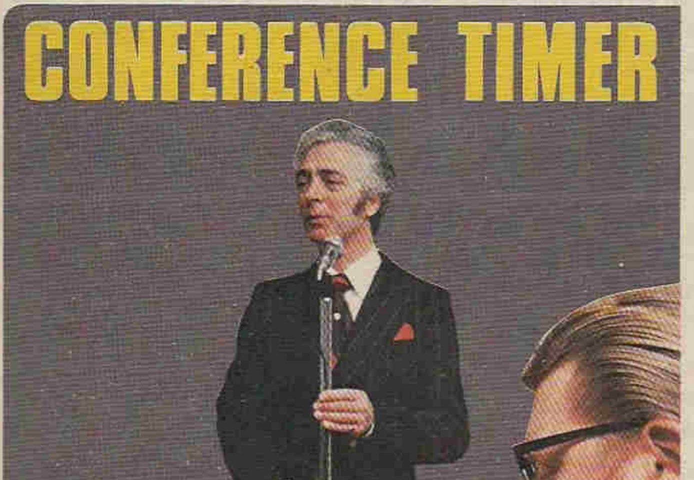
Easy to build projects for everyone

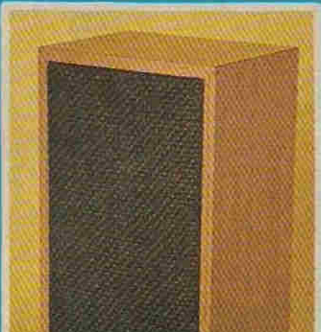
Everyday ELECTRONICS

JULY 79
45p

CONFERENCE TIMER



EE 20 ECONOMY LOUDSPEAKER



WATER LEVEL INDICATOR

Ideal for Beginners

DARKROOM TIMER

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

"ALLY PALLY"
Thursday-Saturday
28th-30th June.

Come to the Great British Electronics Bazaar

FREE!

(AND WAIT TILL YOU SEE OUR SEMINAR PROGRAMME)

The Great Big 'Bazaar' for the hobbyist, amateur, and small buyer.

There's never been an event like this before.

First, the very scale of the exhibition is huge. Virtually all the companies you're used to hearing about (and buying from) will be there. Companies like Fluke and Gould showing off their low cost multimeters; smaller but important manufacturers like Lektrokit and Chromasonics; and even the R.S.G.B. who will have a station 'on the air' throughout the 'Bazaar.'

Then there are the suppliers of low-cost components and equipment. Plus almost all the journals in the business. Plus, oh, so many more interesting people catering for your needs (including computer kits!).

And you get in FREE if you send an s.a.e. (see alongside).

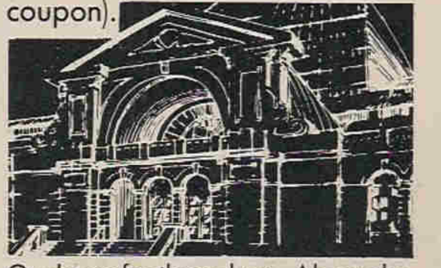
THE GREAT BRITISH ELECTRONICS
BAZAAR

Our Symbol.
We think it tells you just what the Bazaar is all about.

The Seminars.

If you would like to hear just what the experts have to tell you, a *season ticket* for three whole days can be yours for only £1.50.

Send an s.a.e. and we'll give you all the information (just use the coupon).



Our home for three days – Alexandra Palace, where it all began. (Our seminars are sited alongside the organ – for those who know this unique hall.)

SEMINAR TICKETS

£1.50.

I'd like to sit in at your seminars. (And like a free ticket to the exhibition.) Send me full details, please, and I enclose a large-ish s.a.e.

Name: ....

Address: ....

....

....

Post to: 'The Bazaar,' 34/36 High Street, Saffron Walden, Essex.

When?

Between Thursday to Saturday 28th–30th June.

You'll be in very good company; some ten thousand enthusiasts – and over a hundred stands displaying all that you want to see.

You'll come?

Eyes down for the appropriate coupon.

ADMISSION FREE

(or 50p on the door).

I'd like to see 'The Bazaar' FREE. I enclose a large-ish s.a.e. and will receive by return a ticket and full information.

Name: ....

Address: ....

....

....

Post to: 'The Bazaar,' 34-36 High Street, Saffron Walden, Essex. If you'd rather just pay 50p, go to Wood Green Tube Station and take a bus (every 3 minutes) to Alexandra Palace. We're open 10 am-6 pm daily, Thursday to Saturday, 28th–30th June.

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, 0·0047, 0·0068, 0·01, 0·015 **9p**; 0·018 **10p**; 0·022, 0·033, **11p**; 0·047, 0·068 **14p**; 0·1 **17p**; 0·15, 0·22 **24p**; 0·33, 0·47 **41p**; 0·68 **48p**.
160V: 0·039, 0·15, 0·22, **11p**; 0·33, 0·47 **19p**; 0·68, 1·0 **22p**; 1·5 **29p**; 2·2 **32p**; 4·7 **36p**.
DUBILIER: **1000V**: 0·01, 0·015 **20p**; 0·022 **22p**; 0·047 **28p**; 0·1 **38p**; 0·47 **53p**; 1·0 **175p**.

POLYESTER RADIAL LEAD (Values in μF) **250V**:
0-01, 0-015, 0-022, 0-027 **5p**; 0-033, 0-047, 0-068, 0-1 **7p**; 0-15 **10p**; 0-22, 0-33 **13p**; 0-47 **17p**: 0-68 **19p**; 1-0 **22p**; 1-5 **30p**; 2-2 **34p**.

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 **12p**; 63, 100 **27p** **50V** 50, 100, 220 **25p**; 470 **32p**; 1000 **50p**; **40V**: 22, 33, **9p**; 100 **12p**; 2200 **68p**; 3300 **68p**; 4700 **85p**; **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 **45p**; 3300 **68p**; 4700 **85p**; **16V**: 10, 40, 47, 68 **7p**; 100, 125 **8p**; 220, 330 **14p**; 470 **16p**; 1000, 1500 **20p**; 2200 **34p**; **10V**: 100 **6p**; 640 **12p**; 1000 **14p**.
TAG-END TYPE: **70V**: 2000 **89p**; 4700 **135p**; **50V**: 10,000 **255p**; **40V**: 2500 **65p**; 3300, 4700 **70p**; 15,000 **299p**; **25V**: 4700 **70p** 2200 **48p**; **325V**: 200+100+50+100 **190p**; 32+32 **175p**.

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 **20p** **6V**: 47, 68, 100, **30p** **3V**: 68, 100μF. **20p**

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, 0·2 **9p** **50V**: 0·47 **12p**

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

COMPRESSION TRIMMERS
3-40pF, 10-80pF **30p**; 25-190pF **33p**
100-500pF **45p**; 1250pF **60p**

POLYSTYRENE CAPACITORS
10pF to 1nF **8p**; 1·5nF to 10nF **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, 180 **9p** each
220, 250, 300, 330, 360, 390, 600, 820 **16p** each
1000, 1200, 1800, 2000 **20p** each

SOLDERCON PINS★
100 **50p**; 500 **200p**

E.E. INTRUDER ALARM
All parts now available

POTENTIOMETERS: (ROTARY) Carbon Track. 0·25W Log & 0·5W Linear Value.
500Ω, 1K & 2K (Lin. only) Single **27p**
5K-2 MΩ single gang **27p**
5K-2 MΩ single with DP switch **65p**
5K-2 MΩ double gang **78p**

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

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

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

RANGE	VAL	1 99	100
¼W 2-2Ω- 4 7M	E24	1·5p	1p
½W 2-2Ω- 4 7M	E12	2p	1·5p
1W 2-2Ω 10M	E12	5p	4p
2% Metal Film 10Ω-1MΩ		6p	4p
1% Metal Film 51Ω-1M		10p	8p

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

LW to MW Converter for Radio 4 Complete kit of parts inc. instructions. **£4·95** inc. VAT

OPTO ELECTRONICS★
LEDs plus clips

TIL209 Red	13
TIL211 Grn	17
TIL212 Yellow	18
·2" Red	15
2" Yellow Green	18
Square LED	48
ORP12	63
2N5777	45
7 Seg Displays	
LS400	255
TIL312 C An 3"	105
TIL313 C Cth 3"	105
TIL321 C An 5"	115
TIL322 C Cth 5"	115
DL704 C Cth 3"	99
DL707 C.A. ·3"	99
DL747 C.A. ·6"	180
FND357	120
MAN3640	175
LCD 3½ digit	875
TIL307	675

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/off.	15p
½A DPDT	13p
4 pole c/over	24p
PUSH BUTTON Spring Loaded	
SPST on/off	65p
SPDT c/over	70p
DPDT 6 Tag	85p

	JACK PLUGS		SOCKETS	
	Screened chrome	Plastic body	open metal	moulded with break contacts
2·5mm	13p	10p	8p	
3·5mm	15p	10p	8p	
MONO	25p	14p	13p	20p
STEREO	32p	18p	15p	24p

S-DEC **250p★**
T-DEC **400p★**
U-DEC 'A' **465p★**
U-DEC 'B' **899p★**

DIN	Plugs	Sockets	In Line
2 PIN Loudspkr.	10p	6p	20p
3 4 5 Pin Audio	13p	10p	20p
CO-AXIAL			
plastic	10p	12p	12p
metal	18p	18p	22p
PHONO		6p single	—
assorted colours	10p	8p double	15p
Metal Screened	15p	15p 4-way	20p
BANANA 4mm	11p	12p	—
2mm	10p	10p	—
1mm	6p	6p	—
WANDER 3mm	6p	6p	

SWITCHES ★ Miniature Non-Locking
Push to Make **15p** Push to Break **25p**
ROCKER (white) 10A 250V
SP changeover centre off **35p**
ROCKER: SPST 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 **16p**; 20 pin **22p**; 24 pin **25p**; 28 pin **39p**; 40 pin **50p**.

JACKSONS VARIABLE CAPACITORS
Dielectric
100/300pF **140p**
500pF **165p**
6 1 Ball Drive
4511/DAF **115p★**
Dial Drive 4103
6 1/36 1 **650p★**
Drum 54mm **30p★**
0-1·365pF **245p**
00 2.365pF **275p**
0 2 365pF with slow motion Drive **325p**
00 208/176 **285p**
" " with slow motion drive **325p**
C804-5pF 10 15
25 50 pF **175p★**
100, 150pF **250p★**
'L' 3 x 310pF **495p**
00-3 x 25pF **430p**

DENCO COILS
'DP' VALVE TYPE
Range 1 to 5 Bl., Rd., Yl. Wht. **86p**
6-7 B.Y.R. **75p**
1·5 Green **92p**
'T' 1 to 5 Bl., Yl., Rd., Wht. **93p**
B9A Valve Holder **25p**
RDT2 **92p**
RFC 5 chokes **91p**
RFC 7 (19mH) **96p**
1 FT 13; 14; 15; 16; 17 **86p**
1 FT 18/1·6 **99p**
1 FT 18/465 **105p**
TOC 1 **86p**
MW5FR **82p**
MW/LW 5FR **102p**

VEROBOARD★	0·1	0·15	0·15
	(copper clad)		(plain)
2½ × 3¾	46p	39p	24p
2½ × 5	55p	50p	31p
3¾ × 3¾	55p	50p	—
3¾ × 5	62p	67p	43p
2½ × 17	169p	135p	92p
3¾ × 17	218p	180p	120p
4¾ × 17	280p	—	183p
Pkt of 35 pins			30p
Spot face cutter			85p
Pin insertion tool			120p

DIODES

AA119	25
AA129	20
BA100	10
BY126	12
BY127	12
CRO33★	148
OA9	75
OA47	12
OA70	12
OA79	15
OA81	15
OA85	14
OA90	7
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	65

ZENERS
Range 2V7 to 39V 400mW **9p each**
Range 3V3 to 33V. 1·3W **15p each**

NOISE
25J **160**

★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

0·5A/200V	30p
0·8A/100V	30p
0·8A/200A	35p
1A600V	70
5A300V	35
5A600V	43
8A300V	48
8A500V	58
8A600V	85
12A300V	59
12A500V	92
15A/700V	195p
2N444	140p
BT106	150
C106D	38
TIC44	25
TIC45	45

TRIACS★

3A100V	48
3A200V	49
3A400V	50
6A100V	54
6A400V	64
8A800V	108
12A100V	60
12A400V	70
12A800V	130p
16A100V	95
16A500V	150
25A800V	295
25A1000V	480p
40669	120

DIAC★
ST2 **25**

TTL 74★

7400	11
7401	11
7402	11
7403	12
7404	12
7405	18
7406	28
7407	38
7408	17
7409	17
7410	11
7411	20
7412	17
7413	30
7414	45
7416	30
7417	30
7420	16
7421	29
7422	17
7423	27
7425	27
7426	36
7427	27
7428	35
7430	17
7432	25
7433	40
7437	30
7438	33
7440	15
7441	74
7442	68
7443	115
7444	112
7445	94
7446	94
7447	57
7448	51
7450	17
7451	17
7453	17
7454	17
7460	17
7470	28
7472	25
7473	32
7474	25
7475	38
7476	36
7480	48
7481	86
7482	69
7483	72
7484	95
7485	75
7486	31
7489	140
7490	30
7491	75
7492	38
7493	32
7494	78
7495	65
7496	57
7497	189
74100	119
74105	62
74107	29
74109	54
74110	54
74111	68
74112	125
74116	198
74118	83
74119	149
74120	115
74121	25
74122	46
74123	48
74125	38
74126	57
74128	74
74132	73
74136	65
74141	56
74142	209
74143	314
74144	314
74145	65
74147	175
74148	109
74150	99
74151	64
74153	64
74154	96
74155	53
74156	80
74157	67
74159	185
74160	82
74161	92
74162	92
74163	92
74164	105
74165	105
74166	140
74167	200
74170	185
74172	625
74173	120
74174	87
74175	87
74176	75
74177	78
74178	153
74180	85
74181	165
74182	88
74184	135
74185	135
74188	275
74190	95
74191	95
74192	98
74193	98
74194	98
74195	98
74196	93
74197	80
74198	150
75150	175
75491	92
75492	92

CMOS★

4000	13
4001	13
4002	15
4006	87
4007	18
4008	82
4009	38
4010	38
4011	18
4012	18
4013	45
4014	80
4015	82
4016	45
4017	82
4018	87
4019	48
4020	99
4021	95
4022	85
4023	22
4024	66
4025	19
4026	180
4027	45
4028	81
4029	99
4030	58
4031	205
4032	100
4033	145
4034	116
4035	111
4036	325
4037	100
4038	108
4039	320
4040	105
4041	80
4042	75
4043	94
4044	95
4045	145
4046	128
4047	87
4048	58
4049	48
4050	48
4051	72
4052	72
4053	72
4054	110
4055	123
4056	134
4059	480
4060	115
4061	1425
4062	999
4063	110
4066	58
4067	380
4068	22
4069BE	20
4070	32
4071	21
4072	21
4073	21
0475	23
4076	85
4077	40
4078	21
4081	20
4082	21
4085	74
4086	73
4089	150
4093	85
4094	190
4095	105
4096	105
4097	372
4098	110
4099	145
4160	109
4161	109
4162	109
4163	109
4174	110
4175	99
4194	108
4408	720
4409	720
4410	720
4411	958
4412V	1380
4415F	795
4415V	795
4419	280
4422	545
4433	995
4435	825
4440	1275
4450	295
4451	295
4490F	695
4490V	525
4501	19
4502	120
4503	69
4506	51
4507	55
4508	298
4510	99
4511	150
4512	98
4520	108

LINEAR IC's

702	75
709C 14 pin	35
710★	67
723★	38
733★	125
741C★ 8 pin	18
747C★	78
748C★	36
753	150
810	159
8038CC★	340
AY-1-0212	580
AY-1-1313	660
AY-1-1320	315
AY-1-5050	190
AY-1-5051	145
AY-1-6721/6	195
AY-3-8500★	390
AY-5-1224A★	260
AY-5-1230★	450
CA3011★	82
CA3018★	68
CA3020	170
CA3023	170
CA3028A★	80
CA3035	240
CA3043	190
CA3046	71
CA3048	210
CA3080E★	80
CA3081	190
CA3805★	85
CA3089E	210
CA3090AQ	398
CA3123E	200
CA3130★	85
CA3140★	70
ICL7106E★	795
ICL7107★	975
ICM7205★	1150
ICM7217A★	790
ICM7555★	89
LD130★	452
LM300H ★	170
LM301A★	30
LM308	110
LM318★	195
LM324★	68
LM339★	70
LM348★	90
LM379★	375
LM380	80
LM381	145
LM381AN	248
LM382	125
LM1458★	50
LM3900★	60
LM3909N★	70
LM3911★	125
M253AA★	795
MC1304P	260
MC1310	149
MC1312P	195
MC1488★	85
MC1489★	90
MC1495★	350
MC1496	92
MC1710	79
MC3340P★	120
MC3360P	120
MC3401	52
MC3403★	135
MFC6040★	97
MK50362★	650
MK50398★	635
MM2102-2★	170
MM2112-2N★	250
MM5303★	635
MM57160★	620
NE555★	22
NE556DB★	60
NE560★	325
NE561★	395
NE562★	410
NE564★	425
NE565A★	120
NE566★	160
NE567★	170
NE571★	420
RAM2102-2★	170
RC4136D★	120
ROM2513★	650
SAD1024★	1350
SFF96364E★	1150
SG3402	295
SN76003N	170
SN76013N	140
SN6023N	140
SN76033N	175
SN76115N	215
SN76227	115
SN76477★	225
TAA621AX1	250
TAA960	300
TBA120S	70
TBA641BX11	250
TBA651	180
TBA800	90
TBA810S	95
TBA820	70
TBA920	260
TCA270	220
TDA1004★	290
TDA1008★	310
TDA1022★	575
TDA2020	320
TL061CP★	76
TL072★	125
TL081CP★	52
TL082CP★	96
TL083★	105
TL084CP★	130
UAA170	198
ZN414	90
ZN424	135
ZN425E★	415
ZN1034★	200

TRANSISTORS

AC117★	35
AC125★	20
AC126★	20
AC127★	20
AC128★	20
AC141★	24
AC141K★	38
AC142★	24
AC142K★	38
AC176★	24
AC187★	24
AC188★	24
ACY17★	35
ACY18★	40
ACY19★	40
ACY20★	40
ACY21★	35
ACY22★	40
ACY28★	40
ACY39★	78
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BC137	20
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BC147	8
BC148	8
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BC153	27
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BC214L	13
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BC461★	36
BC477★	25
BC547	12
BC548	12
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BC557	15
BC558	20
BC559	20
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BCY34★	75
BCY39★	80
BCY40★	78
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BCY71★	20
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TIP35C★	220
TIP36A★	220
TIP36C★	255
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TIP41B★	73
TIP42A★	72
TIP42B★	82
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TIP3055★	65
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TIS62	52
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2N1671B★	215
2N2160★	350
2N2217★	43
2N2218A★	34
2N2219A★	22
2N2220A★	25
2N2221★	23
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2N2907A★	22
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2N5777★	45
2N6027	40
3N128★	112
3N140★	112
40311★	60
40313★	125
40316★	88
40317★	52
40324★	85
40326★	52
40327★	62
40348★	105
40360★	43
40361★	45
40407★	52
40411★	295
40412★	65
40467★	95
40576★	190
40594★	90
40673★	68

Matched pair add 20p per pair

MICRO CHIMES
FROM THE INVENTORS
OF MICROPROCESSOR
MUSICAL CHIMES

A COMPLETE
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MICRO
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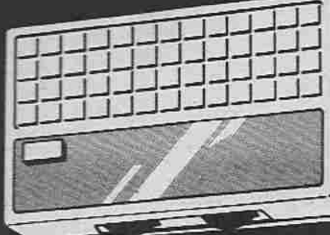

This easy to build kit includes:
- ✻ TMS1000 Custom MPU Chip
- ✻ Special purpose designed case
- ✻ Fully drilled and legended PCB
- ✻ All transistors, Resistors and Capacitors
- ✻ Full set of mechanical parts
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- ✻ IC Socket and Loudspeaker
- ✻ Really Low Price!

only £8.95 + 55p p&p

TMS 1000N – MP0027A Microcomputer chip available separately if required. Full 24 tune spec device supplied with data sheet and fully guaranteed.

New low price only £4.95 inc. p&p

(Only present 24 tune repertoire currently available.)

New price for the original
CHROMA-CHIME 24 tune model!
Due to the fantastic success of this product right across the World we are able to offer it at only £9.95 + 75p p&p

Comes complete with:
- ✻ TMS1000 Micro
- ✻ Superb cabinet
- ✻ All R's & C's
- ✻ Switches & pots
- ✻ Fully detailed kit manual
- ✻ Fully prepared PCB
- ✻ All semiconductors
- ✻ Loudspeaker
- ✻ Socket & Hardware

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I enclose cheque/PO value £
or debit my ACCESS/BARCLAYCARD account no.
Signature

CHROMATRONICS

TANTALUM BEAD CAPACITORS 4·7uf 16v.w. @ 9p, 10uf 10v.w. @ 9p, 33uf 10v.w. @ 9p, 100uf 10v.w. @ 25p.
LED'S TIL 209 @ 6 for 50p, 2" Red @ 6 for 70p, ·2" Green @ 15p.
ERIE REDCAP ·01uf 100v.w. **MINIATURE CAPACITORS** @ 5p each.
PLASTIC BC 108 TRANSISTORS with House Numbers @ 10 for 60p.
VARIABLE CAPACITORS. 25+25+25pf @ 75p.
MINIATURE ELECTROLYTICS 8uf 300v.w., 10uf 250v.w. Both at 10 for 60p.
50. OC 71 TRANSISTORS untested @ 75p.
VERNITRON FM4 10·7MHz CERAMIC FILTERS @ 50p, 3 for £1.
100 MULLARD C 280 CAPACITORS assorted @ 57p.
WIRE WOUND POTENTIOMETERS 2 watt 2K, 4 watt 100K. Both 30p each.
10 AMP S.C.R's 100 PIV @ 25p, 400 PIV @ 50p, 800 PIV @ 60p.
COIL FORMERS. 3/16" Dia. with core at 6 for 25p.
CRYSTALS. 10X type. 7010, 7038·88, 7040, 7070, 7080, 7090, 7100, 7500, 7900, 8000, 8007·69, 8018·82, 8021·54, 8035·38, 8036·25, 8061·18, 8068, 8076·92, 8089·09, 8090, 8092, 8092·5, 8510, 9720 KHz. All at 20p each. 6 for £1.
WIRE ENDED CRYSTALS. 28, 28·5, 29·75, 29·76, 31, 83·997 KH. All at 50p each.
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200 RESISTORS ½, ¼ watt assorted values for 75p.
VARIABLE CAPACITORS. Direct Drive. 5pf @ 75p, 10pf @ 75p, 30pf @ 85p, 125+125pf @ 55p, 100+200pf @ 55p, 200+200+17+17pf @ 55p, 25+25+25pf @ 75p. S.M. DRIVE. 500+500+25+25pf @ 55p, 250+250+20+20+20pf @ 75p.
SEMI-AIRSPACED TRIMMERS 2 To 9pf, 7 To 35pf, 6 To 45pf, 8 To 125pf, 8 To 140pf. All at 15p each.
R.F. TRANSISTORS MPS 6514 @ 15p, AF 239 @ 50p, 2N 5180 @ 50p, BFY 90 @ 50p, 2N 5179 @ 50p, BF 224 @ 10p, BF 362 @ 25p.
VHF FETS. 2N 3819 @ 20p, J310 @ 20p, MF 131 @ 50p, BF 256 @ 25p, E111 @ 12p, E112 @ 10p, DUAL GATE TYPE 40673 @ 33p.
100 ASSORTED DISC CERAMICS for 57p.
MINIATURE POLYESTER CAPACITORS ·1uf 125 v.w. @ 20p doz.
50. 1 AMP S.C.R's TO5 Can untested for £1.
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20. 10 AMP STUD DIODES untested @ 57p.
3 PIN PLUG AND SOCKET like R.S. European 2M Cable @ 75p pair.
AUDIO AMP I.C's TCA 940 @ £1, TBA 820 @ 55p, TBA 810 @ £1, TBA 800 @ 80p, SN 76001N @ 60p.
10 ASSORTED PUSH BUTTON BANKS less knobs @ £1·30.
MULLARD TRANSISTORS. BC 549 @ 10p, 8 for 50p.
400mW ZENERS unmarked good. 3·6v, 6·8v, 10. 11v, 12v, 16v, 18v, 24v, 30v, 33v, 36v. All at 10 for 40p.
MAINS TRANSFORMERS 240 volt input. Type 1. 24 volt Tapped at 14 volt 1 amp @ £1·30 (P&P 25p), Type 2. 30–0–30volt 500mA @ £1·30 (P&P 25p), Type 3. 45 volt 6 amp @ £4·50 (P&P 95p), Type 4. 20 volt 1 amp Twice 10 volt 1 amp Twice @ £4·50 (P&P 95p) Type 5. 45 volt 2 amp 45 volt 500mA @ £3·50 (P&P 85p), Type 6. 16 volt 2 amp @ £1·60 (P&P 25p), Type 7. 24 volt 1·75 amp @ £1·60 (P&P 25p), Type 8. 30 volt lamp @ £1·60 (P&P 25p).
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MIDGET AIRSPACED TRIMMERS 3 To 20pf @ 15p each. Please add 20p for post and packing, unless otherwise stated, on U.K. orders under £2. Overseas orders postage at cost.

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RADIO COMPONENT SUPPLIERS
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C·MORE 2in1
DASHBOARD INSTALLATION
BATTERY CONDITION DISPLAY
& CHARGE RATE MONITOR
TAKES ONLY A FEW MINUTES TO FIT.
ONLY £6·20
INCLUDING VAT & P&P

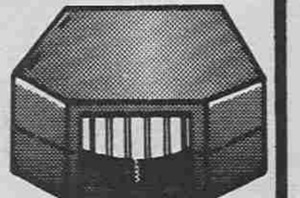
The C-More mounts easily on the dash with adhesive pads (supplied), and connects to earth and an ignition wire through a quick connector (also supplied).

The battery voltage is electronically monitored immediately the ignition is switched on, and presented through a LED display using a novel split colour comparator.

Full fitting and operating instructions even highlight probable cause of faults when they occur. Helps prevent those unnecessary and expensive replacements.

2 YEAR GUARANTEE

HARVELEC 1 Formby Avenue, St. Helens, Merseyside, WA10 3HW.



Shows Red when Battery is Poor.
Yellow when Battery is Overcharging
Red and Yellow when all is Well

HARVELEC (Dept. EE), 1 Formby Avenue, St. Helens, Merseyside, WA10 3HW. (Registered no. 2121206

Please send...........C-Mores at £6·20 ea. (inc.) (+ 25% for export please) to:
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....Cheque/P.O. Value: ....
I understand this order will be despatched within 4 days of receipt, and that if I'm not fully satisfied I can return the units within 10 days for a full refund of the purchase price.

QUARTZ LCD 5 Function

Hours, mins., secs., month, date, auto calendar, back-light, quality metal bracelet.

£6.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

M1

QUARTZ LCD 7 Function

Hours, mins., secs., month, date, auto calendar, back-light, seconds STOP WATCH.

£9.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

M2

QUARTZ LCD 11 Function SLIM CHRONO

6 digit, 11 functions.
Hours, mins., secs., day, date, day of week.
1/100th, 1/10th, secs., 10X secs., mins.
Split and lap modes.
Back-light, auto calendar. Only 8mm thick.
Stainless steel bracelet and back.
Adjustable bracelet.

Metac Price

£12.65 Thousands sold!

Guaranteed same day despatch.

M3

QUARTZ LCD ALARM 6 Function

Hours, mins., secs., month, date, back-light, 24 hour ALARM.
Adjustable stainless steel bracelet.
Only 9mm thick.

£12.65

Guaranteed same day despatch.

M4

QUARTZ LCD ALARM 7 Function

Hours, mins., secs., day, date, alpha day, back-light, auto calendar.
Adjustable stainless steel bracelet.
Only 9mm thick.

£15.95

Guaranteed same day despatch.

M5

QUARTZ LCD Alarm Chronograph with Dual Time Zone Facility

Constant LCD display of hours and minutes, plus optional seconds or date display, plus day of the week and am/pm indication.
Perpetual calendar, day, date, month and year.
24 hour alarm with on/off indication.
1/10 second chronograph measuring net, lap and first and second place times.
Dual time zone facility night light.
Only 9mm thick.

