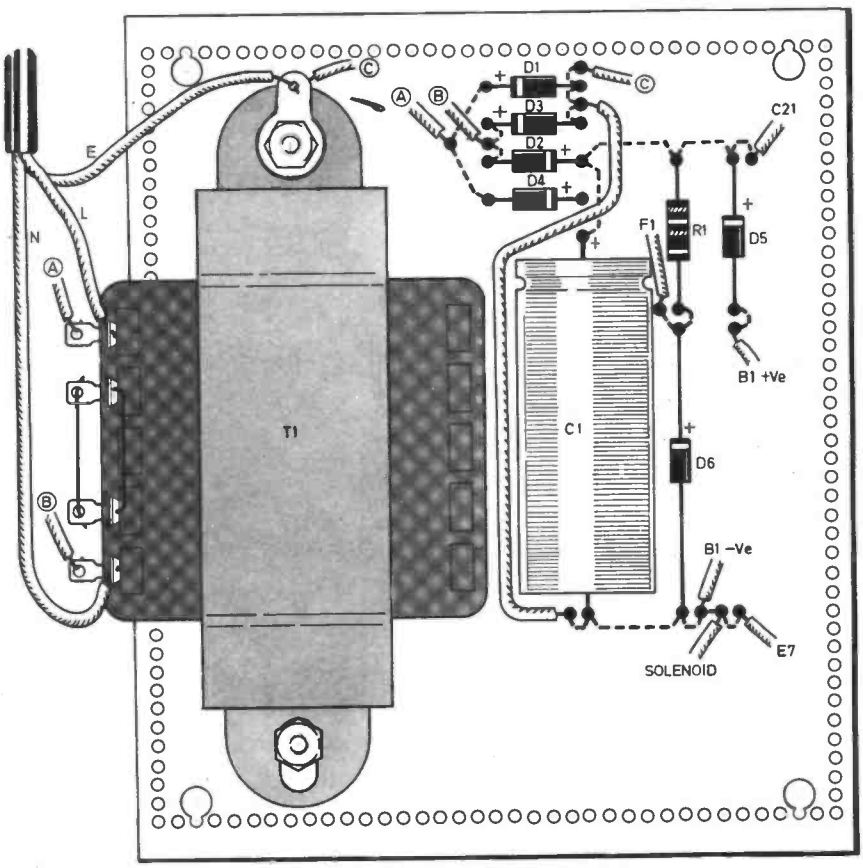


Fig. 6. Wiring details for the power supply.

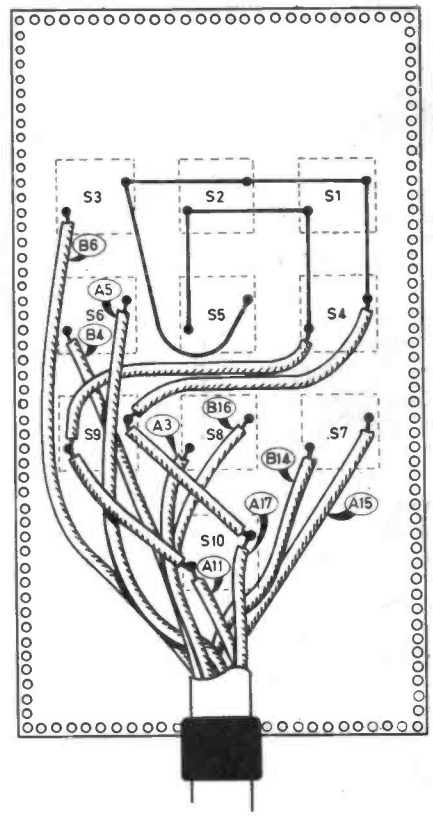
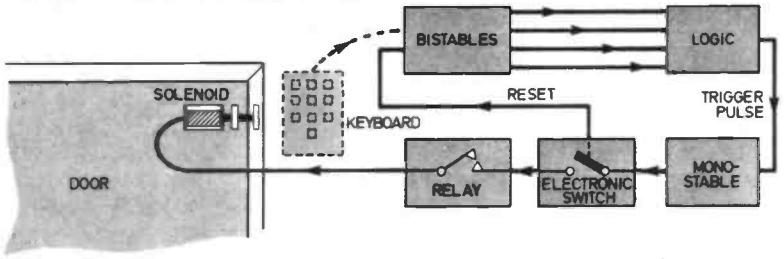


Fig. 4. Wiring details for the keyboard. If a different combination is required refer to the text on how to do this.

HOW IT WORKS



As each digit on the KEYBOARD is selected correctly a BISTABLE associated with that particular switch will change state. Once all four BISTABLES have changed state, the LOGIC circuit will detect this change and provide a trigger pulse to set the MONOSTABLE in operation. As the MONOSTABLE operates and begins its timing period the ELECTRONIC SWITCH is activated. This in turn energises the RELAY which itself in turn operates the SOLENOID. The SOLENOID thus operates and unlocks the door.

After the MONOSTABLE has finished its timing period, it will reset the ELECTRONIC SWITCH and BISTABLES ready for the next operation. The timing period is preset for 20 seconds, long enough to open the door and walk through. If at any time an incorrect digit is pressed the circuit will reset, thus preventing the unwanted intruder to enter.

tinned copper wire was more than adequate, taking into account the number of wires per hole and the small force required to insert them into the hole.

For making external connections, thin solid insulated wire can be used.

KEYBOARD

The ten switches forming the keyboard are mounted on a piece of matrix board, 28 x 49 holes. They are arranged in the familiar calculator style, that is three by three matrix, with the zero at the bottom. There is of course no reason why a ready made keyboard cannot be used, but note that some keyboards have one side of each key common and would be no use in this application.

There is also no reason why extra keys cannot be added, possibly labelled with some unfamiliar symbol. Only four keys are actually wired, but the thought of all those many keys, together with all the different combinations which could be used should be a larger enough deterrent to most people.

If the keyboard is to be used outside the door which is to be locked, then a sturdy weather proof case of some description should be provided. It is left to the constructor to devise his own methods of mounting. We used a small Vero flip top box, which looks neat and has the advantage that the keys are covered against the effects of the weather.

KEYBOARD WIRING

The final combination is decided by the constructor, so there is no necessity to follow our layout.

The switches are wired up as follows:

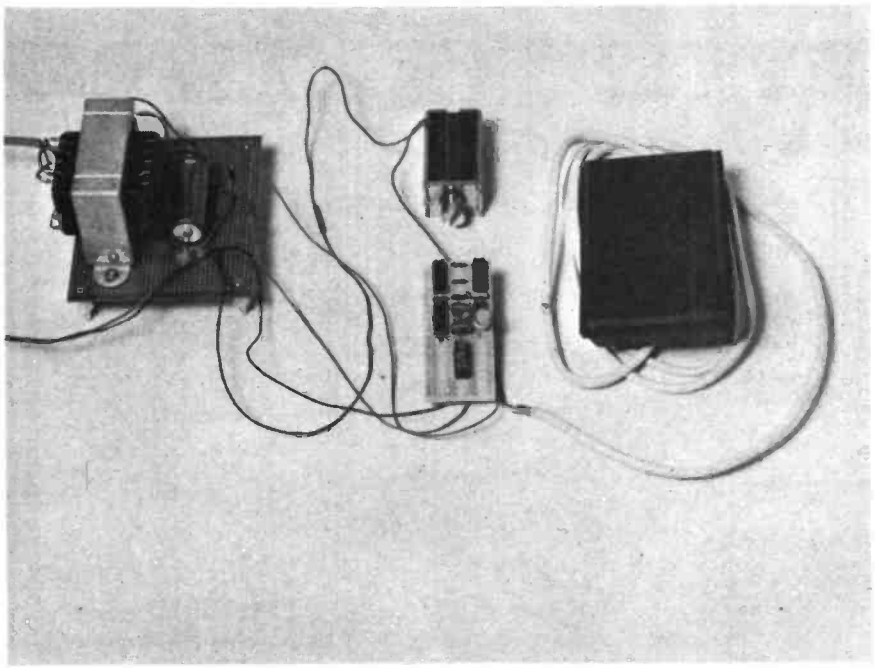
1. First key (9). Connect one terminal to location B6. Connect the other to point A17.
2. Second key (6). Connect one terminal to point B4. Connect the other to A5.
3. Third key (2). Connect one terminal to A3. The other terminal to B16.
4. Fourth key (1). Connect one terminal to point B14. Connect the other to point A15.

All the remaining keys have one terminal commoned and connected to ground, location A17, the other terminals are also commoned and one lead connected to the reset line, point C17.

As shown in Fig. 4 we have wired our keyboard to produce the combination 9621. For other combinations the wiring must of course be altered to suit. The position of the keyboard should now be determined, and a length of nine core cable should be cut to size. Ex-Post Office cable can be used here, alternatively any other type can be used. Most cable bought nowadays will have a screen, and in this instance is ignored.

POWER SUPPLY

Used as described the Combination Lock requires the following power supplies; 12 volts at 800



General photograph of the Combination Lock. On the left is the power supply, with the solenoid and board to its right. Far right is the keyboard housed in a suitable case.

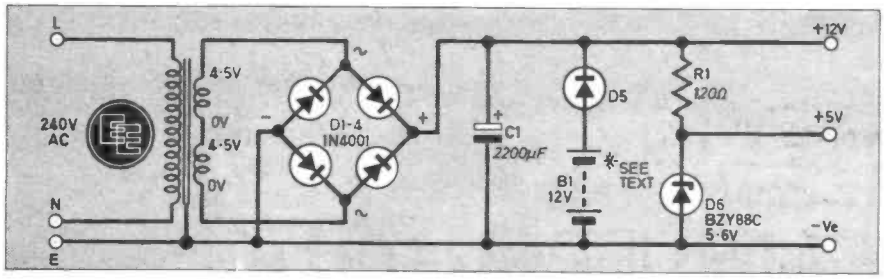


Fig. 5. Circuit for the simple power supply. Note the back-up battery used in the case of power cuts. The battery needs to supply 700mA for about 20 seconds in each operation. Thus a high capacity battery is required to ensure a long life.

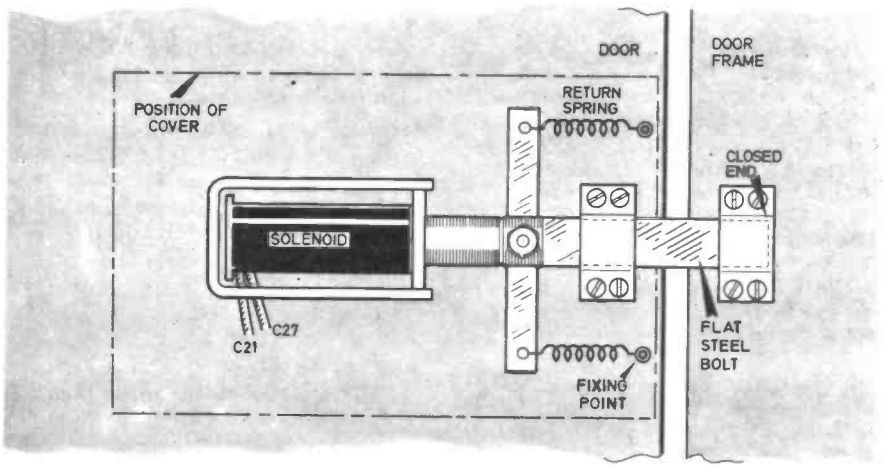


Fig. 7. One suggested arrangement for a door bolt. Other methods will of course need to be used to suit the type of door used. A position for a cover is also shown which is used to enclose the mechanics.

milliamps for the solenoid and 5 volts at 45 milliamps for the "electronics".

Battery operation was ruled out due to the high current drain, albeit for brief periods, when the solenoid is energised. It was therefore decided to use a mains power supply. At the same time it was thought necessary to include some form of back up system in case the mains supply failed. If it did so the solenoid would not operate, with the result that the door would be permanently locked!

A simple battery system was therefore incorporated, the final design is shown in Fig. 5.

Construction is done entirely on plain matrix board, the layout of which is shown in Fig. 6.

DOOR MECHANICS

The mechanical arrangements for the door lock is entirely up to the individual, we give just one suggestion from which the constructor can build on. This is shown in Fig. 7.

IN USE

Once constructed, the unit can be checked for faults. If all appears to be well the power supply can be connected.

By setting up the correct combination the relay should operate, if an external device is connected, the relay contacts should operate this also.

If the lock fails to operate, each section should be checked in turn for correct operation. The circuit easily splits into individual sections for this purpose: bistables; timer and switch.

If all functions satisfactorily, the board and power supply can be housed in a suitable case and the keyboard mounted as desired. ⌑

JACK PLUG & FAMILY... BY DOUG BAKER

ELECTRONICALLY CONTROLLED AIR FRESHENER

By D. Warwick

IT GOES almost without saying that people like pleasant smells and dislike unpleasant ones! Spring flowers, new mown grass, frying bacon, roasting coffee; a delight in the right places at the right time: but what about the lounge the morning after a party, or yesterday's boiled cabbage or the day before's fried fish? Not so good.

It's not always practical to fling open windows to let the smell out and so-called fresh air in. For one thing, in winter time a lot of money has been spent on heating the air in a room and opening the windows lets out all that costly warmth along with the smell.

A number of air freshening devices which mask or neutralise odours are available for use in the home but all have certain disadvantages. Here is an electronic answer to the problem which overcomes many of these disadvantages in a novel and simple way.

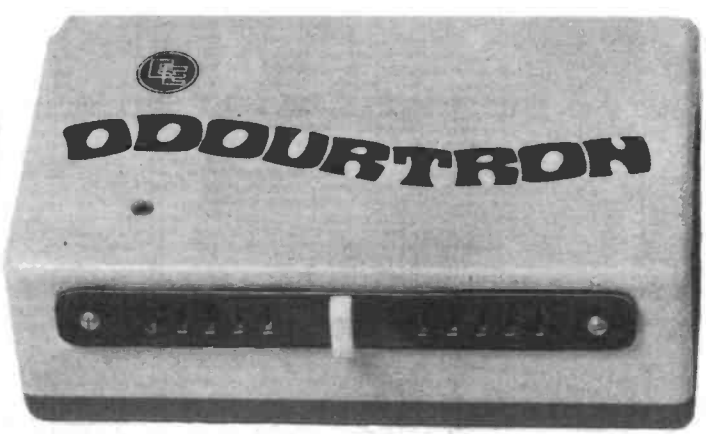
THE FUNCTION OF AN ELECTRONIC AIR FRESHENER

The supermarket shelves are packed with air fresheners of different types—solid blocks, liquids with a wick, impregnated plastics, aerosols, gels and so on. Liquid systems are difficult to handle and can spill. Solid air fresheners rely on convection currents to distribute the fragrance and consequently are localised in their effect. Aerosols force into the room but require manual operation and thus cannot act continuously. In addition there is still a certain amount of controversy about the possible harmful effect of the fluorocarbon propellant used in most aerosol air fresheners on the ozone layer in the upper atmosphere.

So our electronic air freshener should not contain liquids to spill, should act continuously and should have a powered airflow. Obviously, it should also be safe to use. All this can be achieved using a solid perfume emanator, a small fan, and a timing circuit which turns the fan on at regular intervals.

The two circuits described in this article enable the air freshener to operate at either four- or 15-minute intervals. As the former will give off approximately three times the perfume of the latter it will cope with the bigger smell problem but the perfume emanator

COMPONENTS approximate cost £9



The completed "d.i.y." Matrix Board model Air Freshener.

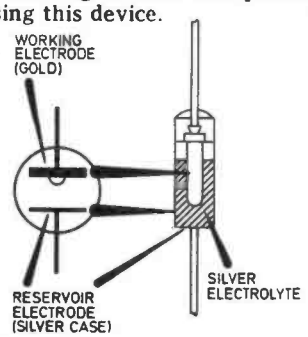
The E Cell

The E cell is worth mentioning in its own right. 'E' stands for electrochemical and its operation makes use of *ion* (as opposed to electron) conduction.

A cross section of the device is shown below. It consists of a silver case, a gold working electrode, and a silver electrolyte. The electrolyte allows ion conduction to take place between the electrodes. One atom of silver is electro-plated on the gold electrode for each electron entering the cell. On reversing the polarity the atom is removed.

When all the silver has been removed from the gold electrode ion conduction ceases and the device becomes effectively open circuit.

Typical plating currents are in the microampere region. For example, the device could be charged by a current of 200μA for 100 seconds and then discharged by 20μA for 1,000 seconds. This is the type of application adopted for the air freshener; however, many other interesting circuits are possible using this device.



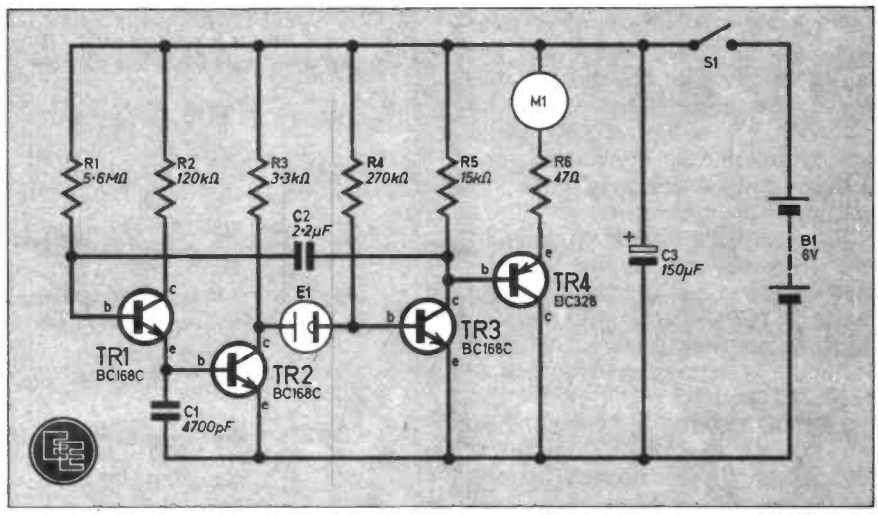


Fig. 1. Circuit for the 15-minute timer. This version uses the E cell.

will only last for a third of the time. The gel emanator recommended here should last for six to eight weeks with the 15-minute timer circuit.

15-MINUTE TIMER

One version of the air freshener has been designed to deliver a measure of perfumed air at predetermined intervals of about 15 minutes. This requires that the motor runs for about 10 seconds in every 15 minutes. This has to be achieved from a battery source and therefore to obtain reasonable battery life, low current drain is required.

The circuit in Fig. 1 achieves an off-time of 10 to 15 minutes and a motor-run time of 8 to 12 seconds, the off-state current being 2mA.

This circuit acts as an astable multivibrator with R1 and C2 timing the motor run or short part of the cycle, and R4 and the E cell the off-state or long part of the cycle.

When S1 is closed the motor will run for a short period depending on the state of C2. The following off-period will be controlled by the charging of the E cell during this period plus any remaining charge when the circuit was last turned off.

When the E cell reaches its end point the voltage at the base of TR3 starts to rise turning on TR3 and TR4 and starting the motor. C2 takes the base voltage of TR1 to −4·8V turning TR1 and TR2 off and C2 starts to change through R1. At the same time the E cell is charged through R3 until the base voltage at TR1 reaches 1·2V and TR1 and TR2 turn on turning off TR3 and TR4 and stopping the motor.

The E cell discharges through R4 until it reaches its end point, when the voltage at the base of TR3 starts to rise. The cycle is now complete and a new cycle restarts.

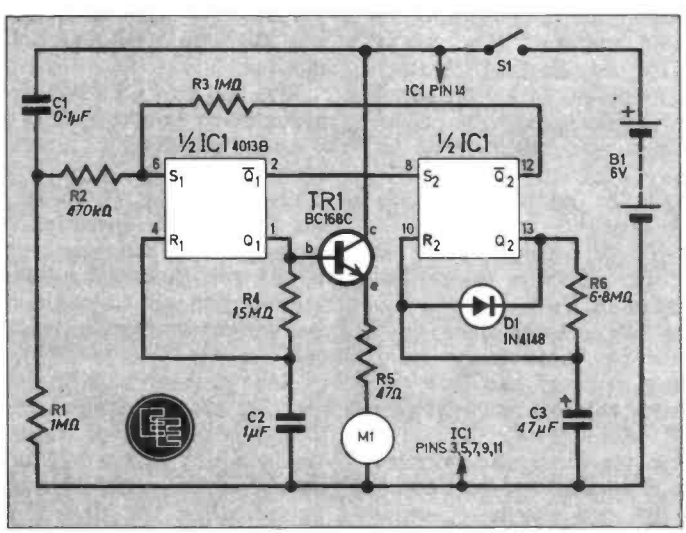


Fig. 2. Circuit for the 4-minute timer. A CMOS i.c. is used as the basis of this version.

4-MINUTE TIMER

The circuit shown in Fig. 2 performs the same function as the E cell circuit but operates at shorter time intervals. This is achieved using a CMOS Dual D type flip flop (IC1) and two RC networks. The advantage of using the integrated circuit is the much lower power consumption, typically 2μA during the off period.

Although the motor is turned on three times as often, nevertheless because of this very low current consumption during the off-cycle battery life is better than in the case of the E cell circuit.

The maximum length of off-time depends on the leakage of the capacitor used in the timing network. Longer times can be achieved by selecting low leakage components. However, four minutes can be achieved with low cost tantalum capacitors.

The complete circuit consists of two independent timing circuits each using one D-type flip flop (half of IC1). These are coupled together so that as one turns off the other is turned on. When S1 is closed C1 and R1 differentiate the supply rail making S_1 go high. This sets Q_1 and Q_2 low so the motor runs whilst C2 is charged through R4. When the voltage on C2 is sufficient to reset Q_1, Q_1 goes low turning off the motor and Q_1 goes high, thus S_2 goes high setting Q_2 high and Q_2 low.

C3 changes through R6 until the voltage is sufficient to reset Q_2. Q_2 goes high setting S_1 high and the motor starts to run and the cycle recommences. In order to discharge C3 during the comparatively short motor-run period it is necessary to put a diode D1 across R6.

Care must be taken when handling the integrated circuit IC1 as it is a CMOS device and as such is easily damaged by static. Do not handle the pins without shorting them together and use an earthed soldering iron when working on the printed circuit board. Any pins not used must be connected to the ground rail.

COMPONENTS

4-MINUTE TIMER

Resistors

R1 1MΩ
R2 470kΩ
R3 1MΩ
R4 15MΩ
R5 47Ω
R6 6·8MΩ

All carbon ¼W ±5%

See Shop Talk page 790

Capacitors

C1 0·1μF polyester (C280 series)
C2 1μF polycarbonate 250V Siemens
C3 47μF tantalum dry bead

Semiconductors

TR1 BC168C *npn* silicon
D1 1N4148 diode
IC1 4013 or 4013B Dual D-type flip-flop

Miscellaneous

B1 6V.HP11 1·5V cells (4 off)
M1 Miniature motor, Mabuchi type RF-510A-1260 or equivalent
S1 Single pole, single throw toggle switch

Matrix board 0·1 inch hole spacing, 1·5mm thick minimum, approx. 100mm square. Bakelite (or s.r.p.b.) sheet 1·5mm thick minimum. Plastic box 188mm × 100mm × 50mm (Verobox 65-2522K). Brass strip, B.A. screws and nuts.

15-MINUTE TIMER

Resistors

R1 5·6MΩ
R2 120kΩ
R3 3·3kΩ
R4 270kΩ
R5 15kΩ
R6 47Ω

All carbon ¼W ±5%

Capacitors

C1 4700pF disc ceramic
C2 2·2μF polycarbonate 100V
C3 150μF elect. 6·3V

Transistors

TR1 BC168C *npn* silicon
TR2 BC168C *npn* silicon
TR3 BC168C *npn* silicon
TR4 BC328 *pnp* silicon

E E-cell Plessey type 560-0002

CONSTRUCTION starts here

TWO APPROACHES

Two approaches are proposed for the construction of the air freshener. The first, a matrix board model housed in a standard plastics case, will suit those who like to make everything for themselves. The second approach makes use of a p.c.b. and proprietary plastic mouldings and parts to provide a stylish snap-together type assembly.

Almost any form of perfume emanator can be used with either model—gels, blocks, or even a lavender bag—as long as they fit the compartment provided.

MATRIX BOARD MODEL

Many methods of construction may be used and since this unit is intentionally on display, it may well be considered as a functional ornament. This being the case, those readers who are artistic by nature may wish to design their own housing or adapt something already in existence.

Whatever the method, it is necessary, for effective operation, to remember a few basic principles. The fan or rotor must:

(1) draw air through an inlet *across the perfumed block or gel* and to blow this air through an outlet. *OR*

(2) draw air through an inlet and *blow it across the perfumed block or gel* and thence through the outlet.

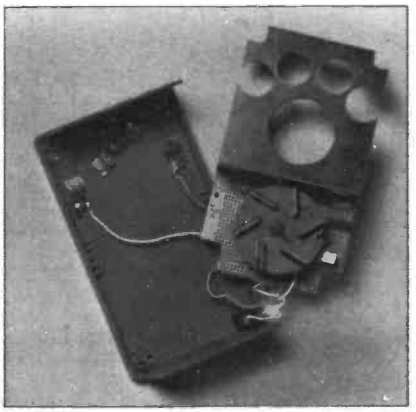
Take care that air is not drawn in and blown out in such a way that the air current avoids passing across the block or gel.

HOUSING DETAILS

The construction detailed here utilises a standard plastics box of internal dimensions 100×188×50mm high and is based on the use of Rizla Ventaine gel pots or similar.

The box and lid should be drilled and slotted in accordance with Fig. 3 and then fitted with battery contacts fabricated from 0·4/0·5mm brass strip (Fig. 5). These contacts are fitted with countersunk screws through the box such that the heads are flush to sub-flush. The appearance will be enhanced if the screws are chrome-plated or similar.