£22.65

M6

SOLAR QUARTZ LCD Chronograph with Alarm Time Zone Facility

Constant LCD display of hours and minutes, plus optional seconds or date display, plus day of the week and am/pm indication.
Perpetual calendar, day, date, month and year.
24 hour alarm with on/off indication.
1/10 second chronograph measuring net, lap and first and second place times.
Dual time zone facility night light.
Only 9mm thick.

£25.65

SOL M7

QUARTZ LCD Alarm Chrono

22 function, 6 digit.
Hours, mins., secs., date, day of week, stopwatch, split time, alarm, second watch (dual time), back-light.
FRONT BUTTON OPERATION.

£22.65

Guaranteed same day despatch.

METAC ★ PRICE

M8

SOLAR QUARTZ LCD Chronograph

6 digit, 11 function.
Hours, mins., secs. 1/100, 1/10 secs., mins.
Split and lap modules.
Auto calendar and back light.
Powered from solar panel with battery back-up.

£13.95

M9

SEIKO Alarm Chrono

LCD, hours, mins., secs., day of week, month, day and date, 24 hour Alarm, 12 hour chronograph, 1/10th secs., and lap time. Back light, stainless steel, HARDLEX glass.

List Price £130.00

METAC PRICE

£105.00

M10

SEIKO Chronograph

LCD, hours, mins., secs., day of week, month, day, date, 12 hour chronograph, 1/10th secs. and lap-time.
Back light, stainless steel water resistant, HARDLEX glass.

List Price £85.00

METAC PRICE

£68.00

M11

SOLAR QUARTZ LCD 5 Function

Genuine Solar

Solar panel with battery back-up.
Back light and auto calendar.
Hours, mins., secs., day, date.
Quality metal bracelet.

£8.95

Guaranteed same day despatch.

M12

HANIMEX Electronic LED Alarm Clock

Features and Specification:
Hour/minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on/off control. Display flashing for power loss indication. Repeatable 9-minute snooze. Display bright/dim modes control. Size: 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm).
Weight: 1.43 lbs (0.65 kg). AC power 220V.

£9.65 Thousands sold!

Guaranteed same day despatch.

M13

QUARTZ LCD Ladies Slim Bracelet

5 function.
Hours, mins., secs., day, date and back light and auto calendar.
Elegant metal bracelet in silver or gold.
State preference.

£15.95

Guaranteed same day despatch.

M14

QUARTZ LCD Ladies 5 Function

Only 25 x 20mm and 6mm thick.
5 function. Hours, mins., secs., day, date and back light and auto calendar.
Elegant metal bracelet in silver or gold.
State preference.

£9.95

Guaranteed same day despatch.

M15

HOW TO ORDER

Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and the order details clearly, enclose 30p for post and packing or the amount stated. We do not wait to clear your cheque before sending the goods so this will not delay delivery. All products carry 1 year guaranteee and full money back 10 day reassurance, Battery fitting service is available at our shops. All prices include VAT.

Trade enquiries: Send for a complete list of trade prices — minimum order value £100.
Telephone Orders: Credit card customers can telephone orders direct to Daventry or Edgware Rd., 24 hour phone service at both shops: 01-723 4753 03272-76545.

CALLERS WELCOME
Shops open 9.30 - 6.00.

DIGITAL LED CLOCK

Automatic brightness control. Weekend alarm cancel.

Features and Specification:
Hour/minute display. Large LED display with p.m. and alarm on indicator. 24 Hours alarm with on-off control. Display flashing for power loss indicator. Repeatable 9-minute snooze. Automatic brightness control. Weekend alarm cancel.

£10.95

Guaranteed same day despatch.

M16

Metac ELECTRONICS & TIME CENTRES

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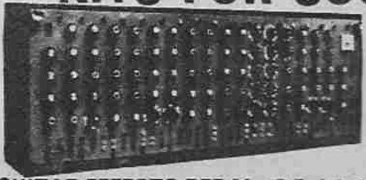
Northamptonshire
Telephone: 03272 76545

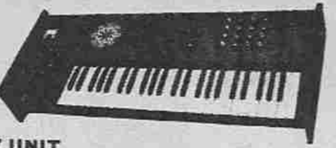
South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

KITS FOR SOUND EFFECTS AND OTHER PROJECTS



PHONOSONICS

MAIL ORDER SUPPLIERS OF QUALITY PRINTED CIRCUIT BOARDS, KITS AND COMPONENTS TO A WORLD-WIDE MARKET.



GUITAR EFFECTS PEDAL (P.E. July 75)
Modulates the attack, decay and filter characteristics of an audio signal not only from a guitar but from any audio source producing 8 different switchable effects that can be further modified by manual controls. Possibly the most interesting of all the low-priced sound effects units in our range. Circuit does not duplicate effects from the Guitar Overdrive Unit.

Component set with special foot operated switches	£7·69
Alternative component set with panel switches	£5·85
Printed circuit board	£1·43

GUITAR FREQUENCY DOUBLER
(P.E. Aug. 77)
A modified and extended version of the circuit published.

Component set and PCB	£4·52

GUITAR OVERDRIVE UNIT (P.E. Aug. 76)
Sophisticated, versatile Fuzz unit, including variable and switchable controls affecting the fuzz quality whilst retaining the attack and decay and also providing filtering. Does not duplicate the effects from the Guitar Effects Pedal and can be used with it and with other electronic instruments.

Component set using dual rotary pot	£6·89
Printed circuit board	£1·82

GUITAR SUSTAIN (P.E. Oct. 77)
Maintains the natural attack whilst extending note duration.

Component set, PCB and foot switches	£5·13
Component set, PCB and panel switches	£3·71

WIND AND RAIN UNIT
A manually controlled unit for producing the above-named sounds.

Component set (incl. PCB)	£4·26

VOICE OPERATED FADER (P.E. Dec. 73)
For automatically reducing music volume during "talk-over"—particularly useful for Disco work or for home-movie shows.

Component set (incl. PCB)	£3·97

PHASING UNIT (P.E. Sept. 73)
A simple but effective manually controlled unit for introducing the phasing sound into live or recorded music.

Component set (incl. PCB)	£3·20

PHASING CONTROL UNIT (P.E. Oct. 74)
For use with the above Phasing Unit to automatically control the rate of phasing.

Component set (incl. PCB)	£4·74

TREMOLO UNIT
Based upon P.E. Sound Design circuit

Component set (incl. PCB)	£2·94

TREBLE BOOST UNIT (P.E. Apr. 76)
Gives a much shriller quality to audio signals fed through it. The depth of boost is manually adjustable.

Component set (incl. PCB)	£2·51

WAH-WAH UNIT (P.E. Apr. 76)
The Wah-Wah effect produced by this unit can be controlled manually or by the integral automatic controller.

Component set (incl. PCB)	£3·63

AUTOWAH UNIT (P.E. Mar. 77)
Automatically produces Wah-pedal and Swell-pedal sounds each time a new note is played.

Component set, PCB, special foot switches	£7·87
Component set and PCB, with panel switches	£4·83

FUZZ UNIT
Simple Fuzz unit based upon P.E. "Sound Design" circuit

Component set (incl. PCB)	£2·05

P.E. TUNING FORK (P.E. Nov. 75)
Produces 84 switch-selected frequency-accurate tones. A LED monitor clearly displays all beat note adjustments. Ideal for tuning acoustic or electronic musical instruments.

Main component set (incl. PCB)	£14·93
Power supply set (incl. PCB)	£6·28

SYNTHESISER TUNING INDICATOR
(P.E. July 77)
A simple 4-octave frequency comparator for use with synthesisers and other instruments where the full versatility of the P.E. Tuning Fork is not required.

Component and PCB (but excl. sw.)	£7·45

DYNAMIC RANGE LIMITER (P.E. Apr. 77)
Automatically controls sound output to within a preset level.

Component set (incl. PCB)	£4·58

CONSTANT DISPLAY FREQUENCY METER (P.E. Aug. 78)
A 5-digit frequency counter for 1Hz to 99999Hz with a 1Hz sampling rate. Readout does not count visibly or flicker due to display blanking.

Component set	£24·05*
Printed circuit board	£3·03*

*This kit & PCB are at 8% VAT (all others are 12½%)

MANY MORE KITS
for Synthesisers, Rhythm Generators, Electronic Pianos and other projects, big, small, simple or complex, are available, plus a range of keyboards, separate components and accessories. Details in our lists.

COMPONENTS SETS include all necessary resistors, capacitors, semiconductors, potentiometers and gransformers. Hardware such as cases, sockets, knobs, keyboards, etc, are not included but most of these may be bought separately

Fuller details of kits, PCBs and parts are shown in our lists.
CIRCUIT AND LAYOUT DIAGRAMS are supplied free with all PCBs unless "as published".

PHOTOCOPIES of texts for most of the kits are available—prices in our lists.
LIST—Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBs, kits and other components.

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

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Metal Film		
0.4 watt Mullard MR25 5.1 to 300K	2% E24	**ea. 5p**
Wirewound		
1 watt 0.22 to 3.9	E12 values	**ea. 15p**
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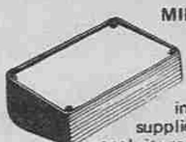
Red, Grey or Orange 14swg Aluminium removable top and bottom covers. 18 swg black mild steel chassis with fixing support brackets.

BIM 3000
(250x167.5x68.5mm)
£14.58

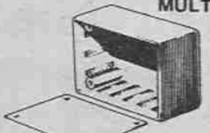
MINI DESK BIMCONSOLES



Orange, Blue, Black or Grey ABS body incorporates 1.8mm pcb guides, stand-off bosses in base with 4 BIMFEET supplied. 1mm Grey Aluminium panel sits recessed with fixing screws into integral brass bushes.

BIM 1005 (161 x 96 x 58mm) £2.18
BIM 1006 (215 x 130 x 75mm) £3.05

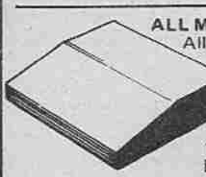
MULTI PURPOSE BIMBOXES



Orange, Blue, Black or Grey ABS with 1mm Grey Aluminium recessed front cover held by screws into integral brass bushes. 1.8mm pcb guides incorporated and 4 BIMFEET supplied.

BIM 4003 (85x56x28.5mm)	£1.18
BIM 4004 (111x71x41.5mm)	£1.62
BIM 4005 (161x96x52.5mm)	£2.19

ALL METAL BIMCONSOLES

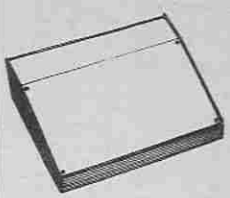


All aluminium, 2 piece desk consoles with either 15° or 30° sloping fronts, sit on 4 self-adhesive non-slip rubber feet. Ventilation slots in base and rear panel for excellent cooling. See latest catalogue for new styles and sizes

Colour Code	Top Panel	Base
A	Off White	Blue
B	Sand	Green
C	Satin Black	Gold

15° Sloping Panel	30° Sloping Panel	
BIM7151 (102x140x51[28] mm)	BIM7301 (102x140x76[28] mm)	£10.67
BIM7152 (165x140x51[28] mm)	BIM7302 (165x140x76[28] mm)	£11.44
BIM7153 (165x216x51[28] mm)	BIM7303 (165x183x102[28] mm)	£12.61
BIM7154 (165x211x76[33] mm)	BIM7304 (254x140x76[28] mm)	£13.82
BIM7155 (254x211x76[33] mm)	BIM7305 (254x183x102[28] mm)	£15.36
BIM7156 (254x287x76[33] mm)	BIM7306 (254x259x102[28] mm)	£16.67
BIM7157 (356x211x76[33] mm)	BIM7307 (356x183x102[28] mm)	£17.58
BIM7158 (356x287x76[33] mm)	BIM7308 (356x259x102[28] mm)	£18.55

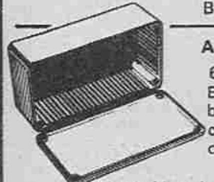
LOW PROFILE BIMCONSOLES



Orange, Blue, Black or Grey ABS body has ventilation slots as well as 1.8mm pcb guides and stand-off bosses in base. Double angle recessed front panel with 4 fixing screws into integral brass bushes. 4 BIMFEET supplied.

BIM 6005 (143 x 105 x 55.5 [31.5] mm)	£2.37
BIM 6006 (143 x 170 x 55.5 [31.5] mm)	£3.08
BIM 6007 (214 x 170 x 82.0 [31.5] mm)	£4.12

ABS & DIECAST BIMBOXES



6 sizes in ABS or Diecast Aluminium. ABS moulded in Orange, Blue, Black or Grey. Diecast Aluminium in Grey Hammertone or Natural. All boxes incorporate 1.8mm pcb guides, stand-off supports in base and have close fitting flanged lids held by screws into integral brass bushes (ABS) or tapped holes (Diecast).

	ABS		Diecast	Hammertone	Natural
(50x50x31mm)	N/A		BIM5001/11	TBA	£1.02
(100x50x25mm)	BIM2002/12	£0.96	BIM5002/12	£1.46	£1.19
(112x62x31mm)	BIM2003/13	£1.13	BIM5003/13	£1.78	£1.46
(120x65x40mm)	BIM2004/14	£1.35	BIM5004/14	£2.24	£1.82
(150x80x50mm)	BIM2005/15	£1.52	BIM5005/15	£2.84	£2.28
(190x110x60mm)	BIM2006/16	£2.37	BIM5006/16	£3.94	£3.33

Also available in Grey Polystyrene with no slots and self-tapping screws
BIM 2007/17 (112x61x31mm) £1.00

EUROCARD BIMCONSOLES

Orange, Blue, Black or Grey ABS body accepts full or ½ size Eurocards, with bosses in the base for direct fixing. 1.8mm wide pcb guides incorporated and 4 BIMFEET supplied. 1mm Grey aluminium lid sits flush with body top and held by 4 screws into integral brass bushes.

BIM 8005 (169x127x70[45] mm)	£4.12
BIM 8007 (243x187x103[66] mm)	£6.10

BIMTOOLS + BIMACCESSORIES

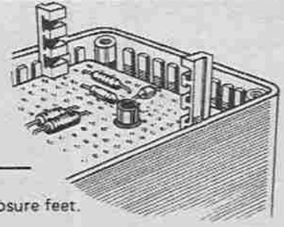
MAINS BIMDRILLS

Small, powerful 240V hand drill complete with 2 metres of cable and 2 pin DIN plug. Accepts all tools with 1mm, 2mm or .125" dia. shanks Drills brass, steel, aluminium and pcb's. Under 250g, off load speed 7500 rpm. Orange ABS, high impact, fully insulated body with integral on/off switch £10.53

Mains Accessory Kit 1 includes 1mm, 2mm, .125" twist drills, 5 burrs and 2.4mm collet £2.48

Mains Kit 2 includes Mains BIMDRILL as above, 20 assorted drills, mops, burrs, grinding wheels and mounted points, 1mm, 2mm, 2.4mm and .125" collets. Complete in transparent case measuring 230x130x58mm £22.14

BIMDAPTORS



Allows pcb's to be flat mounted sandwich fashion in BIMBOXES, BIMCONSOLES, and all other enclosures having 1.5mm wide vertical guide slots. One plastic BIMDAPTOR on each corner of pcb(s) enables assembly to be simply slid into place. 54mm long, 10 slots on 5mm spacing and can be simply snipped off to length. £1.08 per pack of 25.

BIMFEET

11mm dia. 3mm high, grey rubber self-adhesive enclosure feet. £0.77 per pack of 24

12 VOLT BIMDRILLS

2 small, powerful drills easily hand held or used with lathe/stand adaptor. Integral on/off switch and 1 metre cable.

Mini BIMDRILL with 3 collets up to 2.4mm dia. £ 8.10
Major BIMDRILL with 4 collets up to 3mm dia. £13.60

Accessory Kits 1 have appropriate drills and collets as above plus 20 assorted tools. Mini Kit 1 – £15.12, Major Kit 1 – £19.44. Accessory Kits 2 have appropriate drills, collets plus 40 tools and mains-12V dc adaptor. Mini Kit 2 – £34.02, Major Kit 2 – £39.42. Accessory Kits 3 as appropriate Kits 2 plus stand/lathe unit. Mini Kit 3 – £45.36, Major Kit 3 – £50.76.

BIMPUMPS

2 all metal desoldering tools provide high suction power and have easily replaceable screw in Teflon tips. Primed and released by thumb operation with in-built safety guard and anti-recoil system.

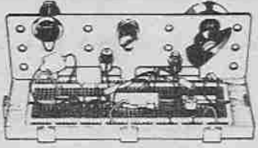
BIMPUMP Major (180mm long) £7.99
BIMPUMP Minor (150mm long) £6.80

BIMIRONS

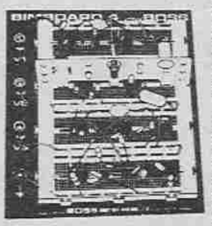
Type 30 General Purpose 27 watt iron with long life, rapid change element, screw on tip, stainless steel shaft and clip on hook. Styled handle with neon. £4.05

Type M3 Precision 17 watt iron, quick change tip, long life element, styled handle with clip on hook. £4.43

BIMBOARDS



DIL COMPATIBLE BIMBOARDS



Accept all sizes (4-50 pin) of DIL IC packages as well as resistors, diodes, capacitors and LEDs. Integral Bus Strips up each side for power lines and Component Support Bracket for holding lamps, switches and fuses etc. Available as single or multiple units, the latter mounted on 1.5mm thick black aluminium back plate which stand on non slip rubber feet and have 4 screw terminals for incoming power.

BIMBOARD 1 has 550 sockets, multiple units utilising 2, 3 and 4 BIMBOARDS incorporate 1100, 1650 and 2200 sockets, all on 2.5mm (0.1") matrix.

BIMBOARD 1	£ 8.83
BIMBOARD 2	£21.01
BIMBOARD 3	£29.84
BIMBOARD 4	£38.79

DESIGNER PROTOTYPING SYSTEM

1, 2, or 3 BIMBOARDS mounted on BIM 6007 BIMCONSOLE with Integral Power Supply (±5 to ±15Vdc @ 100mA and fixed +5Vdc @ 1A) All O/P's fully isolated. Short circuit and fast fold back protection. Power rails brought out to cable clamps that accept stripped wire or 4mm plug.

DESIGNER 1	£55.62
DESIGNER 2	£61.02
DESIGNER 3	£66.42

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CAPACITORS

Electrolytic Axial Leads Order Code
−10% to +50% Tol Cap 015 + µF + V d.c.

µF	V d.c.	16	25	40	63
1.0					8
1.5					8
2.2					8
3.3					8
4.7					8
6.8				8	9
10			7		9
15		7		8	10
22			7		12
33		7		8	
47			7	10	12
68		8			
100			8	12	
150		8	9		29
220		12		24	34
330				28	37
470			21	30	44
680		19	28	36	50
1000		23	28	55	
1500		32	36		
2200		39			

Electrolytic Can Type Order Code
High Ripple, IEC Grade 1, Low E.S.R. Cap HR + µF + Volts
Supplied complete with Vertical Fixing Clip

2200 µF	16V	Ripple 1A @ 85°C	1.4A @ 50°C	166
4700 µF	16V	2.6A	3.6A	184
10000 µF	16V	5.8A	8.1A	222
22000 µF	16V	9.8A	13.7A	346
2200 µF	25V	1.3A	1.8A	175
4700 µF	25V	4.6A	6.4A	201
10000 µF	25V	8.0A	11.2A	264
22000 µF	25V	12.8A	17.9A	438
1000 µF	40V	0.9A	1.2A	168
2200 µF	40V	2.4A	3.3A	188
4700 µF	40V	5.6A	7.8A	231
10000 µF	40V	9.2A	12.8A	367
1000 µF	70V	1.8A	2.5A	190
2200 µF	70V	4.0A	5.6A	235
4700 µF	70V	7.5A	10.5A	376
1000 µF	100V	4.0A	5.6A	222
2200 µF	100V	7.8A	10.9A	346

Miniature Low Value Order Code
Polystyrene, Axial, ±1% Tol., > 63V D.C. Wkg Cap 424
Ceramic Plate, Radial, Low K, 1.8pF–8.2pF ±.25pF Tol, 10-330pF ±2% Tol, 100V D.C. Wkg Cap 632
Ceramic Plate, Radial, Med K, ±10% Tol, 100V D.C. Wkg Cap 630
Ceramic Plate, Radial, High K, −20% to +80% Tol, 63V D.C. Wkg Cap 629
+ Value

pF	424	632	630	629	pF	424	632	630	629	nF	424	632	630	629
1					100	16	6			10	25			6
1.2					120	16	6			12	26			
1.5					150	16	8			15	26			
1.8		5			180	16	6			18	27			
2.2		5			220	16	6			22	28			8
2.7		5			270	18	8			27	38			
3.3		5			330	18	8			33	41			
3.9		5			390	18		5		39	43			
4.7		5			470	18		5						
5.6		5			560	16		5						
6.8		5			680	16		5						
8.2		5			820	16		5						
10		5			1000	16		5	5					
12		5			1200	16		5						
15		5			1500	18		6						
18		5			1800	18		6						
22		5			2200	18		6	6					
27		5			2700	18		6						
33		5			3300	18		6						
39		5			3900	18		6						
47		5			4700	23		7	6					
56		6			5600	23								
68		6			6800	23								
82		6			8200	23								

Tantalum Bead Order Code
20% Tol Cap PR + µF + Volts

µF	V d.c.	3.15	6.3	10	16	25	35
0.1							9
0.15							9
0.22							9
0.33							9
0.47							9
0.68							9
1							9
1.5							10
2.2					9		11
3.3					9	11	14
4.7					10	14	15
6.8			9		11	15	16
10			10	11	14	16	20
15			11	14	15	20	
22		11	14		16		
33			15	16	20		
47			16	20			
68		16	20				
100		20					

Electrolytic Radial Leads Order Code
−10% to +50% Tol. Cap 034 + µF + Volts

µF	V d.c.	6.3	10	16	25	35	40	50	63
.47									6
.68									6
1.0									6
1.5									6
2.2									6
3.3									6
4.7							6		7
6.8					6			7	8
10				6			7		8
15				6	7			8	10
22			6	7			8	10	
33				7	8		10		
47			7	8		10			
68				8	10				
100			8	10					
150			10						
220		10							

Trimmers Order Code
250V D.C. Wkg. Film Dielectric, Miniature

1.4 – 4.1pF	19	Cap 808 A
2 – 8pF	19	Cap 808 B
2 – 20pF	21	Cap 808 C
5.5 – 59.5pF	29	Cap 808 D

Order Code
500V D.C. Wkg. C004 EA Tubular Type

.8 – 3.8pF	46	Cap 802 3
.8 – 6.8pF	48	Cap 802 6
1 – 13pF	61	Cap 802 12
1.7 – 19.7	62	Cap 802 18

Polyester Radial Leads Order Code
Dipped Type, ±20% Tol, > 250V D.C. Wkg. C280/352 Style Cap 352
Moulded Type, ±10% Tol, >100V D.C. Wkg. 10.2mm Pitch Centres Cap 360
Moulded Type, ±10% Tol; >100V D.C. Wkg. 7.6mm Pitch Centres Cap PHE280
+ Value

µF	352	360	PHE280	µF	352	360	PHE280
.001		5	6	.1	6	8	9
.0015		5	6	.15	7	9	
.0022	5	6	7	.22	8	10	
.0033	5	6	7	.33	10		
.0047	5	6	7	.47	12		
.0068	5	6	7	.68	15		
.01	5	6	7	1.0	19		
.015	5	7	8	1.5	27		
.022	5	7	8	2.2	32		
.033	5	7	8				
.047	5	7	8				
.068	6	8	9				

CASES

Small Desk Console — Boss Industrial Mouldings
Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
W161, D96, H39 (57)	186	Case BIM1005 OR
W215, D130, H47 (73)	268	Case BIM1006 OR

Plastic Boxes — Boss Industrial Mouldings
Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W62 D31	87	Case BIM2003 OR
L150 W80 D50	115	Case BIM2005 OR
L190 W110 D60	195	Case BIM2006 OR

Instrument Case — Boss Industrial Mouldings
Covers Manufactured from 14SWG Aluminium
Chassis Manufactured from 18SWG Mild Steel
Covers Finished Orange
Chassis Finished Matt Black

		Order Code
W250 D187.5 H 88.5 (Chassis 153mm Deep)	1480	Case BIM3000 OR

Plastic Boxes with Metal Lids — Boss Industrial Mouldings
Recessed Top Box
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

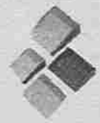
		Order Code
L85 W56 D29	97	Case BIM4003 OR
L111 W71 D42	130	Case BIM4004 OR
L161 W96 D53	182	Case BIM4005 OR

Diecast Boxes — Boss Industrial Mouldings
Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

		Order Code
L113 W63 D31	104	Case BIM5003 NA
L152 W82 D50	181	Case BIM5005 NA
L192 W113 D61	280	Case BIM5006 NA

VERO ELECTRONICS PRODUCTS

2.5" x 5" .1" pitch Veroboard	59	VERO 21069J
3.75" x 5" .1" pitch Veroboard	66	VERO 21072D
2.5" x 1" .1" pitch Veroboard (5)	70/Pack	VERO 21076C
3.75" x 5" .1" pitch Plain Board	56	VERO 21078E
5.82" x 2.9" .1" pitch V-Q DIP Board	111	VERO 21084E
Spot Face Cutter	89	VERO 21013A
Pin Insertion Tool for .040 type pin	122	VERO 21015F
DS Pins .040 (100)	38/Pack	VERO 21087G
SS Pins .040 (100)	38/Pack	VERO 21017B
6mm Board Standoff (100)	181/Pack	VERO 21321K
15mm Board Standoff (100)	215/Pack	VERO 21322G
19mm Board Standoff (100)	226/Pack	VERO 21323D
Verowire Kit (1-pen, 2-wire, 25-comb)	375/Kit	VERO 21341D
Verowire Combs (100)	407/Pack	VERO 21339F
Verowire Wire (4)	228/Pack	VERO 21340G
Flip Top Box, Small, Black	192	VERO 21317D
Flip Top Box, Large, Black	250	VERO 21319J



Small Desk Consoles — Boss Industrial Mouldings
Slope Front Console, Recessed Top
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey
Ventilation Slots In Base

		Order Code
W105 D143 H32 (56)	206	Case BIM6005 OR
W170 D143 H32 (56)	271	Case BIM6006 OR
W170 D214 H32 (82)	375	Case BIM6007 OR

All Metal Desk Consoles — Boss Industrial Mouldings
Slope Front Console, Recessed Top
Two Piece All Aluminium Construction
Ventilation Slots In Rear and Base
Choice of 15° or 30° Sloping Front
Off White Top Panel, Blue Base

		Order Code
W102 D140 H28 (51) 15° slope	1018	Case BIM7151A
W165 D211 H33 (76) 15° slope	1350	Case BIM7154A
W254 D287 H33 (76) 15° slope	1572	Case BIM7156A
W356 D287 H33 (76) 15° slope	1823	Case BIM7158A
W102 D140 H28 (76) 30° slope	1018	Case BIM7301A
W165 D183 H28 (102) 30° slope	1202	Case BIM7303A
W254 D259 H28 (102) 30° slope	1572	Case BIM7306A
W356 D259 H28 (102) 30° slope	1823	Case BIM7308A

Eurocard Size Desk Console — Boss Industrial Mouldings
Slope Front Console
ABS Case, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel, Finished Grey

		Order Code
W169 D127 H45 (70)	375	Case BIM8006 OR

HARDWARE

Order Code

D.I.L. Sockets

8 Pin Low Profile Socket Tin	11	DIL SKT 8
14 Pin Low Profile Socket Tin	13	DIL SKT 14
16 Pin Low Profile Socket Tin	14	DIL SKT 16
24 Pin Low Profile Socket Gold	66	DIL SKT 24
28 Pin Low Profile Socket Gold	78	DIL SKT 28
40 Pin Low Profile Socket Gold	127	DIL SKT 40

Heatsinks

Individual Type for 1 x T05 50°C/W	10	Sink 5F
Individual Type for 1 x T066 10.5°C/W	26	Sink TV2
Individual Type for 1 x T03 7.2°C/W	24	Sink TV3
Individual Type for 1 x T0126 17°C/W	23	Sink TV4
Individual Type for 1 x T0220 17°C/W	23	Sink TV5

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying	92	Pen 33PC

Fuseholders

Suit 20mm x 5mm fuses.