Next prepare and fit the shutter (Fig. 4, using suitable screws (for example, 4BA) with large washers below a nut and a locknut on the inside of the box. The shutter is closed when the unit is switched off in order to reduce evaporation



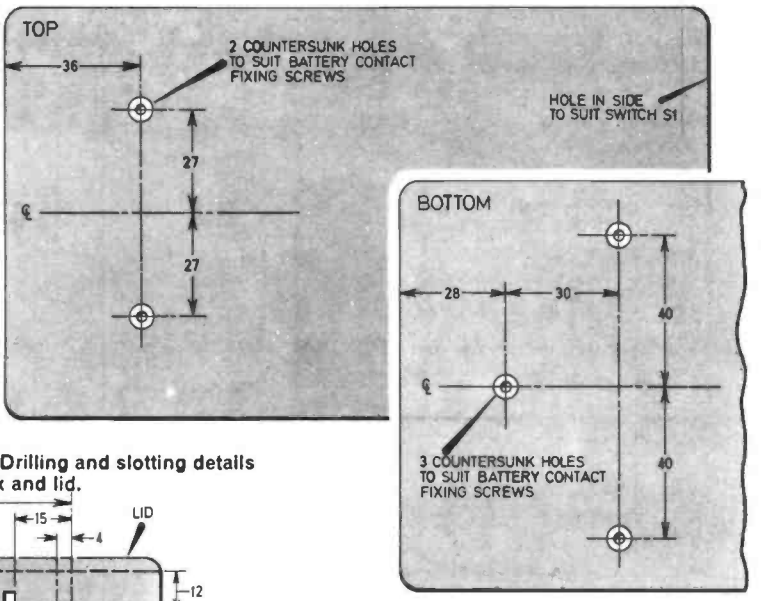
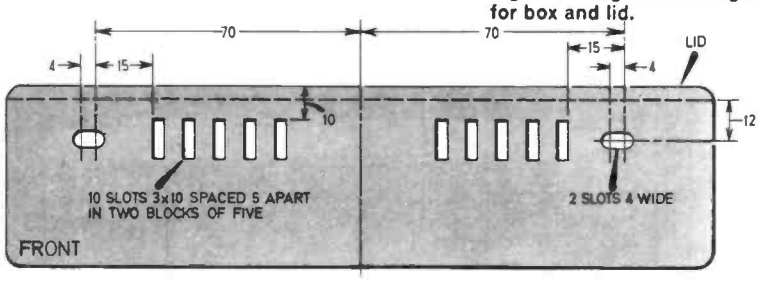


Fig. 3. Drilling and slotting details for box and lid.



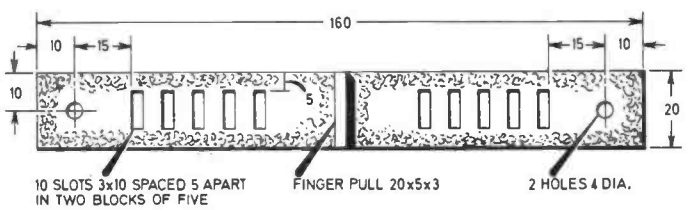


Fig. 4. Shutter details.

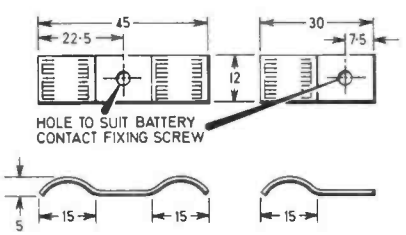


Fig. 5. Battery contacts.

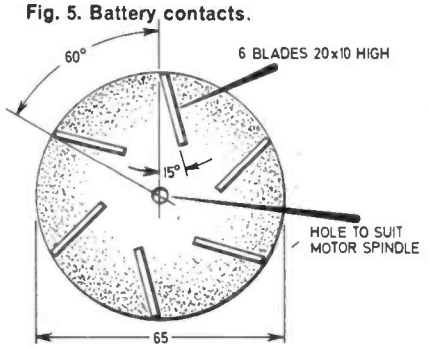
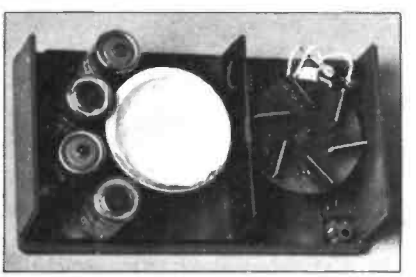
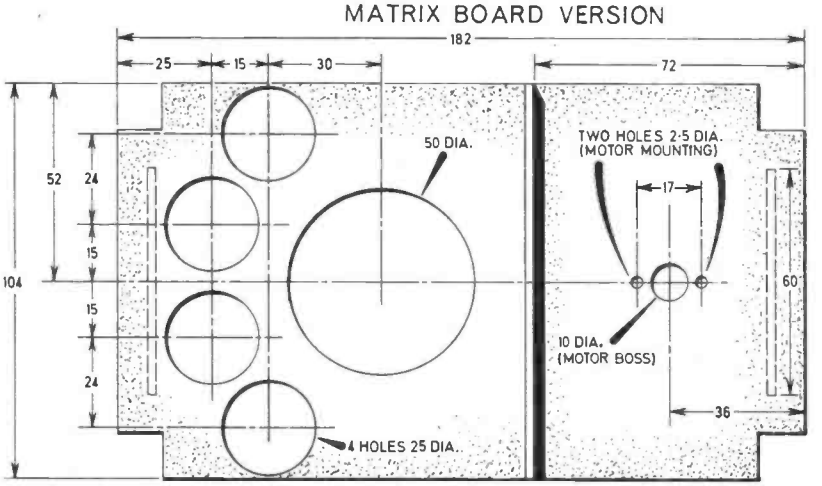


Fig. 6. Rotor assembly.

ODOURTRON
AIR FRESHENER



MATRIX BOARD VERSION



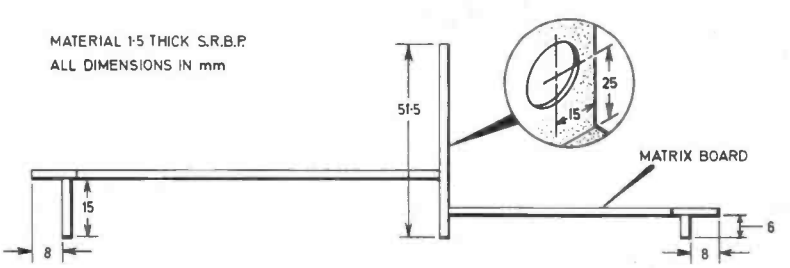


Fig. 7. Inner chassis assembly.

ODOURTRON
AIR FRESHENER

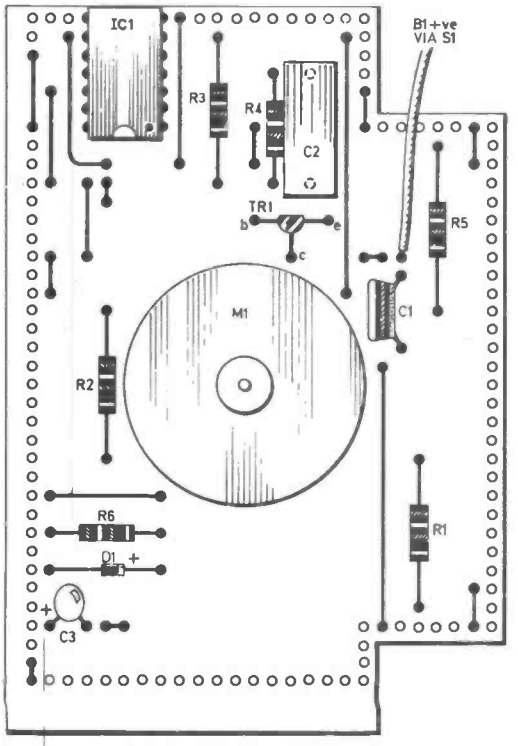


Fig. 8. Top view of matrix board, with components in position.

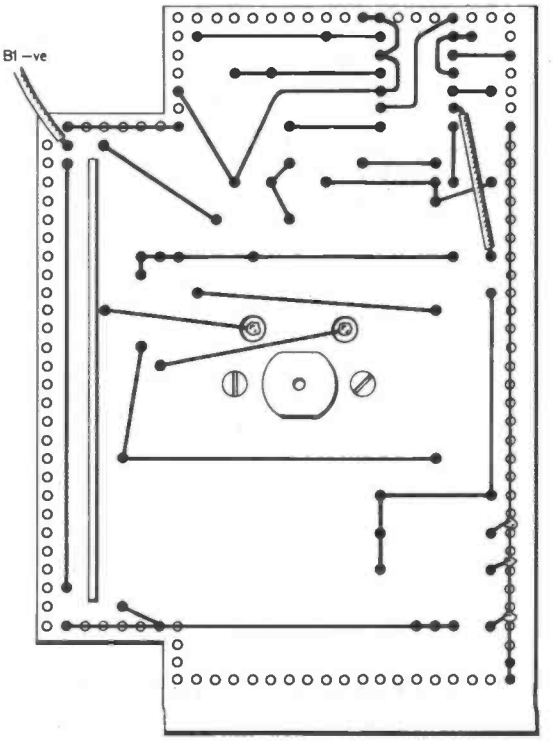


Fig. 9. Underside view of matrix board, showing wiring.

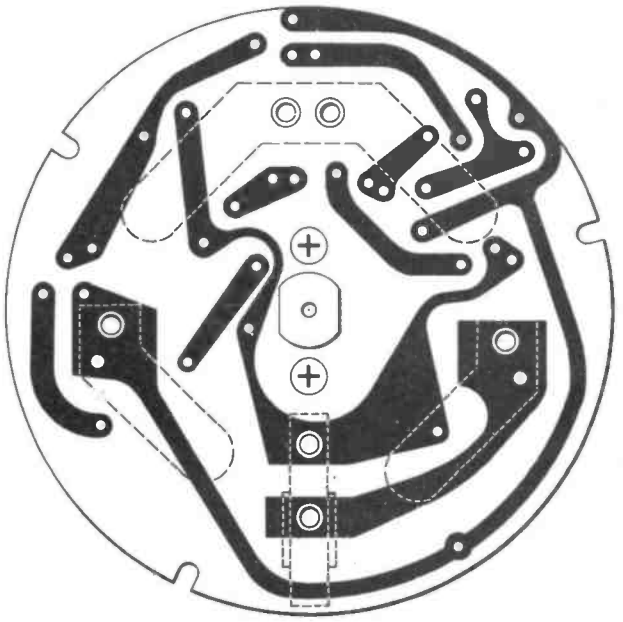


Fig. 10. Printed circuit board for Snap assembly model (15 minute timer). Broken lines indicate position of battery contacts which are secured to the board by eyelet fasteners.

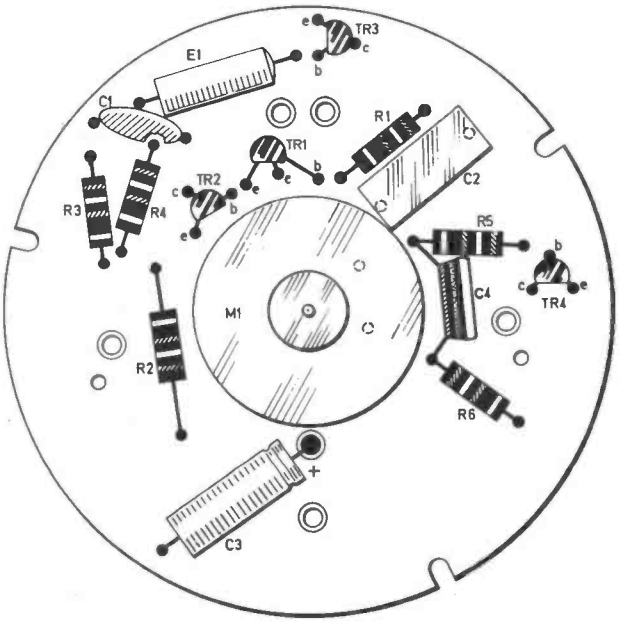


Fig. 11. Top view of circuit board (Fig. 10) with components in position.

of the block or gel and thereby extending the life of the gel.

In this construction a separate on/off switch is incorporated but it would be a simple matter to fit a light-action microswitch which is operated by the end of one of the shutter fixing screws. In this way only a single action would be necessary to open the shutter and simultaneously switch on the unit.

INNER CHASSIS

Next construct the inner chassis which provides a matrix board for circuit component assembly, locates the batteries and gel tub, and provides the two necessary compartments. The centre section should be closely matched to the box profile in order that the main air flow between compartments is via the 15mm diameter hole in the centre section (see Fig. 7). Secure together using suitable adhesive.

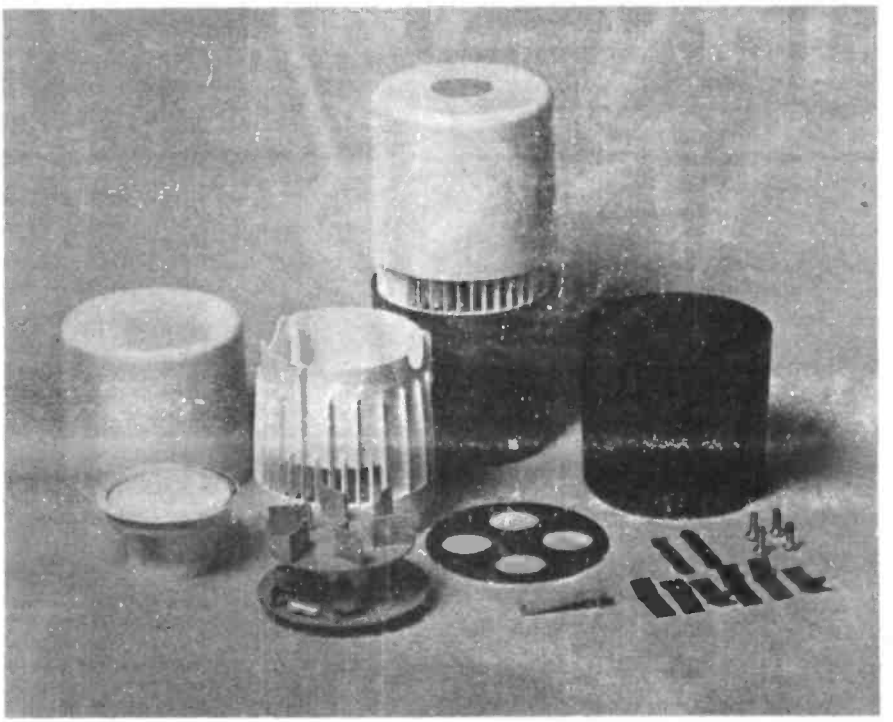
ROTOR ASSEMBLY

Referring to Fig. 6 cut a 65mm diameter disc to 1·5/2·0mm thick Bakelite, s.r.b.p., or similar material and six pieces of 0·75mm thick flexible plastic or similar. These latter pieces which form the blades of the rotor should be secured approximately as shown with suitable adhesive. In the prototype model, the blades are straight but if it is required to increase the "scoop" effect then they should be suitably curved.

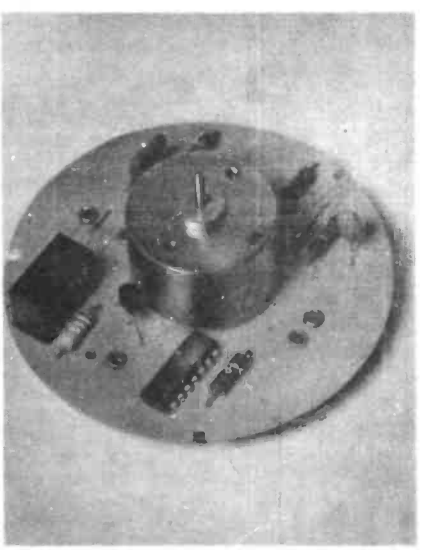
GENERAL ASSEMBLY

Components should be mounted as shown on the matrix board (Fig. 8). This component layout is for the 4-minute version, circuit Fig. 2. (If the 15-minute version is required, the constructor must plan his own layout, based on the circuit in Fig. 1.) The flex leads from the positive and negative battery terminals being fed through the hole in the centre section and dressed to give adequate clearance from the rotor. The rotor assembly may be force fitted or stuck to the motor spindle with a suitable adhesive. Finally fit the motor and rotor assembly, ensuring that the direction of rotation is as shown.

Fit four SP11 batteries taking heed for the polarities, position gel tub, screw on the lid and switch on to "the sweet smell of success."



Complete kit of parts for the "Snap Assembly" model Air Freshener, together with a completed unit (centre). Appropriate components and circular p.c.b. are available for either the 15-minute or the 4-minute timer.



"Snap Assembly" model p.c.b. assembly.

"SNAP ASSEMBLY" MODEL

Those who do not feel able (or inclined) to tackle all this mechanical work may prefer to build the alternative model using proprietary parts.

This model of the air freshener makes use of mouldings in black and white high impact polystyrene to provide a top cover to hold and seal the gel, a bottom cover to house the battery and a centre moulding to support the timing circuit and rotor.

The battery contacts snap into place and the circuit board can be sealed to the centre moulding.

The circuit components are mounted on a circular p.c.b. Patterns for the 15-minute version and the 4-minute version are given in Fig. 10 and Fig. 11.

A complete kit of these parts is available from Greenweld.

Everyday News

INTO SPACE WITH THE POST OFFICE

A new era in British and European space-age communications was reached recently with the handing over to the Post Office of a new all-British radio aerial, to be used with the next generation of communication satellites.

Jointly funded by Marconi Communication Systems, the Department of Industry, and the Post Office it has been designed, developed and constructed at a total cost of £3·25 million. The Department of Industry contribution being £850,000 under its Space Technology programme.

The new aerial, known as Goonhilly 4, will soon be sending test speech and television signals to the Orbital Test Satellite (OTS) launched in May for the European Space Agency. The launching of OTS is the first step in the Eutelsat project, Europe's own satellite system for the 1980s.

With the continuing rapid growth in world communications, international phone calls to and from Britain alone are doubling every four to five years, existing satellite systems are beginning to run out of spare capacity.

A new generation of satellites is needed, based on operation at higher radio frequencies, to meet future needs. The OTS is just one of the first of these satellites. As its name implies, it is a test bed and it will be used by Western Europe to check that the new technology performs as well as its designers predict.

Goonhilly 4 is one of the first of a new design of large Earth terminals to work with the new satellite. During the next 18 months or so, it will be sending simulated speech and TV signals up to the satellite, which will receive them and retransmit back to the aerial.

Detailed measurements will be made of aerial and satellite performance in handling the signals. Similar tests using large Earth terminals will also be carried out in France, Germany and Italy.

One of the new features of OTS is that it operates at much higher radio frequencies than earlier satellites, 11 and 14GHz instead of 4 and 6GHz. (10GHz is equal to ten thousand million cycles a second—equivalent to a wavelength of 3 cms.) Operation at higher frequencies reduces the risk of interference from other terrestrial microwave radio systems.

Part of the test programme with OTS will include trials with digital transmission, a way of sending telephone speech as on-off impulses instead of in their more usual wave form. Some 50 experimenters throughout Europe will be using OTS for other studies of new forms of radio transmission. The organisations taking part include the Post Office Research Centre at Martlesham Heath, near Ipswich, which has its own 6m (20 ft) diameter aerial for this work.

Future Role

During "field trials" the Post Office will also decide on the future operational role for the new aerial. It may be used to link up with the first of the operational European communication satellites, to be sent up by the Eutelsat organisation in 1981. Or it may operate with the first of the next generation of Intelsat satellites. This will be Intelsat V to be launched at the end of 1979 into a geostationary orbit over the Atlantic ocean to meet growth in communications on the busy transatlantic route between Europe and North America.

For this reason, Goonhilly 4's dish aerial is mounted on a circular track so that it can be operated in either direction, to Europe or to the Atlantic.

British First

An interesting footnote to the above story is the news that Ferranti engineers have successfully completed live tests of a new low-cost professional receive-only satellite ground station operating at 11GHz.

The tests were the first in Europe using a small ground station to receive live pictures via the Orbital Test Satellite.

A dozen young ladies are currently taking the 3-year marine radio officer course at Riversdale College of Technology, Liverpool. But still a long way to go to achieve parity. There are 174 male students.

Hunt the Set

Impecunious home-computer buffs are said to be hot on the trail of old and cheap TV sets which can be pressed into service as VDUs, either through adaptation or by using an interface unit direct into the aerial socket.

Silicon-on-sapphire (SOS) techniques of i.c. manufacture are becoming more prominent. SOS chips provide high speed devices but cost more than plain silicon chips.

The technique has been developed largely in the USA but GEC's Hirst Research Centre is working on a British product which could go into production by 1981.

—LES GIRLS!—

Susie and Matilda are not, as you may have imagined, the latest additions to the chorus line. They are both code-names for electronic warfare equipment made by The MEL Equipment Company Ltd.

Susie detects and analyses radar transmissions. Matilda is a radar threat warning system.

SPEECH FOR THE YOUNG

The first time the human vocal tract has been electronically duplicated on a single chip of silicon is claimed by Texas for their new speech-synthesis monolithic integrated circuit.

The speech-synthesis MOS/LSI integrated circuit, along with two 128K dynamic read-only memories, each with the capacity to store over 100 seconds of speech, and a special version of the TMS 1000 microcomputer serve as the main electronics for the company's new talking learning aid, Speak and Spell, for seven-year olds and upwards.

. . . from the World of Electronics

—ANALYSIS—

FIFTY YEARS OF FUN

Fifty years ago the amateur radio experimenter (electronics had not yet appeared) was still making many components. Winding coils, building condensers (capacitors) both fixed and variable, making resistors from resistance wire. All expensive in time and money but great fun.

Forty-five years ago saw the beginning of the boom in home construction, stimulated by the popularity of public broadcasting, and the demand for components was met by eager component manufacturers. In the 1930s you could buy off-the-shelf components and complete radio kits for home assembly. Competition and mass production brought prices down. A few die-hards of the old school complained that "fings ain't what they used to be" but lots more people were having lots more fun. And technology was advancing fast. You had to be bright and alert to keep up with it all—and that was part of the fun.

The post-war years were to see even more drastic changes. The hobby was no longer just radio. It blossomed into the much broader field of electronics. The transistor supplanted the valve, the printed circuit came along and, later, the i.c. and complete circuit modules.

During these latter years, circuit design has moved away from the equipment designers to the component manufacturers. A component today can still be a simple 5k resistor. Or it can equally be a whole audio amplifier on a single-chip—or even a computer.

With each successive advance of the technology the old-timers have said the fun is going out of the game. But they have been consistently wrong. The technology has changed out of all recognition but the fun is still there—otherwise how can one explain the growing popularity of a journal like "EVERYDAY ELECTRONICS".

The electronics constructor has never had it so good. He or she has not only a gold mine of components available compared with the "good old days" but they have never been cheaper, relative to income. As a schoolboy in the 1930s it took me weeks of self-denial to buy a 5/- (25p) valve and another 1/- (5p) for the valveholder.

But it's not a question of money or of a changing technology. The real fun is that of achievement. Building something and making it work. Along the way in any project there is scope for craftsmanship, perhaps some innovation and experiment, and the crowning glory—it works! And we have learnt something and produced something useful or entertaining.

It adds up to self-satisfaction. And there is just as much of this in building today's projects with bought components as there was in fashioning fifty years ago a capacitor from brass plate. In fact, more fun when you think about it.

Brian G. Peck.

Well Advanced

Despite all the publicity on microprocessors they still represent less than two per cent of the total UK market for i.c.s in general. In the latest estimates issued by the Electronic Components Industry Federation the total semiconductor market in the UK for 1977 was £251 million, split £121 million for discretes and £130 million for i.c.s.

The UK is the first country, after the USA, to spend more on i.c.s in a year than on discretes, the implication being that the UK is well advanced technologically.

⁂ ⁂ ⁂

A visual augmentation system is being developed by Marconi for installation in Tornado aircraft. A sensitive low-light TV camera will enable both the pilot and navigator to see the scene ahead on cockpit screens well beyond what can be seen with the unaided eye.

ON THE ROAD

Next year's Cadillac Seville limousines will have a MPU computer system.

By pressing appropriate buttons the driver or front-seat passenger can call up present fuel economy, average economy for the trip, average car speed, total elapsed trip time, driving range on remaining fuel, miles-to-go to a pre-determined destination, estimated time of arrival in prevailing conditions, time of day, engine r.p.m., engine temperature and system voltage. The only thing it doesn't do is to drive the car.

⁂ ⁂ ⁂

The giant GEC group which employs 156,000 people in the UK is looking for another 3,000 skilled men and women. 1977-78 sales at £2,343 million reached another all-time record, some £300 million higher than 1976-77.

Personal Victory

An important piece of news this month is that Japanese companies may have to pay Texas Instruments royalties to produce miniature pocket calculators on single i.c. chips.

This is the result of the Japanese Patent Office decision to issue a patent covering virtually all miniature electronic calculators to Texas. The patent describes work that was carried out in the mid-60s.

The Japanese patent is based on US Patent 3,819,921 and was granted despite strong opposition from Japanese companies in a country where many electronic calculators are made and exported. The patent is for personal-sized battery operated calculators which have their main circuitry in a single integrated circuit chip.

Dial-a-Programme

Access to a central computer through any telephone is now possible with the aid of Tele-Zip, a British development by Data Dynamics. The only other thing you need is a standard TV receiver to act as a visual display. Tele-Zip has a keyboard and an acoustic modem housed in a briefcase.

To use, just dial up the computer, place the telephone handset in the modem, plug into the aerial socket of the TV and you are on-line to the computer with full keyboard access and VDU display. Price is quoted as £550.

RADIO WORLD

By Pat Hawker, G3VA

Expensive self-training

THE attitude of the British licensing authorities to Amateur Radio has for long seemed to be one of benevolent despotism and careless indifference solidly based on administrative convenience. Undoubtedly the officials concerned treat applicants fairly and considerately, but they seem to be erecting ever higher cost barriers with little interest in encouraging the self-training aspects of the hobby.

A country that heavily subsidises virtually all other forms of training and education; that bemoans the shortages of good electronic engineers and our dependence on overseas for microelectronics is surely short-sighted if it makes it unnecessarily difficult for a youngster to acquire a licence. Even the Australians, not noted for administrative encouragement of amateur radio, in reviewing a British amateur radio publication, comment: "The UK regulations differ considerably from ours—for which we should be duly thankful."

The Japanese so shaped their regulations in the 1960s, skating around the international requirement for a Morse test for h.f. operation, that they encouraged hundreds of thousands to become radio amateurs in a space of a few short years and so created the large domestic market for specialised equipment that has since led to their enormous export success in this field. But they reserved stiffer tests for those wanting full operating priviledges.

Incentive Sport

The Americans similarly use "incentive" licensing to encourage study beyond the minimum needed to obtain a "novice" licence. The Russians by recognising Amateur Radio as an official "sport" have created a large reserve of extremely proficient radio operators many using equipment they have built themselves.

I do not suggest that the United Kingdom is worse than some other European countries, but then it is this group of countries that in the past has proved among the most hostile to the hobby.

What could be done? Just for starters why not find some way of reducing the cost to youngsters of taking the increasingly expensive City & Guilds Radio Amateurs' Examination and the Post Office Morse Test. And then what about a novice licence providing limited facilities while preparing to take the full exam?

After colour TV—what?

More than a decade ago, the American electronics industry began getting seriously concerned about finding an answer to the question "After colour TV—what?". They foresaw the need to find something new that would appeal to the public and so maintain the impetus of the important consumer market in electronics. It sometimes seems that no really convincing answer has yet been found, despite all the effort and promotion that have gone into such products as home video recorders, video discs, video games, teletext and viewdata, surround-sound (quadraphony), microwave ovens, home computers and the like.

All these appeal to enthusiasts but hardly to the mass market. The high street shops still depend on colour TV, second-set black-and-white portable TVs, sound radio and medium-fi audio. Microprocessors that could control many domestic chores and robot machines, the whole concept of home information acquisition retrieval and processing, push-button shopping and the like seem only marginally nearer in practice than when they first began to be advocated.

Although I saw the very first demonstrations of teletext by colleagues in the IBA back in April 1973, and retain a profound respect for the technology, it remains increasingly difficult to imagine Mr and Mrs Everyman rushing out to buy at the present level of decoder costs. To appeal to a mass market, home electronics must provide entertainment first and foremost rather than information or instruction; must be extremely simple to use (think of the lack of demand for "all-band" radios though these are at last becoming simpler to use); and must be something which you could not bear the thought of your neighbour having first.

Communicating with neutrinos

The search for means of communicating with deeply submerged submarines continues unabated. Several years ago "Project Sanguine" showed the possibility of using radio signals below 100Hz (yes hertz not kilohertz) but its implementation ("Project Seafarer") has been delayed in the United States by the residents of Michigan who not unnaturally are worried at the massive powers and vast hundred-mile antennas involved.

The latest proposal is to harness modulated beams of those mysterious atomic particles called neutrinos and so form absolutely unstoppable communications systems. The neutrinos, generated in large proton accelerators, would be discharged towards its target in laser-like pencil beams directly *through* the Earth, and then detected in water by photodetectors.

Like the 45Hz extremely low frequency system there could be a problem of data rate (equivalent to perhaps only one or two Morse dots per second) although some researchers claim this would be no problem. It is estimated that a particle beam could pass right through the Earth with less than 1 per cent attenuation!

FREQUENCY CHANGES

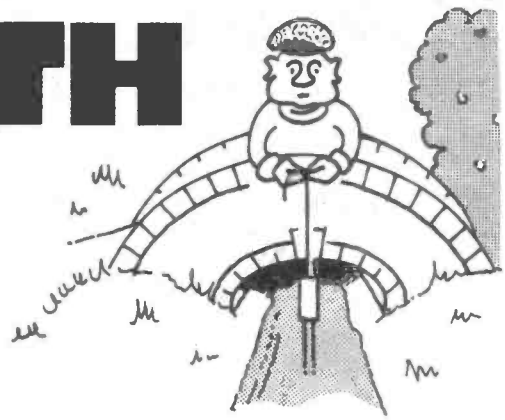
A new international frequency agreement comes into effect from November 23 1978, and many of the frequencies used for BBC Radio will be changed at that time. The principal new frequencies and wavelengths are shown below:

	Frequency (kHz)	Wavelength (M)	
Radio 1	1053 & 1089	285 & 275	Med Wave
Radio 2	693 & 909	433 & 330	Med Wave
Radio 3	1215	247	Med Wave
Radio 4	200	1500	Long Wave

Radio Scotland, Radio Wales, Radio Cymru, Radio Ulster, BBC Local Radio and all v.h.f. services—No Change.

"Dear Teacher, Bobby was unable to attend school yesterday as his calculator broke down."

NEXT MONTH



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Everyday ELECTRONICS

DECEMBER
ISSUE ON SALE FRIDAY, NOVEMBER 17

I MENTIONED recently that I was all in favour of new ideas provided they were an improvement on existing ones, but sometimes useful things disappear without any apparent reason. This was forcibly bought home to me a few days ago, when I wanted to work out how many turns, and on what size former, I needed, to wind a coil of a certain inductance. I immediately thought that to save time I would use an ABAC (hands up all those who know what an ABAC is). In vain I searched through all the likely manuals and Engineers pocket books, without success.

Many years ago I used to work for a firm which made mains transformers and sometimes we would have a request for a special, and it would fall to my lot to design it. This had me worried at first until a colleague of mine showed me that with a couple of ABAC's and a ruler the whole job could be done in five minutes.

What is an A.B.A.C.? I suppose the simplest description is to say it is a slide rule without any moving parts. Several years ago Wireless World produced a book of these containing some 43 ABACs. Armed with these innumerable calculations could be worked out in minutes, saving hours of work. Has anything else replaced them? If not, why did they vanish?

Customers Right

In the bad old days the consumer was sometimes exploited by the crooked retailer. To-day legislation has been passed to safeguard the customers interest, and I am all in favour of this. I do sometimes wonder however if it has gone too far the other way because, it must be said, not all the villains are on my side of the counter.

I thought by way of clarification I would get legal advice as to a customers right to return goods. As I understand it, if the goods are faulty, the customer can return the goods and request his money back. The retailer has not even the option of exchanging them unless of course the customer agrees, nor does there seem to be any time limit. It means if the customer is hard up for a bob or two, he can blow up his multimeter and demand the cost back in full. However, in this instance, if the shopkeeper suspects foul play, he can refuse to return the money, pending an examination of the meter by the maker.

I am sure you will agree that this is reasonable. Not that I am suggesting that any readers of EVERYDAY ELECTRONICS would stoop to such things. I am sure they would not, but at least I hope I have enlightened you as to your rights in the matter.

Better than Concorde

May I give a final "thank you" to all those who were kind enough to write to me on the question of the speed of electricity. I endeavoured to reply personally to everyone, but if I missed anyone I trust they will forgive me. I can think of no better way of rounding off this discussion than by quoting that famous Limerick:

"There was a young lady named Bright,
Who travelled much faster than light,
She set off one day
In a relative way
And returned the previous night!"

EE CROSSWORD No 9 BY D.P.NEWTON

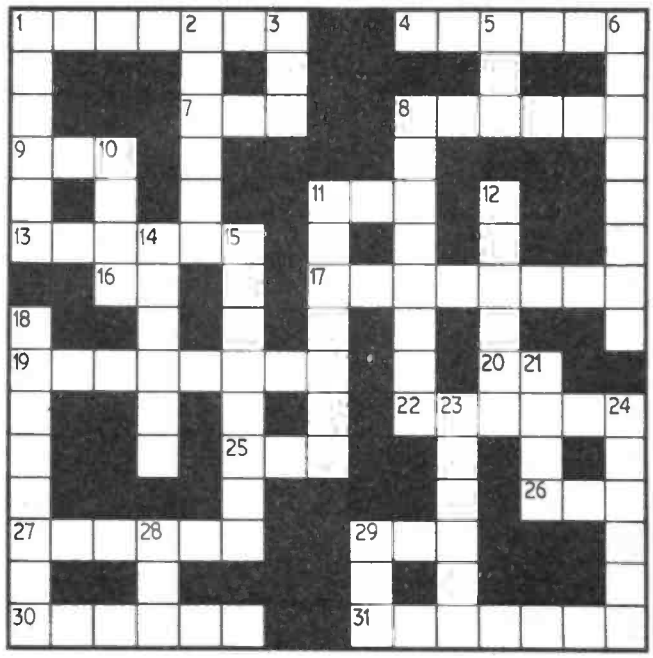
ACROSS

1 The channels equilibrium.
4 Frequently recurring.
7 Around 100MHz.
8 Long distance communicators.
9 A cooler.
11 An age.
13 The insulator in the bath.
16 In the direction of.
17 Lunatic bend?
19 They sample what is going on and give out pencils.
20 A power supply for Washington?
22 Communication from the peaks.
25 Two from the Eastern bloc.
26 It makes soldering child's play.
27 A signally successful suppressor of enthusiasm.
29 A noisy plug?
30 Even after smoothing we can be left with this small wave.
31 A measure of power loss or gain.

DOWN

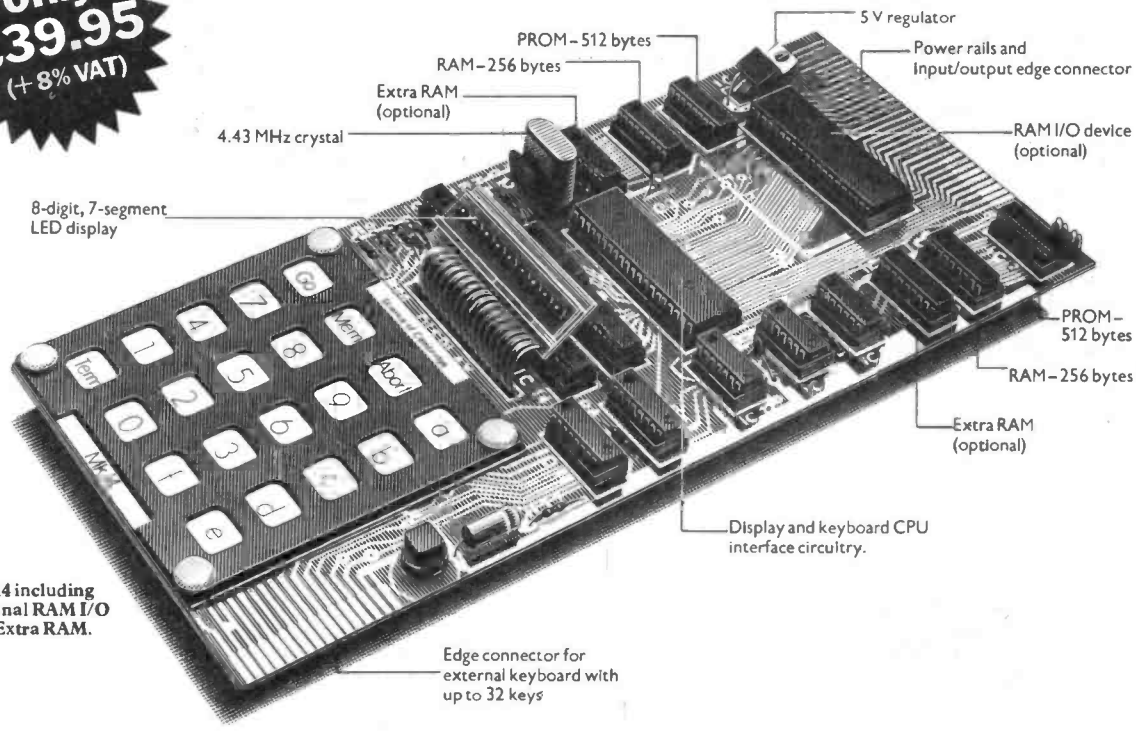
1 Confuse a loudspeaker?
2 A beginner without blemish.
3 It sets electrons in motion.
5 Eight across, reduced to a taxi.
6 The recorder in a test case. (Anag.)
8 Joins, usually by wire.
10 Without soda.
11 Boxed in.
12 A network breaks a cipher.
14 Emotion from a d.c. coil meter.
15 One who works.
18 To solder with subdued fire.
21 The transporter part of a cartridge.
23 A noisy unit in the telephone gives the stereo a fuller meaning.
24 To indicate intentions, often by radio.
28 A squeak from a cheeky timecheck.
29 An inoperative component.

Solution on page 822



From Science of Cambridge: the new MK 14. Simplest, most advanced, most flexible microcomputer – in kit form.

only £39.95 (+8% VAT)



MK 14 including optional RAM I/O and Extra RAM.

The MK 14 is a complete microcomputer with a keyboard, a display, 8 x 512-byte pre-programmed PROMs, and a 256-byte RAM programmable through the keyboard.

As such the MK 14 can handle dozens of user-written programs through the hexadecimal keyboard.

Yet in kit form, the MK 14 costs only £39.95 (+£3.20 VAT, and p&p).

More memory – and peripherals!

Optional extras include:

1. Extra RAM – 256 bytes.
2. 16-line RAM I/O device (allowed for on the PCB) giving further 128 bytes of RAM.
3. Low-cost cassette interface module – which means you can use ordinary tape cassettes/recorder for storage of data and programs.
4. Revised monitor, to get the most from the cassette interface module. It consists of 2 replacement PROMs, pre-programmed with sub-routines for the interface, offset calculations and single step, and single-operation data entry.
5. PROM programmer and blank PROMs to set up your own pre-programmed dedicated applications.

All are available now to owners of MK 14.

A valuable tool – and a training aid

As a computer, it handles operations of all types – from complex games to digital alarm clock functioning, from basic maths to a pulse delay chain. Programs are in the Manual, together with instructions for creating your own genuinely valuable programs. And, of course, it's a superb education and training aid – providing an ideal introduction to computer technology.

SPECIFICATIONS

●Hexadecimal keyboard ● 8-digit, 7-segment LED display ● 8 x 512 PROM, containing monitor program and interface instructions ●256 bytes of RAM ● 4 MHz crystal ● 5 V regulator ● Single 8 V power supply ● Space available for extra 256-byte RAM and 16 port I/O ● Edge connector access to all data lines and I/O ports

Free Manual

Every MK 14 kit includes a Manual which deals with procedures from soldering techniques to interfacing with complex external equipment. It includes 20 sample programs including math routines (square root, etc), digital alarm clock, single-step, music box, mastermind and moon landing games, self-replication, general purpose sequencing, etc.

Designed for fast, easy assembly

The MK 14 can be assembled by anyone with a fine-tip soldering iron and a few hours' spare time, using the illustrated step-by-step instructions provided.

How to get your MK 14

Getting your MK 14 kit is easy. Just fill in the coupon below, and post it to us today, with a cheque or PO made payable to Science of Cambridge. And, of course, it comes to you with a comprehensive guarantee. If for any reason, you're not completely satisfied with your MK 14, return it to us within 14 days for a full cash refund.

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6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Telephone: Cambridge (0223) 311488

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Please send me the following, plus details of other peripherals:

☐ MK 14 Standard Microcomputer Kit @ £43.55 (inc 40p p&p.)
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☐ RAM I/O device @ £8.42 (inc p&p.)

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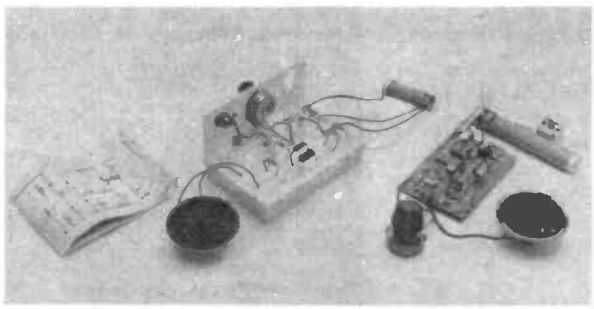
Name_____
Address (please print)_____

EE/11 Allow 21 days for delivery.

Science of Cambridge

DeC-IT and BLOB-IT



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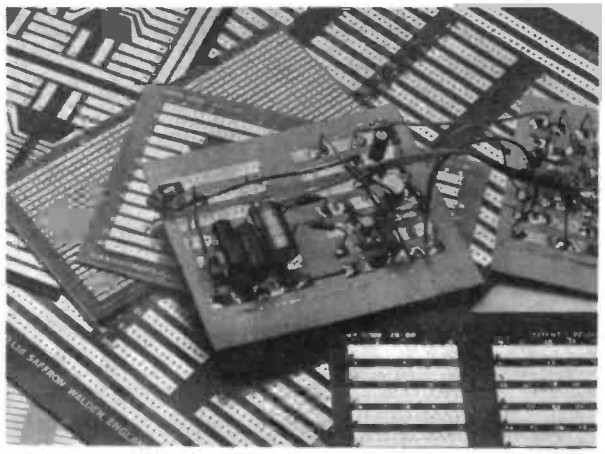

Blob-Board now available in many different layouts and sizes
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MINI-MODULES

By George Hylton

Handy "Beginner" projects based on simple circuits and featuring a variety of building methods.

AUDIO EFFECTS OSCILLATOR 2

THIS circuit (Fig. 1) is a simple RC oscillator whose frequency can be tuned over quite a wide range by varying one resistance. It is also capable of being frequency-modulated and keyed by an external signal.

It is not a sinewave oscillator: the output is a train of pulses of rather variable shape. As such it is most suitable for use as a means of achieving audio effects, where frequency is more important than waveform. (Pulses are in fact more interesting to listen to than pure tones.)

Any oscillator capable of being swept over a wide frequency range can be made to produce interesting "spacy" noises. (If played through a reverberation or echo unit they sound even more interesting.) A very low frequency pulsation, down to about one pulse per second, gives "heartbeat" sounds which also have their uses. If the two are combined by using a v.l.f. oscillator to modulate an audio oscillator the range of effects is increased.

With the design shown here the fact that an input applied to the "MOD" terminal frequency-modulates (or keys on and off), according to its amplitude, makes it possible to produce interesting twittering sounds by modulating an audio version, set to a few kilohertz, with a v.l.f. of a few hertz.

For this reason it is a good idea to build two oscillators, one with a timing capacitor (C2) of about 10μF, to cover roughly 1-30Hz and one with 33nF (0·033μF) to cover the audio range from about 300Hz upwards. You can use both separately or modulate one with the other.

THE CIRCUIT

The transistors TR1 and TR2 form a two-stage amplifier with a direct coupling between the stages. This is turned into an oscillator by connecting the output (at collector of TR2) via a capacitor back to the input (base of TR1), which forms a positive feedback loop.

The timing capacitor C2, then charges and discharges periodically at a rate which can be varied by adjusting VR1. If a good log-law "volume control" is used for VR1 it should provide at least a thirtyfold variation in frequency. (The frequency is lowest when VR1 is highest. Strictly speaking it would therefore be better to call VR1 a period control since it is really the period of oscillation it varies.)

This circuit is very reliable because it works with almost any *npn* transistors and is insensitive to gain variations. D.C. negative feedback via VR1 helps to stabilise the operating points of the transistors.

MODULATION

A small voltage applied to the MOD input and E ("earth") changes the frequency slightly without altering the amplitude. A large voltage stops the oscillation. If the large modulating voltage is a square wave the result is just to key the oscillation on and off, but if it is a sinewave or triangular wave both f.m. and on-off keying are produced. A positive input raises the frequency.

COMPONENTS

Resistors

R1	100kΩ	R4	1kΩ
R2	100kΩ	R5	1kΩ
R3	1kΩ	R6	10kΩ

All 5% tol. ¼W

Potentiometers

VR1 100kΩ carbon track, log
VR2 10kΩ carbon track, log

Capacitors

C1 47μF (or larger) 12V
C2 See text
C3 100nF polyester or paper

Semiconductors

TR1, TR2 BC108 *npn* transistor (2 off)

Miscellaneous

Plastics case (Norman PB1). Two knobs. Piece hardboard. Brass panel pins. 6BA nuts, bolts, earth tags.

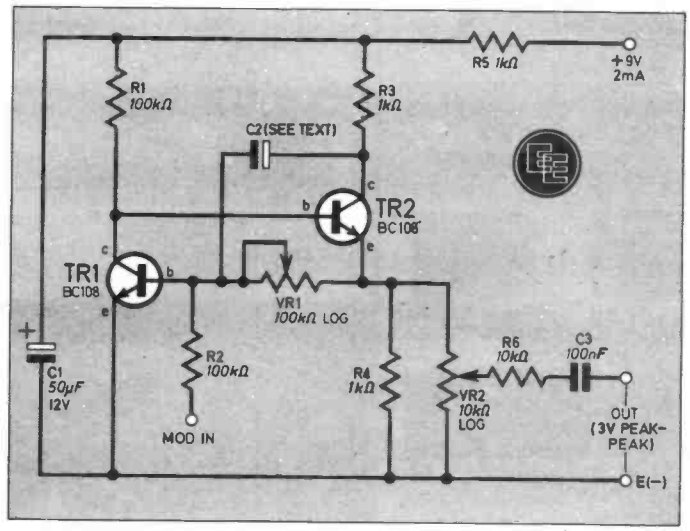
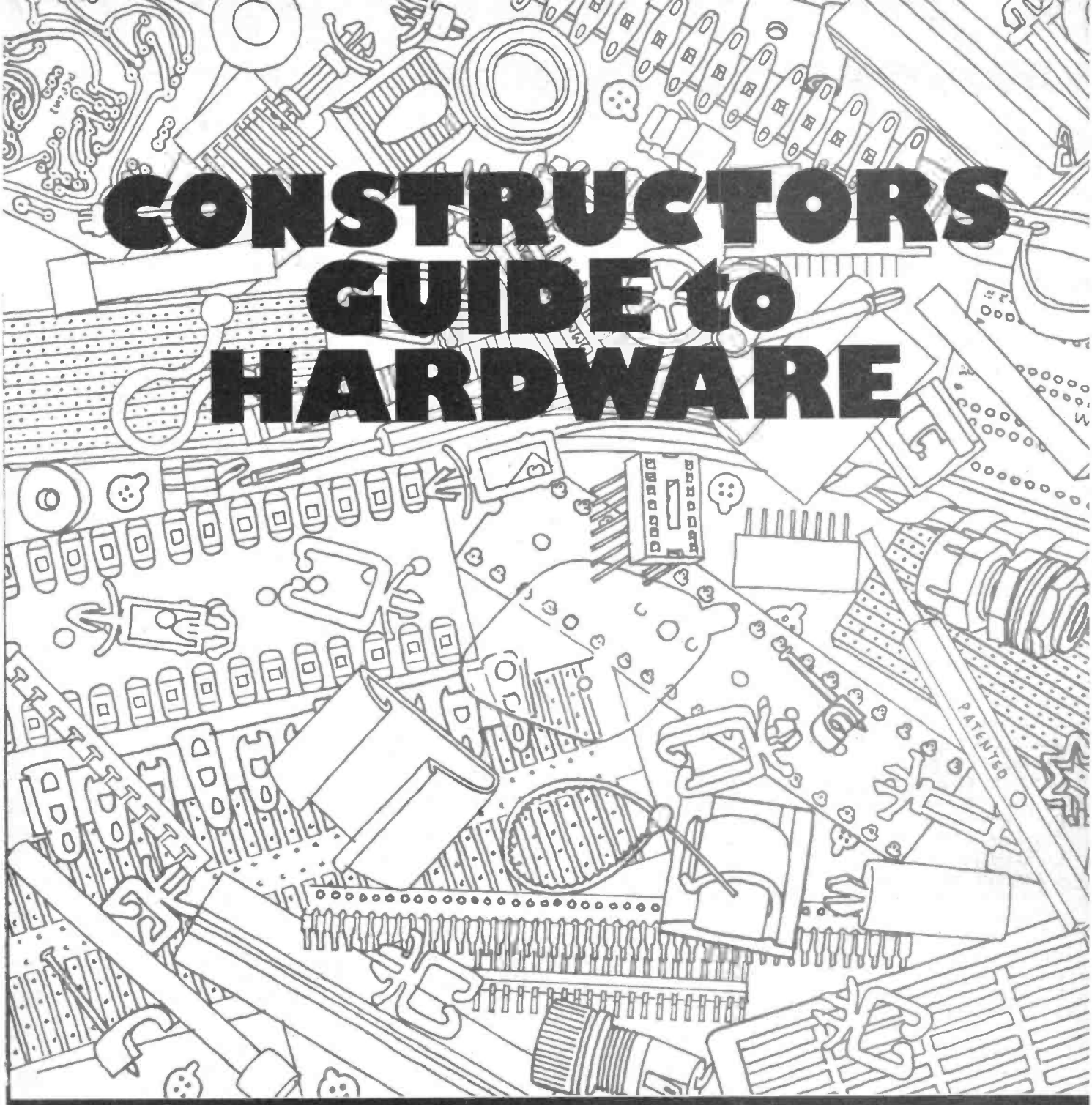


Fig. 1. Audio effects oscillator circuit. C2 is chosen to set the frequency range.

CONSTRUCTORS GUIDE to HARDWARE



CONTENTS

CIRCUIT BOARDS ● BREADBOARDS ● MOUNTING CIRCUIT BOARDS ● CONNECTIONS TO BOARDS ● WIRES and CABLES ● WIRE and CABLE ACCESSORIES ● I.C. and TRANSISTOR HARDWARE ● MISCELLANEOUS ITEMS ● SPECIAL TOOLS

CIRCUIT BOARDS

One thing all electronic assemblies have in common is a framework—a piece of hardware generally referred to as a circuit board—for holding the majority of the electronic devices together. It seems appropriate therefore to begin with the various types of circuit board available to the constructor.