P.C.B. Mounting, Open Type	8	Fuse/H20B
Chassis Mounting, Open Type	17	Fuse/H20C
Panel Mounting, Screwdriver Slot	77	Fuse/H20PT
Panel Mounting, Finger Release	56	Fuse/H20P

Fuses

20mm x 5mm Glass.

Quick Blow, Range 100mA–5A	8	Fuse 20
Slow Blow, Range 250mA–5A	22	A/S Fuse 20
		+ Rating

Lampholders, Panel Mounting

Similar In Style to Fuse/H 20P
Low Voltage Type Suits LES and M/F Bulbs.

Low Voltage, Red, Amber or Green	75	Lamp LV
Internal Neon 200/240V Red or Amber	95	Lamp N
		+ Colour

Bulbs, Low Voltage, L.E.S.

6V, 0.36W; 6.5V, 1W; 14V, 0.75W.	22	Bulb LES
		+ Voltage

RESISTORS

Order Code

Carbon Film, Fixed

0.25W, E24 Values IRO-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.90/1000 (Mult 100/Value)	Res RD¼
0.5W, E12 Values IRO-4M7, 10% Tol.	2 ea.	1.25p/100 (Mult 10/Value)	£10.10/1000 (Mult 100/Value)	Res RD½
				+ Value

Metal Film, Fixed

0.5W, E24 Values, SRI-IM, 2% Tol.	6 ea.	3.80/100 (Mult 10/Value)	£32.40/1000 (Mult 100/Value)	Res MR30
2.5W, E12 Values 10R-27K, 5% Tol.	13 ea.	7.90/100 (Mult 10/Value)		Res PR52
				+ Value

Metal Glaze, Fixed

0.5W, E24 Values, IM-33M, 5% Tol.	10 ea.	5.40/100 (Mult 10/Value)	Res VR37 + Value

Skeleton Presets, Miniature Order Code

0.1W, E3 Values, 100R-IM, Lin. Vertical Mounting	7	Min Preset V
0.1W, E3 Values, 100R-IM, Lin. Horizontal Mounting	7	Min Preset H
		+ Value

Skeleton Presets, Standard

0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	10	Std Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mounting	10	Std Preset H
		+ Value

Potentiometer, Rotary

0.5W, E3 Values, 1K-2M2 Lin.	34	Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	34	Pot Log + Value

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GMT ELECTRONICS

Freepost
Birmingham B19 1BR

DIGITAL INTEGRATED CIRCUITS

4000 Buffered C-MOS – High Speed

5–15V 'B' Series, Up to 20MHz

HEF4000	14	HEF4046	100	HEF4514	250
HEF4001	14	HEF4047	87	HEF4515	299
HEF4002	14	HEF4049	28	HEF4516	90
HEF4006	95	HEF4050	28	HEF4517	382
HEF4007	14	HEF4051	69	HEF4518	69
HEF4008	80	HEF4052	72	HEF4519	55
HEF4011	14	HEF4053	72	HEF4520	65
HEF4012	14	HEF4066	37	HEF4521	188
HEF4013	32	HEF4067	390	HEF4528	99
HEF4014	84	HEF4068	14	HEF4532	120
HEF4015	60	HEF4069	14	HEF4534	510
HEF4016	35	HEF4070	14	HEF4539	110
HEF4017	55	HEF4071	14	HEF4543	155
HEF4018	65	HEF4072	16	HEF4555	78
HEF4019	46	HEF4073	16	HEF4556	78
HEF4020	88	HEF4075	16	HEF4557	386
HEF4021	85	HEF4076	85	HEF4585	97
HEF4022	82	HEF4077	14	HEF4724	171
HEF4023	14	HEF4078	16	HEF40097	90
HEF4024	45	HEF4081	16	HEF40098	73
HEF4025	14	HEF4082	16	HEF40106	62
HEF4027	32	HEF4085	64	HEF40160	119
HEF4028	52	HEF4086	64	HEF40161	119
HEF4029	60	HEF4093	50	HEF40162	119
HEF4030	46	HEF4094	175	HEF40163	119
HEF4031	200	HEF4104	166	HEF40174	119
HEF4035	110	HEF4502	91	HEF40175	119
HEF4040	68	HEF4505	571	HEF40192	140
HEF4041	75	HEF4508	151	HEF40193	140
HEF4042	54	HEF4510	70	HEF40194	119
HEF4043	79	HEF4511	110	HEF40195	117
HEF4044	84	HEF4512	98		

7400 T.T.L.

N7400N	9	N7444N	83	N74122N	39	N74193N	60
N7401N	11	N7445N	65	N74123N	37	N74194N	80
N7402N	11	N7446AN	62	N74125N	32	N74195N	79
N7403N	11	N7447AN	51	N74126N	32	N74198N	120
N7404N	12	N7448AN	44	N74128N	74	N74199N	139
N7405N	12	N7450N	13	N74132N	46	N74221N	160
N7406N	25	N7451N	13	N74145N	60	N74279N	116
N7407N	27	N7453N	15	N74147N	125	N74298N	200
N7408N	13	N7454N	13	N74148N	83	N74365N	150
N7409N	13	N7460N	13	N74150N	65	N74366N	150
N7410N	11	N7470N	26	N74151N	46	N74367N	120
N7411N	18	N7472N	22	N74153N	55	N74368N	150
N7412N	17	N7473N	23	N74154N	96		
N7413N	23	N7474N	23	N74155N	53		
N7414N	46	N7475N	28	N74156N	48		
N7416N	22	N7476N	26	N74157N	49		
N7417N	23	N7480N	43	N74158N	54		
N7420N	11	N7483N	63	N74160N	74		
N7421N	26	N7485N	65	N74161N	74		
N7425N	27	N7486N	23	N74162N	74		
N7426N	22	N7490N	30	N74163N	74		
N7427N	22	N7491AN	60	N74164N	65		
N7428N	30	N7492N	33	N74165N	65		
N7430N	11	N7493N	31	N74166N	93		
N7432N	21	N7494N	74	N74170N	134		
N7433N	30	N7495AN	48	N74173N	111		
N7437N	21	N7496N	46	N74174N	63		
N7438N	21	N74100N	88	N74175N	62		
N7439N	60	N74107N	25	N74180N	80		
N7440N	12	N74109N	42	N74181N	165		
N7442N	40	N74116N	148	N74182N	69		
N7443N	79	N74121N	23	N74192N	65		

74LS

N74LS00N	15	N74LS28N	32	N74LS138N	85	N74LS253N	105
N74LS01N	16	N74LS30N	16	N74LS139N	85	N74LS257N	104
N74LS02N	16	N74LS32N	24	N74LS153N	76	N74LS258N	107
N74LS03N	16	N74LS33N	32	N74LS154N	122	N74LS260N	26
N74LS04N	18	N74LS37N	24	N74LS155N	80	N74LS261N	300
N74LS05N	23	N74LS38N	24	N74LS156N	80	N74LS266N	40
N74LS08N	16	N74LS40N	22	N74LS157N	54	N74LS273N	130
N74LS09N	22	N74LS42N	53	N74LS158N	60	N74LS283N	116
N74LS10N	16	N74LS51N	22	N74LS160N	120	N74LS290N	90
N74LS11N	22	N74LS54N	16	N74LS161N	78	N74LS293N	100
N74LS12N	23	N74LS55N	22	N74LS162N	130	N74LS298N	100
N74LS13N	38	N74LS73N	29	N74LS163N	78	N74LS324N	170
N74LS14N	74	N74LS75N	40	N74LS164N	90	N74LS365N	105
N74LS15N	24	N74LS76N	33	N74LS170N	200	N74LS366N	105
N74LS20N	15	N74LS78N	33	N74LS173N	100	N74LS367N	105
N74LS21N	22	N74LS83AN	97	N74LS174N	100	N74LS368N	105
N74LS22N	24	N74LS85N	70	N74LS175N	100	N74LS373N	150
		N74LS86N	33	N74LS181N	320	N74LS374N	150
		N74LS90N	45	N74LS190N	91	N74LS375N	100
		N74LS92N	70	N74LS191N	95	N74LS378N	160
		N74LS93N	45	N74LS192N	128	N74LS386N	35
		N74LS95BN	65	N74LS193N	130	N74LS390N	170
		N74LS96N	116	N74LS194N	150	N74LS393N	170
		N74LS107N	38	N74LS195AN	120	N74LS395N	160
		N74LS109N	38	N74LS196N	80	N74LS490N	130
		N74LS112N	40	N74LS197N	110	N74LS670N	170
		N74LS113N	38	N74LS240N	160		
		N74LS114N	38	N74LS241N	160		
		N74LS125N	40	N74LS242N	160		
		N74LS126N	40	N74LS243N	160		
		N74LS132N	60	N74LS244N	160		
		N74LS136N	37	N74LS251N	90		

LINEAR INTEGRATED CIRCUITS

CA3011	92	NE592K	162
CA3018	75	RC4136	130
CA3020	191	TBA120S	79
CA3028A	86	TCA580	346
CA3046	76	TCA730	450
CA3048	245	TCA740	450
CA3080E	70	TDA1008	326
CA3089E	253	TDA1022	648
CA3130E	90	TDA1028	338
CA3140E	38	TDA1029	338
CA3189E	266	TDA10348	217
LM301AN	30	TDA2581	266
LM308N	95	TDA2640	292
LM318N	200	TL081CP	75
LM319N	216	TL084CN	140
LM324N	70	UA709CT	46
LM339N	71	UA709CN	40
LM381N	110	UA710CN	41
LM381AN	180	UA711CN	65
LM382	120	UA741CT	42
		UA741CN	18
		UA747CN	50
		UA748CN	35

Voltage Regulators

MC1458N	35		
MC1496N	97		
NE531	119	LM309DA (K)	108
NE536T	216	UA723CN	38
NE540	225	UA7805CU	65
NE555N	25	UA7812CU	65
NE556N	60	UA7815CU	65
NE560N	351	UA7905CU	86
NE561N	427	UA7912CU	86
NE562N	461	UA7915CU	86
NE565N	120	UA78L05CS	32
NE566N	155	UA78L06CS	32
NE567N	170	UA78L12CS	32
NE570N	405	UA78L15CS	32
NE571N	459		

OPTO ELECTRONICS

Light Emitting Diodes, Individual

			Order Code
.125" (3mm)	Red	14	CQY54
	Green	17	CQY95
	Yellow	19	CQY97
Panel Mounting Clip to suit.		3	LED3 Clip
.2" (5mm)	Red	15	CQY24A
	Green	17	CQY94
	Yellow	19	CQY96
Panel Mounting Clip to suit.		5	LED5 Clip

Light Emitting Diodes – 7 Segment Display

.3" (7.6mm)	C. Anode R.H. Decimal Pt. Red	160	XAN3061
	C. Anode R.H. Decimal Pt. Green	199	XAN3051
	C. Cathode R.H. Decimal Pt. Red, Low current drain	160	XAN3074
.6" (15.2mm)	C. Anode L.H. Decimal Pt. Red	230	XAN6620
	C. Anode L.H. Decimal Pt. Green	230	XAN6520
	C. Cathode L.H. Decimal Pt. Red	230	XAN6640

Photoresistors

ORP12	90	ORP12
ORP61	90	ORP61

Phototransistors

OCP71	180	OCP71
BPX25	175	BPX25
BPX29	175	BPX29

Photocoupler

FCD820	150	FCD820

SWITCHES

Miniature Toggle – Honeywell

				Order Code
SPDT		2A/250V A.C., 5A/28V D.C.	58	SW 8A1011
SPDT	C/Off		67	SW 8A1021
SPDT	Double Bias To Centre		75	SW 8A1041
SPDT	Single Bias To Centre		75	SW 8A1051
SPDT	Bias		70	SW 8A1081
DPDT			86	SW 8A2011
DPDT	C/Off		92	SW 8A2021
DPDT	Double Bias To Centre		102	SW 8A2041
DPDT	Single Bias To Centre		102	SW 8A2051
DPDT	Bias		96	SW 8A2061

Miniature Push – C & K

SP	Push To Make, Momentary	0.5A/250V A.C., 1A/28V D.C.	54	SW 8531
SP	Push To Break, Momentary		54	SW 8533

Slide – Switchcraft

DPDT	Standard Actuator	36	SW 46206
DPDT	Slot Actuator, Voltage Change, Marked 110/240	43	SW 46206F

SEMICONDUCTORS

Diodes

IN827	193	IN4006	7	BB110G	61	OA202	9
IN914	4	IN4007	8	BY127	15		
IN916	5	IN4148	3	BY206	34		
IN4001	4	IN5402	15	BYX10	19	**Microwave**	
IN4002	4	IN5404	16	OA47	10		
IN4003	6	BAX13	5	OA90	7	BAW95D	1091
IN4004	6	BAY38	27	OA91	7	CL8960	2592
IN4005	7	BB106(4)	122	OA200	9	CXY11C	1280

Zener Diodes

400mW C4V7-C33		1.3W C7V5-C75	
BZY88/BZX79 + Voltage	8	BZX61 + Voltage	16

Transistors

2N929	37	2N4427	206	BC478	24	BSX88	18
2N1893	30	2N4856	158	BC547	12	MJE340	48
2N2218A	28	2N4858	134	BC548	10	MPF102	32
2N2222	21	2N4860	122	BC548B	15	OC28	107
2N2369	19	2N5294	43	BC549	12	OC35	95
2N2369A	20	2N5416	108	BC549B	20	OC45	82
2N2646	42	2N5457	35	BC557	14	OCP71	180
2N2894	49	2N5458	30	BC558	14	TIP29A	41
2N2895	28	2N5459	32	BC559	17	TIP29C	53
2N2904	24	2N6258	432	BCY34	97	TIP30A	44
2N2904A	24	40673	80	BCY70	14	TIP30C	57
2N2905	22	AC188	22	BCY71	14	TIP31A	43
2N2905A	24	AD161	38	BCY72	15	TIP31C	58
2N2906	19	AD162	38	BD131	35	TIP32A	49
2N2907	22	BC107	10	BD132	35	TIP32C	63
2N2907A	25	BC107B	14	BD135	38	TIP41A	59
2N2918	330	BC108	10	BD136	37	TIP41C	69
2N2926G	11	BC108B	14	BD137	38	TIP42A	59
2N3053	17	BC108C	16	BD138	39	TIP42C	69
2N3054	50	BC109	10	BD139	35	TIP2955	68
		BC109B	17	BD140	35	TIP3055	54
2N3055	50	BC109C	18	BF115	28	TIS43	32
2N3055		BC147	7	BF180	37	ZTX109C	14
Full ISB Test	86	BC148	9	BF181	37		
2N3340	30	BC149	8	BF257	35		
2N3442	141	BC157	10	BF258	32		
2N3702	8	BC158	9	BF259	36		
2N3703	11	BC159	11	BFR90	303		
2N3704	8	BC177	15	BFS21	428		
2N3705	9	BC178	15	BFX13	23		
2N3706	9	BC179	18	BFX84	26		
2N3707	9	BC182	10	BFX85	26		
2N3708	9	BC182L	11	BFX86	30		
2N3709	11	BC183	10	BFX87	22		
2N3773	270	BC183L	11	BFX88	26		
2N3819	20	BC184	10	BFY50	15		
2N3820	39	BC184L	11	BFY51	15		
2N3866	97	BC212	10	BFY52	18		
2N3903	20	BC212L	11	BFY90	97		
2N3904	8	BC213	10	BLX65	238		
2N3905	12	BC213L	11	BLY35	1889		
2N3906	12	BC214	10	BLY93A	2706		
2N3962	95	BC214L	11	BPX25	175		
2N4347	227	BC327	17	BPX29	175		
2N4401	20	BC328	15	BRY39	45		
2N4403	20	BC337	16	BSW69	33		
2N4416	86	BC338	14	BSX20	19		

SEMICONDUCTORS

Rectifier Bridges

		Order Code
1A 400V S.I.L.	93	BY179
1.4A 60V S.I.L.	84	BY164
1.5A 100V D.I.L.	33	VM18
1.5A 400V D.I.L.	35	VM48
1.5A 100V	45	W01
1.5A 400V	52	W04
2A 100V	89	VS148
2A 400V	109	VS448
6A 100V	143	VH148
6A 400V	183	VH448
10A 100V	172	VJ148
10A 400V	201	VJ448
15A 100V	215	VL148
15A 400V	226	VL448
30A 100V	242	VK148
30A 400V	260	VK448

S.C.R.'s

4A 400V	54	C106D
12A 400V	108	TIC126D

Triacs

10A 500V	124	BT138-500
15A 500V	177	BT139-500
23A 500V	492	BTW41-500

MAINS TRANSFORMERS

Secondaries may be connected in series or parallel to give wide voltage range
Primaries 0-220, 240V

6VA – Clamp Type Construction

Approx. 18% Regulation. F.C. 54, H36, W35

		Order Code	
0-4.5V, 0-4.5V Secondaries	220	Trans 6VA	45
0-6V, 0-6V			60
0-12V, 0-12V			120
0-15V, 0-15V			150
0-20V, 0-20V			200

20VA – Clamp Type Construction

Approx. 16% Regulation F.C. 70, H48, W46

0-4.5V, 0-4.5V Secondaries	335	Trans 20VA	45
0-6V, 0-6V			60
0-12V, 0-12V			120
0-15V, 0-15V			150
0-17.5V, 0-17.5V			175
0-20V, 0-20V			200

55VA – Clamp Type Construction

Approx. 10% Regulation F.C. 92, H64, W57

0-6V, 0-6V Secondaries	540	Trans 55VA	60
0-12V, 0-12V			120
0-15V, 0-15V			150
0-20V, 0-20V			200
0-30V, 0-30V			300

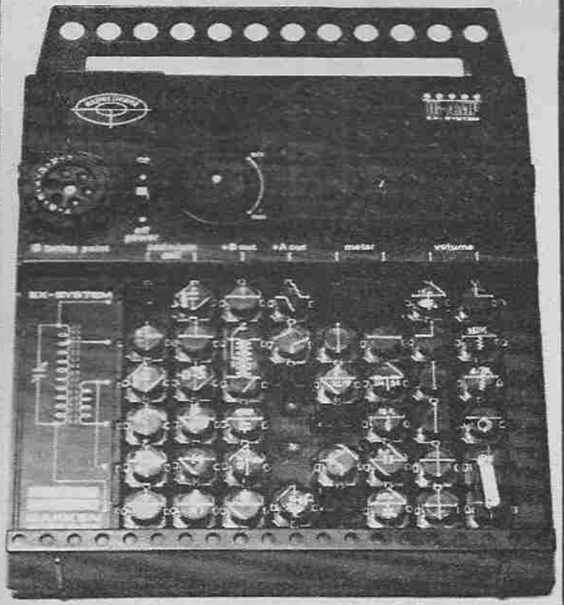
100VA – Frame Type Construction

Approx. 6% Regulation H87, W74, D64

0-25V, 0-25V Secondaries	825	Trans 100VA	250
0-40V, 0-40V			400

COMMUNICATIONS INTEGRATED CIRCUITS – PLESSEY

SL360C	242	SL641C	384								
SL362C	302	SL650C	865								
SL610	230	SL651C	786								
SL611C	230	SL652C	329								
SL612C	230	SL680C	230								
SL613C	394	SL701C	220								
SL620C	347										
SL621C	347	SL1610C	166	SL1823C	251	SL1680C	170	SP8629	446	SP8690	907
SL622C	854	SL1611C	166	SL1625C	225	SL6600C	890	SP8630B	1361	SP8760B	680
SL623C	629	SL1612C	166	SL1626C	251	SL6640C	401	SP8855B	1058	SP8790B	454
SL624C	321	SL1613C	193	SL1630C	166	SL6850C	378	SP8657B	1058	SP8794B	454
SL630C	218	SL1620C	225	SL1640C	193			SP8659B	907		
SL640C	384	SL1621C	225	SL1641C	193			SP8660B	907		



EX-SYSTEM
power
meter
volume

RST VALVE MAIL ORDER CO. (EE 6)

CLIMAX HOUSE, FALLSBROOK ROAD,
LONDON SW16 6ED

SPECIAL EXPRESS MAIL ORDER SERVICE

SEMICONDUCTORS

AA119	0·11
AAY30	0·29
AAY32	0·45
AAZ13	0·19
AAZ15	0·37
AAZ17	0·29
AC107	0·65
AC125	0·22
AC126	0·22
AC127	0·22
AC128	0·22
AC141	0·27
AC141K	0·38
AC142	0·22
AC142K	0·32
AC176	0·22
AC187	0·22
AC188	0·22
ACY17	0·92
ACY18	0·86
ACY19	0·81
ACY20	0·76
ACY21	0·81
ACY39	1·62
AD149	0·76
AD161	0·49
AD162	0·49
AF106	0·49
AF114	0·81
AF115	0·81
AF116	0·81
AF117	0·81
AF139	0·43
AF186	1·30
AF239	0·49
AFZ11	2·97
AFZ12	2·97
ASY26	0·43
ASY27	0·43
ASZ15	1·35
ASZ16	1·35
ASZ17	1·35
ASZ20	1·62
ASZ21	2·16
AU110	1·84
AU113	1·84
AUY10	1·84
BA145	0·15
BA148	0·15
BA154	0·10
BA155	0·11
BA156	0·10
BAW62	0·06
BAX13	0·07
BAX16	0·10
BC107	0·13
BC108	0·13
BC109	0·14
BA113	0·13
BC114	0·14
BC115	0·15
BC116	0·17
BC117	0·19
BC118	0·11
BC125	0·18
BC126	0·23
BC135	0·16
BC136	0·17
BC137	0·17
BC147	0·10
BC148	0·09
BC149	0·10
BC157	0·10
BC158	0·09
BC159	0·11
BC167	0·14
BC170	0·12
BC171	0·11
BC172	0·11
BC173	0·13
BC177	0·16
BC178	0·15
BC179	0·17
BC182	0·12
BC183	0·11
BC184	0·12
BC212	0·14
BC213	0·14
BC214	0·17
BC237	0·10
BC238	0·14
BC301	0·27
BC303	0·26
BC307	0·11
BC308	0·11
BC327	0·23
BC328	0·21
BC337	0·21
BC338	0·19
BCY30	1·08
BCY31	1·08
BCY32	1·08
BCY33	0·97
BCY34	0·97
BCY39	3·24
BCY40	1·08
BCY42	0·27
BCY43	0·27
BCY58	0·17
BCY70	0·16
BCY71	0·18
BCY72	0·14
BCZ11	1·62
BD115	0·49
BD121	1·30
BD123	1·30
BD124	1·40
BD131	0·38
BD132	0·41
BD135	0·37
BD136	0·37
BD137	0·38
BD138	0·43
BD139	0·46
BD140	0·48
BD144	2·16
BD181	1·19
BD182	1·27
BD237	0·43
BD238	0·59
BDX10	0·98
BDX32	2·16
BDY20	1·35
BDY60	1·62
BF115	0·27
BF152	0·19
BF153	0·22
BF154	0·18
BF159	0·25
BF160	0·17
BF167	0·22
BF173	0·22
BF177	0·26
BF178	0·26
BF179	0·27
BF180	0·32
BF181	0·32
BF182	0·32
BF183	0·27
BF184	0·27
BF185	0·27
BF194	0·10
BF195	0·10
BF196	0·11
BF197	0·14
BF200	0·29
BF224	0·23
BF244	0·30
BF257	0·26
BF258	0·28
BF259	0·35
BF336	0·32
BF337	0·32
BF338	0·33
BFS21	4·28
BFS28	2·41
BFS61	0·23
BFS98	0·23
BFW10	0·70
BFW11	0·70
BFX84	0·24
BFX85	0·25
BFX87	0·23
BFX88	0·23
BFY50	0·28
BFY51	0·28
BFY52	0·28
BFY64	0·28
BFY90	1·35
BSX19	0·23
BSX20	0·22
BSX21	0·22
BT106	1·35
BTY79/400R	3·45
BU205	1·97
BU206	2·53
BU208	2·25
BY100	0·49
BY126	0·15
BY127	0·16
BZX61 Series	0·19
BZY88 Series	0·14
CRS/140	0·65
CRS/340	0·81
CRS/360	0·97
GEX66	1·62
GEX541	1·89
GJ3M	0·81
GJ5M	0·81
GM0378A	1·89
KS100A	0·51
MJE340	0·86
MJE370	1·26
MJE371	0·66
MJE520	0·56
MJE521	0·59
MJE2955	1·35
MJE3055	0·81
MPF102	0·34
MPF103	0·34
MPF104	0·34
MPF105	0·34
MPSA06	0·26
MPSA56	0·29
MPSU01	0·41
MPSU06	0·52
MPSU56	0·55
NE555	0·49
NKT401	2·46
NKT403	1·87
NKT404	1·87
OA5	1·03
OA7	0·59
OA10	0·65
OA47	0·15
OA70	0·32
OA79	0·32
OA81	0·32
OA85	0·32
OA90	0·09
OA91	0·09
OA95	0·09
OA200	0·10
OA202	0·10
OA211	1·08
OAZ200	1·08
OAZ201	1·08
OAZ206	1·08
OAZ207	1·08
OC16	2·16
OC20	2·70
OC22	2·70
OC23	2·97
OC24	3·24
OC25	0·97
OC26	0·97
OC28	2·16
OC29	2·16
OC35	1·62
OC36	1·62
OC41	0·86
OC42	0·81
OC43	2·43
OC44	0·65
OC45	0·59
OC71	0·59
OC72	0·59
OC73	1·08
OC74	0·70
OC75	0·70
OC76	0·59
OC77	1·30
OC81	0·70
OC81Z	1·30
OC82	0·70
OC83	0·70
OC84	0·70
OC122	1·62
OC123	1·89
OC139	2·43
OC140	2·97
OC141	3·51
OC170	1·08
OC171	1·08
OC200	1·62
OC201	1·89
OC202	1·89
OC203	1·89
OC204	2·70
OC205	2·70
OC206	2·70
OC207	1·89
OCP71	1·35
ORP12	1·08
R2008B	1·97
R2009	2·46
R2010B	1·97
T1C44	0·32
T1C226D	1·30
T1L209	0·22
T1P29A	0·46
T1P30A	0·50
T1P31A	0·49
T1P32A	0·52
T1P33A	0·75
T1P34A	0·79
T1P41A	0·68
T1P42A	0·76
T1P2955	0·72
T1P3055	0·60
T1S43	0·51
ZS140	0·28
ZS170	0.24
ZS178	0·61
ZS271	0·26
ZS278	0·64
ZTX107	0·12
ZTX108	0·11
ZTX109	0·14
ZTX300	0·14
ZTX301	0·15
ZTX302	0·17
ZTX303	0·19
ZTX304	0·21
ZTX311	0·14
ZTX314	0·23
ZTX500	0·15
ZTX501	0·16
ZTX502	0·18
ZTX503	0·19
ZTX504	0·23
ZTX531	0·23
ZTX550	0·18
1N914	0·06
1N916	0·08
1N4001	0·07
1N4002	0·07
1N4003	0·08
1N4004	0·08
1N4005	0·09
1N4006	0·09
1N4007	0·10
1N4009	0·07
1N4148	0·07
1N5400	0·14
1N5401	0·14
1S44	0·05
1S920	0·08
1S921	0·08
2G301	1·08
2G302	1·08
2G306	1·19
2N404	1·08
2N696	0·27
2N697	0·27
2N698	0·32
2N705	1·30
2N706	0·16
2N708	0·22
2N930	0·22
2N1131	0·28
2N1132	0·28
2N1302	0·38
2N1303	0·38
2N1304	0·49
2N1305	0·49
2N1306	0·54
2N1307	0·54
2N1308	0·59
2N1309	0·59
2N1613	0·27
2N1671	1·62
2N1893	0·27
2N2147	1·89
2N2148	1·78
2N2218	0·27
2N2219	0·26
2N2220	0·19
2N2221	0·19
2N2222	0·19
2N2223	2·97
2N2368	0·18
2N2369A	0·23
2N2484	0·22
2N2646	0·59
2N2904	0·27
2N2905	0·27
2N2906	0·23
2N2907	0·23
2N2924	0·24
2N2925	0·25
2N2926	0·16
2N3053	0·27
2N3054	0·54
2N3055	0·76
2N3440	0·65
2N3441	0·86
2N3442	1·19
2N3614	1·62
2N3702	0·12
2N3703	0·15
2N3704	0·15
2N3705	0·15
2N3706	0·15
2N3707	0·15
2N3708	0·11
2N3709	0·15
2N3710	0·11
2N3711	0·11
2N3771	1·87
2N3772	2·16
2N3773	3·24
2N3819	0·41
2N3820	0·51
2N3823	0·62
2N3866	0·81
2N3904	0·15
2N3905	0·15
2N3906	0·15
2N4058	0·16
2N4059	0·11
2N4060	0·14
2N4061	0·14
2N4062	0·15
2N4124	0·18
2N4126	0·18
2N4286	0·23
2N4288	0·25
2N4289	0·27
2N5457	0·39
2N5458	0·39
2N5459	0·39