Stripboard

Stripboard, as its name implies, consists of parallel strips of copper bonded to a sheet of s.r.b.p. (synthetic resin bonded paper). The board is perforated along the strips so as to form a regular matrix of holes.

Components are intended to be mounted on the un-coppered side of the board with component leads protruding through the holes and soldered to the copper strips. The latter can be linked and/or cut to suit the required circuit configuration. Cuts along the strips are carried out with a drill bit or spot-face cutter (see later).

The matrix pitch can be either 0·1 inch or 0·15 inch and is available in an extensive range of sizes.

Non standard sizes are easily cut from a larger sheet by means of a small hacksaw.

Perforated Board

Perforated board, often called plain matrix board is identical to stripboard with the copper strips removed. Components are mounted on either or both sides of the board and interconnections between the components accomplished by means of the component leads and other wiring.

More versatile than stripboard, this board is often used for designing prototype p.c.b. (see below) assemblies and is especially useful for circuits operating at high frequencies where the capacitance/inductance of the copper strip would become significant and interfere with circuit operation.

This is available in both 0·1 inch and 0·15 inch matrix pitch. Re-usable.

Printed Circuit Board

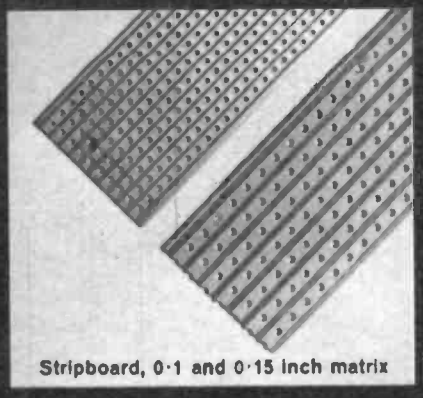
Unlike the previous two systems, a printed circuit board (p.c.b.) is dedicated to a particular circuit configuration, and generally cannot be used for any other. The p.c.b. consists of a piece of plain s.r.b.p. or fibreglass with copper bonded to one (or both) side(s). An interconnection pattern is devised to connect the components according to the circuit diagram and this pattern is produced on the copper laminate by an etching process. This form of circuit board was primarily "invented" for large volume production where all that is required is for the components to be located and soldered. The use of p.c.b. eliminates, track cutting and interwiring as required by the above mentioned boards.

This system is found in most commercial equipment presently produced and is regularly featured in EVERYDAY ELECTRONICS for ease of construction for the amateur constructor and the professional appearance of the finished assembly.

Plain board

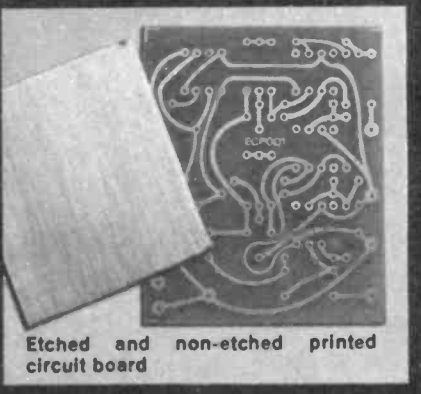
Completely plain, non-perforated unclad board, Paxolin or s.r.b.p. is rarely used nowadays as a circuit board but at one time, especially in the valve era, was in extensive use. This is cheaper than any system so far mentioned and may be of interest to some constructors.

Components can be mounted on one or both sides but all holes for mounting components, or connecting terminals need to be drilled by the constructor. Due to the reduced number of holes to be found in this type of board compared with matrix types, this has more rigidity which may be an important factor in some applications.

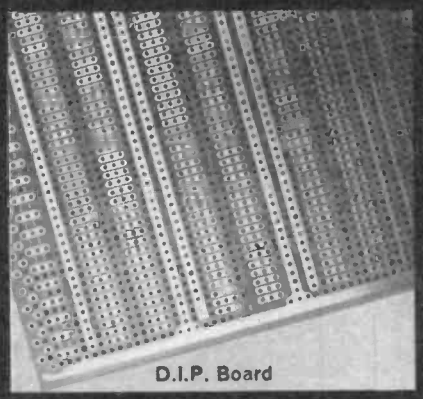


Stripboard, 0·1 and 0·15 inch matrix

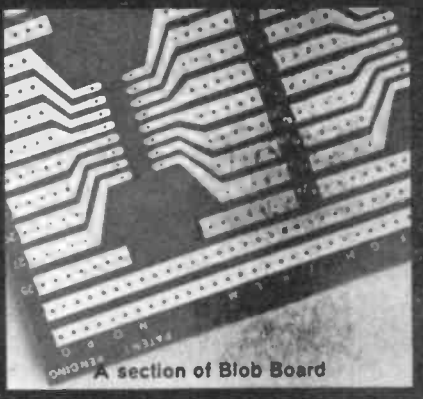
Perforated Board (0·1 inch and 0·15 inch matrix) and Plain Board



Etched and non-etched printed circuit board



D.I.P. Board



A section of Blob Board

Solderless Wonderboard

A common use for this is where areas of rigid insulated panel are required for mounting for example, audio sockets to be electrically isolated from the main chassis for earthing reasons. Available in different thicknesses.

Tag Strip

An old form of "circuit board" is tag strip. This is still in frequent use in radio and TV sets and has been featured in EVERYDAY ELECTRONICS on occasions.

It consists of a strip of s.r.b.p. fitted at regular intervals with tinned tags. The tags are used as multiple connection points. Various versions exist, large and small tags, short and long strips and can be cut to size. Some types have some of the tags extended with feet to allow screw fixing to chassis, a convenient method for connecting multiple earthing points.

Advantages of tag strip include the accessibility of all connection points, ease of component replacement and circuit tracing—and most important—cheapness. Re-usable.

Group Board

Group board, sometimes called tag board, could be viewed as a double row of tag strips on a single piece of s.r.b.p. Usually components are mounted across the length of the board and connection between components accomplished by wiring between tags.

Available in miniature and standard sizes, and lengths which can easily be cut to requirements.

Versions where tags are replaced by hollow pins can also be obtained.

Cheap and re-usable.

Verostrip

Designed to be a replacement for group board, Verostrip, however, is not often seen. This is seen to be an extra wide version of stripboard divided along the middle. Can accommodate large and small components to produce a neater appearance than tag board. Available as 79 strips × 14 holes (0·1 inch matrix) and 53 strips × 8 holes (0·15 inch matrix.

D.I.P. Board

D.I.P. board is a cross between stripboard and p.c.b. being shaped copper strips on a 0·1 inch pitch hole matrix, and is available in a number of basically similar versions. It is designed specifically for mounting d.i.l. integrated circuits, particularly logic i.c.s.

Two power rails run between the copper pad format for easy link up to the i.c.s. The topside (copper clad) has supply lines bonded for ease of construction and can hold up to twenty 14 pin i.c.s.

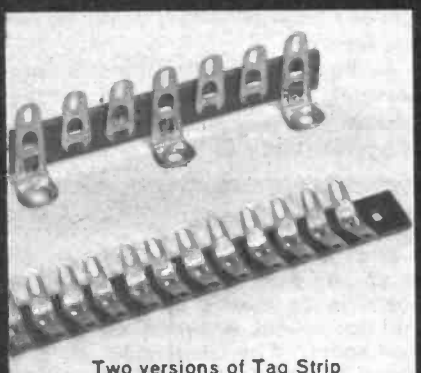
Blob-Board

There are two versions of Blob-Board, one looking very much like stripboard except that there are no drilled holes. The second type has a pattern bonded to one side designed to accommodate d.i.l. integrated circuits. This also has no holes drilled. Components are intended to be mounted on the copper side, leads soldered to the copper strips. Allows quick assembly and is re-usable.

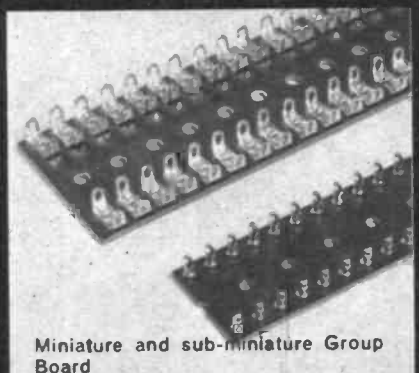
Wonderboard

It is appropriate that this board is left to the end of this section as it could well be included in the next section on breadboards.

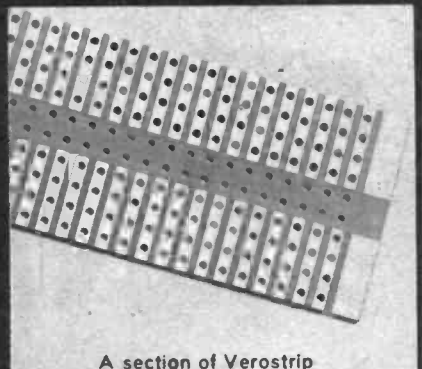
Construction on this board eliminates soldering, connection between components being via a conductive elastomer. There are 186 "plated through" holes on the board filled with this material and component leads are pushed into this rubber like material and gripped by it. Components can be mounted on both sides allowing a high density layout. Up to six component leads can be inserted in each pad.



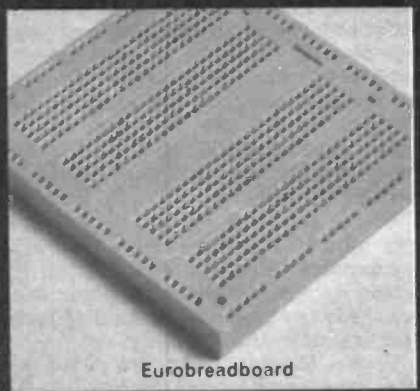
Two versions of Tag Strip



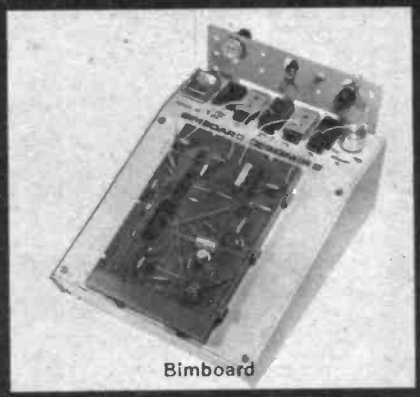
Miniature and sub-miniature Group Board



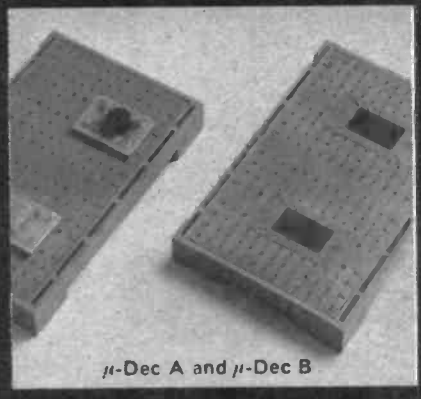
A section of Verostrip



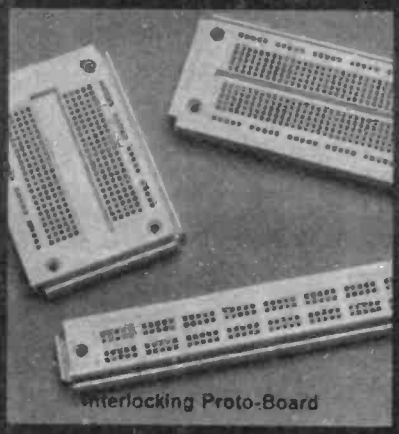
Eurobreadboard



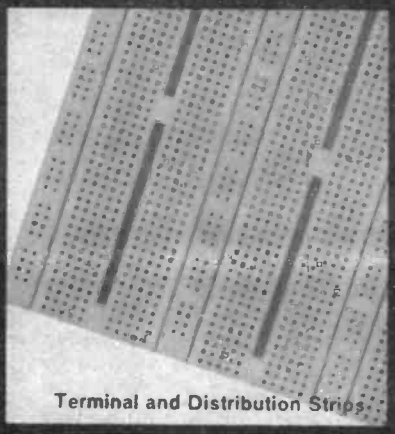
Bimboard



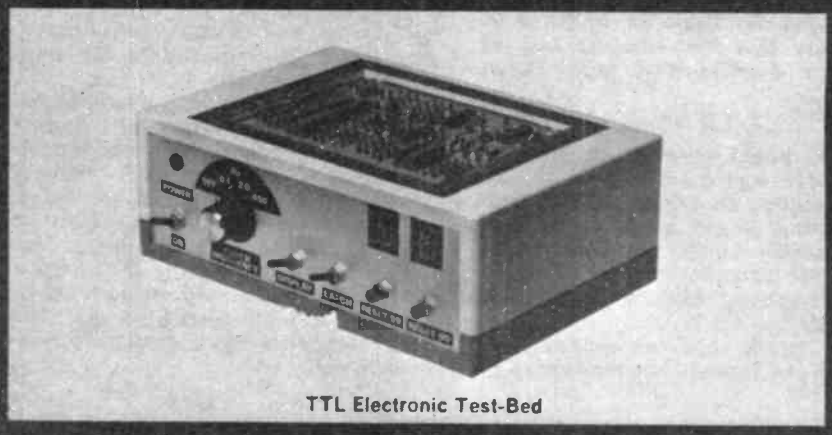
μ-Dec A and μ-Dec B



Interlocking Proto-Board

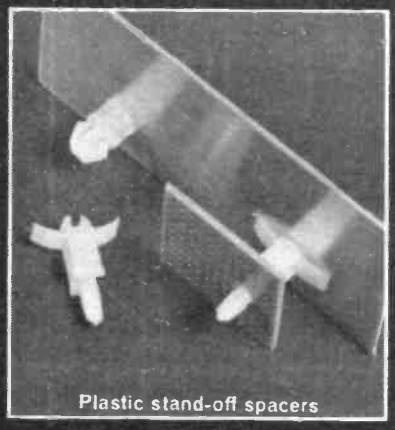


Terminal and Distribution Strips

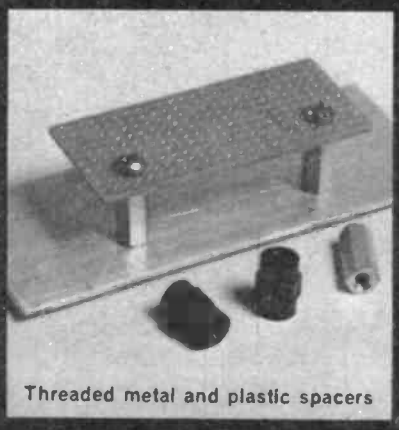


TTL Electronic Test-Bed

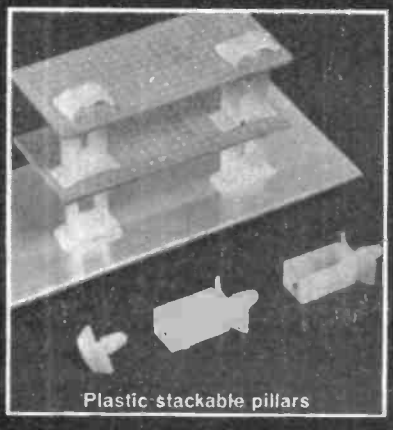
Plastic stand-off spacers



Plastic stand-off spacers



Threaded metal and plastic spacers



Plastic stackable pillars

BREADB

When experimenting with, or designing electronic circuits, it is essential to have some means for connecting together components to check out a theoretical circuit—in other words a breadboard before proceeding to a permanent form of construction. In the past tagstrip, group board and others have been used but these have required soldering.

Available at present are a number of solderless breadboard systems able to accommodate a wide range of components including i.c.s.

Connection to the breadboard is made by pushing the component leads into a matrix of holes on the working area. The leads pass down to the base of the board and make good contact with nickel-silver or

MOUNTING OF C

A major consideration when constructing electronic projects is the mounting within the case or whatever, of the completed circuit boards. Many ingenious d.i.y. methods conjured up by the constructor have appeared in these pages in the past using nuts/bolts, grommets, aluminium angle, plastic book spines, etc.

There seems to be a reluctance among the majority of constructors/designers of "amateur" projects to use any of the hardware available that has been purposely designed for this function.

A host of plastic fitments are presently available that add to the internal appearance and accessibility of boards. Many of these accessories

CONNECTION

The usual form of connection of an off-board component to the circuit board is by means of a wire from the component soldered directly in the board. The underside of the board is not in general accessible requiring that these leads be attached prior to board mounting. Care then must be taken to attach a lead of sufficient length to reach the remote component. To overcome this "guess work" and to facilitate easier removal of remote leads from the system, the constructor can use Veropins, sometimes called terminal pins, and turret tags. The former are also available in a wirewrap version.

Turret tags are for connection on one side of the board only whereas the terminal pins can be obtained in single or double-sided versions and are made to suit the holes on 0·15 inch and 0·1 inch matrix boards.

These terminal pins are push fit and provide a rigid anchor point; likewise with turret tags which require

OARDS

phosphor bronze sprung contacts which are connected in rows. Inter-wiring is carried out with insulated solid or tinned stranded wire. Crocodile clips are not necessary.

Quite complex circuitry can be rapidly erected on these boards and several breadboards can be linked to provide the right size board to fulfil your needs. Some systems come complete with built in electronics.

A purpose designed "dynamic" breadboard system for TTL experimenting called the *TTL Electronic Test-Bed* appeared in last month's issue where full constructional details for building this were given, which included a built in power supply, clock generator, two counter/display sections and various logic elements.

IRCUIT BOARDS

are of the snap or slide on type thereby eliminating the need for screws/bolts etc. An added advantage of plastic fittings is that they are insulators and thus require no isolating of fixing points on the board. Also they are quite cheap.

Among these supports are a couple of self adhesive ones. These are of particular importance where for example a board needs to be fitted to an external panel, say a front panel, and it is not wished to have any unsightly bolt-heads on show.

An interesting fitment featured is the board guide. Besides holding a board on a chassis panel, it can be used to mount one or more boards on another (mother/daughter board arrangements).

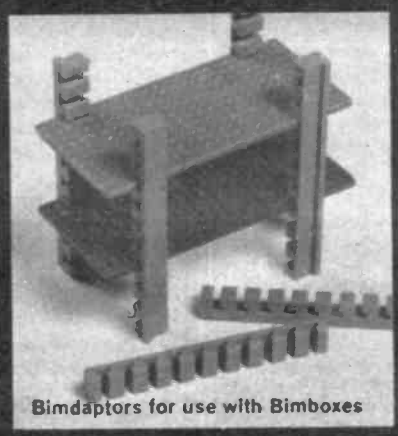
TO BOARDS

a special tool for insertion and are effectively riveted to the board. Turret tags are much heftier than terminal pins have a slot at one end and a ridged outer, enabling a choice of fixings.

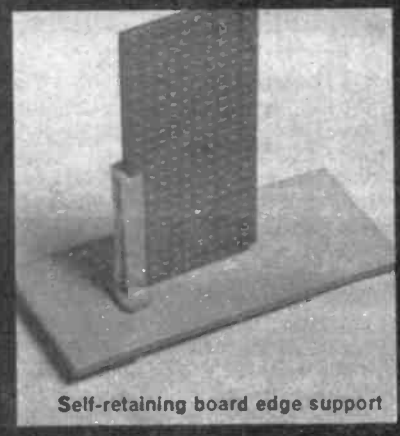
The above mentioned terminals are also very useful for forming component anchorage points; a matrix of terminal pins could form a solder type breadboard.

Commercial equipment demands more flexibility than that mentioned so far and wiring to the board or inter-boards is carried out via edge connectors of various configurations. Interesting connections are "wireless" types for joining two boards, in-line or perpendicularly.

It is often required to make measurements on a completed system, hook probes/crocodile clips being used for connection. Snap-on test sockets for board mounted "ball" pins are manufactured for this job.



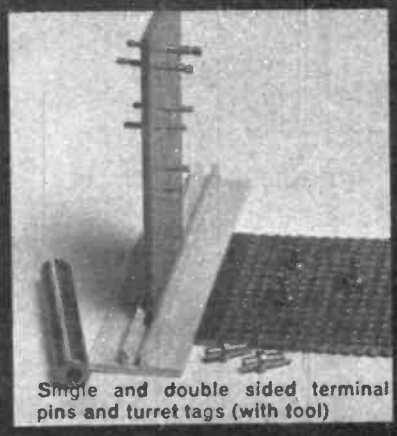
Bimdaptors for use with Bimboxes



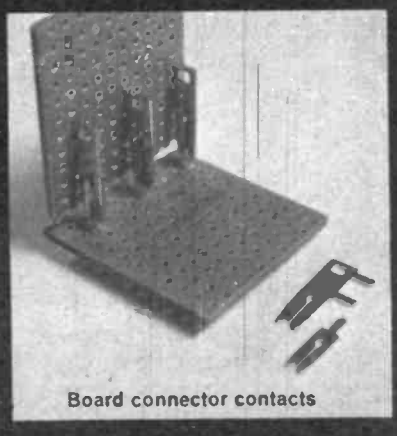
Self-retaining board edge support

Self-adhesive guide for horizontal mounting

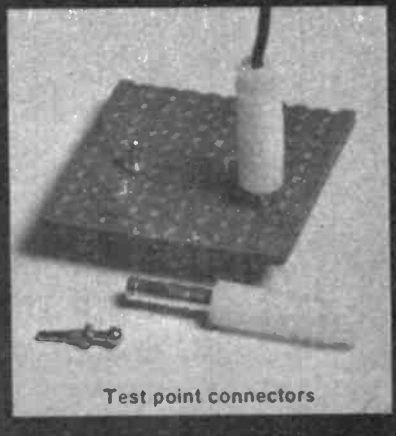
Self-adhesive guide for vertical mounting



Single and double sided terminal pins and turret tags (with tool)



Board connector contacts



Test point connectors

WIRE, CABLE AND ACCESSORIES

Wire

It is important to choose the correct wiring for the job from the multitude of types available. For link wires on circuit boards, use tinned copper wire. This is bare copper wire with a special coating for easy soldering and generally doesn't oxidise. Sold by weight on reels this is available in a vast range of standard wire gauges (s.w.g.). For the majority of EE projects, 22 s.w.g., is suitable. If there is any possibility of contact with other similar wiring or component leads use sleeving. This is a thin tube of plastic material which is slipped over the wire to provide electrical isolation (insulation). Available in many colours and diameters. Sleeving is also useful for covering the connection between two other wires (of any construction) or shielding wire/tag connection at component terminals e.g. potentiometers, switches etc.

Enamelled copper wire is solid copper wire with a very thin coating of enamel (usually brown or red) for insulation purposes. Suitable for winding coils, transformers, aerials etc. Sold by weight on reels in many different gauges (s.w.g.).

For interwiring between circuit board and remote components the constructor has a basic choice from insulated solid or insulated stranded wire—insulated referring to the coloured plastic sleeving covering the wire. The wire(s) is usually tinned.

The solid variety is easiest to route around the system and will normally lay where put, but should be avoided on items where vibration is experienced. Less expensive than stranded type.

Wire is specified as: number of strands/strand diameter in mm e.g. 7/0·2mm.

Cable

Cable is the term used for a two or more "wire" conductors e.g. 2-core bell cable, 3-core mains cable. The separate insulation wires are contained in a further insulation sleeve. Mains cable on equipment is always the flexible (stranded) type; domestic electricity wiring is insulated solid.

Screened cable or co-axial cable consists of a single or more insulated wires (solid or stranded) individually or group covered by a mesh conductor forming a "screen" for the other wire(s). The whole is sleeved. Mainly used in audio equipment, especially input signal leads.

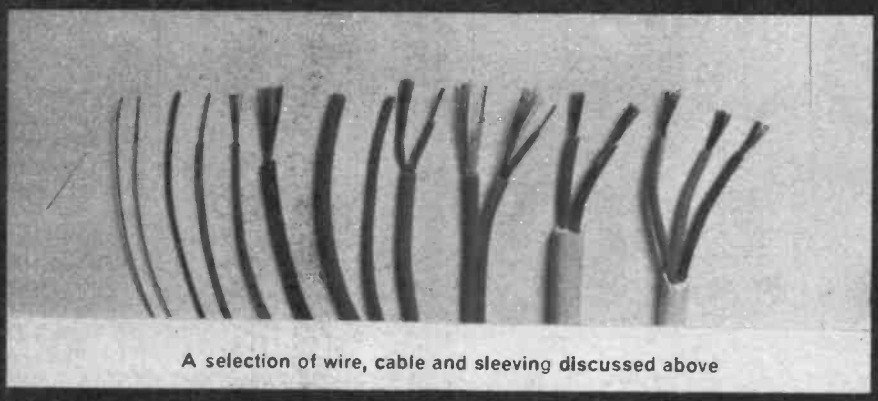
Ribbon or "rainbow" cable as it is often called is a number of different colours of the same wire bonded together so as to be tape or ribbon-like in appearance. Can have single (solid) or stranded core. Ideal for digital work especially microprocessor systems. Cables can be 10 or 20-way or split at any number as required. Rather expensive.

Wire and Cable Accessories

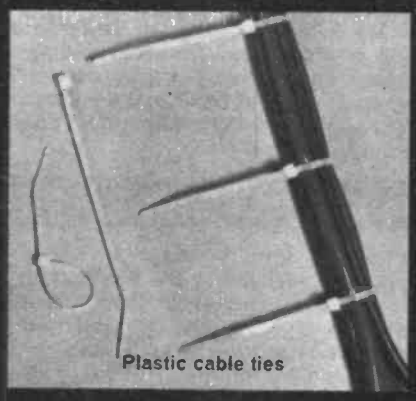
The life line between an electronic system usually takes the form of a power cable out through a hole in the case of the system. Whether the casing be of metal or plastic some form of protection must be given to the cable at its point of exit.

In the amateur electronics field it is rare to see anything other than rubber grommets being employed, plain or sleeved. This gives suitable protection against chaffing and cuts but needs back-up with a cable securing clamp to prevent possible damage by pushing/pulling or twisting of the cable. Rubber has a limited life, and in time corrodes.

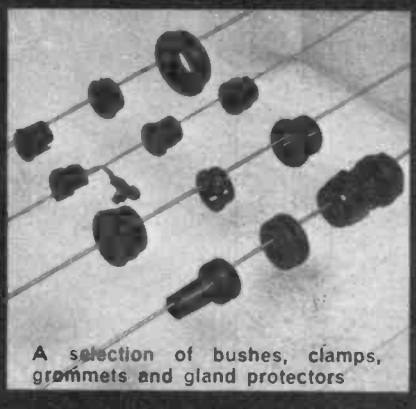
A better alternative is a plastic grommet which, does offer some additional protection in the way of cable grip, but still needs a strain clamp of some sort.



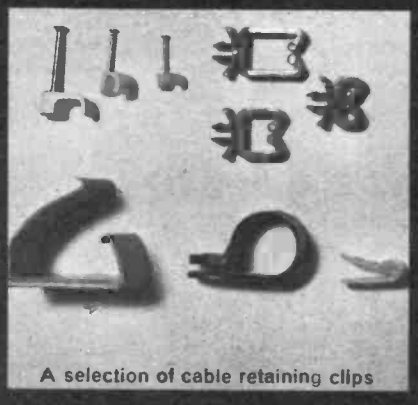
A selection of wire, cable and sleeving discussed above



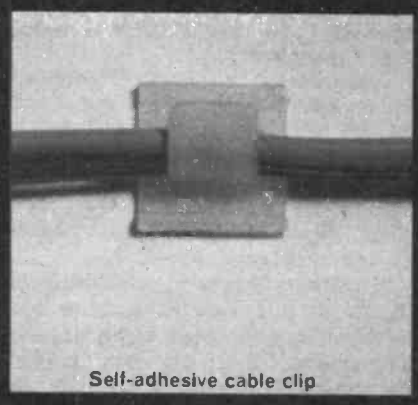
Plastic cable ties



A selection of bushes, clamps, grommets and gland protectors



A selection of cable retaining clips



Self-adhesive cable clip

The complete answer is a nylon strain-relief bushing which doubles as a clamp and grommet, and snap fits into panels. These can also be obtained fitted with flexible springs for excessive flexing of the cable. There is also a version for turning cables through 90 degrees especially useful where space is at a premium.

For feed through holes requiring no strain-relief fixing, snap fit bushings are available which will convert a sharp edged metal hole to a smooth insulated hole suitable for cable, or can even act as low r.p.m. bearings for motor shafts. These were also found for lining the holes for push button switches.

For holding loose wires and small cables in orderly looms the constructor has a wide choice of both free and panel mounted ties and clips. For a rapid means of securing wires and cable to flat surfaces, there are adhesive clips that can be mounted on panels or circuit boards.

Panel mounting ratchet operated cable straps primarily intended for semi-permanent looming can also be used for securing large components e.g. electrolytic capacitors, to circuit boards.

When a large number of cables/wires are in use, easy identification is achieved with colour and symbol coded slip-on markers.

Accessories known as glands are to be used when a weatherproof exit from a case/panel is required. They are compression-fitting devices.

Ideal for holding a number of wires together and still remain flexible is spiral wrap, a preformed plastic spiral which is wound around wiring.

IC AND TRANSISTOR HARDWARE

When fixing integrated circuits to circuit boards the constructor must decide whether to use sockets for these devices or connect them directly to the board, be it a soldered joint or a wire wrap joint. There are no hard and fast rules for this but it is wise to always mount expensive i.c.s in sockets so as to eliminate the possibility of damage by heat from the soldering iron. Use of sockets provides easier maintenance—a suspect device being rapidly removed for testing—and avoids the risk of disturbance to other components and wiring if de-soldering or unwrapping is required.

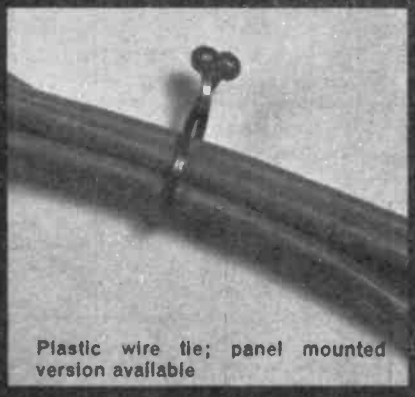
Sockets for most i.c. pin configurations can be obtained, 8, 14, 16 and 24 pin d.i.l., TO-99 (8-pin) and TO-100 (10 pin).

As far as we know, no sockets are made for quad-in-line devices but these can be realised by using Soldercon pins. These are produced in strips and the required number cut from this and arranged as desired. Use was made of these on the *TTL Electronic Test-Bed* (EE October 1978) for interwiring connections.

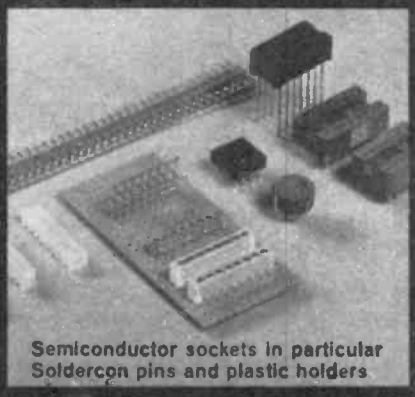
Three and four-pin (TO-18, TO-5 and TO-3 and TO-66) transistor sockets exist but the use of the first two types in permanent systems is debatable, but are ideal for home-made breadboard systems and, for example, in a transistor tester project.

Power transistors require heatsinks which must in general be isolated from the devices. This is accomplished using mica washers and insulating bushes. To completely isolate TO-3 and TO-66 type transistors exposed on a back panel for example, push-on plastic caps may be used.

To enhance the appearance of a circuit board and afford mechanical protection to transistors and prevent any possibility of shorting lead-outs, constructors can use transistor pads. These are discs of plastic with holes for the leadout wires which are sandwiched between the board and transistor.

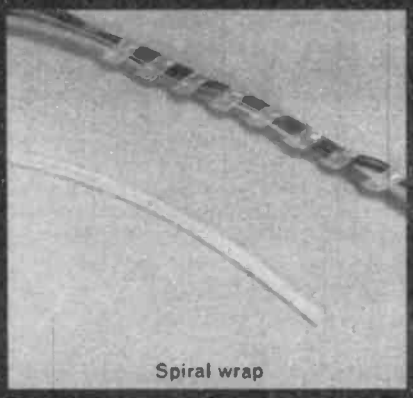


Plastic wire tie; panel mounted version available

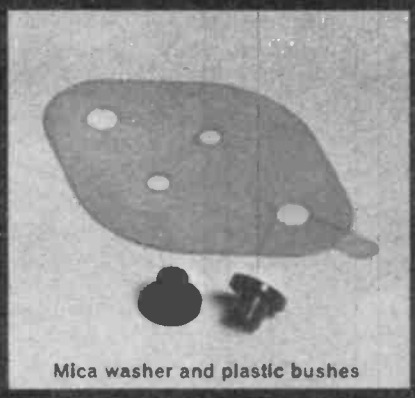


Semiconductor sockets in particular Soldercon pins and plastic holders

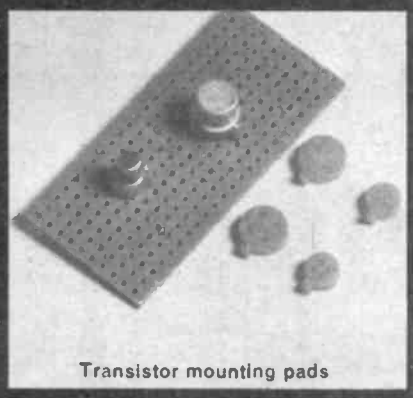
TO-3 mounting socket and cover



Spiral wrap



Mica washer and plastic bushes



Transistor mounting pads

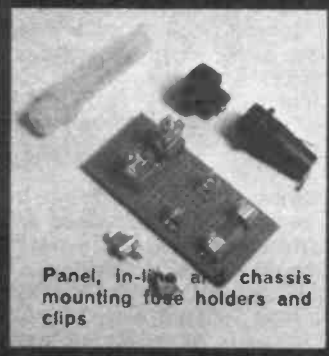
MISCELLANEOUS ITEMS

Not until one researches the world of "electronic hardware" can one imagine the vast number of different shapes and designs that have been engineered to hold together your electronic projects.

Likewise with tools, there seems to be at least one for every conceivable situation with a constant flow of new ones, particularly in the wire-wrap area.

There are far too many for them all to be mentioned in an article of this nature and readers are advised to check through advertisers' catalogues when the need for a special item arises; it is almost certain to have been required in the past and someone has manufactured it.

The photographs below show a selection of miscellaneous items and special tools that will be of interest to the electronic constructor.

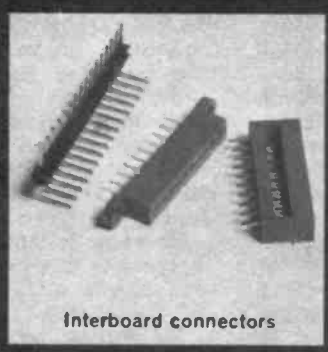


Panel, in-line and chassis mounting fuse holders and clips

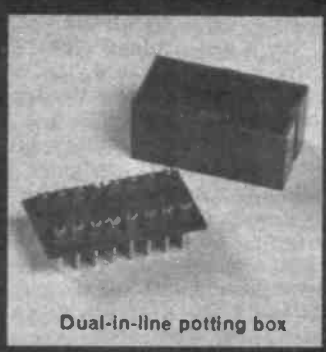
Vertical mounting capacitor clips

Spindle couplers and extensions

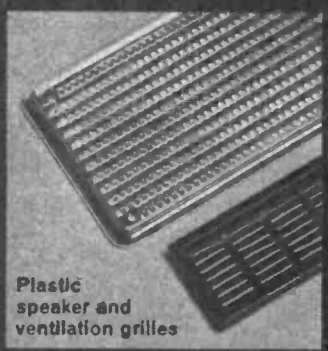
Plastic coil formers with ferrite slug



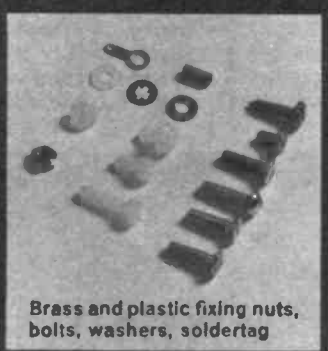
Interboard connectors



Dual-in-line potting box



Plastic speaker and ventilation grilles



Brass and plastic fixing nuts, bolts, washers, soldertag

Recoil type solder suckers

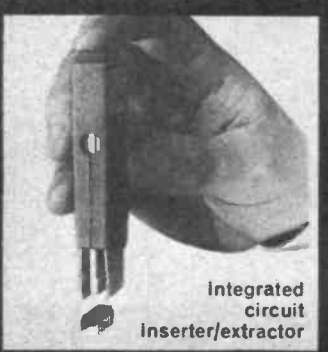
Battery wire wrapping gun and hobby hand-wrap tool

Cable stripper, Q-Max cutter and wire bending gauge

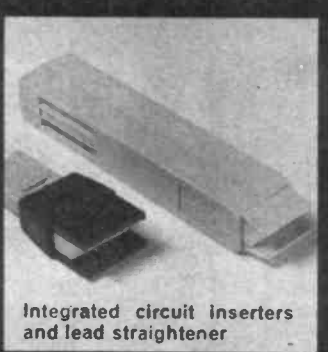
A set of nut-spinners

Coil trimmer tools

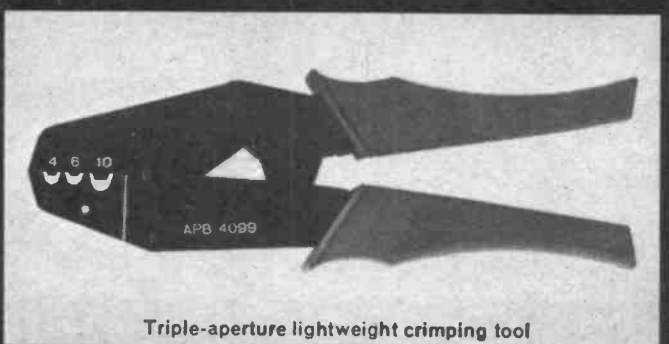
Mini mains Bimdrill



Integrated circuit inserter/extractor



Integrated circuit inserters and lead straightener



Triple-aperture lightweight crimping tool

CONSTRUCTION

Any standard type of baseboard can be used for the circuit. The prototype was wired up on a hardboard base with brass panel pins as solder points. (Layout in Fig. 2.) This base was cut to fit into a small plastics case, the "Norman" Type PB1, which is available from some components stockists. It measures 4·5×3 inches× 1·4 inches deep (114×76×35mm) outside.

Another possible housing is a two-ounce rectangular tobacco tin.

The PB1 case has two pillars inside, for the panel fixing screws. The baseboard, after cutting to size, has to be notched to fit round these pillars. In the prototype it did not seem necessary to secure the baseboard inside the case, but it was insulated from the panel components by a sheet of card also cut to size and notched.

The leadouts on the prototype are 6BA bolts through the panel. Connecting points on the inside are provided by washer-type earth tags. WARNING! Solder these tags QUICKLY or the plastic of the case will melt! Fig. 2 shows how to drill the panel for the controls and leadouts.

USING THE OSCILLATOR

Capacitor C2 must be selected to give the required tuning range. In the prototype, 33nF (0·033μF) tuned 330Hz to over 15kHz. Doubling C2 will halve the frequency, and so on.

On this basis 10μF should tune down to 1Hz, but since an electrolytic capacitor must then be used, and since these generally have a wide tolerance some variation is to be expected. The polarity of an electrolytic should be as shown in Fig. 1.

When VR1 is turned fully anticlockwise the oscillation stops. This can be quite useful in practice but if desired it can be prevented (and the h.f. limit of the tuning range defined more precisely) by inserting a fixed resistance in series with VR1 so that there is always some resistance in circuit. A suitable value would be about one-thirtieth of the nominal value of VR1, for example, 3·3kΩ for VR1 of 100kΩ. (Other values of VR1 may be used but should not be very large or oscillation may stop at the l.f. end of the range.)

Since it is generally more satisfying to the ear to modulate a high frequency with a low one than vice versa this suggests an economy where two oscillators are to be used together. This is to provide only the v.l.f. oscillator with an output control (VR2). The audio oscillator can be operated at fixed output by omitting VR2 and connecting R6 to the emitter of TR2.

Next Month: Microphone Amplifier

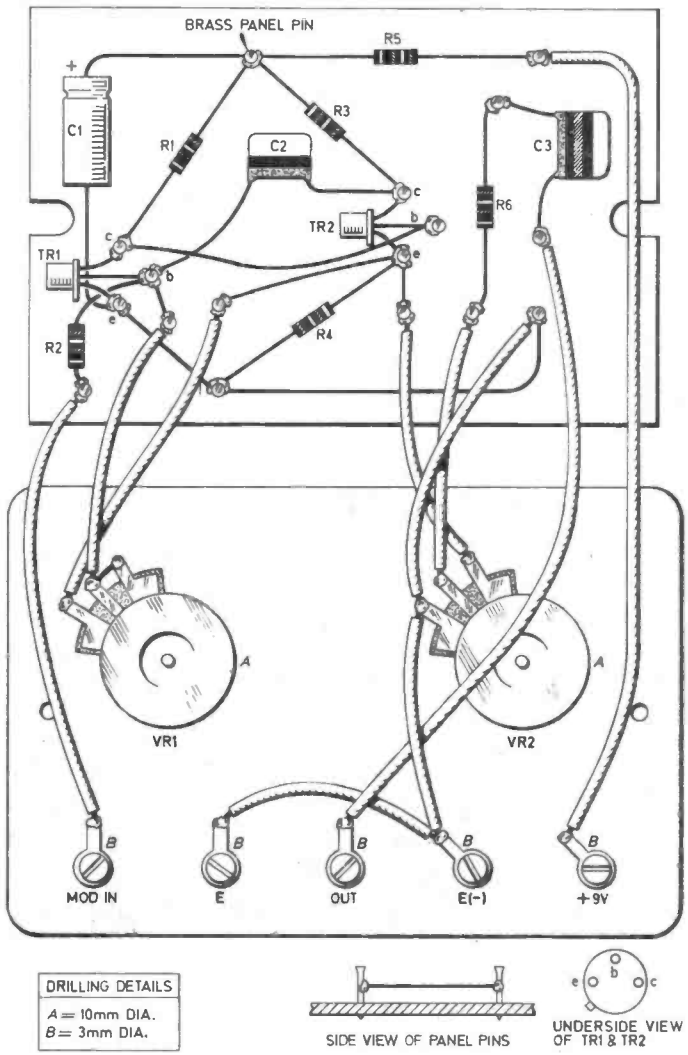
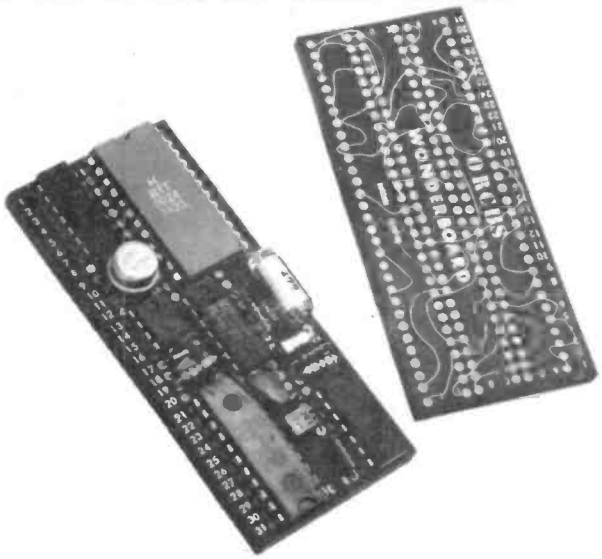


Fig.2. Complete wired-up assembly "opened-out" and showing hardboard base with components mounted and case panel with potentiometers and terminals in position.

EE SPECIAL REPORT



Wonderboard

A NEW solderless prototype and production board called "Wonderboard" has recently appeared on the market. This product consists of a plastic board, 4mm thick with six rows of 0·1 inch spaced holes which are filled with a conductive elastomer. After polymerisation the contacts are elastic like rubber, but due to the high percentage of silver used, they are highly conductive.

Since the contacts are accessible from both sides of the board, it is possible to insert wires from above and below. Using tinned copper wire of around 26 s.w.g., a maximum of six leads can be inserted into any one hole. The elastic conductive material forms a seal around each wire and the high electrical conductivity of the material insures a very low contact resistance, in the order of 10 milliohms.

Since no soldering is involved there is less chance of damage to sensitive components. Components can easily be changed.

The fact that it is possible to insert several wires into each contact has considerable importance. First, it means that the board can be exactly like a corresponding printed circuit. That is, each component lead and its interconnection paths go and come from that same hole position.

This has the advantage of eliminating errors when producing artwork for the p.c.b.

COMPARISONS

Conductive Elastomer Circuit Boards have many advantages over other types of prototype boards, such as stripboard, wirewrap, etc. All suffer from certain disadvantages. For example, on stripboard where it is required to connect say five wires to a component lead, it takes a total of six holes and relatively long lengths of copper strip. Using Wonderboards the total number can be reduced to only one, with a considerable saving on space.

Wirewrapping technique does overcome this, but has the failing of being difficult to modify at a later stage. To get at a bottom wire of one tie point involves removing all the wires above it, hoping that the wires are not damaged in the process, and hoping they all get wired back where they came from. With Wonderboard a wire can be removed from a hole easily without disturbing any others.

PROTOTYPE WORK

Using Wonderboard is simplicity in itself, just trim the components to be a snug fit, cut the leads and insert into the contact. Nothing could be easier . . . or could it?

We found when using Wonderboard, that apart from the i.c.s fitting perfectly, not many other components would. For instance, capacitors: when using one popular range we had to bend and otherwise mangle the leads to fit the rather small spacing of the contacts. Much to our dismay one or two capacitors gave up in disgust after the leads fell off. Not a promising start, nevertheless, we persevered and obtained much smaller components.

An important point to note when finally producing your working model—small components are of a real necessity.

No other problems were encountered when fitting the components, but the best was yet to come. The manufacturer's claim that five additional wires can now be inserted into the same contact as the component lead. This is perfectly true, but a great deal of patience is required to effect this.

One point to watch when wiring on the underside is to remember which wires you have put in, ensuring they go to the right place. The underside of the board is printed, as is the top, with reference points making this task much

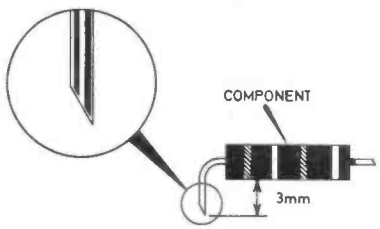


Fig. 1. Trimming and bending a lead of a component. Note the pointed end.

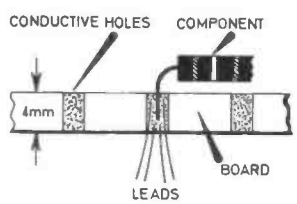


Fig. 2. Conductive contacts as used on the Wonderboard. A total of six wires can be inserted into any one hole.

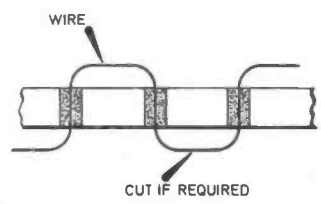


Fig. 3. Forming a "bus" on Wonderboard. In this way a strip of conductive holes can be used similar to that on stripboard.

15—240 Watts!

HY5
Preamplifier

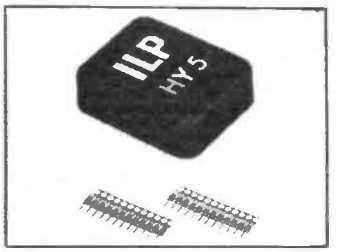
The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

APPLICATIONS: HI-FI—Mixers—Disco—Guitar and Organ—Public address.

SPECIFICATIONS:
INPUTS. Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliary 3-100mV; input impedance 4·7kΩ at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS. Treble ± 12dB at 10kHz; Bass ± at 100Hz.
DISTORTION. 0·1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD. 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.

Price £6·27 + 78p VAT P&P free.



HY30
15 Watts into 8Ω

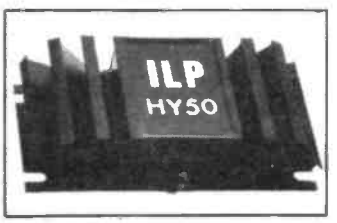
The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

FEATURES: Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

APPLICATIONS: Updating audio equipment—Guitar practice amplifier—Test amplifier—audio oscillator.

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω: DISTORTION 0·1% at 1·5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16Hz—3dB.
SUPPLY VOLTAGE ± 18V.

Price £6·27 + 78p VAT P&P free.



HY50
25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components.

APPLICATIONS: Medium Power HI-FI systems—Low power disco—Guitar amplifier.

SPECIFICATIONS: INPUT SENSITIVITY 500mV.
OUTPUT POWER 25W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 25W at 1kHz.
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB.
SUPPLY VOLTAGE ± 25V SIZE 105 50 25mm.

Price £8·18 + £1·02 VAT P&P free

HY120
60 Watts into 8Ω

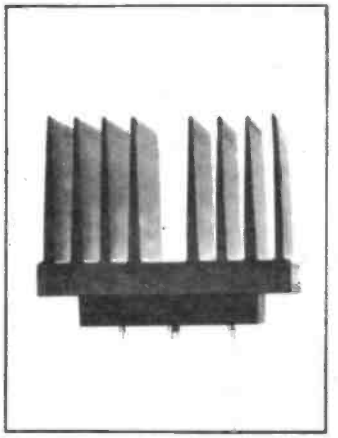
The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components.

APPLICATIONS: HI-FI—High quality disco—Public address—Monitor amplifier—Guitar and organ.

SPECIFICATIONS:
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 1kHz.
SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 100Hz-45kHz—3dB SUPPLY VOLTAGE ±35V.
SIZE 114 50 85mm.

Price £19·01 + £1·52 VAT P&P free.



HY200
120 Watts into 8Ω

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components.

APPLICATIONS: HI-FI—Disco—Monitor—Power slave—Industrial—Public Address.

SPECIFICATIONS:
INPUT SENSITIVITY 500mV.
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz—3dB SUPPLY VOLTAGE ±45V.
SIZE 114 50 85mm.

Price £27·99 + £2·24 VAT P&P free.

HY400
240 Watts into 4Ω

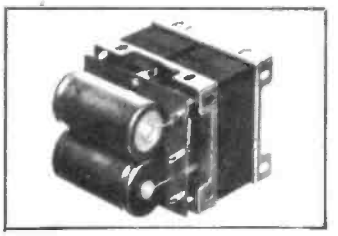
The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω. It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.

APPLICATIONS: Public address—Disco—Power slave—Industrial.

SPECIFICATIONS:
OUTPUT POWER 240W RMS into 4Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·1% at 240W at 1kHz.
SIGNAL/NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz—3dB SUPPLY VOLTAGE ±45V.
INPUT SENSITIVITY 500mV SIZE 114 100 85mm.

Price £38·61 + £3·09 VAT P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £6·44 plus 81p VAT. P/P free.
PSU50 suitable for two HY50's £8·18 plus £1·02 VAT. P/P free.
PSU70 suitable for two HY120's £14·58 plus £1·17 VAT. P/P free.
PSU90 suitable for one HY200 £15·19 plus £1·21 VAT. P/P free.
PSU180 £25·42 + £2·03 VAT.
B1 £0·48 + £0·06 VAT.

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easier. Any mistakes at this stage can be corrected but is not too easy if the wire you want is under several others.