VALVES

AZ31	1·24
CBL31	1·69
CL33	2·25
CY31	1·13
DAF91	0·45
DAF96	1·13
DF91	0·45
DF96	1·13
DK91	1·18
DK92	1·41
DK96	1·24
DL92	1·24
DL94	1·35
DL96	1·24
DY86/7	0·72
DY802	0·95
E80CC	6·22
EABC80	1·35
EAF42	1·41
EAF801	1·97
EB41	2·25
EB91	0·95
EBC33	1·97
EBC41	1·41
EBC81	1·24
EBC90	0·96
EBF80	0·57
EBF83	1·41
EBF89	0·96
EBL31	2·81
ECC40	1·41
ECC81	0·99
ECC82	0·81
ECC83	0·99
ECC84	1·34
ECC85	1·35
ECC88	2·03
ECC91	7·45
ECC189	1·87
ECF80	1·22
ECF82	1·35
ECH35	2·25
ECH42	1·29
ECH81	1·35
ECH83	1·41
ECH84	1·44
ECL82	1·13
ECL83	1·69
ECL86	1·35
EF37A	3·94
EF39	3·09
EF40	1·29
EF41	1·35
EF42	2·25
EF50	1·69
EF80	0·90
EF83	1·97
EF85	0·90
EF86	1·71
EF89	1·80
EF91	2·03
EF92	5·63
EF98	1·41
EF183	0·90
EF184	0·95
EH90	1·58
EL32	1·69
EL33	3·94
EL34 (Thorn)	2·48
EL34 (Mullard)	2·52
EL41	1·41
EL42	1·97
EL81	1·24
EL84	1·13
EL86	2·43
EL91	6·92
EL95	1·49
EL360	5·98
EM80	1·24
EM81	1·13
EM84	1·13
EM85	1·41
EM87	1·69
EN91	2·76
EY51	1·97
EY86	0·95
EZ40	1·41
EZ41	1·41
EZ80	0·95
EZ81	0·95
EZ90	1·35
GZ32	1·41
GZ33	4·50
GZ34	2·14
KT61	3·94
KT66	7·03
KT88	9·00
KTW61	1·97
KTW62	1·97
KTW63	1·97
MU14	1·13
N78	10·13
OA2	2·16
OB2	1·35
OC3	2·07
OD3	2·07
OZ4	1·80
PC86	1·58
PC88	1·58
PC97	1·35
PC900	1·35
PCC84	1·13
PCC88	1·35
PCC89	1·53
PCC189	1·58
PCF80	1·13
PCF82	1·13
PCF86	1·80
PCF87	1·80
PCF200	2·77
PCF201	2·40
PCF801	1·80
PCF802	1·78
PCF805	1·80
PCF806	1·80
PCF808	1·80
PCL82	1·13
PCL83	1·78
PCL84	1·13
PCL85	1·22
PCL86	1·22
PCL805/85	1·22
PD500	4·05
PFL200	2·03
PL36	1·35
PL81	1·35
PL81A	1·35
PL82	1·35
PL83	2·50
PL84	1·22
PL504/500	1·58
PL508	2·03
PL509	3·38
PL519	3·65
PL801	1·24
PL802	3·33
PY33	1·24
PY81	0·95
PY82	0·90
PY83	0·79
PY88	0·95
PY500A	2·03
PY800	0·95
PY801	0·95
QQV02-6	11·23
QQV03-10	5·11
QQV03-20A	18·90
QQV06-40A	18·90
R17	1·86
R19	1·35
R20	1·62
U18-20	2·81
U25	1·31
U26	1·62
UABC80	1·41
UAF42	1·41
UB41	1·41
UBC41	1·69
UBF89	1·35
UCC84	1·24
UCC85	1·35
UCF80	1·29
UCH42	1·35
UCH81	2·61
UCL82	1·17
UCL83	1·62
UF41	1·13
UF80	1·62
UF85	1·62
UF89	1·62
UL41	1·82
UL84	1·35
UM80	1·13
UY41	1·41
UY85	1·17
Z803U	8·53
1B3GT	2·44
1R5	1·18
1S5	0·45
1T4	0·45
2AS15	10·80
2D21	2·76
3A5	1·46
3CX100A5	21·60
3S4	1·24
4CX250B	26·79
5R4GY	2·25
5U4G	4·25
5U4GB	2·54
5V4G	1·71
5Y3GT	0·96
5Z3	1·69
5Z4G	1·71
5Z4GT	1·69
6-30L2	1·76
6AB7	1·69
6AC7	1·58
6AF4A	1·80
6AG7	2·25
6AH6	5·40
6AK5	3·89
6AK6	2·75
6AL5	0·99
6AM4	2·59
6AM5	4·29
6AM6	2·03
6AN5	5·99
6AN8A	4·66
6AQ5	1·08
6AR5	1·80
6AS6	6·28
6AS7GA	7·29
6AT6	0·96
6AU5G7	4·70
6AU6	1·22
6AV5GA	4·25
6AV6	0·96
6AX5GT	3·49
6B7	1·69
6B8	1·97
6BA6	1·13
6BA7	5·76
6BA8A	4·22
6BC4	4·17
6BE6	1·22
6BH6	1·71
6BJ6	1·22
6BK4	4·74
6BL6	91·80
6BL7GT	4·34
6BN6	1·86
6BQ7A	4·05
6BR7	4·50
6BR8	1·97
6BS7	4·50
6BW6	4·50
6BW7	1·71
6BX7GT	5·58
6BZ6	2·57
6C4	0·99
6CB6A	2·70
6CD6GA	5·51
6CG7	2·50
6CH6	7·31
6CL6	4·03
6CW4	8·15
6D2	0·99
6DK6	2·53
6DQ6B	4·39
6EA8	3·24
6EB8	2·39
6EW6	1·69
6F6	1·99
6F23	1·80
6F28	1·31
6H2N	1°18
6H3N	1·18
6H6	1·69
6J4	5·96
6J6	3·51
6J7	8·84
6K4N	1·41
6K6GT	1·46
6K7	1·69
6K8	1·97
6KD6	6·93
6L6G	2·81
6L6GA	1·69
6L6GT	0·96
6L6GC	2·19
6L7	2·25
6N2P	1·18
6N3P	1·18
6N7	1·69
6P25	4·05
6Q7	2·48
6R7	2·03
6SA7	1·63
6SC7	1·69
6SF7	1·80
6SH7	1·69
6SJ7	1·80
6SK7	1·46
6SL7GT	3·02
6SNG7	1·80
6SQ7	1·47
6SR7	1·69
6SS7	2·03
6U5G	2·25
6U8	0·90
6U8A	3·17
6V6GT	1·80
6X4	1·35
6X5GT	0·96
7B7	1·91
7C5	1·97
7C6	1·41
7H7	2·25
7R7	1·69
7S7	2·53
7Y4	1·80
7Z4	2·08
12AT6	1·35
12At7	0·99
12AU6	2·77
12AU7	0·81
12AV6	2·25
12AV7	3·89
12AX7	0·99
12AY7	5·13
12B4A	3·42
12BA6	2·36
12BE6	2·50
12BH7	1·26
12BY17	2·95
12E1	7·67
19H4	27·00
30C15	1·80
30C17	1·80
30C18	1·80
30F5	1·89
30FL1/2	1·26
30FL12	2·03
30FL14	1·80
30L1	1·13
30L15	2·03
30L17	2·03
30P4	1·04
30P19	1·35
30PL1	1·49
30PL13	2·03
30PL14	1·89
30PL15	2·03
35W4	0·68
50C5	0·79
85A2	2·00
90AG	8·60
90AV	8·60
90C1	1·94
90CG	14·77
90CV	14·36
92AG	8·60
92AV	8·60
95A1	5·24
150B2	2·32
150B3	4·21
150C2	1·62
150C4	1·89
211	6·48
723AB	37·80
807	3·89
811A	9·18
812A	9·02
813	34·56
833A	81·00
866A	6·21
872A	14·85
931A	13·22
2050	7·52
5642	5·68
5654	3·80
5651	1·94
5670	4·97
5814A	4·51
6080	7·40
6146A	5·53
6146B	6·03
6159	8·62
6973	3·96
7586	12·80
7587	22·05
7868	4·43
8068	6·19
8136	2·75
4CX 250B	5·40

Tested ex equipment.

INTEGRATED CIRCUITS

7400	0·17
7401	0·17
7402	0·17
7403	0·17
7404	0·18
7405	0·17
7406	0·43
7407	0·43
7408	0·22
7409	0·22
7410	0·17
7412	0·28
7413	0·35
7416	0·35
7417	0·35
7420	0·18
7422	0·22
7423	0·35
7425	0·32
7427	0·32
7428	0·46
7430	0·18
7432	0·32
7433	0·39
7437	0·35
7438	0·35
7440	0·19
7441AN	0·92
7442	0·78
7447AN	0·97
7450	0·19
7451	0·19
7453	0·19
7454	0·19
7460	0·19
7470	0·38
7472	0·36
7473	0·39
7474	0·43
7475	0·58
7476	0·43
7480	0·59
7482	0·81
7483	0·97
7484	1·08
7486	0·38
7490	0·56
7491	0·86
7492	0·65
7493	0·65
7494	0·86
7495	0·78
7496	0·86
7497	3·24
74100	1·62
74107	0·49
74109	0·76
74110	0·54
74111	0·76
74116	1·89
74118	1·08
74119	1·62
74120	0·90
74121	0·43
74122	0·65
74123	1·08
74125	0·59
74126	0·59
74128	0·65
74132	0·76
74136	0·59
74141	0·86
74142	2·48
74143	2·70
74144	2·70
74145	0·97
74147	2·16
74148	1·89
74150	1·73
74151	0·92
74154	1·89
74155	0·92
74156	0·92
74157	0·81
74159	2·27
74170	2·48
74172	4·75
74173	1·51
74174	1·62
74175	0·97
74176	1·19
74178	1·35
74179	1·35
74180	1·25
74190	1·62
74191	1·62
74192	1·46
74193	1·46
74194	1·35
74195	1·06
74196	1·30
74197	1·19
74198	2·43
74199	2·43
76013N	1·97
LM309K	1·62
TAA570	2·59
TAA630S	3·94
TAA700	4·22
TBA480Q	2·07
TBA20Q	2·59
TBA530	2·23
TBA540Q	2·59
TBA550Q	3·62
TBA560CQ	3·62
TBA673	2·46
TBA700	1·71
TBA720Q	2·59
TBA750Q	2·33
TBA800	1·30
TBA920	3·13
TBA920Q	3·36
TBA990Q	3·36
TCA270Q	3·36
TCA760A	1·55

DIL Sockets

8 PIN	0·16
14 PIN	0·16
16 PIN	0·18

BASES

B7G unskirted	0·16
B7G skirted	0·32
B9A unskirted	0·16
B9A skirted	0·32
NUVISTOR	0·59
Int Octal	0·22
Loctal	0·59
8 pin DIL	0·16
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16 pin DIL	0·18
Valve screening cans all sizes	0·32

CRT'S

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2BP1*	9·72
3BP1	8·64
3DP1*	5·40
3EG1*	7·56
3FP7	6·48
3GPI	6·48
3JPI*	8·64
3JP2*	8·64
3JP7*	10·80
3KPI*	16·20
3RPI*	37·80
5ADP1	37·80
5BPI*	10·80
5CPI*	5·40
5CP1A	43·20
5FP15A	16·20
5UP7	15·12
DG7-5	27·00
DG7-32	38·88
DH3-91	33·48
DH7-11	73·44
VCR97*	5·40
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VCR138A*	13·50
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Projects... Theory...

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Loudspeaker systems have not received much attention in our pages in the past. But when we planned the *EE2020 Tuner Amplifier* it seemed sensible to offer the constructor a loudspeaker system design also, so that he would be independent of commercial enclosures if he so wished.

Our investigations into this fringe area of electronics convinced us that the possibilities are as wide and varied in range as the size of audiophile pockets—to say nothing of space considerations. This lead us to the view that the differing needs of our readers could best be served producing two loudspeaker systems. The first, the EE20 published this month, is a low cost design which seems likely to meet the needs of the greater number of constructors. We shall follow this (in September) with a three-way upmarket design to satisfy the most fastidious and affluent audio enthusiasts.

These loudspeakers have been designed with the EE2020 in mind but they can be used with any hi fi amplifier of similar output power.

When considering loudspeakers and acoustics we move from the strictly objective field of electronics, into one where much is subjective. Measurements can be made on loudspeaker systems in laboratories and echo-free chambers but the real world where the loudspeaker has to perform is a furnished room. This itself is a delightfully ambiguous term. One man's room may be a modest 10ft by 9ft parlour, another's a commodious 30ft by 15ft lounge. The nature of the furnishings will give the room its own peculiar acoustic properties. But over and above these concrete factors is the great imponderable—the auditory equipment of the listener. This is a very personal thing and ears cannot be equalised or otherwise modified in their response characteristics as with a piece of inanimate equipment.

So at the end of the day it is what we actually hear that counts. Hence it is a highly subjective matter and one should not make dogmatic assertions about the excellence or otherwise of particular loudspeakers. The best "measurement" one can get is a general consensus from a number of people who have listened to the equipment in the same environment.

Here we must be fair. You can't go into a showroom and hear our EE20. What we can tell you is that both EE loudspeaker systems have been specially designed for us by a well-known specialist, long experienced in this field. We believe these loudspeaker systems will be a credit to their constructor and to the amplifying equipment with which they are used.

Fred Bennett.

Our August issue will be published on Friday, July 20. See page 413 for details.

Readers' Enquiries

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

We cannot undertake to engage in discussions on the telephone.

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Everyday ELECTRONICS

VOL. 8 NO. 7

JULY 1979

CONSTRUCTIONAL PROJECTS

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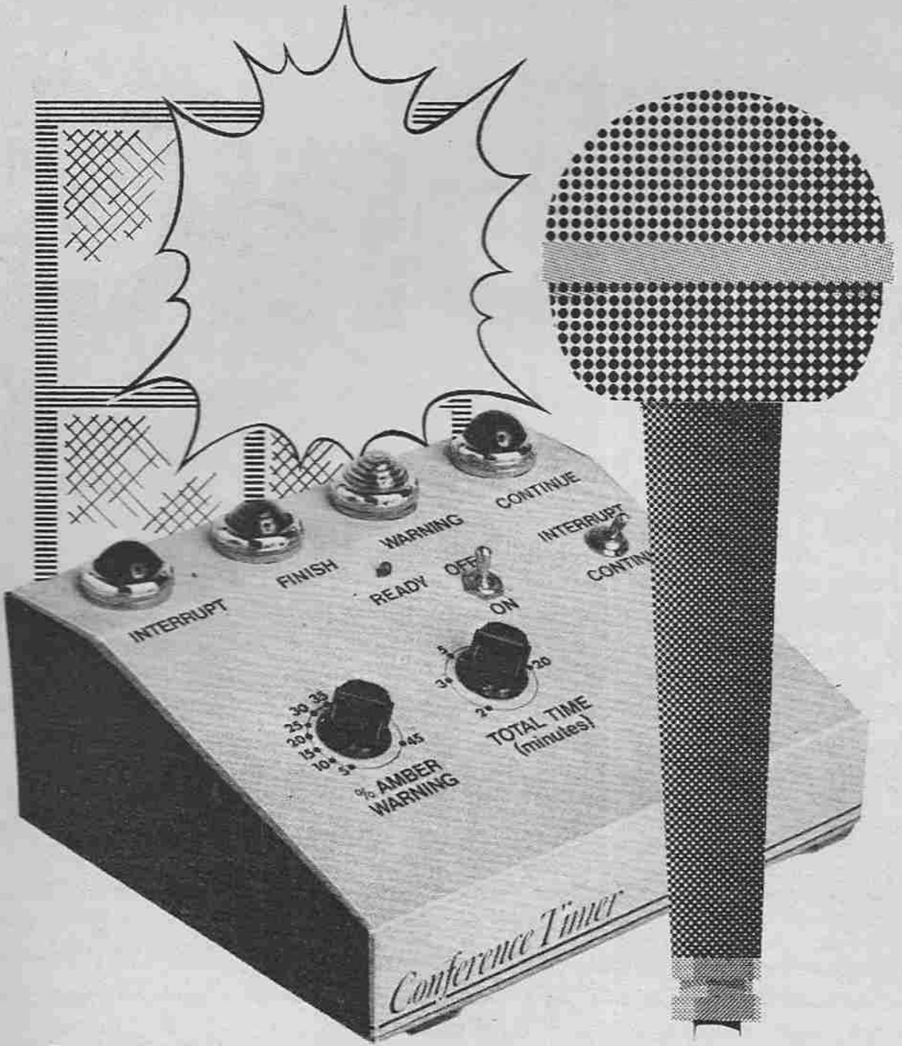


CONFERENCE TIMER

By A. J. Bassett

THIS DEVICE is intended for the timing of speeches at conferences etc, by means of coloured light signals.

Such a device will be a boon to speakers' clubs, discussion groups, debating societies, schools and universities. It might also have applications in offices, factories, the home and for various hobby interests.

The unit contains five indicators which operate as follows:

1. A light emitting diode. This shows that the unit is ready for use.
2. A green lamp which comes on, and stays on, at the commencement of the speech.
3. An amber lamp which comes on shortly prior to the full time allocated, as a signal to warn the performer that time is nearly up.
4. A red lamp lights signifying that the allotted time has expired.
5. A blue lamp to signal that an interruption is being made. The chairman can switch on the blue light in order to make an urgent announcement, and the timing function is suspended until the blue light is switched off again, thus the speaker does not lose time as a result of interruptions.

CIRCUIT DESCRIPTION

The circuit diagram for the Conference Timer, excluding its power supply section is shown in Fig. 1.

When switch S1 is placed in the RESET position as shown in the diagram, the timing capacitor, formed by the parallel combination of C1, C2 and C3, is rapidly discharged via R2 to bring the output voltages of IC1 and IC2 to a value of almost 12 volts.

At the same time, the positive supply voltage to the indicator lamps, LP2, LP3 and LP4 is removed, except for the light emitting diode, D1, which now receives current through R1 and lights up to indicate when the unit is connected to the supply, and switched on ready to use.

When S1 is switched over to the START position the timing commences as C1, C2 and C3 begin to charge by way of VR1 and R3, causing the voltage at pin 3, IC1 to slowly fall towards the 0V rail. At the same time, the l.e.d. extinguishes and the green lamp, LP2 comes on as it receives current by way of power transistors TR1 and TR2 which are biased on by current from the output of IC1. This bias is applied to the base of TR1 by way of resistor R7.

AMBER ON

When the voltage at pin 3 of IC1 reaches the same level as VR2 wiper, the integrated circuit IC1 responds and its output voltage falls rapidly towards the negative supply rail. This removes the bias from TR1 and TR2 and the green lamp goes out as these transistors cease to conduct. The output voltages of IC2 remains near the positive supply and a voltage thus develops across the potential divider R9 and R10 sufficient to cause TR3 to conduct. This also enables TR4 and TR5 to conduct as the collector current of TR3 passes through R13 to the base of TR4, and the amber lamp lights up.

As the voltage at pin 3 continues to fall it eventually reaches the same level as the voltage at the junction of R5 and R6. Thus we have the situation where the voltages at pin 2 and 3 of IC2 are the same, the output voltage thus falls rapidly towards the negative supply rail. This lowers the voltage across the potential divider R9 and R10 so that TR3 is no longer biased on and ceases to conduct. Tran-

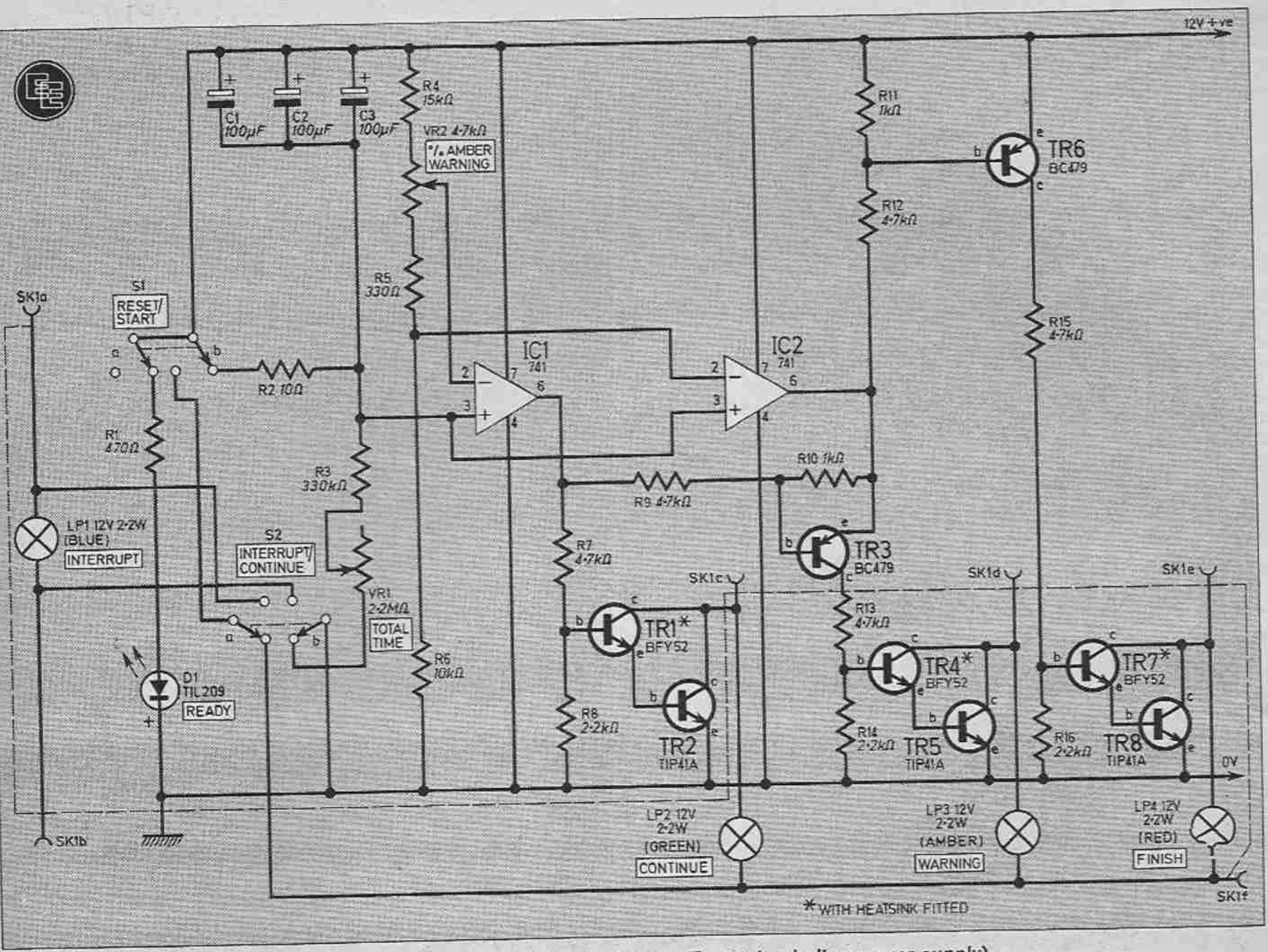


Fig. 1. The circuit diagram of the Conference Timer, (excluding power supply).

sistors, TR4 and TR5 then also stop conducting and the amber lamp goes out.

Now, because the output of IC2 is low, the voltage across potential divider R11 and R12 is sufficient to bias TR6 into conduction. Current is now supplied to the base of TR7 via R15; TR7 and TR8 begin to conduct and the red light comes on, signifying that the allotted time has come to an end.

If during the period when the amber or the green lamp is lit the chairman decides to make an interruption, he switches S2 to the INTERRUPT position. This switches on the blue lamp to signify that an interruption is being made, and at the same time stops the charging of the timing capacitors by interrupting the flow of current through VR1 and R3.

Although in this condition the voltage on these capacitors will in fact fall, it does so very slowly and, for short-term interruptions the timing is affected very little. When the interruption is over, S2 is returned to the CONTINUE position and the timing proceeds as before.

POWER SUPPLY

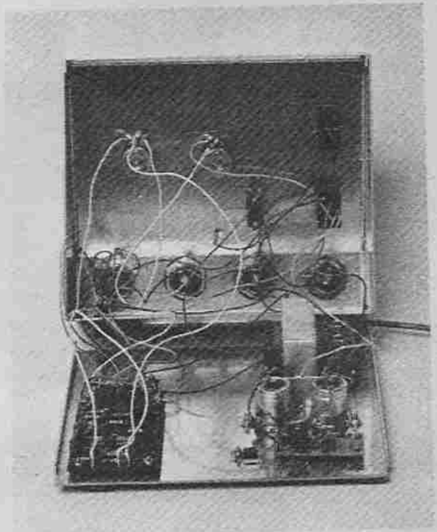
The circuit of Fig. 1 requires a power supply of 12 volts; the current taken varying between 250mA and 1·5 amps according to whether the extension indicators are fitted.

Batteries or the 12 volt mains derived power unit shown in Fig. 2 may be used.

Mains voltage is stepped down by transformer T1 and the voltage appearing across T1 secondary is full-wave rectified by D2 and D3 and smoothed by C4. A 16 volt d.c. level is developed across C4.

Transistors TR11 and TR12 are arranged to form a constant current source, control voltage being derived from the output. The volt-

COMPONENTS approximate cost £21 excluding case



Interior view of the completed prototype unit.

age at R17/R18 is derived from the potential divider chain composed of R17/R18 and TR11 collector/emitter resistance.

For an output voltage of 12 volts, TR12 base is clamped at 1 volt which causes the voltage at R17/R18 to be about 13·2 volts. This biases on TR9 and TR10 and allows current to be drawn through TR10. A drop of 0·6 volts across each of TR9 and TR10 base emitter junctions produces 12 volts at TR10 emitter completing the loop to the output.

If there is a tendency for the output voltage to rise, TR11 and TR12 are caused to conduct more since voltage drop across R20 increases) producing a larger current in the divider chain. Hence R17/R18 voltage decreases thereby reducing the output voltage to 12 volts.

Any tendency for the output voltage to decrease would cause TR11 and TR12 to conduct less resulting in the voltage at R17/18 rising to restore the output level to 12 volts similar to above.

The output is thus stabilised at 12 volts and appears across C6.

The circuit features current limiting which is achieved by the inclusion of R21. If the voltage drop across this resistor reaches 0·6 volts, TR10 stops conducting since its base and emitter terminals will be at the same potential. This happens when the output current reaches about 2 amps.

CONSTRUCTION starts here

CIRCUIT BOARDS

The prototype unit used two circuit boards in its construction, one for the main timing and lighting circuitry (board A) and a smaller one for the power supply section (board B).

Component layout details for board A are shown in Fig. 3 together with the breaks to be made on the underside. Veropins are used for all wiring to the board. Transistors TR1, 4, and 7 are fitted with heatsinks.