It helps when inserting component leads and wires into the contacts if they have been cut so as to form a point. The accompanying drawing shows how this is done.

No other problems were encountered during construction, but the take-off wires were a cause of some bewilderment. With any small lightweight circuit board the board can have a nasty habit of jumping around due to the "springiness" of the take-off wires. In the case of Wonderboard this eventually caused the wires to fall out, leaving us wondering why the circuit did not work, until we noticed the loose wires. No doubt if the Wonderboard had been fixed down in the first place this would not have happened. It is an important point to note if any serious circuit proving work is to be done.

In this respect it could be an advantage if several boards were used together thus forming a heavier more stable system. Any type of cyanocrylic adhesive can be used for this purpose. Four Wonderboards cemented together equal the dimensions of a standard Eurocard.

CONCLUSION

As the old saying goes "the proof of the pudding is in the eating", and there is no doubt that Wonderboard does work, as our project in this issue shows.

Wonderboard certainly lives up to its maker's claims as regards compactness of components and wiring though this can be a questionable advantage sometimes, as we have already suggested.

We did not prove the manufacturer's claim of 100 insertions and withdrawals, but the number of times a wire apparently jumped out leaves this claim a little to be desired!

For large-scale prototype work, and in this we mean proving a circuit several times over on the same board, we doubt if Wonderboard will stand up to the heavy usage for very long.

But for constructing the final circuit, possibly after it has been proved on some other breadboard, or "lash-up", Wonderboard does live up to its claims mentioned earlier.

Summing up then we can say that Wonderboard is another useful addition to the existing range of circuit assembly systems. It is a fairly expensive alternative to stripboard when discrete components predominate. But fully justified when a large number of i.c.s are involved, thus maximising the utilisation of the board.

One-off price, including VAT and post and packing, £2·80; available from the UK agent of Eaton Associates: Charcroft Electronics, Charcroft House, Sturmser (Haverhill), Suffolk. ⌑

BRIGHT IDEAS

ETCH RESIST

I often use printed circuit boards in my projects, but was unhappy about the usual method of etching. I therefore devised my own. My method does not rely on the often expensive etch resist pens. Instead take an old used felt pen and thoroughly clean the inside and the sponge. When dry, soak the sponge in acetone (nail varnish remover) until it is saturated. Replace the sponge and the pen is then ready for use.

To prepare the p.c.b. cover the entire surface with nail varnish and allow to dry. Then mark out the areas not required and apply the acetone from the pen. This action will effectively remove the nail varnish and allow the etchant to remove the unwanted copper. Finally, rinse the board before etching. I have found that my method gives professional results easily and cheaply.

J. G. Duffy,
Co. Derry,
N. Ireland

SOLDERING IRON STAND

A very good but cheap stand can be made from a scrap of wood about 150 x 50 x 25mm, and a thick piece of wire, such as from a metal clothes hanger.

A spring about 100mm long and 25mm diameter is wound. One end is pushed into a small hole drilled at one end of the block.

To finish the stand a piece of felt, useful for cleaning the bit, is glued at the opposite end.

A. Robinson, Stockton-on-Tees, Cleveland.

CURTAIN WIRE SCREENING

When short lengths of screened wire are needed, perhaps in a gauge not to hand, or maybe a common screen for several thin leads, I have often used a suitable alternative from the junk box.

Curtain wire in short odd lengths can be used cut to length, connected to the circuit earth, and slipped over one or more leads. Many bits of curtain wire were found that had plastic sleeving over the outside, these provide insulation from other parts of the circuit, if used internally.

If the curtain wire screened leads are used outside of the project box, they also act as "armour plating", protecting the leads within from attack of any kind, short of a demon eight year-old with bolt cutters!

K. Croft, Broadstairs, Kent.

Crossword No. 9—Solution

Now even better, even more powerful! The unique wrist calculator.

AVAILABLE ONLY AS A KIT.

A wrist calculator – the ultimate in common-sense portable calculating power. Goes where you go, ready for action at a flick of your wrist.

By virtue of its size, a wrist calculator is different to a pocket calculator. And now this wrist-machine has another difference. It has even more power than some much larger pocket calculators!

And what's more, because it's a kit, supplied to you direct from the manufacturer, it costs just £9.95 (plus 8% VAT, P&P). And for that you get a calculator with extra power, and all the satisfaction of building it yourself!

Put real calculating power up your sleeve.

The Science of Cambridge wrist calculator gives you the full range of arithmetic functions (+, −, ÷, ×, =). It uses ordinary algebraic logic, which means you enter calculations as you would write them. It has a % key, the convenience functions, $\sqrt{x}$, $1/x$, x^2 and a full 5-function memory.

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Very few ordinary calculators have the same functions for the same sort of money.

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All those functions, from just 10 keys? In such a small calculator? The secret lies in the special four-level keyboard. Each level has a different set of functions. Simple two-way switching system allows you to select any keyboard level quickly and easily. Each set of functions is carefully grouped, to let you whisk through calculations with the minimum of switching.

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Assembling the Science of Cambridge wrist calculator.

The wrist calculator comes as finished components, ready for assembly. All you need is two or three hours, and a fine-tip soldering iron.

If anything goes wrong, we'll replace damaged components free. We want you to enjoy building the kit, and to end up with a valuable, useful, powerful calculator.

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Acrylic/ABS case and display window parts. Two-part stitched strap and spring bar clips. PCB. Special direct-drive chip (no interface chip required). Display. Keyboard components. Batteries.

Each of the 34 components is contained in a plastic box; and neatly shrink-wrapped, accompanied by full instructions for assembling and using the calculator. All components are fully guaranteed.

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The wrist calculator kit is available only direct from Science of Cambridge. If, for any reason, you're not completely satisfied with your wrist calculator, return it to us within 10 days for a full cash refund. Send the coupon today!

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LETTERS

Tone Booster Transistors

Frequently when I go to make up your projects I cannot find a supplier for the transistors etc., quoted in the article. As it is very expensive to order all of the catalogues that are advertised, could you please tell me which one you base your plans on.

My particular problem at the moment is to buy the transistors for the *Tone Booster*, without having to buy the case and plugs, which I already have.

S. Pearce,
Seaford,
East Sussex

The constructional projects appearing in EVERYDAY ELECTRONICS *are not in general designed by us, but by individuals like yourself who are involved in electronics as a hobby or professionally.*

Therefore the designers component source is unknown to us and could be any from the advertisers in this magazine, or his local shop (or even his place of employment!) However, we do try our best to eliminate obscure types from designs and replace them with more well known devices.

Having said this, it does not seem to have occurred in the Tone Booster *project.*

A number of advertisers are now listing kits of parts for many of our projects and the Tone Booster *is one of them. This means that they must have stocks of the required devices (or suitable alternatives) and will therefore be able to supply your requirements though they are not specifically listed in their current lists/catalogues.*

We have built a couple of these units using a BC108 (ZTX384) and 2N3702/OC204 (BC415P) which work satisfactorily. The listed transistor types are not critical and can be replaced by any low power silicon devices of the correct polarity (i.e. npn, pnp).

Guidance Please

I would like to express my appreciation for the many hours of enjoyment and the knowledge gained from following the *Teach-In '78* course.

I feel, as many others must, the need for further guidance in tackling the more complex circuits. Particularly for help in selecting from the bewildering range of integrated circuits. An article listing and, telling of their functioning and use would be of great help in starting to use them. An explanation of triacs, fets and projects to use them in would also be welcome.

Many others, like myself must have built the short wave set as published in the July issue, but are unable to gain access to an outside aerial, due to living in flats, etc. I'm sure an article regarding an inconspicuous indoor aerial for this set would be of widespread interest.

E. Pilkington,
Bradford

Across The Speaker?

I am writing to enquire about the *Sound to Light Unit* featured in the September issue of EVERYDAY ELECTRONICS.

I have only recently become interested in electronics and thought the project would be quite easy, and a practical construction for me to begin with. I have managed to follow the constructional details of the control box but I do not understand how to connect the control box to the sound system.

In the article the instructions are "... take the audio input from across one of the speakers in the system." I am not sure what this means and I was wondering if it would be possible to use the 5-pin DIN socket in the system.

If this is possible could you tell me how it is done and if not could you tell me how to connect "across the speaker".

Ian Gardner,
Helsby,
Cheshire.

I would like to make an enquiry on the *Sound to Light Unit* which appeared in the September edition. I would like to know if it will work from any stereo set? And if so, where to take the audio output from.

Ian Price,
Shoreham,
Sussex.

In answer to the above two letters, the Sound to Light Unit *may be used with any stereo amplifier or mono come to that. If it is to be used for stereo set-ups, two units will be required—one for each channel. It is not possible to wire this unit* between *the two channels of a stereo amplifier.*

Connecting across the speaker means wiring the unit in parallel with the speaker. In Mr. Gardner's letter, he refers to a 5 pin DIN socket on his amplifier, This type of connector is usually reserved for inputs to the amplifier and signals here will be inadequate for triggering the light-unit.

Speaker outlet terminals are usually in the form of 2-pin DIN sockets (1 round and 1 flat pin), screw terminals, or 4mm banana type sockets and, in one particular case we know of, phono sockets (normally used for input connections).

The exact point of connection between the unit and speaker will depend on the method of connection between the speakers and the amplifier. If the speakers are fitted with sockets or screw terminals, merely connect the two wires from VR1 on the unit, one to each of the terminals on the rear of the speaker enclosures.

Some speaker enclosures have no sockets/terminals so those at the amplifier will need to be used. If these are screw terminals this is easily carried out as already explained.

For plug/socket arrangements the connection can be wired into the plug; this is not recommended for phono plugs and readers are advised to obtain a phono Y-adapter. The output from the Sound to Light Unit *would then need to be fitted with a phono plug.*

Sound-to-Light

I have just successfully built the excellent Sound-to-Light converter in September's EVERYDAY ELECTRONICS and I have designed a very simple improvement to it.

Your author says in his article that commercial sound-to-light units have frequency selective channels, my idea enables several of the E.E. units to be linked together and be frequency selective.

In my idea an ordinary two or three element loudspeaker crossover is used. The sound-to-light units are linked to each of the crossover's outputs, i.e. one unit to the "tweeter" output, one to the mid range and one to the woofer output as indicated in Fig. 1.

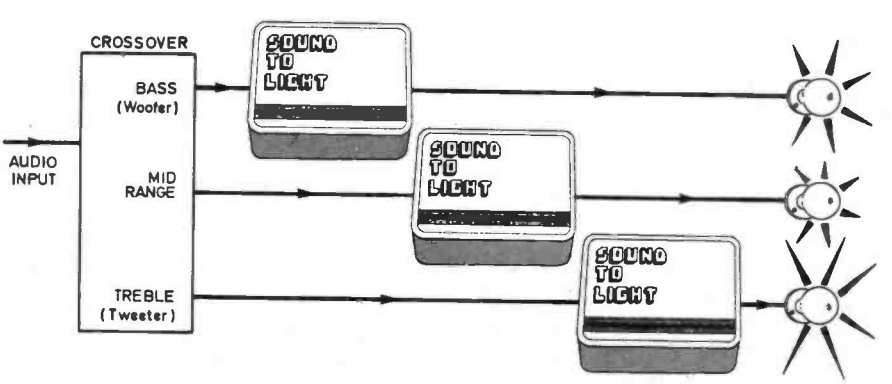
The system would cost (using the cost of my unit as an example) about £7·00. This is much cheaper than most commercial units which cost around £14·00.

Recently I have noticed that you have been printing labels in the magazine as part of the artwork to projects featured in the magazine. I thought that this was a good idea, so I photo-copied the first page of the Sound-to-Light unit article and used the label printed on that page to decorate my project.

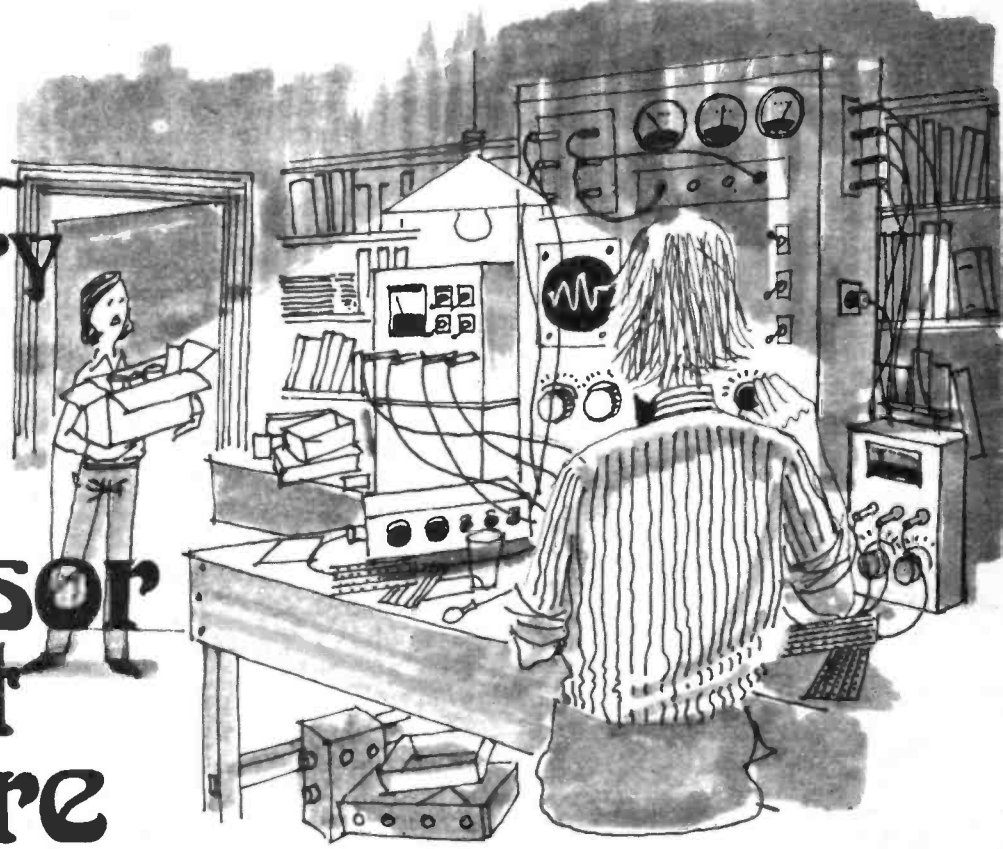
Keep up the good projects and ideas, which I enjoy very much.

Russell Reid (age 15 years)
Kettering, Northants

Fig. 1. Block diagram of Mr. Reid's frequency sensitive Sound-to-Light arrangement.



The Extra-ordinary Experiments of Professor Ernest Eversure



by Anthony John Bassett

LAST month Bob and the Prof. had been discussing an interesting circuit which can be used to add a transistor preamplifier to a valve audio circuit without the need for an extra power supply circuit, and without the need for inefficient h.t. dropper resistors.

They are about to fit this circuit to a VOX AC30 amplifier which belongs to one of Bob's friends.

"Here is the circuit of the 'Vib/Trem' valve," the Prof. quickly drew a sketch, Fig. 1, "and by using just five components we can add a preamplifier which will give a substantial extra sensitivity to the equipment. Your friend will then be able to use his new guitar without lack of volume. Here is the modified circuit incorporating a single low-noise transistor, Fig. 2.

"The original circuit, Fig. 1, is a conventional preamplifier with bias provided by a cathode resistor R34. The valve grid is at earth potential by R33, and because it is at earth potential there is no need for an input blocking capacitor, during normal use of the amplifier, and one is not provided. The inputs from two input sockets are mixed at the junction of resistors R31, R32 and fed into the valve grid. After amplification the amplified signal is passed on to the next valve stage from the anode (pin 1) of V9 via resistor R38 and capacitor C18.

"In the modified circuit, Fig. 2, the bias voltage, applied between the control grid and the cathode of the valve, is still developed across the same resistor R34, and this tends to give the same no-signal current through the valve, about 0·6mA, most of this current also flows through the collector of TR1, thus the collector current of TR1 is defined. The collector voltage of TR1 is influenced by the ratio between R6 and R7, and this can be set to a low voltage, giving a low-noise input circuit."

MYSTERIOUS VOICES

"Prof. my friend complains sometimes that he and the other members of his band occasionally hear mysterious sounds and voices from the loud speakers of their band amplifiers. One of them explains that these are known as 'Raudive Voices' but he cannot really tell me what this means.

Fig. 1 "Vib/Trem" input circuit.

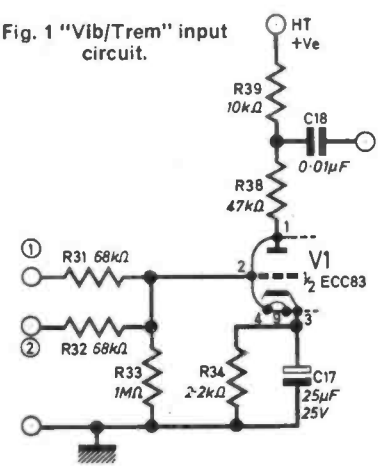
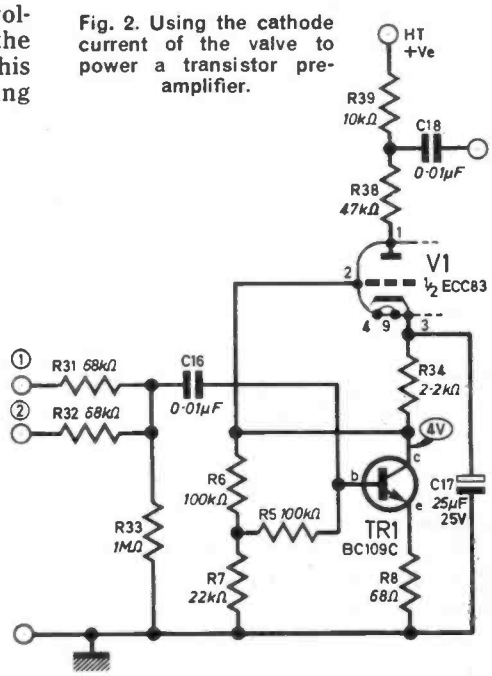


Fig. 2. Using the cathode current of the valve to power a transistor pre-amplifier.



"Is this something to do with the input circuitry of each amplifier, and if so is there some way in which it could be prevented?"

"Ah, yes, Bob; there are some researchers who claim that not all such sounds and voices can be explained in terms of conventional radio transmissions picked up by freak reception on an audio amplifier. Such sounds and voices may be a nuisance to the bands and many other users of electronic audio equipment, but there are also some people only too keen to hear them, tape record them and investigate them!

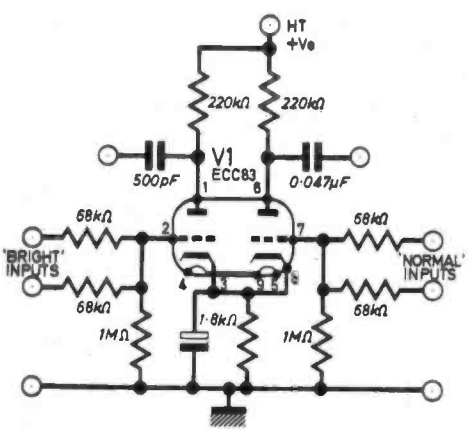
"It is very interesting to notice that electronic techniques can cater to the requirements of both viewpoints, and there are a number of electronic circuits which have been devised especially for the purpose of listening in to, and recording, these mysterious communications. There are also a number of 'electronic countermeasures' which appear to be effective in most instances, from those who do *not* wish to hear mysterious communications!

"One of these counter measures consists of threading ferrite beads over the signal carrying input wires of the equipment, both at the point of entry just inside the equipment cabinet, and also at the input lead of the first stage amplifying device, which in this case would mean one or two beads on the base lead of TR1.

"The use of ferrite beads is effective against freak reception of short wave radio communications, especially police, radio taxi and other mobile transmitters which may, upon passing by, break through audibly and spoil a recording session. Also a small value capacitor. Often about 1000pF may be used to shunt the high frequencies of the transmission away from the input.

"So we have at our disposal a number of ways in which unwanted interference can be combated."

Fig. 3. Circuit for "Normal" and "Bright" Inputs.



BRIGHT INPUTS

"Prof. I've noticed that the input valve for the other inputs is a double triode type ECC83. One of the triodes is used for the 'bright' inputs and the other is used for the 'normal' inputs, but the two cathodes are joined together with only a single cathode resistor and capacitor."

By carefully examining the amplifier Bob slowly and painstakingly drew out a circuit, Fig. 3.

"The only difference between the 'normal' and the 'bright' inputs is in the value of the output coupling capacitors. The smaller value 500pF, of the output coupling capacitor of the "bright" input circuit tends to attenuate low frequencies so that the high frequencies are emphasised. But if we wanted to add a transistor to each of these input circuits, how would we do it, Prof.?"

DECOUPLING

"It would be necessary to use two separate cathode circuits, Bob. So the cathodes would need to be separate and each would then be wired to a separate transistor, decoupling-capacitors and resistors to give two further circuits similar to my diagram, Fig. 2. The same anode circuits would still be used, so that one set of inputs would still have a 'bright' response and the other a 'normal' response. I know that the owner of this amplifier wanted us to incorporate a degree of 'treble boost' or extra 'brightness' as it is sometimes called and this is why I have specified a relatively small value, 0·01μF for the input coupling capacitor to the transistor, Fig. 2. If the 'right sound' or 'treble boost' is not wanted, a larger value capacitor may be tried. I would suggest about 1μF electrolytic with its positive terminal to the transistor."

"What is the function of R33, Prof.? In the original circuit, Fig. 1, it was used to bring the control grid of the valve to zero volts. But in the modified circuit, Fig. 2, it does not perform this function at all, as the grid is no longer at zero volts, being at the same potential as the collector of TR1. Could we not omit this component?"

"Yes, Bob, this is a very astute observation of yours. But if we did leave out this resistor this could result in some embarrassing moments for users of the amplifier especially if a larger input coupling capacitor is used, when the amplifier is switched on, one terminal of the capacitor becomes charged to the base bias voltage of the input transistor. R33 causes the other end of the capacitor, which goes through R30 and R32 to the input sockets, to settle down to zero volts.

"If R33 were omitted the inputs would tend to be at some other voltage, and when an instrument was plugged in to the input this would result in a very loud crackle through the amplifier, followed by a period when no sound would come through at all! But with R33 in circuit this situation is avoided."

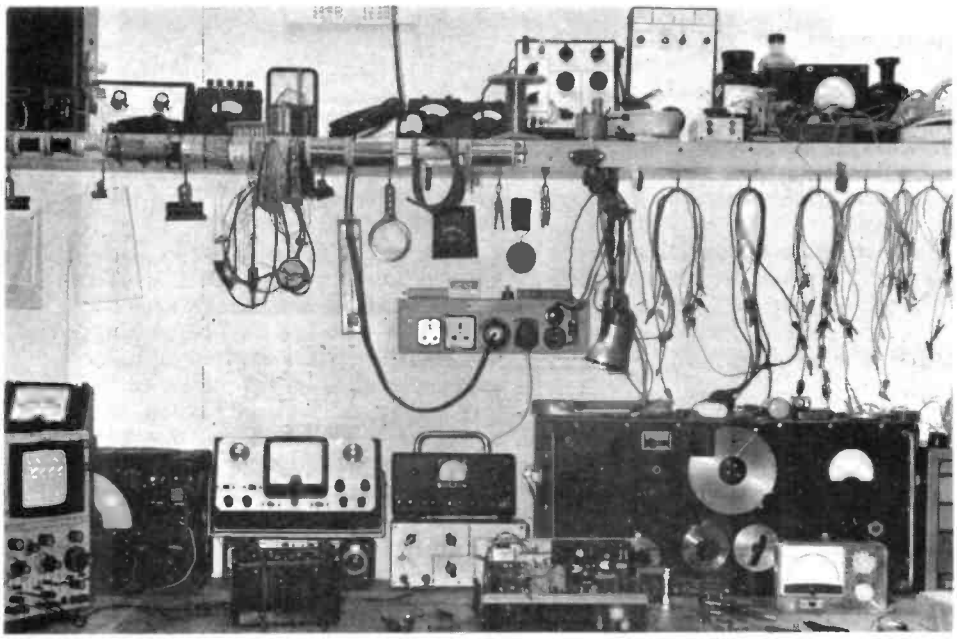
"Now I understand," said Bob, "can I build it?"

He set to work and soon had the extra components assembled together on a small piece of perforated board, which he fitted neatly and carefully into the amplifier to give the input circuit shown in Fig. 2. After checking it to ensure that he had no mistakes, he switched on, and as the valves warmed up, Bob found, using a multimeter, that the voltage at the collector of TR1 rose to about 4 volts. He plugged in a microphone to test the amplifier, and found that as he cautiously turned up the volume, the sensitivity of the amplifier was now much greater than before, and that the treble response had been heightened.

"I see that you're not taking many chances of reception of mysterious voices and communications on this amplifier, Bob." The Prof. commented as he eyed the row of ferrite beads which Bob had threaded on the input wires.

"No, Prof." Bob replied. "The new guitar has been specially treated with coats of electrically conducting paint connected to earth, so that the entire input circuitry is well screened. If any mysterious communications succeed in penetrating that, I will feel that these voice phenomena will really be worthy of investigation!"

To be continued



WORKSHOP MATTERS

By Harry T. Kitchen

Introduction

We are, all of us, beginners at some time. Experience is gained sometimes rapidly, sometimes slowly, according to aptitude and to opportunity. It can be a painless process or, as I can personally testify, can be exceedingly painful. It is the intention in the following series to guide the beginner along gently, to present the tools and techniques of a modern electronics workshop simply and without undue complication. The gentle, simple, approach is quite deliberate; I well remember how off-putting I found the ponderous, pontifical approach of so many authors; it may have done their egos some good, but my word! it made heavy going.