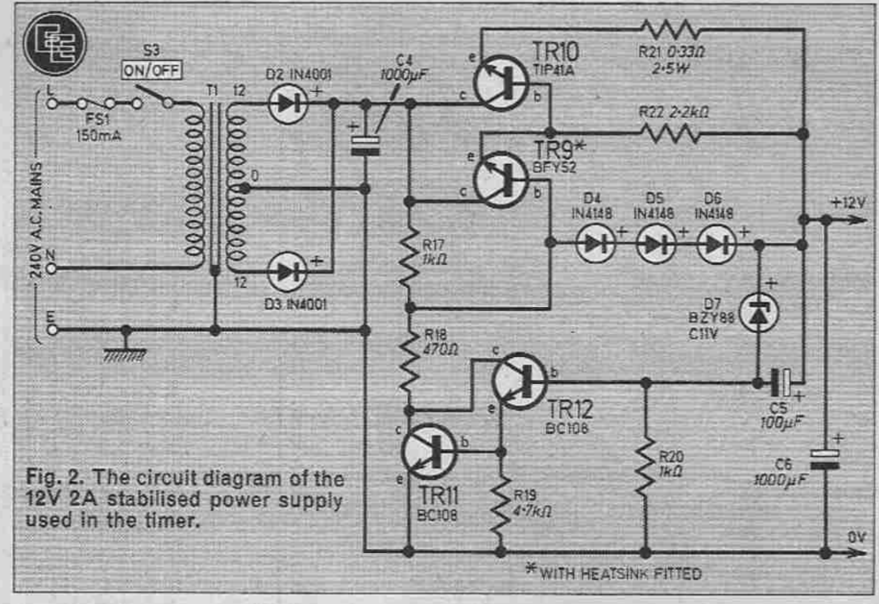


Fig. 2. The circuit diagram of the 12V 2A stabilised power supply used in the timer.

COMPONENTS

Resistors

R1	470Ω
R2	10Ω
R3	330kΩ
R4	15kΩ
R5	330Ω
R6	10kΩ
R7	4·7kΩ
R8	2·2kΩ
R9	4·7kΩ
R10	1kΩ
R11	1kΩ
R12	4·7kΩ
R13	4·7kΩ
R14	2·2kΩ
R15	4·7kΩ
R16	2·2kΩ
R17	1kΩ
R18	470Ω
R19	4·7kΩ
R20	1kΩ
R21	0·33Ω 2·5W
R22	2·2kΩ

All ½W carbon ±5% except R21

Potentiometers

VR1	2·2MΩ carbon lin.
VR2	4·7kΩ carbon lin.

Capacitors

C1, 2, 3	100μF 12V tantalum (3 off)
C4	1000μF 25V elect.
C5	100μF 25V elect.
C6	1000μF 25V elect.

See **Shop Talk** page 426

Semiconductors

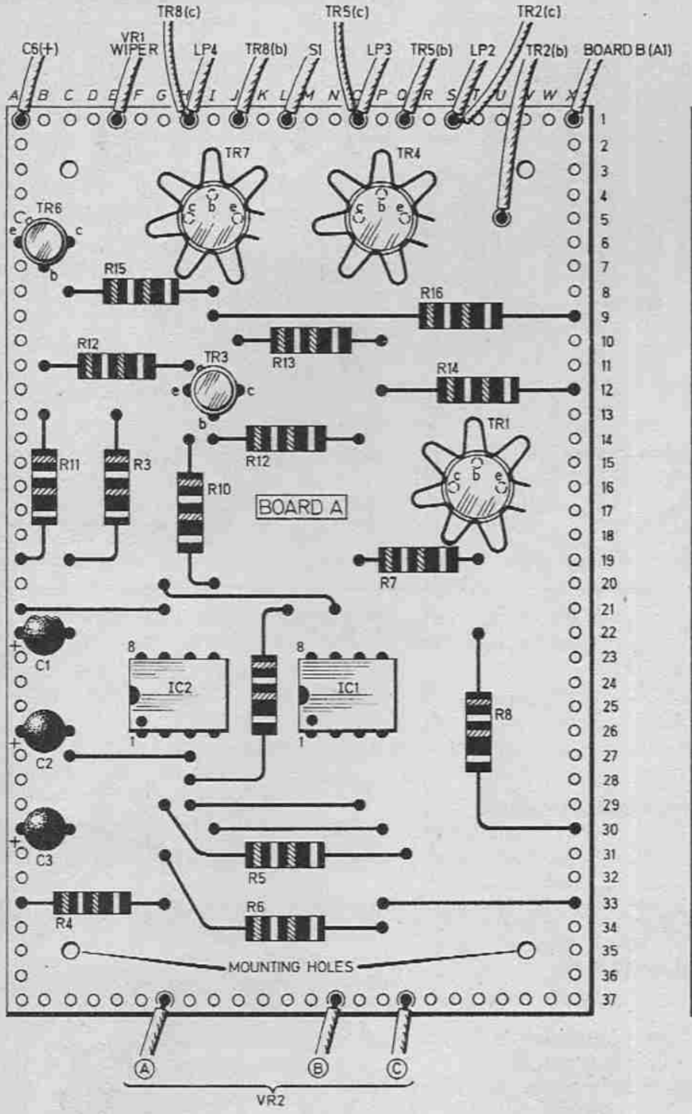
D1	TIL209 red light emitting diode
D2, 3	1N4001 1A silicon rectifier (2 off)
D4, 5, 6	1N4148 small signal silicon diode
D7	BZY88C11V 11V 400mW Zener diode
TR1, 4, 7, 9	BFY52 silicon *npn* (4 off)
TR2, 5, 8, 10	TIP41A silicon *npn* (4 off)
TR11, 12	BC108 silicon *npn* (2 off)
IC1, 2	741. operational amplifier 8-pin d.i.l. (2 off)

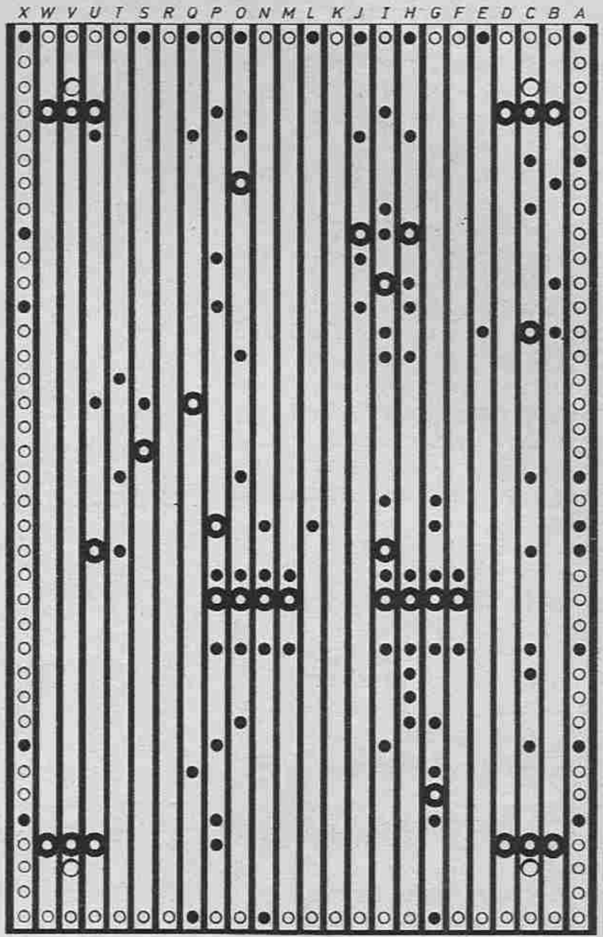
Miscellaneous

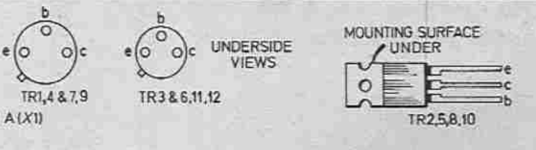
T1	mains primary/ 12–0–12V 2A secondary
S1, 2	d.p.d.t. toggle
S3	single-pole on/off mains toggle
LP1 to 4	12V 2·2W m.e.s. bulb (4 off)
LP5 to 8	12V 6W car sidelamp bulb (4 off)
SK1	six-pin panel mounting socket
PL1	plug to suit SK1
FS1	150mA with chassis holder to suit

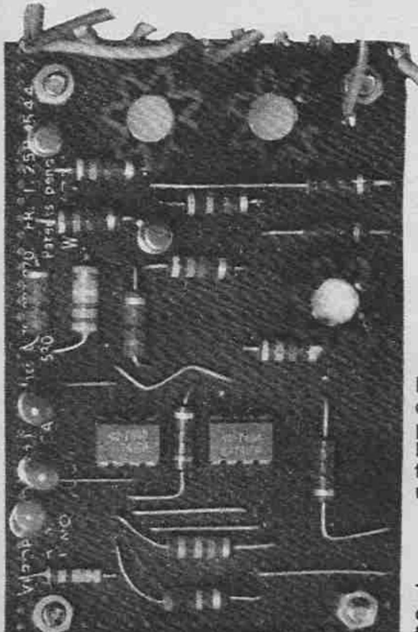
Stripboard: 0·1 inch matrix 24 strips × 37 holes, 10 strips × 24 holes; insulating kits for power transistors (4 off); TO-5 heatsinks (4 off); Veropins (18 off); panel mounting m.e.s. bulb holders with domed cap (4 off); control knobs (2 off); 8-pin d.i.l. sockets; capacitor clips to suit C4 and C6; 4BA and 6BA fixings; insulated connecting wire; mains cable 3-core; 6-way tagstrip (2 off); 6-core cable; cable clips (2 off); cases (2 off).

Fig. 3. The layout of the components on the topside of board A, the main circuit board and the breaks to be made along the copper strips on the underside.

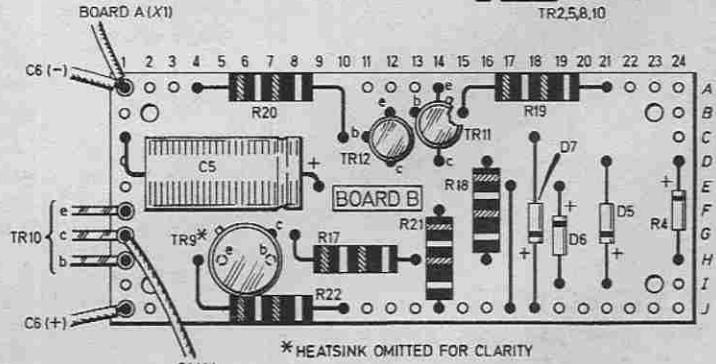








The prototype main circuit board removed from its case.



*HEATSINK OMITTED FOR CLARITY

◉ = VEROPINS

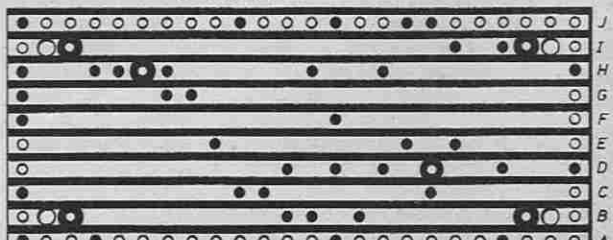
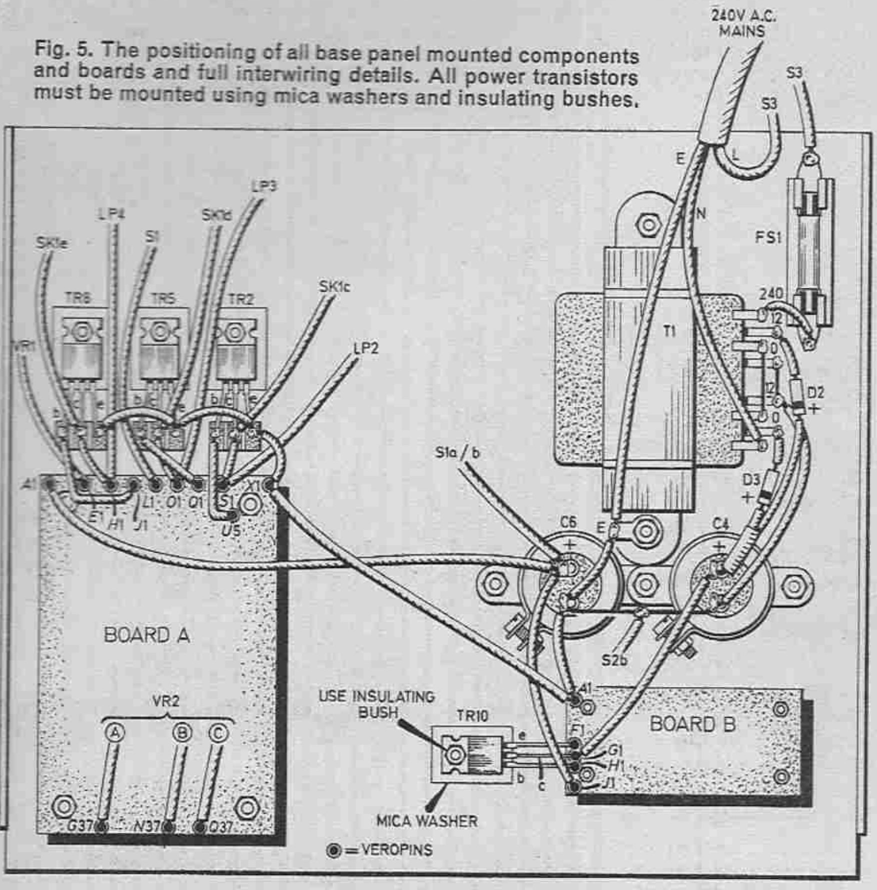
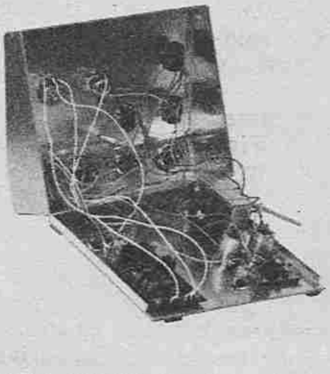


Fig. 4. The layout of the components on the power supply board, board B and the breaks to be made on the underside.

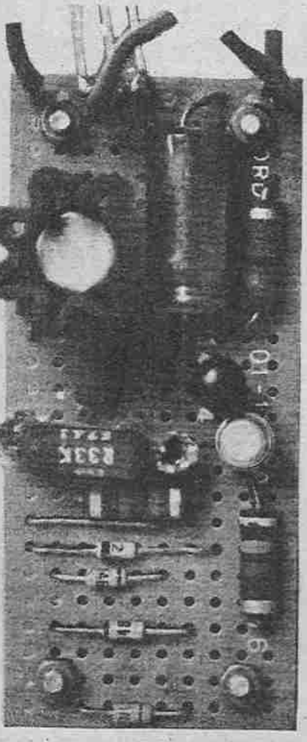
CONFERENCE TIMER

Fig. 5. The positioning of all base panel mounted components and boards and full interwiring details. All power transistors must be mounted using mica washers and insulating bushes.



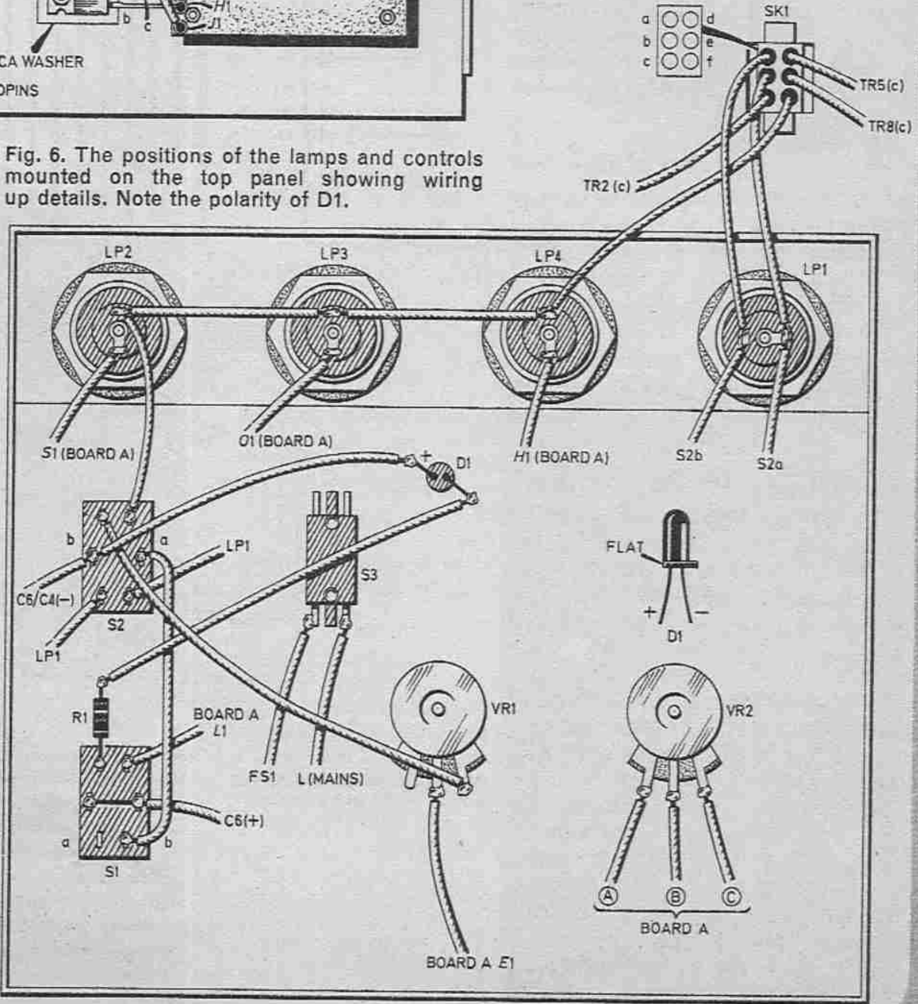


The completed unit ready for final assembly.



A close-up of the power supply board.

Fig. 6. The positions of the lamps and controls mounted on the top panel showing wiring up details. Note the polarity of D1.



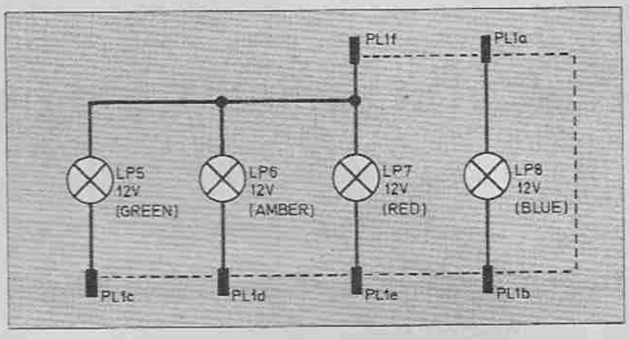


Fig. 7. The circuit diagram for the extension indicators. Note that the supply for the blue interrupt lamp is separate from the rest.

Having made the breaks and fixing holes, solder in the Veropins, link wires, resistors and capacitors paying attention to the polarity of the latter. Dual-in-line sockets for IC1 and 2 were not used in the author's model but are recommended. Finally solder in the transistors using a heatshunt on their leads to avoid thermal damage from the soldering iron. Do not attach any flying leads at this stage.

Similar details for board B are shown in Fig. 4 and should be assembled in a similar manner as board A. Note that a heatsink is required for TR9. Do not connect flying leads or TR10 just yet.

Before proceeding, inspect the boards for any solder bridges or wire whiskers between tracks. A bradawl or fine-blade screwdriver run between the tracks should dislodge such items.

The prototype used an aluminium box with a removable flat base size 227×190mm, and most of the components are mounted on this panel as shown in Fig. 5. The power supply smoothing capacitors are mounted by means of vertical type capacitor clips.

All power transistors are bolted to the case for cooling purposes but must be insulated from the base by using mica washers and insulating bushes. Silicon grease or other heatsink compound is advised for good thermal contact.

Fix all the base mounted components in position and then make all the interwiring connections as shown in Fig. 5.

EXTENSION INDICATORS

The six-way socket SK1 mounted on the rear panel is to connect the unit to four more indicator lamps in an extension indicator unit. This uses more powerful bulbs, and 6 watt car sidelamp bulbs were found to be suitable. The unit described will power up to three of these extensions, and extra six-way sockets, wired in parallel with SK1 may be fitted if required.

The circuit arrangement for such an extension indicator is shown in Fig. 7. A point to notice here is that the blue lamp receives its positive supply separate from the other three lamps.

Although there is obviously scope for imagination in the positioning and arrangement for the extension indicator lamps, the following suggestions may be helpful.

1. Use a box with four separate compartments. Line each compartment with reflecting metal foil and place a different coloured filter in front of each bulb. Suitable filters may be made by coating pieces of transparent glass or Perspex with an even layer of transparent coloured varnish such as Winsor and Newton Vitrina transparent glass painting colours, or transparent "lens marking colours" available at many art stores.

2. Use a box with only one compartment, and install coloured bulbs. Ordinary bulbs may be coloured using Deka transparent heat-resisting paint, available from art stores. With this method, it is a good idea to colour a few extra bulbs as spares.

The prototype used this method with a sheet of embossed Perspex fitted to disperse the light. Details for construction are given in Fig. 8.

TESTING THE TIMER

When construction has been completed and the unit checked and visually inspected, it may be switched on. The l.e.d. should light up when S1 is at RESET. Turn the timing control VR1 to give minimum time and switch S1 to the START position. The green lamp should light up, and the l.e.d. extinguish.

Check the INTERRUPT switch S2. When this is operated the blue lamp should light and the green extinguish, then back to green when S3 is set to CONTINUE.

After a timing period of just over 1 minute the green lamp

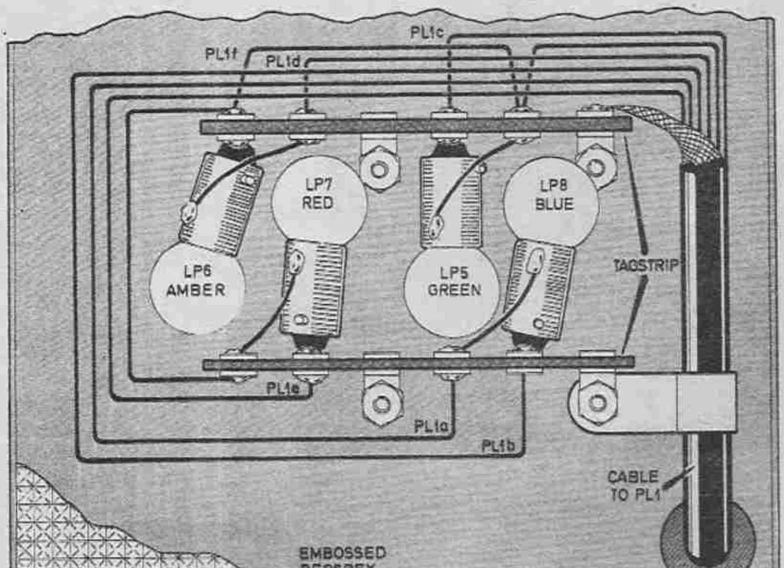


Fig. 8. The layout of the bulbs and wiring up details for the extension indicator box used in the prototype.

should extinguish and the amber lamp should light, and after about 2 minutes the amber lamp should go out and the red lamp should light. By changing the value of R3 the minimum timing period may be adjusted if necessary to suit individual requirements.

CALIBRATION

By setting VR1 to maximum resistance a time period of just over 20 minutes should be obtained. Adjust VR1 so that the total time period is 20 minutes and mark this point. Then turn it down until a time of 15 minutes is obtained.

By small adjustments of VR1, in succession, it is possible to obtain accurate positioning of the calibration marks, and the author found that timing could be made accurate to within a few seconds even for the longer periods of 20 minutes.

However, due to the time taken by these successive adjustments and tests a considerable amount of time should be allocated for the purpose and it is a good idea to settle down with a book, or some small assembly job, which can be done adjacent to the indicator lights.

Set VR1 to give a timing period of 10 minutes and place a small calibration mark in this position.

Leaving VR1 at the 10 minute position, set VR2 fully clockwise; the amber light will then come on quite early in the timing cycle, probably after 55 per cent or 60 per cent of the time has elapsed. The time remaining will then be 45 or 40 per cent of the total, so that a 45 per cent calibration mark can be placed after 5½ minutes have elapsed, and the amber lamp just lights, then after 6 minutes a 40 per cent mark can be placed.

Prepare to make a number of calibration marks in quick succession, at intervals of 30 seconds around the VR2 control. With VR1 still set at 10 minutes switch S2 to the START position, timing this as accurately as possible. Set VR2 fully clockwise, and when the amber lamp lights, you will find that by adjusting VR2 very slightly back and forth, the green and amber lamps will light alternately.

The position at which this alternation can be observed changes slowly due to the operation of the timing circuit, and calibration marks may be placed at 30 second intervals each corresponding to 5 per cent of the total time, so that marks may be placed from 40 per cent down to 5 per cent corresponding to 4 minutes remaining down to 30 seconds remaining when VR1 is set at 10 minutes.

Because the calibration of VR2 is expressed as a percentage of the total time set by VR1, VR2 cannot be calibrated in minutes for every setting of VR1; this would require a more complex circuit than the one presented in this article. This is not a major drawback as such percentages can be very readily worked out, especially so with the aid of a calculator!

The calibration points may now be labelled using Letraset or any similar method to give a presentable finish to the Conference Timer.

The user should find that functions may be timed electronically, effectively, tactfully, easily and fairly with the assistance of this device.

MINI-MODULES

By George Hylton

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

9

VOLTAGE SPLITTER

THIS month's Mini Module is a simple but effective circuit for turning a single-ended d.c. voltage supply into a centre-tapped supply. Such a supply is needed for powering operational amplifier circuits and other circuits which call for a three-rail supply with positive, zero-voltage and negative lines.

Normally the zero voltage rail is earthed or commoned but this is not obligatory and any *one* output terminal may be earthed. The circuit in the form given here (Fig. 1) can deliver enough output current for most low-power circuits. Higher outputs are obtainable by adding a power transistor output stage.

The *input* voltage is, however, limited to 30V by the ratings of the 741 op-amp, which is used. This gives a maximum output of 15-0-15V.

If what is needed is not a centre-tapped supply but one divided unequally, for example, 20-0-10V, this is easily arranged by a simple change of resistances. The low-voltage limit of useful input voltage is about 6V, to give outputs of 3-0-3V.

A 741 op-amp, IC1, is used to compare the output voltage with half the input voltage, as set by the voltage divider R1+R2. Any error is amplified and used to adjust the output voltage to the correct value. In other words the circuit acts as a negative feedback stabiliser but the reference voltage is not a fixed value but is half the input voltage, whatever that may be.

The BFY51 output transistor, TR1, is able to deliver more current than the 741 alone. It acts as an emitter-follower buffer amplifier and the maximum output current is as shown in the chart in Fig. 1.

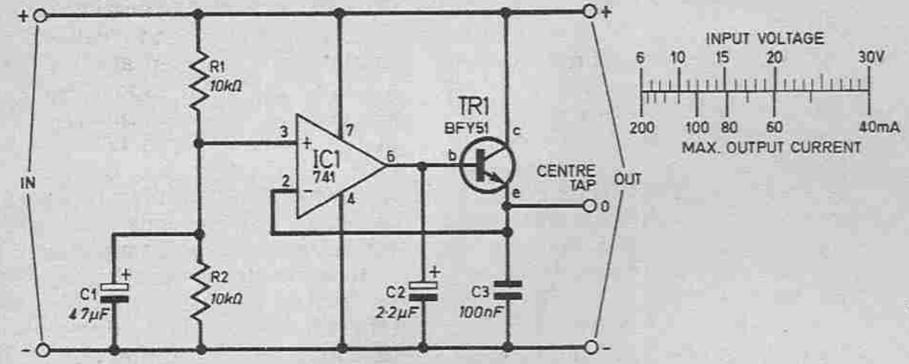


Fig. 1. Circuit diagram of the Voltage Splitter and input voltage/output current chart.

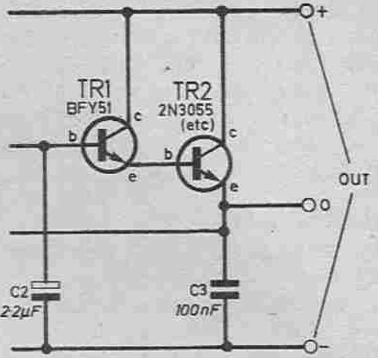


Fig. 2. The addition of a power transistor (TR2) for higher output currents.

CONSTRUCTION

A small piece of 0·1-inch matrix stripboard (such as given free with the March, 1979 issue of this magazine) forms a convenient baseboard. Four breaks in the conductor strips are required, below the 741 integrated circuit, which is in the 8-pin DIL format. Otherwise no preparation is needed.

The finished board can be mounted inside an existing power supply unit or (as here) put in a small plastics box such as the Norman Type PB1. No special mounting arrangements are required: the board can be hung on the input and output terminals by its own leads so long as these are of reasonably thick wire. (See Fig. 3.)

Components

Resistors
R1 10kΩ
R2 10kΩ
All carbon film, 5% tol. ¼W

Capacitors
C1 4·7μF 25V elect.
C2 2·2 or 3·3μF 25V elect.
C3 0·1μF met. polyester

Semiconductors
IC1 741 operational amplifier in 8-pin DIL package
TR1 BFY51 *npn* transistor

Miscellaneous
Stripboard (10 strips × 17 holes). Plastic case (Norman PB1). Five screw terminals. Five earth tags. Heat sink for TR1 (TO-5 cooler).

OPERATION

Connect the input and outputs. Take care not to exceed the maximum output currents shown on Fig. 1. Remember that only one terminal at a time may be earthed; if for instance the centre-tap is earthed it is not permissible to earth also the negative or positive terminal.

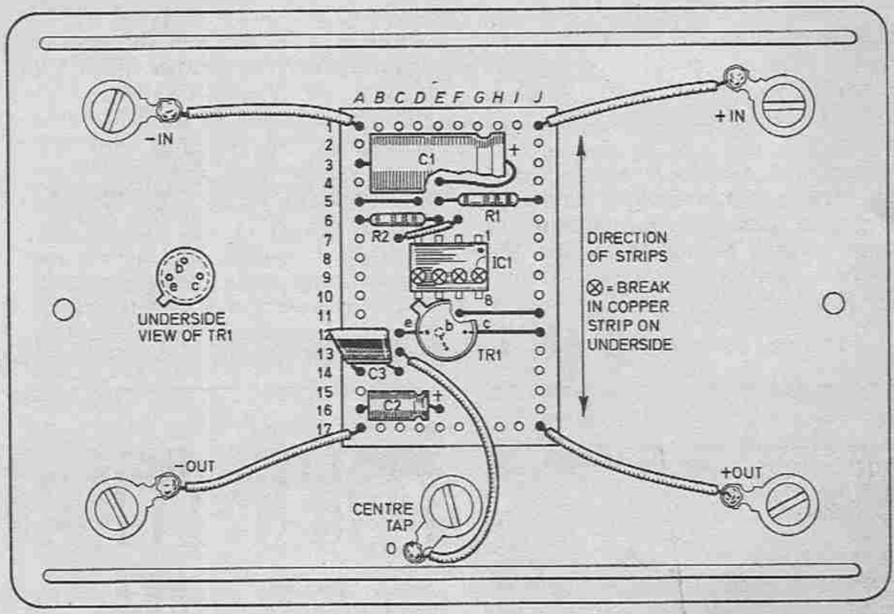


Fig. 3. The completed stripboard assembly mounted inside the plastics box.

OUTPUT OPTIONS

The maximum output current is limited by the permissible collector power dissipation of the BFY51. This is 600mW and gives the currents shown on the chart. A small increase (50 per cent) is obtainable by fitting a good cooling cap to the BFY51 (a useful thing to do anyway).

For larger currents a proper power transistor must be added, on an adequate heat sink (Fig. 2). The collector dissipation, with a centre-tapped output arrangement, is half the input voltage times the whole of the output current. Thus a 20V input arranged for 10-0-10V out at 1 ampere gives a dissipation of 10W.

The power transistor (a 2N3055 or similar TO-3 device) must then be mounted on a heat sink whose thermal resistance is low enough to prevent the transistor temperature from rising to a dangerous level when dissipating 10W. (Articles on the choice of heat sinks appear from time to time in magazines like this one.)

Another common requirement is for a stabilised negative rail, between output terminals "0" and "—". This can be arranged by exchanging R2 for a Zener diode, D1, whose operating voltage is the required stabilised negative output voltage.

If, instead of a centre-tap, some unequal division of the input voltage is required this is easily arranged by changing the relative values of R1 and R2.

For example, if the input is 18V and an output of 12-0-6V is required, R2 should be half R1 since it will then drop one third of the input voltage. In other words the usual voltage-divider rule applies:

$$R1/R2=(V_{in}/V_{out})-1$$

where V_{out} is the tap voltage.

Next month: Electronic Swanee Whistler.

For your ENTERTAINMENT

By ADRIAN HOPE

Master Inventor

I was in the USA recently researching the story of a millionaire inventor by the name of Armstrong who committed suicide twenty-five years ago. He killed himself because he could no longer face the burden of literally a score of legal actions which involved his patents.

Who?, said most people, when I told them I was visiting New York's Columbia University Library to scratch the surface of nearly a quarter of a million Armstrong documents archived there. It's a predictable query because the world of electronics owes more to Major Edwin Howard Armstrong than many people will ever realise.

It was Armstrong who in 1912, and while still a student at Columbia University, discovered how to turn the primitive triode or audion valve invented six years earlier by Lee de Forest into an amplifier and oscillator. It was Armstrong who in 1918, while serving in the Signal Corp in France, devised the super heterodyne solution to receiving radio waves of much higher frequency than had previously been feasible.

It was Armstrong in 1921 who invented a super-simple amplifying principle which made him a millionaire but has never been fully exploited and is today forgotten by all but the most avid radio enthusiast. It was Armstrong who in 1933 proved the mathematicians wrong and succeeded with the theoretically impossible by achieving static free transmission and reception using frequency rather than amplitude modulation.

Feedback

There is no doubt that it was Lee de Forest who in 1906 first came up with the idea of adding a third electrode to the diode rectifying valve which had been invented two years earlier by John Ambrose Flemming of University College London. But there is also little doubt that de Forest saw the triode or audion simply as a glorified rectifier or detector. De Forest was also very hazy over how the audion actually worked, talking in his patents only vaguely of "molecular activity" and "hot gas detection" and admitting that "the action and theory" of the extra grid electrode was "merely hypothetical".

The young student Armstrong had the classic enquiring mind and was dissatisfied with Lee de Forest's explanations because they actually explained nothing. It was while looking for a fuller answer to why the triode grid improved detection that Armstrong hit on the idea of feeding back some of the anode output into the grid input via a tuned inductance.

Thus was the idea of feedback or regeneration born, and with it the phenomena of amplification and oscillation as we know them today.

Heterodyne

In the meantime, Armstrong had joined the army and during the First World War set his enquiring mind to the problem of detecting and amplifying high frequency radio signals with feedback valve circuits intrinsically unsuitable for the purpose.

His solution was brilliantly simple. He heterodyned or "beat" the incoming high frequency signal with a locally generated high frequency signal of fairly close frequency. This produced a difference or "intermediate frequency" signal which could easily be handled by conventional feedback amplifiers. Thus was the concept of super heterodyning and i.f. amplification conceived.

It made Armstrong even more rich and famous and nobody ever seriously disputed his rights on the idea. Virtually every radio receiver in use today relies on both the feedback and superhet ideas originally conceived by Armstrong.

Super Regeneration

In 1921 Armstrong devised a way of taming the wild oscillation of a feedback circuit so that it operated as an enormously efficient amplifier. He did this by continuously varying the relationship between the feedback and damping factors to establish a new and artificially high state of amplifying equilibrium without oscillation. It seemed as if 'super-regeneration', as Armstrong christened the system, would offer the world ridiculously cheap amplifiers and radio receivers.

Frequency Modulation

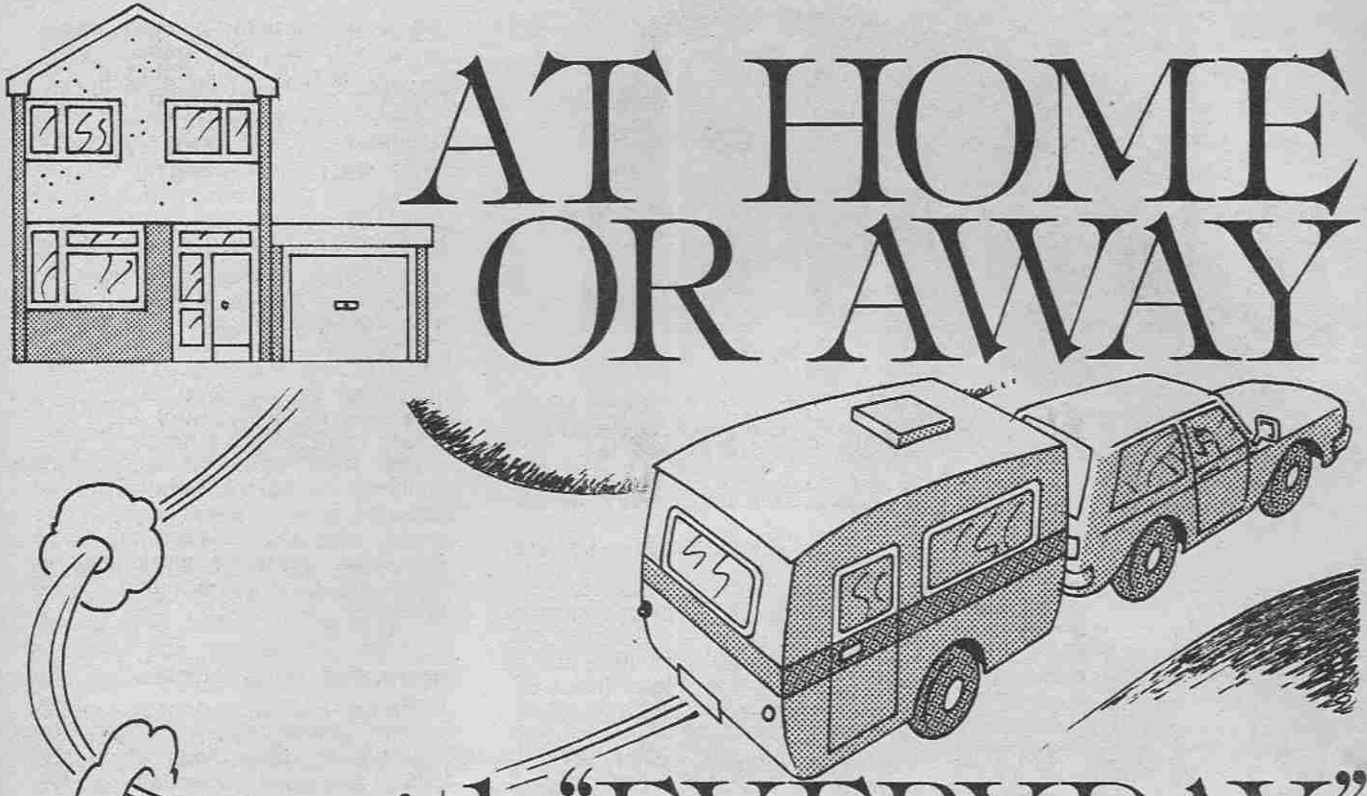
The fourth, final and most famous Armstrong invention, frequency modulation (f.m.), was made in 1933. Here he succeeded by researching the problem of static interference on radio in exactly the opposite direction to that which everyone else had taken.

With a.m. transmission it was established practice to use a receiver with a wide bandwidth tuning "window" which accepted as much wanted signal as possible to swamp unwanted a.m. static noise. But attempts at using the same technique with f.m. showed that there was f.m. static as well, albeit at a fairly low level.

As a stroke of genius Armstrong *narrowed* the reception tuning window, heavily modulated the f.m. carrier with the programme and used drastic a.m. limiting at the front end. The a.m. limiting eliminated static noise due to a.m. and the narrow reception window allowed in only a little f.m. static noise. This was swamped by the wanted programme on the heavily modulated f.m. carrier.

By 1934 Armstrong was transmitting static free f.m. radio on an experimental basis from the top of the Empire State Building in New York. By 1939 he had built his own f.m. station at Alpine Heights, seventeen miles from New York and this broadcast commercial-free f.m. radio, at Armstrong's expense, until his death in 1954.

He killed himself because f.m. became a commercial success after the Second World War and it galled him to see some of the largest radio manufacturers in the USA cocking a snoot at his f.m. patents while others paid royalties.



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BIT SAVER

By R. A. PENFOLD

A COMMON problem with soldering irons which do not have thermostatic control is that of a surprisingly short bit life. One soldering iron used by the author, admittedly for frequent and prolonged periods, has an average bit life of only about six weeks!

The main reason for this is that most soldering irons are designed to be able to carry out almost constant, heavy duty soldering jobs. They therefore have a fairly high power output as otherwise the soldering iron bit would soon drastically fall in temperature when undertaking demanding soldering jobs, with the bit tending to "freeze" to the joint in consequence.

Normal amateur requirements do not require a powerful iron, with the majority of joints being quite small and intricate, and requiring little power. The excess power tends to cause overheating, and a reduction in bit and element life.

Another cause of overheating is that even when switched on, the soldering iron probably spends a good deal of time in its stand, particularly when troubleshooting or undertaking experimental work. Most soldering iron stands are designed to have a heatsinking effect, but this is unlikely to be enough to prevent overheating.

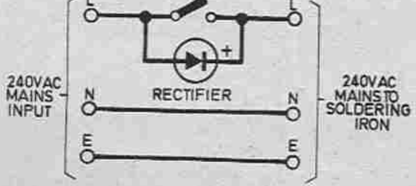


Fig.1. A simple method of enabling a soldering iron to run at reduced power is to switch in a silicon rectifier. In normal operation the rectifier is short circuited by the switch, and only comes into operation when the iron is in the stand.

There are probably other contributory factors, such as many irons having a nominal supply voltage of 220V, whereas the standard UK mains voltage is 240. And in many areas it is usually a little higher than this in actual fact. It is also very easy to leave a soldering iron left on after a soldering session.

REDUCED POWER

One way of overcoming this problem is to run the iron at reduced power while it is in its stand, and the usual method of achieving this is shown in Fig .1. This merely consists of a switch and a rectifier connected in parallel with one another, and wired in series with one input lead of the iron.

Full power will obviously be applied to the iron when the switch is closed. When the switch is open, some power will still be supplied to the iron since the rectifier will conduct on one set of mains half cycles. However, the other set will be blocked, and the iron will be run at half power. This is enough to bring the bit up to soldering temperature while the iron is in its stand. When out of its stand and in use, the switch is closed and the power needed for normal useage will be available.

The switch could be operated manually, but it is more convenient to have automatic operation by either using a micro switch, or, as in this case, a simple electronic switching circuit.

CIRCUIT DESCRIPTION

The circuit diagram of the Bit Saver appears in Fig. 2.

Mains transformer T1 isolates the circuit from the mains and provides a low voltage output which is full wave rectified by D2 and D3 and smoothed to a steady d.c. voltage by C1. This produces a nominal supply voltage of about 9 volts.

Diode D5 is a panel mounted light emitting diode and is fed from the supply rails through current limiting resistor R2. This is merely a pilot light and reduces the likelihood of the soldering iron being accidentally left switched on.

Transistor TR1 is an emitter follower amplifier and it has a relay coil as its emitter load. A set of normally closed relay contacts are used and they are connected in series with the live power lead to the soldering iron. Thus, full power is applied to the soldering iron when the relay is not activated.

As the circuit stands, TR1 will receive no base current, only leakage currents will flow through its emitter circuit, and the relay will therefore be switched off. The base of TR1 is connected to the soldering iron stand via R1 and a connecting cable.

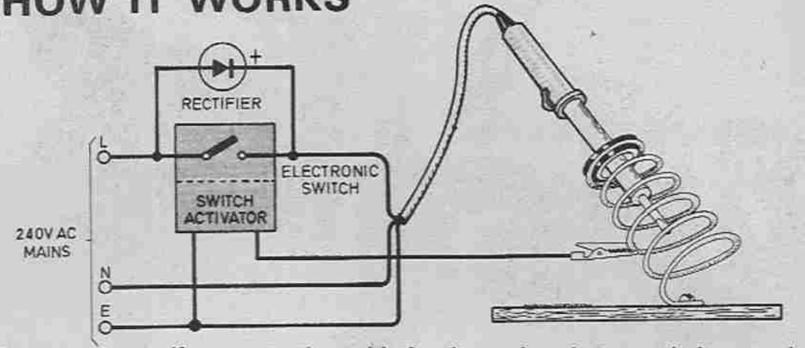
RELAY SWITCHING

It is assumed that the soldering iron is a type which has an earthed bit (any normal iron for use in electronic applications will be of this type), and so when the iron is in its stand the left hand side of R1 will be connected to earth.

As the positive supply rail of the circuit is earthed, this will result in the left hand side of R1 being connected to the positive supply rail. This results in a large base current being fed to TR1, and so an emitter current of sufficient level to switch on the relay is produced.

When the relay switches on, the two relay contacts open and power is supplied to the soldering iron through D1. This removes one set of mains half cycles and so only half power is applied to the iron. In this way the soldering iron is switched on normally when out of its stand, and is only driven at half power when in its stand.

HOW IT WORKS



By supplying half power to the soldering iron when it is not being used, an increase in bit life is obtained. In this circuit a *silicon rectifier* is caused to be switched in and out by an *electronic switch.* When the iron is inserted in its stand, a circuit is made between the earth lead of the iron and the stand. This turns on the *switch activator* which then turns on the *electronic switch,* which opens to allow the rectifier to come into operation. Thus half power is being applied to the iron. When the iron is removed, the circuit is broken, the *electronic switch* closes and removes the rectifier. The iron thus quickly heats up to its normal temperature ready for use.

The iron is powered through a rectifier rather than a dropper resistor when driven at reduced power as a rectifier is cheaper, smaller, and does not generate any significant heat.

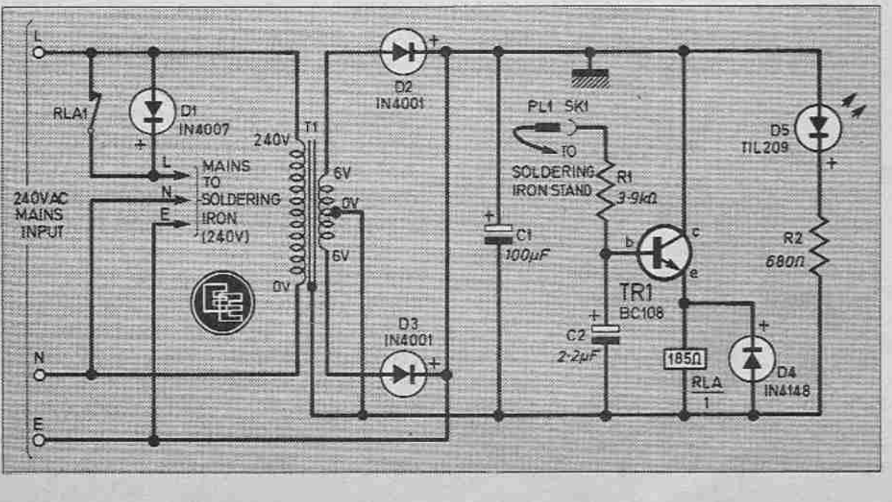
The relay is operated via an amplifier so that only a small switching current is needed, and even a fairly poor connection is good enough to produce proper operation from the equipment.

Capacitor C2 prevents rapid switching of the relay as the iron is placed in, and removed from its stand. This could otherwise result in reduced relay contact life and the radiation of radio interference.

Resistor R1 is a current limiting resistor and prevents a high surge current flowing as C2 initially charges up. This surge would be undesirable as it could cause a small spark as the iron touched the stand, with reduced bit life occuring in consequence.

Diode D4 is a protective diode, and this suppresses the high reverse voltage that would otherwise be generated across the relay coil as it de-energised. If not suppressed, this could be of high enough amplitude to damage the semiconductor devices in the circuit.

Fig. 2. Complete circuit diagram of the Bit Saver.



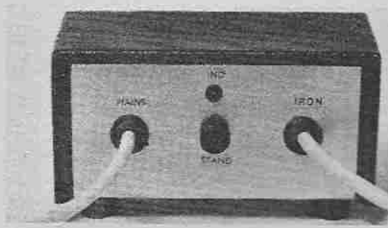
CONSTRUCTION starts here

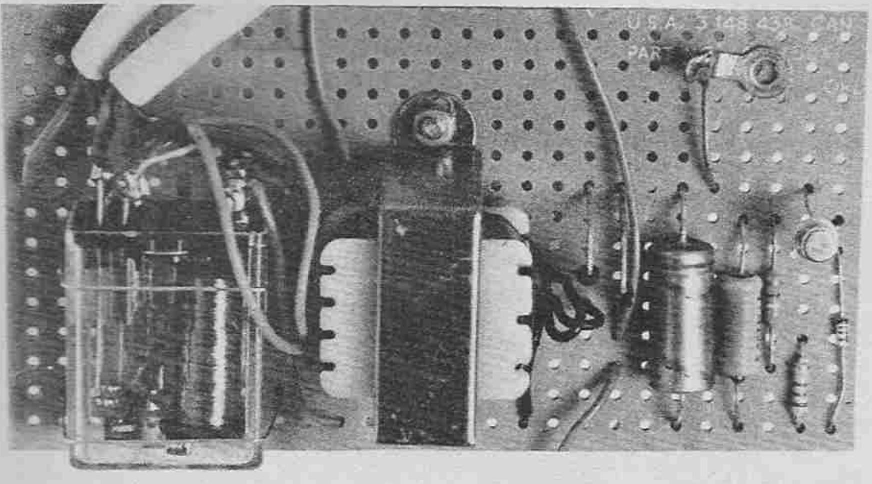
CIRCUIT BOARD

The prototype circuit was built on a piece of 0·15-inch matrix stripboard having 14 strips by 27 holes, and it is housed in a small metal instrument type case which has approximate outside dimensions of 112 x 42 x 55mm. Any similar case should also be suitable, but it is recomended that a metal case should be employed and that it should be earthed.

The component layout of the stripboard panel is shown in Fig. 3. Start by cutting the board to size and then drill the two mounting holes plus the mounting holes for T1. These are all drilled 6BA,

BIT SAVER





The completed circuit board for the soldering iron bit saver.

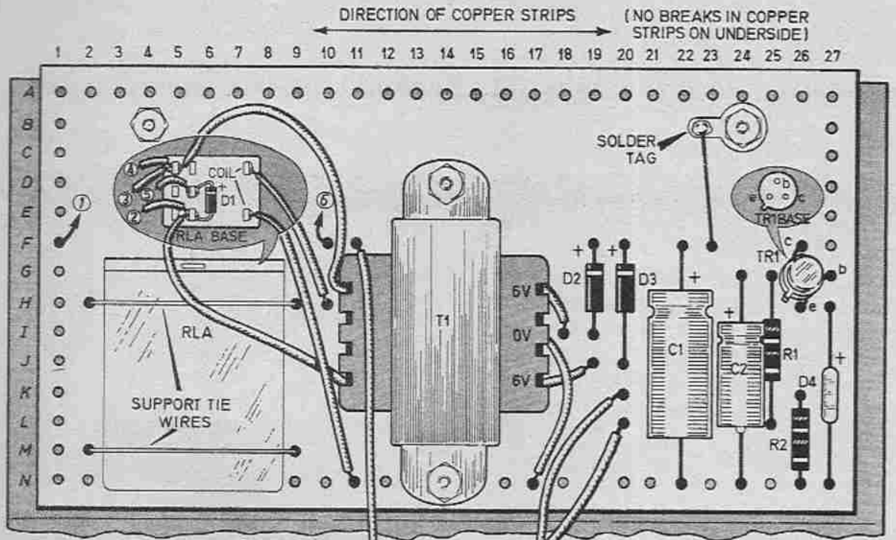


Fig. 3. Wiring details for the unit. The front and rear panels of the case have been opened out for clarity. There are no breaks to be made on the stripboard. Note that the transformer does not need to be of the same type as specified. If a different type is used then there is a possibility that it will not fit on the board, if this is the case then mounting it on the case will be the best idea.

clear, about 3·2mm in diameter. No breaks in the copper strips are required.

Next T1 is bolted into position and the relay is mounted on the board. The latter is glued into place, and a couple of single strand wire loops, about 22 s.w.g., are used to hold it firmly in position. It is not essential to use the specified relay, and any type having a nominal coil voltage of about 6 to 12V, a coil resistance of about 150 ohms or more, and at least one set of normally closed contacts capable of switching mains voltages, is electrically suitable. Other types may necessitate some alterations to the physical construction of the unit though.

COMPONENTS approximate cost £6 excluding case

The various components are then soldered into the appropriate positions on the board, except D1 which is mounted on the two relay contacts that are utilized. Also connect the solder tag, this being used to provide the earth connection for the case when the component panel is bolted to the case

FRONT PANEL

A hole for SK1 is drilled in the centre of the front panel of the case and D5 is mounted just above this in a plastic panel holder. A hole for the mains input lead is drilled on the left-hand side of the front panel, and a hole for the soldering iron lead is drilled opposite this. Both these holes are fitted with grommets. The component panel will be mounted on the rear panel of the case, and suitable mounting holes must be made here.

Before mounting the component panel, wire it up to D5 and SK1 using ordinary multistrand p.v.c. covered connecting wire. Also thread the mains input lead and the soldering iron lead through the front panel holes, and then wire them to the relay and component panel. One tag of the unused set of relay contacts is used as a suitable junction point for neutral connections of the mains lead, soldering iron lead and T1.

Do not use the spare tag of the relay contacts that are used, for this would short circuit the mains supply.

COMPONENTS

Resistors
R1 3·9kΩ
R2 680Ω
Both ¼W carbon ± 5%

Capacitors
C1 100μF 10V elect.
C2 2·2μF 10V elect.

Semiconductors
TR1 BC108 silicon *npn*
D1 1N4007 silicon
D2, D3 1N4001 silicon (2 off)
D4 1N4148 silicon
D5 TIL209 red light emitting diode

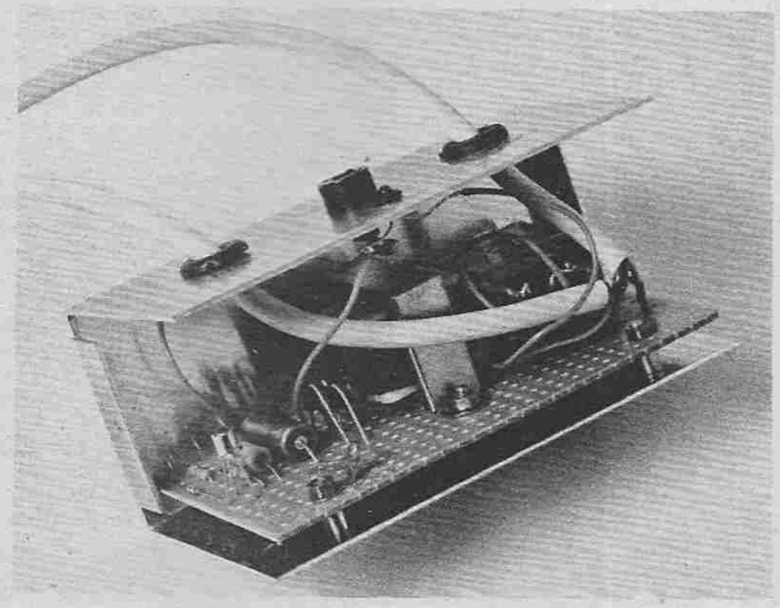
Miscellaneous
T1 mains primary 6–0–6V at 100mA secondary
RLA 6 to 12V, coil resistance 185Ω, with one set of normally closed contacts.
SK1 wander socket
PL1 wander plug
Stripboard, 0·15 inch matrix 14 strips by 27 holes; small metal case 112 × 55 × 42mm or similar; crocodile clip; two rubber grommets; mounting clip for D5; solder tag; standard connecting wire; length of mains cable as required.

See **Shop Talk** page 426

FITTING THE IRON

If a separate soldering iron is not available it will obviously not be possible to solder the lead from the iron direct into circuit. One way around this is to use a three way connector block so that the soldering iron lead can be connected into circuit using screw terminals.

Connector blocks are usually sold in twelve-way strips, and a block of the required length is simply cut off using a sharp knife.



Interior view of the U-shaped chassis showing the method of mounting the circuit board on spacers. Care must be taken to ensure that SK1 solder tag does not short on the transformer.

An alternative method is to use a larger case so that a mains socket can be mounted on it. The three output leads would then connect to this socket and the soldering iron would plug into the socket. In some ways this is the best form of construction, although it would be more expensive and difficult to build.

Finally, the component panel is mounted on the rear panel of the case using countersunk 6BA screws, and spacers about 6mm or so long are used to keep the connections on the rear of the component panel clear of the metal casing.