Whatever your station in life may be, it is the intention of this column to assist you. It will be a practical column, dealing with practical matters. The opinions expressed will be mine, tempered by many years experience. As it will be a series I will probably find myself struggling for inspiration occasionally. If you have suggestions (sensible ones I mean) a note to me via the Editor will very likely prove to be of mutual benefit.

Wiring up the work bench

So you're lucky enough to have a room to yourself, complete with work bench, and you want to wire up the bench to provide the maximum of versatility and convenience? Well, it's all really very simple provided a few basic rules are adhered to.

But first a word of warning.

Let me say quite categorically that *every* electrical installation should be inspected and approved by the appropriate authority. To fail to obtain this approval is exceedingly foolish for if you have any sort of misfortune that involves "the authorities" you will be very likely to be prosecuted, and very rightly too, for you are hazarding other peoples' lives and property as well as your own.

Sockets

Before starting on the wiring proper, you have to make a decision: are you going to try servicing work, or are the fruits of your work shop purely for the edification of yourself, family, and friends?

If servicing is the aim then you must, for the maximum in versatility and convenience, provide as wide a variety of sockets as you can think of; the ubiquitous 13-amp plug is by no means universal and you will meet inevitably a 5-amp or 15-amp round pin plug, a two-pin plug, and even a bayonet plug intended for plugging into lamp sockets! Yes, even in this day and age.

If your servicing ambitions are to succeed, time will be of the essence, and by providing a variety of sockets from the outset you will save the time involved in changing plugs.

Many years ago I too fancied a spot of servicing, and built my installation to suit. Although my ambitions foundered as soon as launched, due to my friends and neighbours expecting free servicing at all times of the day and night—I was once asked to look at a TV set at 10pm on Xmas night!—the installation was retained for the constructional activities that followed. And since it has served me well will be described as being representative of good amateur practice, and better than some professional installations that I have seen, come to think of it.

You, of course, can modify or expand upon the installation to be described. But please do bear in mind that an installation, irrespective of its intended useage, planned from the outset for the maximum in versatility and convenience, will give greater and longer lasting satisfaction than one planned just for the moments requirements.

I am a very great believer in fuses, and so fuses proliferate in all my circuits; the fact that very few have blown over the years has not diminished my belief, for I regard them as comprehensive insurance policies against bad times that we all hope will never come, but just might.

Distribution panel

Above my work bench is a distribution panel comprising the following: three 13-amp flat-pin sockets, one 5-amp and one 15-amp round-pin sockets, a miniature 5-amp two-pin socket, a bayonet socket into which a plug is normally fitted to prevent accidental short circuits; a fuse holder and a master switch complete the installation.

All the sockets are wired in parallel, and are fed from the fuse holder, this being fitted with a 2-amp fuse wire. The loading being so light, a normal domestic light switch suffices for the master switch.

This panel now feeds an assortment of test equipment. This equipment is of a semi-permanent nature and so the assorted plugs present no problems.

Edge connectors

To my left, and on the edge of the work bench, I have two 13-amp flat-pin sockets and one 5-amp round-pin socket, together with a fuse holder. The 13-amp sockets are wired in parallel, and are fed from the fuse holder. The fuse holder is fitted with a 10-amp fuse wire, and the sockets are intended for use with heavy duty loads like fan heaters and vacuum cleaners. By deliberately under fusing I have increased my margin of safety.

To my right, and also on the edge of the work bench, are a further group of sockets, and these comprise two 13-amp flat-pin, and two 5-amp round-pin sockets, together with a fuse holder. The fuse wire here is of 5-amp rating, and the sockets are intended primarily for light to medium duty loads such as soldering irons, oscilloscopes, and the like.

This fuse holder also feeds the 5-amp round-pin socket on the left hand edge of the work bench. Here, also, the value of the fuse wire has been kept deliberately on the low side to improve the safety margin.

BOOKS AND COMPONENTS

BOOKS BY BABANI

Purchase books to the value of £5·00 from the list below and choose any 60p pak from this page *FREE*.

BP2	Handbook of Radio, TV & Industrial & Transmitting Tube & Valve Equivalents	60p†
BP6	Engineers and Machinists Reference Tables	40p†
BP7	Radio & Electronic Colour Codes and Data	15p†
BP10	Modern Crystal and Transistor Set Circuits for beginners	35p†
BP15	Constructors Manual of Electronic Circuits for the Home	50p†
BP22	79 Electronic Novelty Circuits	75p†
BP23	First book of Practical Electronic Projects	75p‡
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BP27	Giant Chart of Radio Electronic Semiconductor and Logic Symbols	60p†
BP29	Major Solid State Audio Hi-Fi Construction Projects	85p†
BP32	How to Build Your Own Metal & Treasure Locators	85p†
BP34	Practical Repair & Renovation of Colour TVs	95p†
BP35	Handbook of IC Audio Preamplifier & Power Amplifier Construction	95p†
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BP37	50 Projects Using Relays, SCRs and TRIACS.	£1·10†
BP39	50 (FET) Field Effect Transistor Projects	£1·25†
BP43	How to Make Walkie Talkies	£1·25†
BP44	I.C. 555 Timer Projects	£1·45†
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BP129	Universal Gram-motor Speed Indicator	10p†
BP160	Coil Design and Construction Manual	75p†
BP196	AF-RF Reactance—Frequency Chart for Constructors	15p†
BP202	Handbook of Integrated Circuits (ICs) Equivalents and Substitutes	75p†
BP205	First Book of Hi-Fi Loudspeaker Enclosures	75p†
BP213	Electronic Circuits for Model Railways	85p†
BP214	Anglo Enthusiasts Handbook	85p†
BP216	Electronic Gadgets and Games	85p†
BP217	Solid State Power Supply Handbook	85p†
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BP220	Build Your Own Solid State Hi-Fi and Audio Accessories	85p†
BP222	Solid State Shortwave Receivers for Beginners	95p†
BP223	50 Projects Using IC CA3 130	95p†
BP224	50 CMOS IC Projects	95p†
BP225	A Practical Introduction to Digital ICs	95p†
BP226	How to Build Advanced Short Wave Receivers	£1·20†
BPRCC	Resistor Colour Code Disc Calculator	10p†

BOOKS BY NEWNES

No. 229 Beginners Guide to Electronics	Price £2·25†
No. 230 Beginners Guide to Television	Price £2·25†
No. 231 Beginners Guide to Transistors	Price £2·25†
No. 233 Beginners Guide to Radio	Price £2·75†
No. 234 Beginners Guide to Colour Television	Price £2·25†
No. 235 Electronic Diagrams	Price £1·80†
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No. 237 Printed Circuit Assembly	Price £1·80†
No. 238 Transistor Pocket Book	Price £3·90†
No. 225 110 Thyristor Projects Using SCRs & Triacs	Price £2·50†
No. 227 110 COS/MOS Digital IC Projects For the Home Constructor	Price £2·75†
No. 226 110 Operational Amplifier Projects for the Home Constructor	Price £2·50†
No. 242 Electronics Pocket Book	Price £3.90†
No. 239 30 Photoelectric Circuits & Systems	Price £1·80†

NUTS AND BOLTS

BA BOLTS – packs of BA threaded cadmium plated screws slotted cheese head.

Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in OBA	839	£1·20	¼in 4BA	846	£0·32
¾in OBA	840	£0·75	⅜in 4BA	847	£0·25
1in 2BA	842	£0·65	1in 6BA	848	£0·40
¼in 2BA	843	£0·45	¼in 6BA	849	£0·21
⅜in 2BA	844	£0·52	⅜in 6BA	850	£0·25
1in 4BA	845	£0·44			

BA NUTS – packs of cadmium plated full nuts in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	855	£0·72	4BA	857	£0·30
2BA	856	£0·48	6BA	858	£0·24

BA WASHERS – flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	859	£0·14	4BA	861	£0·12
2BA	860	£0·12	6BA	862	£0·12

SOLDER TAGS – hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	851	£0·40	4BA	853	£0·22
2BA	852	£0·28	6BA	854	£0·22

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0·11*
DPDT standard slide	1974	£0·14*
Toggle switch SPST 1½ amp 250V a.c.	1975	£0·33*
Toggle switch DPDT 1 amp 250V a.c.	1976	£0·42*
Rotary on-off mains switch	1977	£0·50*
Push switch – Push to make	1978	£0·13*
Push switch – Push to break	1979	£0·18*

ROCKER SWITCH A range of rocker switches SPST – moulded in high insulation. Material available in a choice of colours ideal for small apparatus.

Colour	No.	Price
RED	1980	£0·30*
BLACK	1981	£0·30*
WHITE	1982	£0·30*
BLUE	1983	£0·30*
YELLOW	1984	£0·30*
LUMINOUS	1985	£0·30*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0·50*
Miniature SPDT toggle, 2 amp 250V a.c.	1959	£0·58*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0·70*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0·85*
Push button SPST, 2 amp 250V a.c.	1962	£0·78*
Push button SPDT, 2 amp 250V a.c.	1963	£0·83*
Push button DPDT, 2 amp 250V a.c.	1964	£0·98*

MIDGET WAFER SWITCHES

Single-bank wafer type – suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactiver loads make-before-break contacts. These switches have a spindle 0·25in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	£0·48*
2 pole 6 way	1966	£0·48*
3 pole 4 way	1967	£0·48*
4 pole 3 way	1968	£0·48*

MICRO SWITCHES	Order No.	Price
Button gives 1 pole change over action Rating 10 amp 250V a.c.	1970	£0·25

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0·07*
1¼in x ¼in chassis mounting	507	£0·12*
1¼in car inline type	508	£0·15*
Panel mounting 20mm	509	£0·20*
Panel mounting 1¼in	510	£0·30*

QUICK BLOW 20mm

Type	No.	Price	Type	No.	Price	Type	No.	Price
150mA	611	8p	1A	615	5p	3A	619	5p
250mA	612	5p	1·5A	616	6p	4A	620	6p
500mA	613	5p	2A	617	5p	5A	621	5p
800mA	614	7p	2·5A	618	6p			

All 5p each excepting b l b which is 7p.

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1·6A	627	5A	630

All 7p each

QUICK BLDW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 7p each

Type	No.	Type	No.	Type	No.
1A	635	2·5A	638	4A	641
2A	637	3A	639	5A	642

All 8p each

CASES AND BOXES

INSTRUMENT CASES. In two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5½in	2in	£1·52*
156	11in	6in	3in	£2·12*
157	6in	4¾in	1¾in	£1·30*
158	9in	5¼in	2¼in	£1·76*

ALUMINIUM BOXES. Made from bright all., folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5½in	2½in	1½in	82p*
160	4in	4in	1½in	82p*
161	4in	2½in	1½in	82p*
162	5½in	4in	1½in	70p*
163	4in	2½in	2in	64p*
164	3in	2in	1in	44p*
165	7in	5in	2½in	£1·04*
166	8in	6in	3in	£1·32*
167	6in	4in	2in	86p*

P.C.B. BOARDS

C26 4 pieces 8″ × 3½″ (approx.) Single-sided fibreglass 80p

C27 3 pieces 7″ × 3½″ (approx.) Double-sided fibreglass 80p

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	90p*
2022	9V-0-9V 100mA	90p*
2023	12V-0-12V 100mA	95p*

MINIATURE MAINS Primary 240V with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V, 0-6V RMS	£1·50*
2025	MT150-0-12V, 0-12V RMS	£1·50*

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	£2·50*	P. & P. 45p
2027	9V-0-9V 1 amp	£2·00*	P. & P. 45p
2028	12V-0-12V 1 amp	£2·60*	P. & P. 55p
2029	15V-0-15V 1 amp	£2·75*	P. & P. 66p
2030	30V-0-30V 1 amp	£3·45*	P. & P. 86p

STANDARD MAINS Primary 240V

Multi tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33 40 50V.

Voltages available by use of taps:

4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V.

No.	Rating	Price	
2031	½ amp	£5·50*	P. & P. 86p
2032	1 amp	£6·80*	P. & P. 86p
2033	2 amp	£8·40*	P. & P. £1·10

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0·60*
113	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	£0·75*
114	5 pin DIN plug to 3.5mm. Jack connected to pins 3&5. Length 1.5m	£0·85*
115	5 pin DIN plug to 3.5mm. Jack connected to pins 1&4. Length 1.5m	£0·85*
116	Car aerial extension. Screened insulated lead. Fitted plug & skt.	£1·10*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0·68*
118	5 pin DIN phono plug to stereo headphone jack socket	£1·05*
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0.2m	£0·90*
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions.	£0·60*
123	6.8m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1·50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0·75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0·75*
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0·75*
127	5 pin Din plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1·30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0·80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1·05*
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0·68*
131	5 pin DIN plug to 3 pin DIN plug. 1&4 and 3&5. Length 1.5m	£0·83*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£0·98*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	£0·75*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	£0·68*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	£0·68*
136	Coiled stereo headphone extension lead. Black. Length 6m	£1·75*
178	AC mains lead for calculators etc.	£0·45*

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Belt and braces!

Large, heavy equipment, of a permanent nature, such as my revered Marconi TF144G signal generator, and my equally revered R1155 receiver are wired permanently into circuit. "Ahah!" you will triumphantly declaim "he has omitted his fuses".

No, my dear reader, I have done no such thing. Both the TF144G and the R1155 are fitted with self contained fuses; and you may well guess who performed that little act. Belts, braces, and the bit of string. Yes, I use them all, for I don't want to die so young.

Each group of sockets is served by its own fuse holder, the fuse wire being calculated to afford the maximum protection *to the group*. Additionally, all equipments run from 13-amp plugs have fuses appropriate to that equipment. The fuse holders, needless to say, *must* be connected into the live side of the mains.

Lastly, the wiring itself. Copper wire is very expensive. and so you may be tempted to use any old wire available. Don't. Go to a reputable electrical dealer if you're your own handy man and he will advise you accordingly. If you are not confident of your own ability, play safe, and to go a reputable electrician. Whoever does the job, don't forget that approval for the complete installation. It's worth it for the peace of mind it gives.

GEORGE HYLTON brings it

down to earth

Doppler Effect

A number of electronic instruments and systems make use of the Doppler effect. What is it and how is it used?

Doppler is the name of the scientist who first explained why, when light is emitted by a moving source such as a star moving through space, the colour changes. The colour of light depends on its wavelength. In the middle of the visible spectrum where the colour is green the wavelength is about a two-thousandth part of a millimetre. Red light has a slightly longer wavelength and blue a slightly shorter one.

If a source of red light is moving towards you, the front edge of each wave has to travel a little further than the back edge. This is because, while the first part of each wave is being emitted, the movement brings the light source a little closer. So the back edge has a shorter distance to go; consequently it arrives a little earlier than expected.

The wave then seems shorter than it should be and the colour is different. If the light source is moving at great speed red light may turn green or even blue.

Heavenly Bodies

Doppler effect is of great importance to astronomy because by studying the light from stars it is possible to find out if they are moving towards the earth or away from it. Most heavenly bodies are in fact moving away, and at high speed. This shifts their colours towards the longwave end of the optical spectrum. Since this is the red end these changes are called red shifts.

Doppler effect is more familiar in the world of sound where it explains the change in pitch heard by a pedestrian as a car goes by.

As the car approaches, the wavelength of the sound it makes is reduced and the pitch increased. As it goes away the wavelength increases and the pitch drops. At 25 miles an hour the "departing" sound is about a semitone lower in pitch than the "approaching" sound.

Reflected Waves

The effect occurs also with reflected waves.

If an aircraft is in the beam of a radar transmitter on the ground then the reflected waves are at a longer or shorter wavelength. If the aircraft is moving towards the transmitter then the waves bouncing back off it are crowded together; that is the wavelength is shortened (and the frequency increased).

For an aircraft moving away the wavelength is increased and the frequency reduced. By comparing the frequency of the reflected waves with the transmitted waves the crew of the radar station can see whether the aircraft is approaching or moving away and how quickly.

Speed Traps

The same principle is used by the police in radar speed traps. If the radar is placed by the side of a straight stretch of road and made to look along the road at the approaching or departing traffic the speed of a vehicle shows up as a change in the reflected frequency.

This kind of radar is very simple because the transmitter does not need to be switched on and off in short pulses like a traditional radar. It just emits steadily all the time on a constant frequency. The "target" itself, the vehicle in this case, does all that is necessary for speed measurement, by changing the frequency of the transmitted waves.

The speed trap doesn't measure the range of the vehicle, only its speed, but of course that is what the police are interested in.

It follows that static objects such as houses and trees do not change the frequency of the waves they reflect and so are invisible to a simple Doppler radar like the speed trap. This ability to see only things that are moving is put to good use in radar burglar alarms.

A low power Doppler radar is placed in a room. It ignores reflections from the walls and ceilings but responds to the movements of the burglar's body when he comes into the room. The change in frequency, if expressed as a percentage of the transmitted frequency, is minute, especially if the burglar moves very slowly. But by working at a frequency of several thousand megahertz even a minute percentage change produces an easily detectable effect.

Sound Cameras

Another important use of the Doppler effect as an indicator of movement is in medicine. One way of looking into the body is with very short acoustic waves—ultrasonic waves.

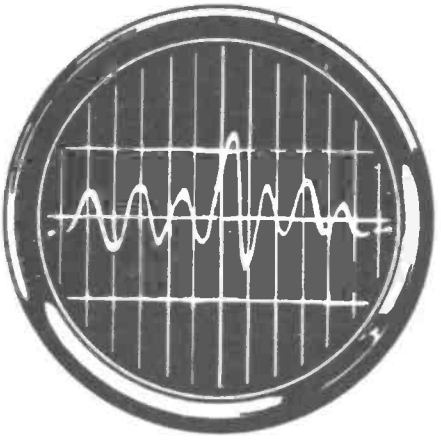
It is possible to make instruments which are in effect "sound cameras"; that is they use the reflections from internal organs of the body to build up images like X ray pictures, on a TV screen.

One advantage is that unlike X rays ultrasound is harmless at the low powers used. But another is that it can detect movements such as the beating of the heart.

The beating of the heart of an unborn baby can also be detected and it is a great comfort to the mother-to-be to be allowed to listen to her baby and to know that it is alive and well.

LOOK! Here's how you master electronics.

....the practical way.



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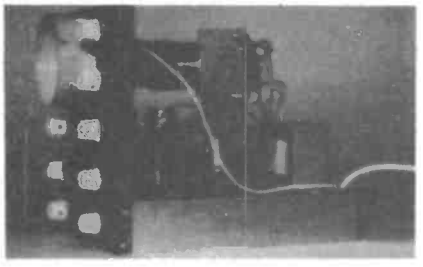

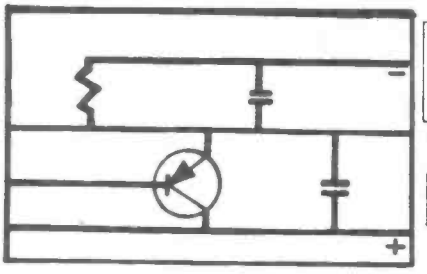

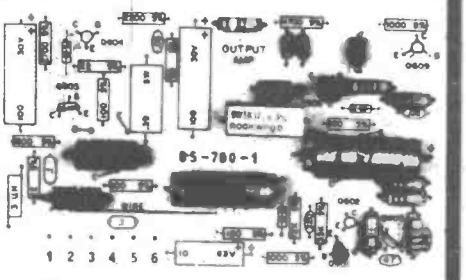

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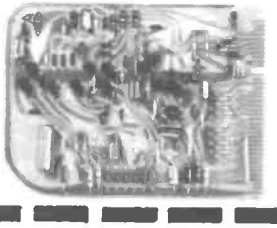

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COMBINATION LOCK
All components inc. DIL reed relay (not PCB or case) £3·95

WATER LEVEL ALERT
All components inc. earpiece, vero, studding, cable and 2 boxes 115 × 75 × 38mm. £3·95 (without boxes £2·75)

HOT LINE GAME
All electronic parts inc. vero, but not wood, etc. £2·25

AUDIO EFFECTS OSCILLATOR
All parts inc. knobs and case for £2·25

TELE-TEL METER
All resistors, caps, semis, switches, transformer, fuse and holder, matrix board, DIL sockets, knob, wire, cable (not box) £12·50

AIR-FRESHENER KIT
See our half-page ad. elsewhere in this issue for details.

NOTE: A more detailed list of parts supplied in these and other kits is available on receipt of a SAE.

Kits of last month's projects still available.

DOING IT'' ''DIGITALLY

This new series which started last month is bound to be a big success. We supply a complete set of parts (as we did for last years' Teach-in series) for just £19·75 + £1 post for the Electronic Test Bed, and £2·75 for additional parts required for first 6 parts.

The GREENWELD Amplifier Kit
Ideal for the beginner to make, this kit is complete right down to the last screw!! Easily constructed on the PCB provided, the 4 transistor circuit will give 2W output from a crystal cartridge. Battery version £1·75, or with transformer for mains operation £3·95

PC ETCHING KIT MK III
Now contains 200 sq. ins. copper clad board, 1lb. Ferric Chloride, DALO etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. £4·25

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★ *HAVE THE RIGHT PART—No guesswork or substitution necessary!*

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K003 Polyester capacitors, 10 each of these values: 0·01, 0·015, 0·022, 0·033, 0·047, 0·068, 0·1, 0·15, 0·22, 0·33, 0·47μF, 110 altogether for £4·75

K004 Mylar capacitors, min 100V type. 10 each all values from 1000pF to 10,000pF. Total 130 for £3·75

K005 Polystyrene capacitors. 10 each value from 10pF to 10,000pF. E12 series 5% 160V. Total 370 for £12·30

K006 Tantalum bead capacitors. 10 each of the following: 0·1, 0·15, 0·22, 0·33, 0·47, 0·68, 1, 2·2, 3·3, 4·7, 6·8, all 35V; 10/25 15/16 22/16 33/10 47/6 100/3. Total 170 tants for £14·20

K007 Electrolytic capacitors 25V working small physical size. 10 each of these popular values: 1, 2·2, 4·7, 10, 22, 47, 100μF. Total 70 for £3·50

K008 Extended range, as above, also including 220, 470 and 1000μF. Total 100 for £5·90

K021 Miniature carbon film 5% resistors, CR25 or similar. 10 of each value from 10R to 1M, E12 series. Total 610 resistors, £6·00

K022 Extended range, total 850 resistors from 1R to 10M £8·30

K041 Zener diodes, 400mW 5% BZY88, etc. 10 of each value from 2·7V to 36V. E24 series. Total 280 for £15·30

K042 As above but 5 of each value £8·70

TRANSFORMERS
All mains primary: 12-0-12V 50mA 85p; 100mA 95p; 1A £2·50. 6-0-6V 100mA 85p; 1½A £2·40. 9-0-9V 75mA 85p; 1A £2·10. Multitapped type 0-12-15-20-24-30V, 1A £3·95; 2A £5·35; 3A £6·90; 20V 2½A £3·90; 25V 1½A £2·25; 12V 8A £4; 24V 5A £7·50; 0-22-34-41V 4A £7·50; 20V @ 300mA twice £2·50; 12V @ 250mA twice £2·00

RELAYS
W847 Low profile PC mntg 10×33×20mm 6V coil, SPCO 3A contacts. 93p
W832 Sub. min type, 10×19×10mm 12V coil DPCO 2A contacts £1·15
W701 6V SPCO 1A contacts 20×30×25mm Only 56p
W817 11 pin plug in relay, rated 24V ac, but works well on 6V DC. Contacts 3 pole c/o rated 10A. 95p
W819 12V 125OR DPCO 1A contacts. Size 29×22×18mm. min plug-in type 72p
W839 50V ac (24V DC) coil. 11 pin plug in type. 3 pole c/o 10A contacts. Only 85p
W846 Open construction mains relay. 3 sets 10A c/o contacts. £1·20
Send SAE for our relay list—84 types listed and illustrated.

HEAT SINK OFFER
Copper TO5 sink 17mm dia × 20mm. 10 for 40p; 100 for £3; 1000 for £25

POLYTHENE SHEET
Size 36 × 18" 200g. Hundreds of uses around the home. 100 sheets for £1·50. Box of 1500 for £19

NEW! BUILD-IT-YOURSELF TEST GEAR KIT

BASIC SERVICING INSTRUMENTS WITH EASY STAGE BY STAGE BUILDING INSTRUCTIONS—IDEAL FOR THE AMATEUR

MULTI RANGE TEST METER

A general purpose meter covering all usual ranges of A.C. and D.C. volts current and resistance measurements

AUDIO SIGNAL GENERATOR

New design covering 10Hz to 10KHz and variable output. Distortion less than 0·01% Ideal for HIFI Testing.

OSCILLOSCOPE

A basic 3" general purpose cathode ray oscilloscope for simple testing and servicing work. Sensitivity 0·3 volts/cm

SEND NOW FOR FREE DETAILS

To LERNAKITS, P.O. Box 156, Jersey.

Name_____

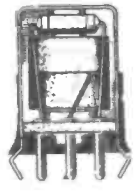
Address_____

EEO11

DENCO (CLACTON) LIMITED

Dept. E.E.

**357-8-9 OLD ROAD
CLACTON-ON-SEA
ESSEX CO15 3RH**



Our components are chosen by technical authors and constructors throughout the world for their performance and reliability, every coil being inspected twice plus a final test and near spot-on alignment.
General Catalogue showing full product range 36p. Overseas Customers 70p, Air-Mail Post Paid.

U.K. & OVERSEAS MANUFACTURERS/STOCKISTS ENQUIRIES WELCOME

Australian Readers Please Note—Our Complete Range of Coils are available from Watkin Wynne Pty. Ltd., 32, Falcon Street, CROWS NEST, 2065, AUSTRALIA. P.O. Box 392.