USING THE UNIT

A connection is made to a metal part of the soldering iron stand via an insulated lead terminated in a wander plug (which fits into SK1) at one end, and a crocodile clip which clips onto the stand at the other end.

If the crocodile clip is a type having a plastic cover, this should be removed as it is likely that the clip will become quite warm in use. The prototype equipment was tested and used with an Antex type ST3 soldering iron stand, and as this has a spring-like metal part which actually holds the iron, there is no problem in making the connection to the stand.

When the iron is placed in its stand, the relay should be heard switching on almost immediately. When the iron is removed from the stand there will be a delay of about one second before the relay is heard switching off.

The equipment has been noticed to work properly even when the stand is quite dirty with flux, and the soldering iron bit is quite dirty and corroded. However, if either of them are excessively dirty it is likely that the electrical connection between the two will be inadequate for correct operation to occur. ⌑

DOING IT DIGITALLY

PART 10

By O. N. Bishop

THIS MONTH we look at some digital circuits for making noises and ways of interfacing these to the outside world to produce alarm systems and others that give audible output.

TTL OSCILLATOR

The simplest form of sound generator is the circuit shown in Fig. 10.1a, ignoring the connection to CLOCK. You may recall that this is the circuit used for the Test-Bed built-in clock. The way it works was described in Part 3. The values of the capacitors C1 and C2 have been chosen to give an audible output.

The output is fed to the speaker via capacitor C3. This can have any value over the range 1μF to 100μF, but if its capacitance is smaller than about 0·47μF there is a reduction in the volume of sound produced by the speaker. When wiring and testing this circuit on the Test-Bed, the unused inputs of the gates may be left floating (effectively high inputs), but if you are building this circuit as a permanent device, such as a door buzzer, or morse code practice set, the unused inputs should be joined together and connected to V_{cc} through a 1 kilohm resistor.

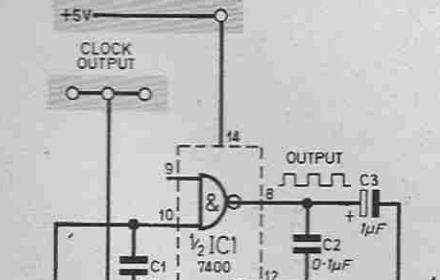


Fig. 10.1a. Circuit for an intermittently sounding audible tone generator.

Since this circuit is identical to that of the Test-Bed clock, you can use the clock itself as the sound generator for most of the other circuits described this month. It should be switched to its highest frequency (450Hz), but you have the advantage of being able to run it at low frequency if you want to follow the stages of operation of a circuit.

INTERMITTENT TONES

An intermittently sounding note catches the attention much more readily than a continuously sounding note, especially in a noisy environment. We use a second oscillator, running at low frequency (say 1Hz) to achieve this. The low-frequency oscillator consists of two NAND gates connected as in Fig. 10.1a but the values of C1 and C2 are in the range 220μF to 1000μF.

The output of this oscillator is taken to one of the unused inputs of the a.f. oscillator. When the low - frequency oscillator output is high, the a.f. oscillator can operate and sound is produced. When the low - frequency oscillator output is low, the output of the gate to which it is connected is continuously high, whatever the state of the other input to that gate. The a.f. oscillator is inhibited, and no sound is produced. The result of this action is an intermittent tone.

By varying the values of the capacitors of the low-frequency oscillator, making one, say, 250μF and the other 1000μF, you can alter the duty cycle and so vary the effect, obtaining a series of short "pips" with a relatively long time-interval between them, or a series of longer bursts with short periods of silence.

Wire up this oscillator on the Test-Bed as shown in Fig. 10.1b. As shown, the clock output (at low or medium frequency) is being used to provide the low-frequency output required for the intermittent note. Having used the clock as shown disconnect it and wire up a complete low-frequency oscillator, using the two remaining NAND gates of IC1.

As a door alarm, this circuit is based on only a single 7400 i.c. producing a cheap and effective system. As such, the wire ending *A* is connected through a 1 kilohm resistor to V_{cc}. The note is made to sound

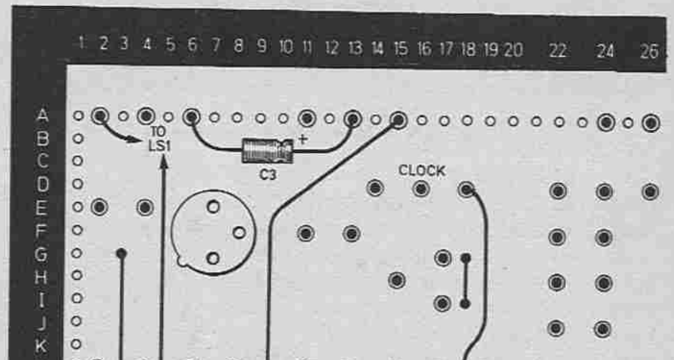


Fig. 10.1b. The circuit of Fig. 10.1a wired up on the Test-Bed

by switching on the power, for example, by pressing a bell-button.

Although we use a 5V supply on the Test Bed, a 6V dry cell with series "dropper diode" can more conveniently be used to power a door-alarm system. Please note that a door-bell transformer supplying 6V alternating current output should definitely *not* be used.

If you touch wire *A* to ground, the action of the a.f. oscillator is inhibited and no note is heard. The only sound is a series of very soft "ticks" as the low-frequency oscillator changes state. This is an indication that the system is working though not triggered to emit the intermittent sound. When *A* is removed from ground, the note is heard. This gives us a clue as to how the sounding of the note can be controlled by logic circuits.

If *A* is connected to the output of a logic gate, the alarm is silent as long as the logic gate output is low, but sounds as soon as the logic gate output goes high.

We will next investigate how various events can be made to trigger a gate to give a high output, and so sound the alarm. In other words, we are going to interface the alarm system to various kinds of happening in the outside world.

LIGHT DETECTOR

The light sensor and the high speed light sensor, described in Part 7 can both be interfaced to an alarm system. As explained in Part 7, these sensors give a high output either when light level falls or when it rises, depending on how they are constructed. Thus the output from either type of light sensor is suitable for controlling the action of the simple TTL a.f. oscillator of Fig. 10.1a, in place of CLOCK, or the more complicated intermittent tone generator.

A light-triggered alarm system has many uses. As an intruder alarm it can be made to operate when a light beam is broken. If we use daylight, a room lamp, or a distant street lamp as the light source, the alarm sounds when the shadow of the intruder falls on the photosensitive device. The alarm can be triggered by the headlights of an arriving car, or by the light of the rising sun.

If you intend to use the latter as an early morning wakener, be prepared for a late awakening on dull cloudy mornings!

If connected as described, the alarm sounds only while the light sensor is responding to changed lighting conditions. This may be suitable in many applications, but if you wish the alarm to continue to sound indefinitely after it has been triggered, connect a bistable between light sensor and alarm as shown in Fig. 10.2.

TRIGGER LEVEL

The variable resistor VR1 allows the triggering level to be set. You may find that you can dispense with this resistor altogether if your system is intended for working at fairly high light levels. The required bistable consists of one gate that is already part of the high-speed light sensor circuit, and the other unused gate of the 7413 i.c., a Schmitt trigger.

If you have already built the high speed light sensor as a separate module, it is a simple matter to amend the connections to the 7413. The whole triggered alarm circuit requires only two i.c.s and is a good illustration of the way one can design and build digital circuits from very simple units.

If you wire up this circuit on the Test-Bed, you will find that it is triggered by an increase of light falling on the phototransistor. It could be triggered by a flash from the headlamps of an approaching car, or from the torch of an intruder. It could also be used to detect fire.

If you need the opposite function, connect the input of the a.f. oscillator to point *B* instead of to point *A*. In either mode you will find that when the circuit is correctly adjusted its speed of operation is extremely high. If the beam is broken for an instant (or the briefest flash of light occurs) the alarm is triggered. You will find it difficult to "beat the system." If you do not need response to such brief events, you can use the other light sensor, based on a light-dependent resistor. This can be modified and coupled to the alarm circuit in a manner similar to that already described.

OTHER INTERFACES

The circuits for a number of other interfaces are shown in Fig. 10.3 to Fig. 10.5. The thermistor RTH1 in Fig. 10.3 is a bar, disc or bead of semiconductor material. As temperature increases the resistance of the thermistor decreases. As a result of this, the voltage at point *A* falls. When it has fallen to approximately 0·8V, the input to the NAND Schmitt gate reaches its lower threshold. At

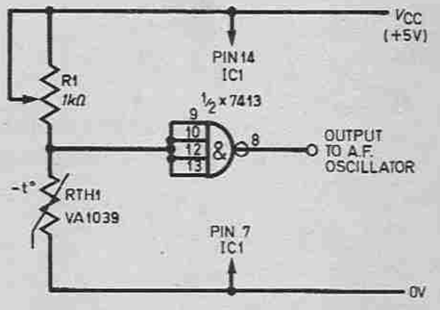


Fig. 10.3. Thermistor interface circuit; RTH1 has a resistance of 470 ohms at 25 degrees C.

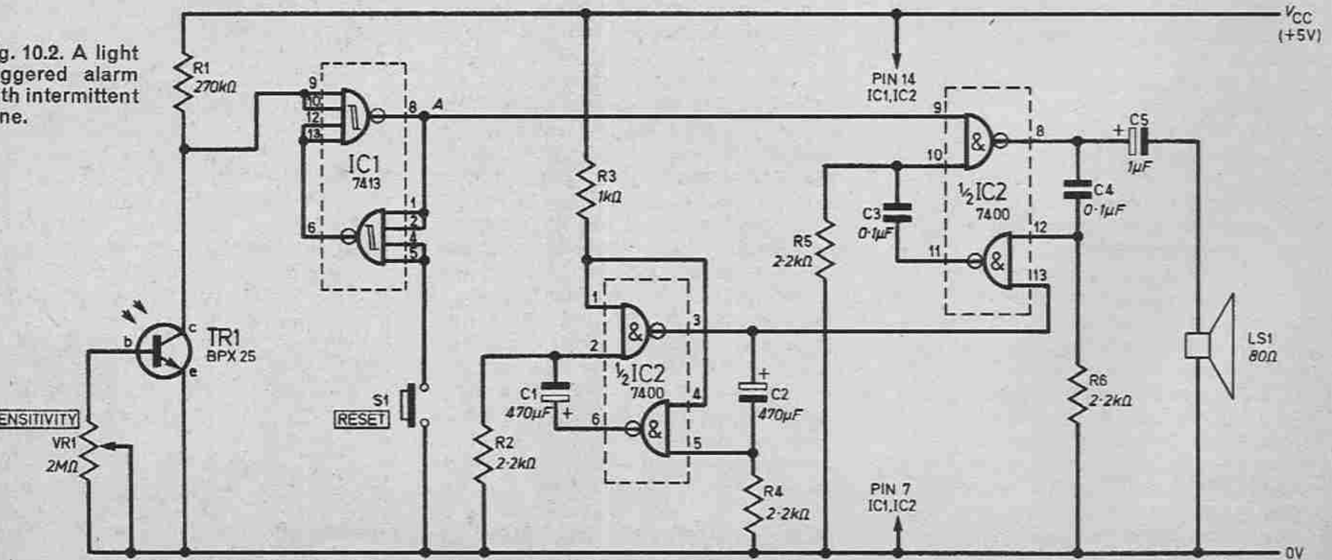


Fig. 10.2. A light triggered alarm with intermittent tone.

this stage the output of the gate changes from low to high. If connected to the alarm circuit, this high output allows the a.f. oscillator to operate and an alarm sounds. The level at which triggering occurs can be set by adjusting the variable resistor VR1.

The reverse operation, causing the warning to be sounded when temperature drops *below* a given level, can be obtained by interchanging the thermistor and the variable resistor. This could have applications as a frost warning device, or to indicate that the greenhouse temperature is lower than it should be.

Note that the thermistor can be connected to the remainder of the circuit by leads several metres in length, so that the thermistor can be situated outdoors and the power supply and alarm circuit to any convenient location indoors. By choosing a thermistor with an appropriate resistance value at 25 degrees Centigrade, and choosing a corresponding value for VR1, the interface can be designed to operate at any required temperature over a very wide range.

MOISTURE SENSOR

The moisture-detecting interface (Fig. 10.4) depends on the electrical conductivity of water. The probe can consist of a piece of stripboard with alternate strips wired together. Placed outdoors where it is exposed to rain, the probe becomes conductive when a raindrop bridges the gap between two adjacent strips. This allows base current to flow to TR1. When the transistor switches on, its collector potential falls, giving a low input to the NAND gate. The resulting high output from the gate is fed to the a.f. oscillator of the alarm circuit.

Another form of probe consists of two bare wires, mounted a few millimetres apart. These can be used to detect a rising water level in a tank or bath, giving warning when the water has reached a certain level. The reverse action can also be obtained by simply omitting the NAND gate and connecting the collector terminal (point *A*) directly to the a.f. oscillator.

This interface is able to detect water, even when it is present as a thin film, as you can demonstrate by pressing a moist finger-tip on the probe plate.

To make a soil moisture probe, two parallel wires about 3cm long and about 0·5cm apart are thrust into the soil. Conduction through the soil from one wire to the other is sufficient to supply adequate base current to TR1.

In normal use, the collector of TR1 is connected directly to the a.f. oscillator. If the soil becomes dry, conduction is reduced, TR1 switches off and its collector potential rises. This allows the alarm to sound. This interface has several applications in the home, garden or greenhouse.

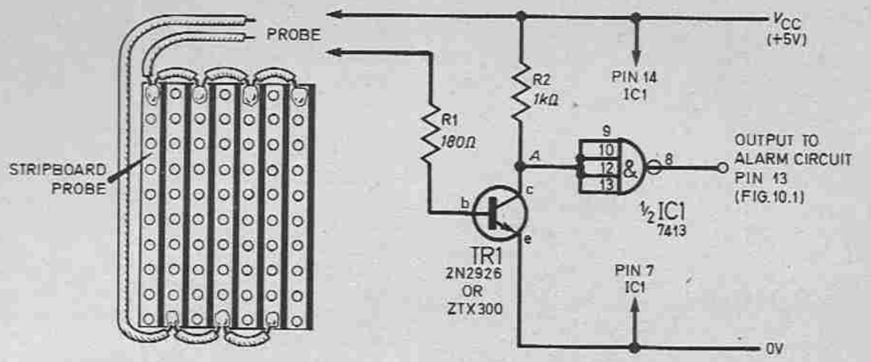


Fig. 10.4. Moisture detecting interface with probe for detecting rain.

SUPER-SENSITIVE INTERFACE

The interface shown in Fig. 10.5 detects currents even smaller than those detected by the interface of Fig. 10.4. When using this interface you may find that the small current flowing between the probe wires or plates is sufficient to switch TR1 on. In these applications, VR1 may be omitted. If the interface is required to operate under conditions of very low moisture content, VR1 is required.

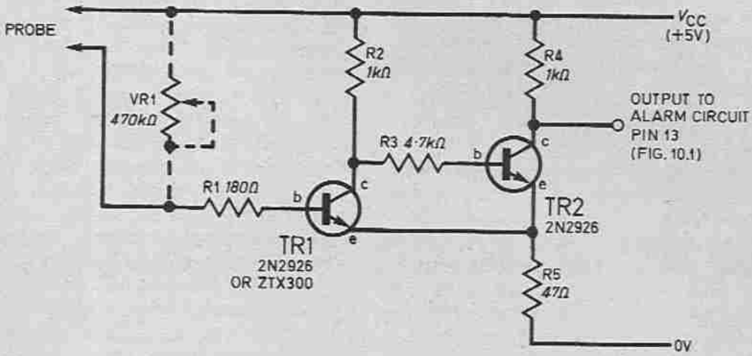


Fig. 10.5. A more sensitive conductivity interface; VR1 is optional, see text.

After adjusting the setting of VR1 so that base current is not quite enough to turn TR1 on, we rely on the small additional current flowing between the probe wires to supply the deficiency; TR1 turns on and the output of the device is low. The alarm is silent. When conditions become drier, the flow between probe wires is reduced and that flowing through VR1 is insufficient to supply TR1 which turns off and the interface output goes high. The alarm sounds.

This interface can be connected to a touch-plate consisting of two metal strips or plates mounted on a non-conductive material, with a narrow gap between them. For this purpose you can use a small piece of stripboard, wired as in Fig. 10.4, or make a touch plate by etching a design on copper-clad board. Suitable designs are illustrated in Fig. 10.6.

When the gap is bridged by a finger-tip, conduction through the skin is enough to operate the interface.

If this interface is connected directly to the alarm circuit, the alarm sounds for as long as the touch-plate is contacted.

This combination of circuits has applications as a door-alarm, or as a bedside alarm system for an invalid incapable of operating an ordinary push-button.

The circuit of Fig. 10.5 is not restricted to moisture detection. The reader may like to investigate the use of this circuit with a light-dependent resistor, a phototransistor or a thermistor connected in place of the probe wires, in parallel with VR1. It should be possible to build a sensor that responds to very small changes in incident light, or in temperature.

Yet another modification of the previous circuit is shown in Fig. 10.7a. Here we use the small current generated by a crystal microphone when sound waves make it vibrate. A sound-operated interface has several applications, including detecting intruders, listening for the telephone bell, or sounding an alarm when baby

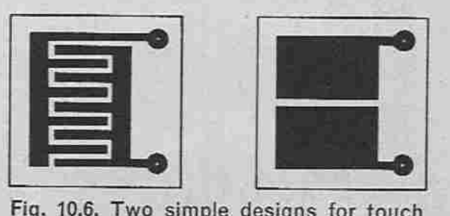


Fig. 10.6. Two simple designs for touch plates on p.c.b.

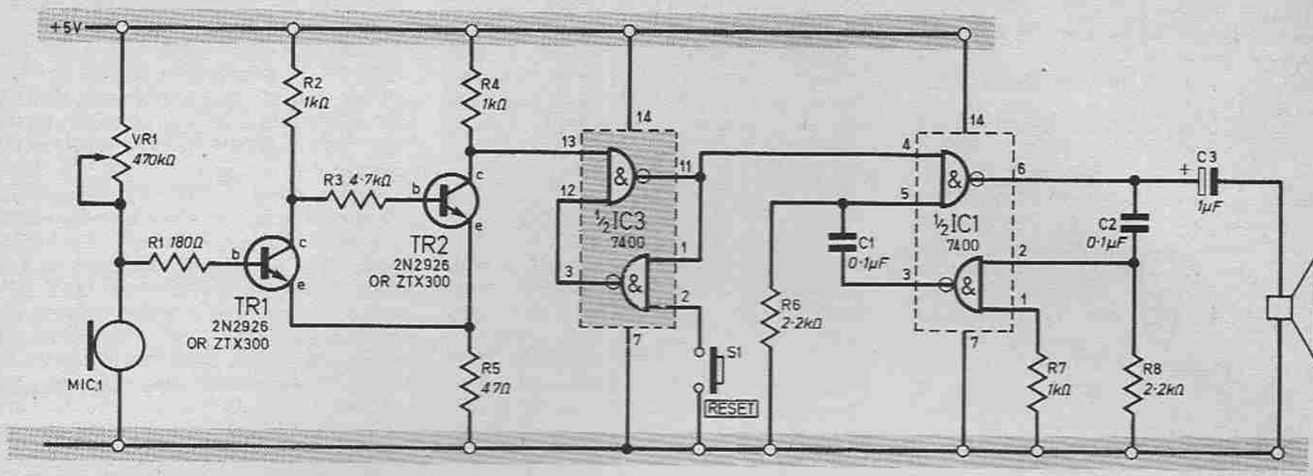


Fig. 10.7a. A sound triggered interface operating a simple audio generator and loudspeaker.

cries. The circuit incorporates a bistable, for it is assumed that we require that the noise which is of relatively short duration will trigger the alarm to sound for a longer period, until the reset button is pressed.

When sound is received by the microphone a brief, irregularly alternating current is produced. The high peaks of this current add to the steady current flowing through VR1. The current through VR1 is *just* insufficient to turn on TR1, but when the additional current flows, TR1 is turned on for very brief periods of time. The first time that the interface output falls low, the bistable changes state, even though the output may be low for only a very short period. From then on, until it is reset, the bistable output is high and the alarm sounds.

SOUND OPERATED ALARM

In Fig. 10.7b we see how the sound-operated alarm system is set up on the Test-Bed. In this version the note is continuous, though an intermittent note can be obtained if the clock output is connected to Test-Bed location *P4* and the 1 kilohm resistor is omitted.

In a permanently wired unit, the low-frequency oscillator could be built around the other two gates of the 7400. The emitters of the transistors are not to be connected directly to ground so the transistor socket of the Test-Bed cannot be used. Instead the transistors are mounted on the "free" strips at the lower edge of the board. Resistors R2 and R5 cannot be connected directly to V_{cc} or ground, as their leads are not long enough; instead, use is made of the connections between pins *DD17* and *DD19* and between pins *EE21* and *EE23*, since the corresponding i.c. socket is unoccupied.

When setting up the circuit it is not necessary to use the oscillator for testing purposes; this spares neighbours a certain amount of noise. The interface circuit is first connected to two l.e.d.s (dotted lines), which indicate the state of the bistable. In a reasonably quiet environment the setting of VR1 is first adjusted to a position in which the interface is just *not* triggered. The easiest way to do this is to turn VR1 to minimum value and then repeatedly press the reset button. The bistable remains permanently set, but if VR1 is then turned *slowly* toward its maximum value, and reset is pressed repeatedly, a point is eventually reached at which resetting occurs.

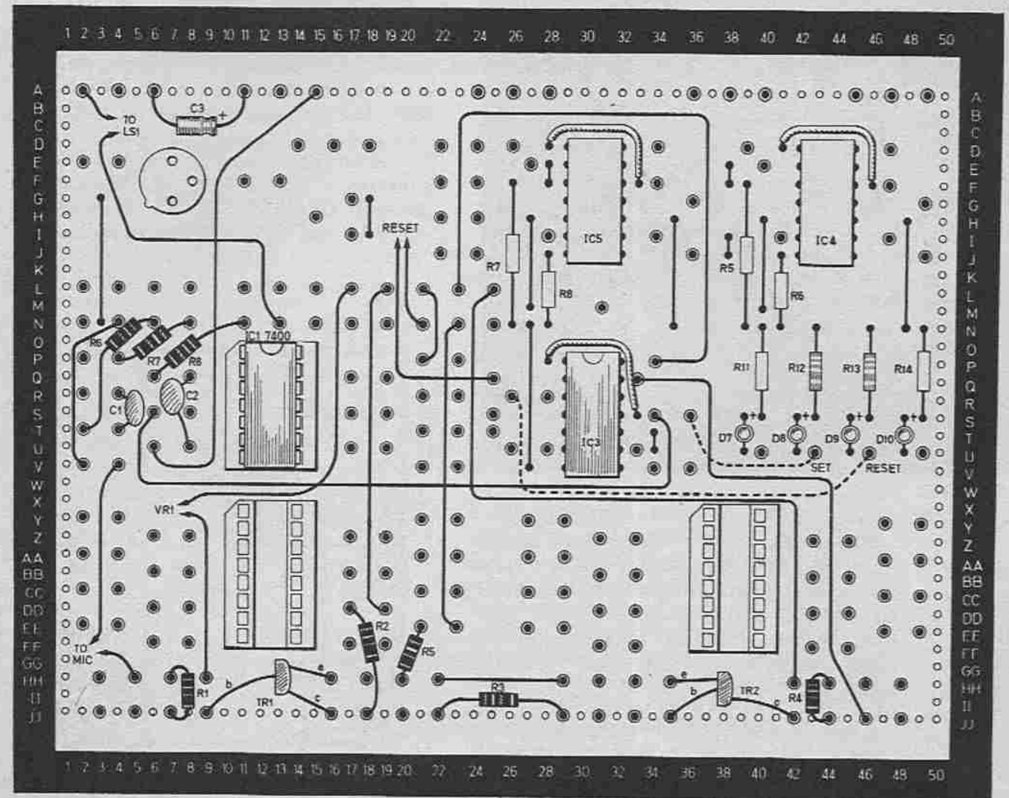


Fig. 10.7b. The circuit of Fig. 10.7a wired up on the Test-Bed.

Leave VR1 in this position. Now, when a noise is made beside the microphone, the bistable should set. Further slight adjustment of VR1 can then be made to find the most sensitive setting.

At this stage the reader may find it worthwhile to remove VR1 from the circuit without altering its setting, and use a testmeter to measure its resistance. When the circuit was under trial on the Test-Bed it was found that the effective resistance of VR1 at this stage was a little over 60 kilohms; VR1 was then replaced by a fixed carbon resistor of 56 kilohms in series with a 10 kilohm preset. This arrangement made it easier to adjust the circuit for greatest sensitivity.

When adjusting is complete, the connections to the l.e.d.s are removed and the oscillator is assembled and connected to the bistable output at *S34*.

Before leaving the subject of interfaces we should mention the simplest interface of all—a pair of metal contacts forcibly brought together or parted.

For burglar alarm systems a number of pairs of contacts can be positioned on windows and doors, so as to be in contact when the window or door is shut, but parted when it is opened. Parting the contacts, one of which is connected to ground and the other to the a.f. oscillator, causes the alarm to sound.

Pressure mats are available for use beneath carpets and make contact when they are trodden on. These too can be used as interfaces to alarm circuits.

TTL VERSATILITY

This part of the series has been almost entirely concerned with alarm circuits, but many of the units described have applications in other fields. The sound-triggered interface can be used with the digital dice (April 1979) to make a novel voice-operated dice that displays a random number when a play shouts "Stop".

The temperature-sensitive interface can be connected to a timing circuit so that we can measure for how many hours of the day or night the temperature of a room (or greenhouse) exceeds a given level. We can build a circuit that switches on an electric fan when the room becomes too hot. With a little more ingenuity we can cause an electric train to stop, or start, or reverse in sequence each time a whistle is blown. By blowing the appropriate number of blasts on the whistle the motion of the train can be remotely and realistically controlled. Such a controller would need only the sound-operated interface, a number of flip-flops, a few power switches and some relays.

Most of these have all been described in previous articles in this series, and all that needs to be done is to work out the logical way of connecting them together so as to perform the required function.

There seems to be virtually no limit to the number of ways of connecting together the relatively few basic units that we have examined so far. Whatever you want to do electronically, the great versatility of TTL makes it highly likely that you will succeed in *doing it digitally*.

To be continued

ERRATUM

An error occurred in the Keyboard construction diagram Fig. 5.5. Four 470 ohm pull-down resistors and the connection to ground were omitted. These resistors should be inserted to span I25/A25, I26/B26, I27/C27, and I28/B28. Also a Soldercon pin, Veropin or flying lead needs to be connected to location I34.

It is important that this amendment be made as the Keyboard is used a lot in Parts 11 and 12.

DARKROOM TIMER

By A. R. Winstanley

THERE MUST be many instances when a simple visual indication of elapsed time could prove to be just as effective as the most sophisticated of electronic timepieces. The unit described here is a small portable device which illuminates a light emitting diode once per second.

The circuit itself is very simple and so phenomenal accuracies cannot be expected from it. It is possible however to obtain an accuracy of about ±1/60th of a second.

The reader will no doubt find other uses, besides its intended use a timer in the darkroom. It should be possible to use the unit for both colour and black/white printing and enlarging, although one must be aware of its accuracy.

CIRCUIT DESCRIPTION

The circuit diagram appears in Fig. 1. The transistor arrangement illustrated will be familiar to many readers and is called an *astable multivibrator*. Operation of this configuration is as follows.

When power is initially applied, one of the transistors must turn on before the other, this is due to inherent component tolerances. For simplicity, let us assume that TR1 will switch on first. The positive plate of C1 is therefore grounded, and this negative pulse is transmitted to TR2 base, which effectively biases TR2 off. With TR1 on and TR2 held off, C1 charges up via VR1 and R2 until the potential at

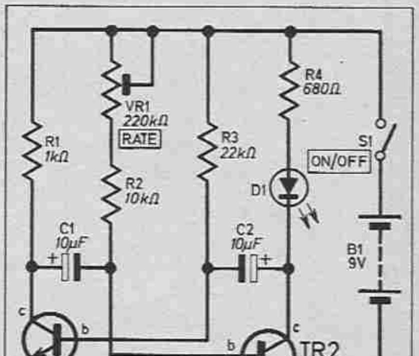


Fig. 1. Circuit diagram of the Darkroom Timer.