ELECTROVALUE Buying Guide

Section 4

If you have bought before from Electrovalue, you know just how large and varied our stocks are and how good our service is. For those who have yet to know us, we are publishing a series of five ads. month by month to give up-to-date information and prices on much of the stocks we carry. These ads are appearing in rotation in Everyday Electronics, Elektor, Practical Wireless and Practical Electronics so that the complete series will appear each month. So no matter which journals you read, BY DETACHING AND SAVING THESE PAGES YOU WILL ACQUIRE A VALUABLE AND COMPREHENSIVE MONEY SAVING CATALOGUE.

Resistors

(Prices in pence)

Type	1+	10+	100+
CR25	●1Ω to 3Ω9 5% *E12*		
.33W	3p	2p	1.76N
UPM033	●4Ω7 to 1M 5% *E24*		
.33W	2p	1.6	1.43N
CR25	●1M2 to 10M 10% *E12*		
.33W	3p	2p	1.76N
MR25	5Ω1 to 300K 2% *E24*		
.4W	5p	4p	3.60N
UPM050	●4Ω7 to 4M7 5% *E12*		
.5W	2p	1.6	1.43N
CR37	●1Ω to 3Ω9 5% *E12*		
.5W	3p	2p	1.87N
UPM075	●4Ω7 to 10M 5% *E24*		
.75W	2p	1.6	1.43N
UPM100	●4Ω7 to 4M7 5% *E12*		
1W	5p	4p	3.27N
UPM100	●5M6 to 10M 10% *E12*		
1W	5p	4p	3.27N
TR5	10Ω to 1M 2% *E24*		
.5W	5p	4p	3.20N
TW1	0.22Ω to 0.47Ω ± 0.05Ω *E12*		
1W	15p	13p	11.8N
TW1	D.56Ω to 3R9 1D% *E12*		
1W	15p	13p	11.8N
GWS3	0.47Ω, 1Ω to 10Ω 10% *E12*		
3W	18p	14p	11.0N
GWS3	12Ω to 10K 5% *E12*		
3W	18p	14p	11.0N
GWS7	1Ω to 10Ω 10% *E12*		
7W	18p	14p	11.0N
GWS7	12Ω to 10K 5% *E12*		
7W	18p	14p	11.0N

Net prices apply for complete 100s only. Bulk prices available.
E12 values: 1.0, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2.
E24 values: as *E12* plus 1.1, 1.3, 1.6, 2.0, 2.4, 3.0, 3.6, 4.3, 5.1 6.2, 7.5, 9.1, *and their decades.*

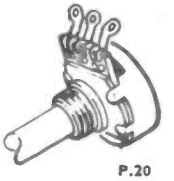
NEW — ERG DUAL IN-LINE SWITCHES

One-pole change-over SDC.1	42p
Two-pole change-over SDC.2	78p
Three-pole change-over SDC.3	£1.08

On-off 2-pole SDS.2	42p	On-off 6-pole SDS.6	£1.08
On-off 4-pole SDS.4	78p	On-off 8-pole SDS.8	£1.32

(Above types colour coded)
Multi-type one-pole 8 way Type DS16A-8 99p
Multi-type two-pole 4-way Type DS16A2-4 £1.08
For fuller range of switches, see section 5 in our current ads.

Pots.


P.20

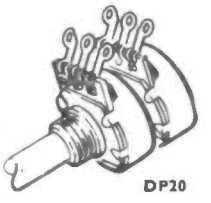
CARBON TRACK, ROTARY●
Long spindle, without flat. 0.25" 0.375" B.S. bush, nut and washer

P20 lin 1-gang	23p
P20 log 1-gang	23p
P20 lin +switch	67p
P20 log +switch	67
JP20 lin 2-gang	67p
JP20 log 2-gang	67p
JP20 lin +switch	1.11
JP20 log +switch	1.11
DP20 2-gang (separate spindles)	£1.17
DP20 +switch	£1.67

Resistance values stocked:

P20 lin	100Ω to 4M7
P20 log	220Ω to 2M2
JP20 lin	1K, 4K7 to 2M2
JP20 log	4K7 to 2M2

DP20 made to order in any values available in P20. State front (near bush) and rear tracks clearly.

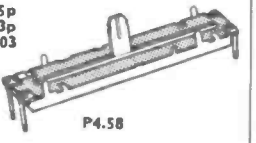

DP20

MINIATURE PRE-SETS
Type PR10, horizontal or vertical. All values 100Ω to 4M7. each 9p

CARBON TRACK SLIDER ●
(58mm travel)
For knobs see JV slider

PG58 mono	35p
C1PG58 mono	63p
C1PG58ST stereo	£1.03

new supplied with connecting lugs to mount alright in to PCB's


P4.58

Resistance values stocked

PG58 lin	4K7 to 1M
PG58 log	4K7 to 1M
C1PG58 lin	4k7 to 1M
C1PG58 log	4K7 to 1M
C1PG58ST lin	4K7 to 1M
C1PG58ST log	4K7 to 1M

Log stereo matching ± 2d8 @ 10%R
± 3d8 @ 3.2%R
± 4d8 @ 1%

NEW—JOYSTICK TWIN POT. UNIT

Pan pot assembly comprising two carbon track pots mounted at right angles on rigid plastic box and operated individually by joystick control. 100K or 220K per section

£2.25

Knobs

All screw fitting

ALUMINIUM (plastic inner)

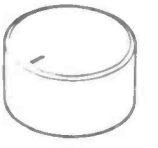
EV18A 18mm	56p
EV22A 22mm	64p
EV32A 32mm	73p
EV38A 38mm	78p

BULGIN

K107 pointer 32mm black or white	22p
K108 pointer 57mm black only	35p

"Modern range"

K491 29mm	46p
K492 37mm	46p
K493 32mm	46p
K382 dial 270° 0-10	22p
K389 dial 300° 0-10	22p


Type EV

SI FAM COLLET KNOBS
Caps must be ordered separately
15mm diameter:

S1508 short	27p
K1508	28p
W1508B winged	32p

22mm diameter

S2108 short	35p
K2108	36p
W2108 winged	39p

Caps 15mm:

C150	3p
C151 with line	5p
C152 w. spot	5p

Caps 21mm:

C210	3p
C211 with line	5p
C212 w. spot	5p

Nut covers 15mm only:

N1508	5p
N1518 with line	10p
Dials 15mm	17p
Dials 21mm	18p


Type K/CK


K5

Types available:
D151, D211 0-11
D152, D212, 1-12
D158, D258 wedge
D159, D259 white arrow
Caps in black, red, yellow, green, blue and grey.
All other items black only.


K6

JV SERIES
Plastic cylindrical — black, red, yellow, green, blue, light or dark grey, white

JV18 18mm	27p
JV23 23mm	27p

The following pair are designed for DP20 pots, and have 4mm and 6mm bores:

JV18/4	40p
JV23/6T	40p

JV Slider knobs for Radiohm mono and stereo pots. In eight colours as above

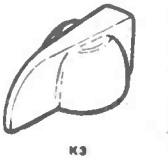
JVS + colour	8p


NK

BLACK PLASTIC

K1 25mm S	13p
CK1 25mm SM	18p
K2 35mm S	15p
CK2 35mm SM	20p
K3 27mm P	12p
K4 32mm P	12p
K5 19mm	20p
K6 25mm	25p
SK6 41mm SK	36p
K7 19mm B/W	20p
K8 25mm S	20p
NK 36mm SK	37p
PK 36mm	37p

S skirted
M metal insert
P pointer
Sk skirt, 0-10
B/W black or white


K3


Si Fam Collet


K8

BOXES

ALUMINIUM

AB7	133 x 70 x 38	60p
AB8	101 x 101 x 38	60p
AB9	101 x 70 x 38	60p
AB10	133 x 101 x 38	62p
AB11	101 x 64 x 51	60p
AB12	76 x 51 x 25	50p
AB13	152 x 101 x 51	77p
AB14/2	127 x 89 x 64	74p

DIECAST

992	89 x 35 x 30	1.24
993	114 x 64 x 30	1.32
998	114 x 64 x 55	1.62
994	114 x 89 x 55	2.10
999	171 x 121 x 55	3.07
974	171 x 121 x 106	4.09

PLASTIC

PB1	116 x 77 x 36	48p
PB601	122 x 67 x 43	66p

(PB301 is "double U" type and has vent and various holes)

We are appointed National Distributors for

NASCOM 1

MICROCOMPUTER KITS

£197.50 + VAT
We give delivery from stock (Net Price)

● Discounts for quantity buyers ● Retail buyers invited

MOTOROLA Microprocessor Evaluation Kit **£175.87 (N)** + VAT

- GOODS SENT POST FREE C.W.O. ORDERS IN UK OVER £5 LIST VALUE. If under, add 27p for handling charges.
- ATTRACTIVE DISCOUNTS ON CASH WITH ORDER (C.W.O.) ORDERS — 5% where list value is over £10; 10% where list value is over £25.
- TOP QUALITY MERCHANDISE—— ALL BRAND NEW AND GUARANTEED.
- ACCESS or BARCLAYCARD ORDERS — just phone or write your number.
- V.A.T. — Add 8% to value of order For items marked ●, add 12½%.
- *No discount allowable on items marked Net or N.*
- *TEAR OUT AND TAKE GOOD CARE OF THIS PAGE. LOOK OUT FOR THE FOLLOWING ADS. AND COLLECT THEM TOO.*
- *OUR COMPUTER SERVICE TAKES GOOD CARE OF YOUR ORDER NO MATTER HOW LARGE OR SMALL.*

All communications to Dept. E.E.

ELECTROVALUE LTD
28, ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB
Telephone Egham 3603 Telex 264475
Northern Branch 680, BURNAGE LANE, BURNAGE, MANCHESTER M19 1NA (061) 432 4945

SMALL ADS

The prepaid rate for classified advertisements is 18 pence per word (minimum 12 words), box number 60p extra. Semi-display setting £4·40 per single column centimetre.

All cheques, postal orders, etc., to be made payable to Everyday Electronics and crossed "Lloyds Bank Ltd." Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, Everyday Electronics, Room 2337, IPC Magazines Limited, King's Reach Tower, Stamford St., London, SE1 9LS. (Telephone 01-261 5918).

Receivers and Components

NO LICENCE EXAMS NEEDED

To operate this miniature, solid-state **Transmitter-Receiver Kit.** Only £9·75 plus 25p P&P.
'Brain-Freeze' 'em with a MINI STROBE Kit, pocket-sized 'lightning flashes', vari-speed, for discos and parties. A mere £4·10 plus 20p P&P. Experiment with a psychedelic DREAM LAB, or pick up faint speech/sounds with the BIG EAR sound-catcher; ready-made multi-function modules. £5·00 each plus 20p P&P.
LOTS MORE! Send 20p for lists. Prices include VAT. (Mail order U.K. only).

BOFFIN PROJECTS
4 CUNLIFFE ROAD, STONELEIGH
EWELL, SURREY. (E.E.)

DISCOVER ELECTRONICS. Build forty easy projects including: Metal Detector; Wireless Transmitter; Breathalyser; Radios; Stethoscope; Lie Detector; Touch time-switches; Burglar Alarms, etc. Circuits, plans all for £1·29 including FREE circuit board. Mail only. RIDLEY PHOTO/ELECTRONICS, Box 62, 111 Rockspark Road, Uckfield, Sussex.

FURAMA ELECTRONICS
32/34 Scot Lane, Doncaster, Yorkshire, DN1 1ES. Tel: Doncaster (0302) 65234

NOTE—ALL PRICES INCLUDE V.A.T.
TERMS—C.W.O. CHEQUES and P.O. PAYABLE FURAMA ELECTRONICS. P&P 25p. *Callers Welcome*

BRAND NEW & FULL SPEC DEVICES ONLY
OPTO ELECTRONICS
L.E.D.s 5mm

RED	10 £1·00	CLEAR	10 £1·30
YELLOW	10 £1·00	PACK OF 10	40 £3·00
GREEN	10 £1·00	OF EACH COLOUR	

SUPERIOR QUALITY AMERICAN MADE 15mm 4 DIGIT 7 SEG L.E.D. CLOCK DISPLAY COMMON/CATHODE £4·50

ELECTRONIC KITS
0–35 volt, 3 amp, variable power supply, S/C protected, P.C.B. and all parts except transformer £6·50
0–45 volt, 3·5 amp variable power supply, S.C.R. S/C protected. P.C.B. and all parts except transformer £7·50
32 L.E.D. V.U. display (stereo).
P.C.B. and all parts except power supply 12-18 volt, 500ma D.C. £9·50
FLUORESCENT INVERTER will run 4w–40w tube H/F very efficient £2·50
MOTOROLA POSITIVE VOLTAGE REGULATORS—1 amp

MC 7805	95p	MC 7815	95p
MC 7806	95p	MC 7818	95p
MC 7808	95p	MC 7824	95p
MC 7812	95p		

MICRO-SWITCHES
ex equipment 10p each
Rubber Feet 10p per doz
BC 107-8-9 10p each
Diodes (unmarked) 20p per doz
Pkt. 25 mixed resistors 15p per pkt
Potentiometers 10k lin 25p each
Croc. Clips 12p each
1 meg min. Pre-sets 10p each
Banana sockets 15p each
B9A Valve holders 14p each
Resistors 820 ohm ½w 10p per doz
Plus large stocks of electronic components.
Prices include VAT. Add 20p for p & p.
DURRANT RADIO (COMPONENTS) 9 St. Mary's Street. Phone: SHREWSBURY 61239
S.A.E. FOR CATALOGUE

7lb ASSORTED COMPONENTS £3·60. 3½lb £1·95. Small Audio Amplifiers. 3 Transistors equivalent to AC128, OC72, with circuit, 3 for £1. 300 small components, Transistors, Diodes £1·50. Wire ended Neon's 7p, 20 for £1. No postage. List 15p refundable. Insurance add 15p. J.W.B. RADIO, 2 Barnfield Crescent, Sale, Cheshire M33 1NL.

FULL SPEC COMPONENTS. Brand new no surplus. 9p for list. TERO, 109 Clitheroe Road, Sabden, Blackburn, Lancs.

Miscellaneous

DISCOUNT BOXES, INSTRUMENT CASES, COMPONENTS

Boxes from 44p
LM741c 8 pin dil I.C.s
Discounts up to 20%
Send stamped self addressed envelope for pamphlet to
HARRISON BROS., P.O. Box 55, Milton Road, Westcliff-on-Sea, Essex, SS0 7LQ

STYLI—illustrated equivalents (List 28) also cartridges, leads, etc. Superb quality and service at lowest prices. Fully guaranteed, free for SAE from: FELSTEAD ELECTRONICS (EE), Longley Lane, Gatley, Cheadle, Cheshire SK8 4EE.

RESISTORS ¼W 5% 2R2-2M2 (E12).
10 each or more of each value 90p/100. 100 assorted, ou mixture 75p/100. C60 cassettes in library cases 30p each. miniature relays 17 × 30 × 28mm 800 Ω coil 4 sets change over contacts 50p each.
Prices include V.A.T. Add 10% postage.
SALOP ELECTRONICS. 23 Wyle Cop, Shrewsbury.

TUNBRIDGE WELLS COMPONENTS, BALLARD'S, 108 Camden Road, Tunbridge Wells, Phone 31803. No lists, enquiries S.A.E.

ENAMELLED COPPER WIRE

swg	1 lb	8 oz	4 oz	2 oz
14–19	2·40	1·20	·69	·50
20–29	2·45	1·40	·82	·59
30–34	2·60	1·70	·89	·64
35–40	2·85	1·90	1·04	·75

Inclusive of p&p and VAT. SAE brings Catalogue of copper and resistance wires in all coverings.
THE SCIENTIFIC WIRE COMPANY
PO Box 30, London E4 9BW
Reg. Office: 22 Coningsby Gardens

COMPUTER HOBBIST, components lowest prices. Write for free price list, stating your specific interests. PACS, 12 Alma Road, Monkstown, Co. Dublin, Ireland.

Service Sheets

SERVICE SHEETS for Radio, Television, Tape Recorders, Stereo, etc. With free fault-finding guide, from 50p and s.a.e. Catalogue 25p and s.a.e. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex.

BELL'S TELEVISION SERVICE for service sheets of Radio, TV etc. 75p plus SAE. Colour TV Service Manuals on request. SAE with enquiries to BTS, 190 King's Road, Harrogate, N. Yorkshire. Tel: 0423 55885.

Tapes

C60 CASSETTE TAPES in library cases 32p each. POST PAID. Send your order to: A. W. & J. M. West, 56 Frankwell Drive, Coventry CV2 2FB.

For Sale

EVERYDAY ELECTRONICS: Nov. 71 to date including unfinished Delta Guitar. Sell or exchange. Offers SAE. 10 Blakemore Road, Streatham, London SW16 1NH.

E.E. VOLUMES 5, 6, 7, incl. binder, offers with SAE. 5 Deedes Avenue, Shrewsbury, Salop.

ADVANCE TEST EQUIPMENT. Alpha II Digital Multimeter £60. VM77E AC Voltmeter £80. Nearly new. Hornchurch 49695.

NEW BACK ISSUES of "EVERYDAY ELECTRONICS". Available 60p each Post Free, open PO/Cheque returned if not in stock. BELL'S TELEVISION SERVICES 190 Kings Road, Harrogate, Yorkshire. Tel: (0423) 55885.

ELECTRONIC KITS—SAE for new catalogue, and clearance list of obsolete kits. AMTRON UK, 7 Hughenden Road, Hastings, Sussex.

Books and Publications

MYSTIFIED ABOUT MICROS? Read Home Computer Revolution, by Ted Nelson, to see what is happening plus gain "Computer-ease" From your local Computer Store or send £3·45 to COMPUTER BOOKSHOP, Temple House (E), 43-48 New Street, Birmingham.

WHY NOT START YOUR OWN BUSINESS REWINDING ELECTRIC MOTORS

A genuine opportunity to success. LARGE PROFITS. You can't help but make money if you follow the easy step by step, instructions in our fully illustrated Manual showing how to rewind Electric Motors, Armatures and Field coils as used in Vacuum Cleaners, Electric Drills and Power Tools. NO PREVIOUS KNOWLEDGE IS REQUIRED, as the Manual covers in 13 Chapters, where to obtain all the work you need, materials required, all instructions rewind charts and how to take data, etc. A goldmine of information. How to set up your home workshop and how to cost each job to your customer. £4·00 plus 30p P. & P. U.K. CWO to:

INDUSTRIAL SUPPLIES
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SIMPLIFIED TV REPAIRS. Full repair instructions individual British sets £4·50, request free circuit diagram. Stamp brings details unique TV publications. Ausee, 76 Church Street, Larkhall, Lanarkshire.

Educational

COURSES—RADIO AMATEURS EXAMINATION. City and Guilds. Pass this important examination and obtain your G8 Licence, with an RRC home study course. For details of this, and other courses (GCE, professional examinations etc), write or phone:— THE RAPID RESULTS COLLEGE, Dept. JR1 Tuition House, London SW19 4DS. Tel: 01-947 7272 (Careers Advisory Service) or phone for a prospectus only ring 01-946 1102 (24hr recording service).

Wanted

WANTED, one copy of "Everyday Electronics" dated February 1978. Please phone: 01-856 1310/01-304 2646.

Record Accessories

STYLI for Hi-Fi, Music Centres. Ill list free for SAE. Also cartridges, leads, accessories details. Felstead Electronics (EE), Longley Lane, Gatley, Cheadle, Ches. SK8 4EE.

TRANSFORMERS

ALL EX-STOCK—SAME DAY DESPATCH. VAT 8%

12 OR 24 VOLT OR 12-0-12V PRIMARY 220-240 VOLTS

Ref	Amps 12V	Amps 24V	£	P & P
111	0·5	0·25	2·20	0·45
213	1·0	0·5	2·64	0·78
71	2	1	3·51	0·78
18	4	2	4·03	0·96
70	6	3	5·35	0·96
108	8	4	6·98	1·14
72	10	5	7·67	1·14
116	12	6	8·99	1·32
17	16	8	10·39	1·32
115	20	10	13·18	2·08
187	30	15	17·95	2·08
226	60	30	26·82	OA

50 VOLT RANGE

Pri 220/240v Sec 0-20-25-33-40-50V Voltages available 5, 7, 8, 10, 13, 15, 17, 20, 33, 40 or 20V-0-20V & 25V-0-25V.

Ref	Amps	£	P & P
102	0·5	3·41	0·78
103	1·0	4·57	0·96
104	2·0	6·98	1·14
105	3·0	8·45	1·32
106	4·0	10·70	1·50
107	6·0	14·62	1·84
118	8·0	17·05	2·08
119	10·0	21·70	OA

MAINS ISOLATING (SCREENED)

PRIM 120/240 SEC 120/240 CT

Ref	VA (Watts)	£	P & P
*07	20	4·40	0·79
149	60	6·20	0·96
150	100	7·13	1·14
151	200	11·16	1·50
152	250	12·79	1·84
153	350	16·28	1·84
154	500	19·15	2·15
155	750	29·96	OA
156	1000	37·20	OA
157	1500	45·60	OA
158	2000	54·80	OA
159	3000	79·05	OA

*State Volts required 115V or 240V.

HIGH VOLTAGE ISOLATOR

Prim 200/220V or 400/440V
Sec 110/120V CT or 200/240CT

Va	Ref	£	P & P
60	243	5·89	1·32
350	247	14·11	1·84
1000	250	41·76	OA
2000	252	58·63	OA

30 VOLT RANGE

Pri 220/240 Sec 0-12-15-20-24-30V Voltages available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30V or 12V-0-12V & 15V-0-15V.

Ref	Amps	£	P & P
112	0·5	2·64	0·78
79	1·0	3·57	0·96
3	2·0	5·27	0·96
20	3·0	6·20	1·14
21	4·0	7·44	1·14
51	5·0	8·37	1·32
117	6·0	9·92	1·45
88	8·0	11·73	1·64
89	10·0	13·33	1·64

60 VOLT RANGE

Pri 220/240V Sec 0-24-30-40-48-60V Voltages available 5, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60 or 24V-0-24V, 30V-0-30V.

Ref	Amps	£	P & P
124	0·5	3·88	0·96
126	1·0	5·58	0·96
127	2·0	7·66	1·14
125	3·0	10·54	1·32
123	4·0	12·23	1·84
40	5·0	13·95	1·64
120	6·0	15·66	1·84
121	8·0	20·15	OA
122	10·0	24·03	OA
189	12·0	27·13	OA

AUTO TRANSFORMERS

Ref	VA (Watts)	£	P & P
113	15 0-115-210-240	2·48	0·71
84	75 0-115-210-240	3·85	0·96
4	150 0-115-200-220-240	5·35	0·96
87	500 0-115-200-220-240	10·98	1·84
84	1000 0-115-200-220-240	18·76	2·08
93	1500 0-115-200-220-240	23·36	OA
95	2000 0-115-200-220-240	34·82	OA
73	3000 0-115-200-220-240	48·00	OA
80a	4000 0-10-115-200-220-240	67·50	OA
57a	5000 0-10-115-200-220-240	77·48	OA

CASED AUTO TRANSFORMERS

240V cable in 115V USA flat pin outlet

VA	£	P & P	Ref
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150	8·48	1·14	4W
200	9·92	1·45	65W
250	10·49	1·45	69W
500	15·73	1·64	67W
750	18·55	1·76	83W
1000	22·68	OA	84W
1500	26·02	OA	93W
2000	37·65	OA	95W

Our wide range of transformers are too numerous to list, please call (open 9am-5pm Mon-Fri) or send your requirements. Electroall and semiconductor stockists. Audio accessories.

SCREENED MINIATURES

Ref	mA	Volts	£	P&P
238	200	3-0-3	1·99	0·55
212	1A, 1A	0-6, 0-6	2·85	0·78
13	100	9-0-9	2·14	0·38
235	330, 330	0-9, 0-9	1·99	0·38
207	500, 500	0-8-9-, 0-8-9	2·59	0·71
208	1A, 1A	0-8-9, 0-8-9	3·53	0·78
236	200, 200	0-15, 0-15	1·99	0·38
214	300, 300	0-20, 0-20	2·56	0·78
221	700 (DC)	20-12-0-12-20	3·41	0·78
206	1A, 1A	0-15-20-0-15-20	4·63	0·96
203	500, 500	0-15-27-0-15-27	3·99	0·96
204	1A, 1A	0-15-27-0-15-27	5·39	0·96
239	50	12-0-12	1·99	0·38
S112	500	12-15-20-24-30	2·64	0·78

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MM8	£27·56	Wee Megger	£65·90

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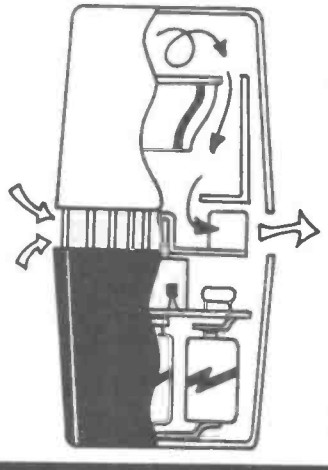

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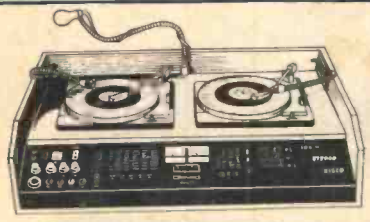

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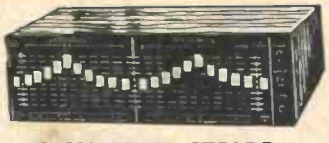

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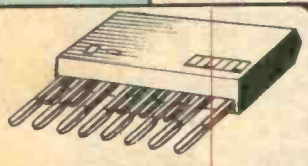

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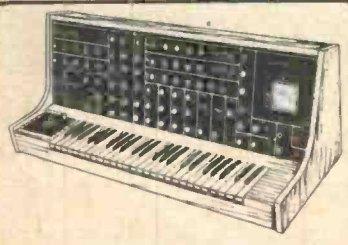

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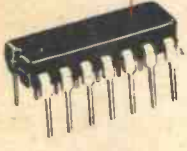

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