TR2 base equals some 600mV.

When this point is attained, TR2 is now able to switch on, as its base is now correctly biased. As TR2 switches on, D1 is able to illuminate, R4 serving to limit the current to a safe level; also, a negative pulse is transmitted via C2 and TR1 base and effectively switches TR1 off.

With TR2 on and TR1 off, C2 can charge through R3 until 600mV is present at TR1 base, this permitting TR1 to switch on again, and so causing TR2, via C1, to be forced off.

It can be seen that the whole circuit is oscillating, the charging cycles repeating themselves, and this will continue until the power supply is removed. By adjusting the timing components, VR1, R2, R3, C1 and C2 we can adjust the frequency of operation of the circuit, and in fact VR1 is included so that a near perfect one hertz frequency (one cycle per second) is achievable.

CONSTRUCTION starts here

The circuit, with the exception of the l.e.d., is built on a piece of 0·1 inch stripboard measuring 9 strips by 23 holes.

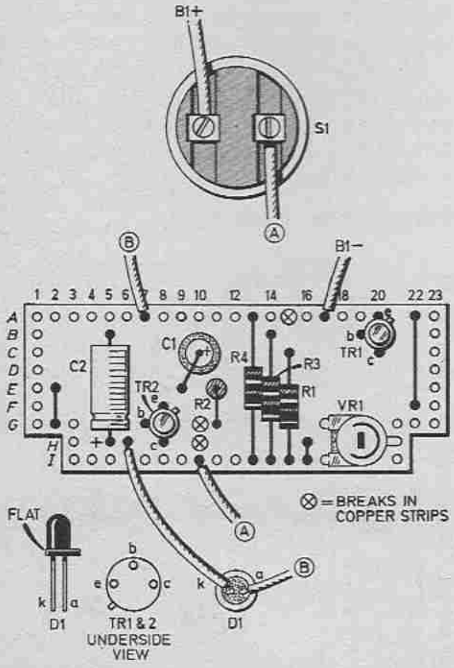
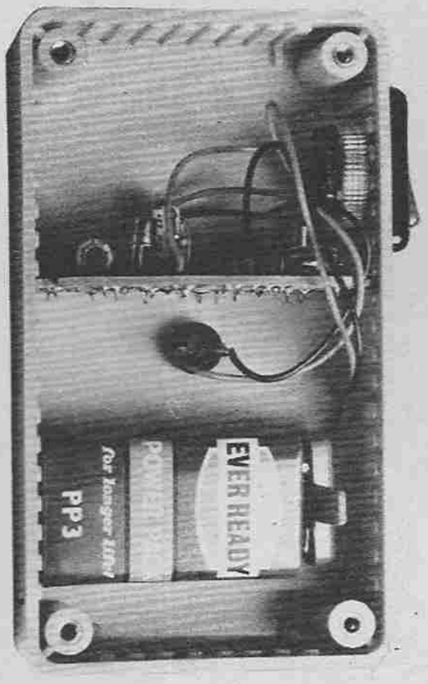
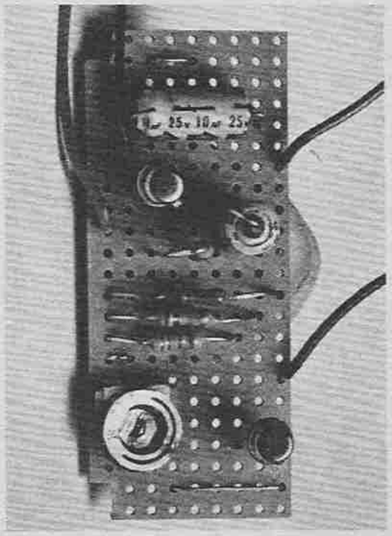


Fig. 2. Complete wiring details for the unit. Take particular care when soldering heat sensitive components, and observe polarity.



The completed prototype with base panel removed.

These dimensions permit the retention of the circuit by the p.c.b. guides moulded within the case. The plastic box used is a Bimbox type BIM2003/13 and it measures 112 x 62 x 31mm, although any similar size can be used.



The component layout on the stripboard.

Construction of the unit will be quite straightforward as seen from Fig. 2, and there should be no problems. Note that $^{1}{}_{4}$ watt resistors are used throughout; these can be quite heat sensitive (as are the transistors) so take care to use a heat-shunt during soldering. Take care to orientate the transistor leadouts correctly and similarly note the connections to the l.e.d.—the cathode is indicated by the "flat" on the case.

Drill the case to take the l.e.d. mounting clip and the switch. Letter the case as required using proprietary rub-down lettering and then spray the case with a coat or two of clear aerosol lacquer to protect the lettering.

Check the wiring carefully, set VR1 to its midway position and then switch the unit on. The l.e.d. should be flashing at an arbitrary frequency. Unfortunately setting up is rather a trial and error affair, and consists of trimming VR1 until the l.e.d. is illuminating once per second at the desired accuracy.

One method of monitoring the accuracy is to count the number of flashes in 60 seconds, and divide this answer by 60 to obtain the interval between flashes. ⌑

COMPONENTS

See Shop Talk page 426

Resistors
R1 1kΩ
R2 10kΩ
R3 22kΩ
R4 680Ω
All ¼W carbon ± 5%

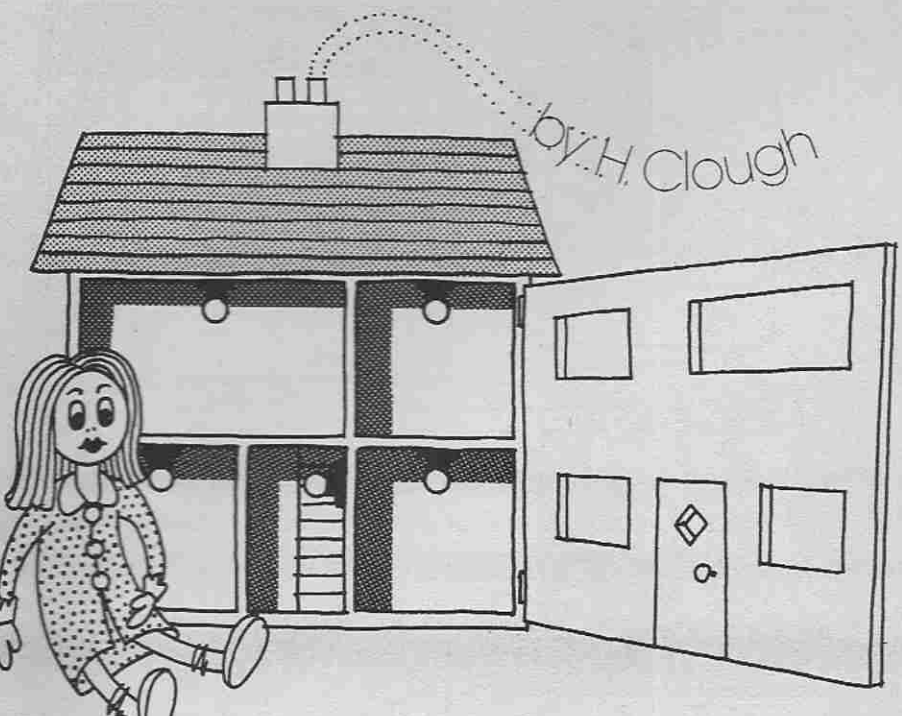
Potentiometer
VR1 220kΩ miniature horizontal preset

Capacitors
C1 10µF 10V elect.
C2 10µF 10V elect.

Semiconductors
TR1, 2 BC108 silicon *npn* (2 off)
D1 TIL209 red light emitting diode

Miscellaneous
B1 9V PP3 battery
S1 s.p.s.t. "Hekla" rocker switch (Maplin)
Stripboard: 0·1 inch matrix 23 holes × 9 strips; plastic case: Bimbox type BIM2003/13 orange or similar 112 × 62 × 31mm; battery clip to suit B1; mounting clip for D1; lettering as required; connecting wire.

Approx cost Guidance only
£1.50 excluding case



DOLLS HOUSE LIGHTS ECONOMISER

by: H. Clough

THE SIMPLE project to be described here was originally designed by the author as an automatic time switch for a dolls house lighting system, which will switch off the lights after a preset delay, thus reducing battery drain caused by forgetful children.

The circuit is very easily constructed and should be ideal for the beginner to tackle. There is wide tolerence on the components which can be used, thus the constructor can use components already to hand, thus saving cost.

The circuit can also be used for a variety of uses other than that originally intended, such as a predetermined timer, a games timer, possible uses in the photographic darkroom etc. No doubt other uses will come to mind. It should be remembered however, that the circuit can only control external devices which operate within the voltage and current capabilities of the battery used.

This problem can be overcome by using a relay with an additional set of contacts, which can then be wired into the supply of the external device.

CIRCUIT DESCRIPTION

The complete circuit for the unit appears in Fig. 1 and operates as follows.

Upon closing the on/off switch S1, capacitor C1 is discharged via S1a to earth. The second half of the switch, S1b applies power to the circuit. Current flows through R2 thus switching transistor TR2 on. As TR2 is now turned on current is able to flow thus energising the relay.

The contacts close and apply power to the lights. At the same time, the contacts also provide a hold facility. That is, when S1 is released, the relay is held on via its own contact. Because S1 is a momentary action switch, if the contact was not in circuit, the relay would just switch on and release each time the switch was pressed, and would not maintain power to the circuit. Hence the very simple hold arrangement.

SWITCHING

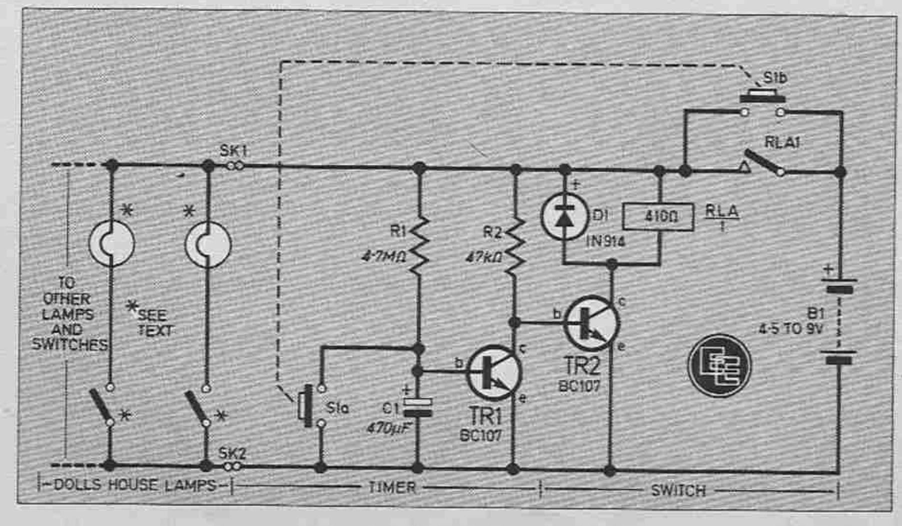
With the release of S1 the short circuit across the capacitor is removed, C1 thus starts to charge up via R1. When 0·6V is reached, transistor TR1 turns on, and as it does so the collector voltage falls to very nearly zero volts. The normal base bias on TR2 is cut off, and so this transistor turns off. In turning off, the collector voltage rises towards the positive supply.

This action causes the relay to de-energise, the relay contacts open, removing all power from the circuit, including the lights in the dolls house.

The entire cycle may be repeated by a further depression of S1.

The timing components, R1 and C1 have been chosen to give a delay of approximately five to seven minutes, which seems a reasonable time for this particular application. Diode D1 is included to prevent damage to the transistor from back e.m.f. due to the relay de-energising.

Fig. 1. Complete circuit diagram of the Dolls House Timer.



The battery B1 is the normal supply used in the dolls house, and in most instances will be 4·5V. No ratings for the lamps have been given as these should already be existing in the dolls house.

CONSTRUCTION starts here

The entire circuit excluding the switch and relay are mounted on a piece of 0·1 inch matrix stripboard, having 13 strips by 16 holes, and is shown in Fig. 2. There is nothing critical about the layout and could be altered as desired. Remember to observe polarity of the electrolytic capacitor and the correct orientation of the transistors.

The diagram also shows the remainder of the wiring to the relay, the on/off switch, and the battery. A connector block is used to wire the lights to the unit. In some cases very many wires will probably be wired, so it is best to get a large block which will accommodate them easily.

COMPONENTS

Resistors
R1 4·7MΩ
R2 47kΩ
Both ¼W
carbon ± 10%

See **Shop Talk** page 426

Capacitor
C1 470μF 10V elect.

Semiconductors
TR1 BC107 *npn* silicon
TR2 BC107 *npn* silicon
D1 1N914 silicon or similar

Miscellaneous
S1 push switch with two normally open contacts
RLA miniature open relay, 410Ω coil, one make contact (RS 349 125)
B1 See text
SK1, 2 two terminal connector block
Stripboard, 0·1 inch matrix 13 strips by 16 holes; connectors to suit battery; connecting wire.

Approx cost Guidance only
£1.50 excluding case

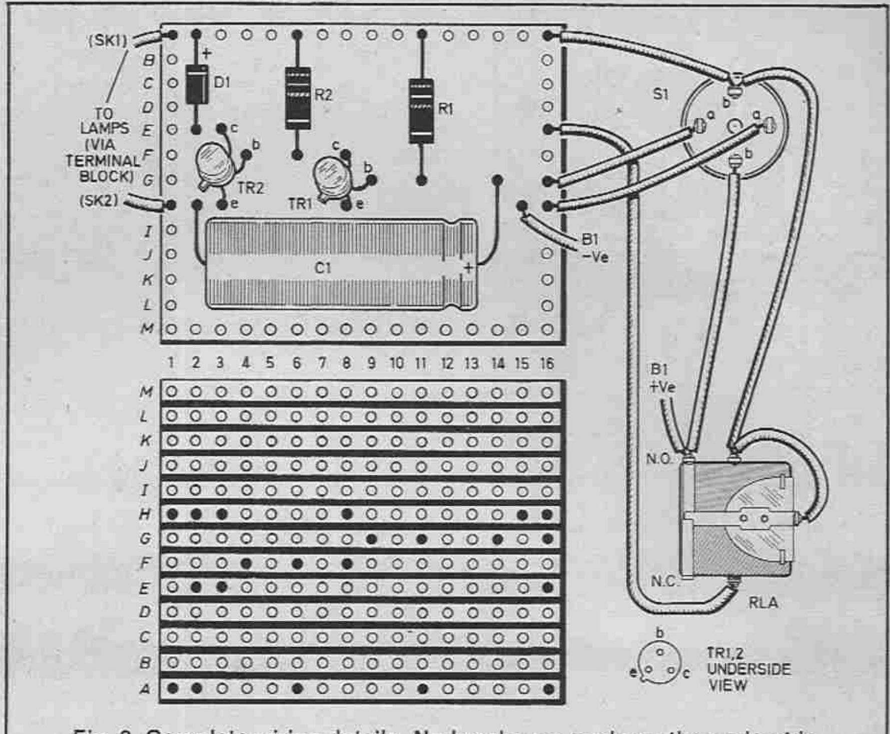


Fig. 2. Complete wiring details. No breaks are made on the underside.

MOUNTING

The overall constructional design of the dolls house will eventually decide where to mount the unit. In the author's arrangement, the unit was mounted under the stairs with the on/off switch projecting through the outer wall.

It is assumed that the dolls house will already have a suitable lighting system, if this is the case then all that is needed is to disconnect the battery and wire the unit between that and the lights. If the existing system has a master on/off switch this should be retained.

If, as might be the case, the dolls house does not have a lighting system, then this will have to be designed by the constructor. A typical system would possibly have three lights upstairs, and four downstairs, possibly with a few small wall lights here and there. Telephone cable can be used for the circuit, running it in the loft space and under carpets.

Each light should have its own on/off switch, with possibly a master controlling all the lights. No doubt the constructor will have his/her own ideas.

IN USE

With the components specified, the delay is about seven minutes. If it is desired to alter this time then there are two ways of doing so. The first is to change both the values of C1 and R1, the higher the values the longer the delay and vice versa. The second is to use a potentiometer in series with R1. The value can be 2·2 megohms, or some other value as desired. This will then give a fairly wide range of times.

To turn on the lights, S1 is momentarily pressed, this will cause the unit to switch on and apply power to the lights. Individual lights can then be turned on as required. After the predetermined time the relay will de-energise and thus switch off all the lights. If further time is required, then once again S1 is momentarily pressed, whereupon a further time period is started.

In terms of the expense of run-down batteries this small unit will most certainly pay for itself in the course of time. ⌘

By Dave Barrington

Mini Drill

We have been pleasantly surprised by the popularity of the *EE 2020 Tuner Amplifier* project, which, for us was an ambitious undertaking and necessitated the use of printed circuit boards to ease construction for our readers. Also, after reading the special feature on making your own printed circuit boards (January '79 issue) many readers are now attempting to make their own boards.

Due to the large size and component density of the boards the most time consuming item is the drilling of the wiring and component locating holes. To this end, we should like to recommend the miniature Bimdrill from Boss Industrial Mouldings.

The mains powered Bimdrill with collets and tommy bar.

The Bimdrill is mains powered and housed in a fully insulated bright orange ABS body. The drill weighs only 250 grams and has an off-load speed of approximately 7500 r.p.m.

The drill is fitted with 2 metres of two core mains cable terminated in a moulded 2-pin DIN plug. The on/off rocker switch is neatly recessed at the top of the body. A tommy bar and three collets are supplied which enable drill bits with shanks of 1mm, 2mm and 0·125 inch diameter to be used and is ideal for work on s.r.b.p. and Fibreglass p.c.b.s., as well as steel, aluminium and brass.

The Bimdrill can be obtained direct from the manufacturers, Boss Industrial Mouldings Ltd., Dept. EE, Higgins Industrial Estate, 2 Herne Hill Road, London SE24 0AU. The cost including VAT and post and packing is £10·53.

Also, the more comprehensive Bimdrill Mk2, having four collets and twenty other tools (drills, grinders, polishers, etc.), and housed in a carrying/presentation case is available for £22·14 inclusive.

New Premises

With the need to keep updating and adding to their already large range of "off-the-shelf" components and equipment, Marshall's have just moved their Bristol branch to new premises.

The new retail shop is larger than their old shop and is situated only five minutes walk from the main shopping centre of Bristol at: 108A Stoke's Croft, Bristol.

Readers presently engaged in teletext experiments may be interested to learn that Marshall's have been appointed sole distributor for the amateur market for the new Mullard series SAA 5000 teletext "chips".

Mainline Amplifiers

The entire stock of Mainline Electronics Ltd., previously of Windsor and Slough, has been acquired by Arrow Electronics.

The Mainline audio equipment spares will also be available from Arrow and it is contemplated that production of the Mainline amplifier will be continued, as it is proposed to merge this production with their existing "Leader" range of kits.

CONSTRUCTIONAL PROJECTS

Soldering Iron Bit Saver

All components for the *Soldering Iron Bit Saver* should be readily available but two components require special mention.

The first is the transformer. The type used in the prototype allowed fixing directly onto the circuit board. This is by no means an essential requirement, but if preferred, care must be exercised in choosing this component. The type used in the prototype was obtained from Maplin and specified in their catalogue as MIN TR6V, Cat. No. WB06G.

The relay is the other component. The circuit requires one with one normally closed set of contacts capable of handling mains voltages. The prototype used a type having two sets of changeover contacts and one of the spare contact tags used as an anchor point for flying leads. This anchor point could be transposed to a spare strip on the circuit board if a single contact relay is obtained.

Darkroom Timer

No problems should be encountered in obtaining the components for our very simple project this month the *Darkroom Timer*. An attractive low profile single nut fixing rocker switch was employed in the prototype to enhance the appearance and is available from Maplin. This can be replaced by any other switch available. The case is available from the manufacturers, Boss Industrial Mouldings, address elsewhere in this page.

Conference Timer

The *Conference Timer* has the largest component count of all the projects appearing this month and most should be readily obtainable.

Six-core cable is required for connecting to the extension indicators. This may be difficult to locate and 8-core cable may have to be used. In fact 8-core screened was used by the author. A cheaper alternative may be to use a double length of 3-core mains cable or even a triple length of twin-core bell wire.

There are many multipin plugs/sockets available from the numerous component suppliers. The types used in the prototype were from RS Components under QM multipole connectors. You cannot buy direct from them but your local electronic or T.V. service shop will be able to obtain them for you. Alternatively, screw fixing terminal blocks are suitable and will certainly be much cheaper.

OBITUARY

DAVID COHEN

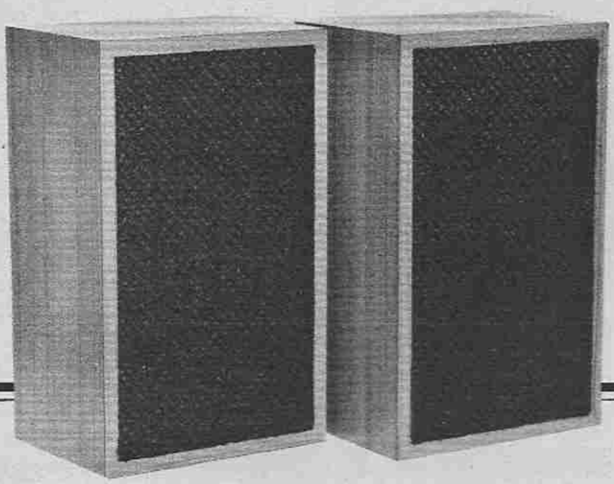
David Cohen, proprietor of Radio and TV Components (Acton), died in April after a short illness, age 64.

One of the longest in the retail component trade and one of its colourful characters, David Cohen started his first business during the 'thirties when only 16 years old in a Birmingham shop, charging accumulators and supplying receiver kits and components.

During the 1939-1945 war he was employed on Government work at EMI Hayes. In 1945 he started up again on his own, dealing in the then prolific war surplus market of electronic equipment. His success, based on long experience in the radio field and an acute business flair, lead to the establishment of Radio and TV Components at Acton, West London, in 1958.

The business, which includes a retail shop in Edgware Road, London, is now managed by David's son, Leslie Cohen.

We offer our condolence to Mrs. Cohen and family at their sad and unexpected loss.



WITH THE EE2020 IN MIND— THE FIRST OF TWO QUALITY LOUDSPEAKER SYSTEMS*

BY R. F. STEPHENS

ee20 loudspeaker

THIS article describes the construction of an inexpensive two-way loudspeaker system. Whilst primarily intended for use with the *Everyday Electronics* 2020 Tuner Amplifier, this speaker will give good results with any amplifier delivering an output of 15-20 watts (into 8 ohms) per channel.

Surprisingly good results can be obtained with quite inexpensive speaker drive units if sufficient care is devoted to such things as enclosure and crossover network design.

DESIGN CONSIDERATIONS

The first decisions to be made in designing a loudspeaker system are fairly obvious: power handling? price? size?

The power handling decision was already made—at least 20 watts r.m.s. to suit the 2020 Tuner Amplifier. Price?—well as this loudspeaker design puts the accent on economy, £25 or so seemed a reasonable target for the drive units and crossover components (for a stereo pair).

Size? Every loudspeaker design is the sum of many compromises. A small cabinet may be economical in its material requirements, but it does impose two restrictions (which are inter-related): poor sensitivity and restricted bass response. On the plus side, a compact cabinet has small and rigid panels which give little trouble from panel resonances and subsequent colouration.

SPECIFICATION

Infinite baffle speaker enclosure:
Dimensions: 508 × 305 × 228mm
Drive units: 8 inch bass, 3 inch tweeter
Frequency range: ±3dB 50Hz to 19kHz
Crossover frequency: 4,000Hz
Impedance: 8 ohms
Amplifier output: up to 30W

An 8-inch bass drive unit seemed to offer the best compromise of bass response, power handling and cost, and this in turn goes a long way towards determining the compromises of cabinet size and type of cabinet loading.

Reflex loading ("vented" or "ported" enclosure) has its attractions as a means of extending the bass response from a given size of cabinet, but as it was desired to give some flexibility in the method of construction (more of that later) it seemed prudent to opt for a simple infinite baffle, that is, a completely sealed enclosure.

THE DRIVE UNIT

In practice, finding a suitable bass drive unit was easier said than done—most 8-inch bass units seemed to fit into one of two categories: "hi-fi and expensive" on the one hand, and "low-fi and nasty" on the other.

Eventually Electro Acoustic Industries Limited agreed to make a unit specifically for this design at a very reasonable price. This, known as model 8NC367, is a paper-coned unit with a roll surround and a hefty 12,000 gauss magnet.

This bass unit matches the Elac 3-inch cone tweeter for sensitivity and whilst a dome type may have given a slight improvement in quality, the extra cost of the dome tweeter would have increased the cost of the system by some 50 per cent.

THE ENCLOSURE

The cabinet dimensions chosen were 508×305×228mm (external). The enclosure may therefore be described as large bookshelf/small floorstanding. This would give acceptable bass response with a suitable bass unit and is a domestically convenient size.

The prototype cabinets were constructed from 18mm chipboard and lined with laminated bituminous felt panels of 13mm thickness.

The object of the felt panels is to stiffen the cabinet panels so making it less likely that these resonances will be excited by the frequencies produced by the bass unit.

*** This is strictly an "optimum-value-for-money" design. Later we shall describe an up-market three-way system in the £150 bracket.**

The home constructor who has wood offcuts lying about his workshop can use these to obtain much the same results as are achieved with the felt panels. The cabinet should be lined with the offcuts of plywood or chipboard securely glued and screwed to all the inside surfaces of the cabinet (except the baffle board). In the diagrams the dimensions given for the cabinet assume the 13mm felt panels are used to line 18mm chipboard or plywood.

The case dimensions should be adjusted accordingly if material of a different thickness is used to line the cabinets.

Conventional loudspeakers which have large cabinet panels which are undamped and unbraced can actually generate more sound from the cabinet panels (cabinet sides and back, generally) at certain frequencies than is generated by the speaker drive units themselves. This is obviously an unsatisfactory state of affairs as it adds a high level of undesirable colouration to the sound produced.

Rigid, well constructed cabinets are therefore essential for anything approaching "hi fi" results.

CONSTRUCTION starts here

CABINET CONSTRUCTION

Full details of the enclosure appear in Fig. 1.

The front and back frame external dimensions correspond with internal dimensions of the case. These frames are fitted flush with edges of case and glued and pinned, or screwed, in position.

If speaker grille fabric is to be used for the frontal trim, a grille panel of 10 or 12mm plywood is necessary. The grille fabric is glued or stapled to the back of the panel (see drawing). Velcro hook-and-loop tape provides a simple method of fixing the grill panel to the cabinet.

An alternative trim is possible with "acoustically transparent" (reticulated) foam. This does not require a supporting frame and can be fixed with "single-sided" Velcro. This is similar to the hook half of the familiar hook-and-loop type, but with larger hooks which fit directly into the holes in the reticulated foam.

COMPONENTS and MATERIALS

Resistors

R1 10Ω 5W wirewound, ceramic insulated

Capacitors

C1 4μF }
C2 4μF } reversible electrolytics, 50V ("Elcap")
C3 10μF }

Inductors

L1, 2 (2 off) 0·6μH ferrite cored

Loudspeakers

LS1 3 inch tweeter unit Elac TW3/04
LS2 8 inch drive unit Elac 8NC367

Miscellaneous

Stripboard or p.c.b. Two tyraps (for L1, 2). 1 sq. yd. 10 oz Acoustilux BAF wadding. 8 "T" nuts and bolts. 8 laminated bituminous felt panels (or offcuts of plywood or chipboard). Chipboard and plywood for cabinet—see Fig. 1.

All the above items (except wood) are obtainable from Wilmslow Audio Limited, Swan Works, Bank Square, Wilmslow, Cheshire, who also offer a Kit for two enclosures, comprising:

2 Elac 8NC367, 2 Elac TW3/04, and 2 crossover kits (with p.c.b's). Price £26·50 inclusive of VAT, but plus £2·50 carriage.

or including the laminated bituminous felt panels, Acoustilux BAF wadding and "T" nuts and bolts for £35 plus £5 carriage.

The three photographs on the right show (*top*) the completed EE20 Loudspeaker, (*centre*) before grille panel fitted and (*bottom*) speaker units and crossover unit wired up before being secured to enclosure; the Acoustilux wadding lining can also be seen.

ee20 loudspeaker enclosure

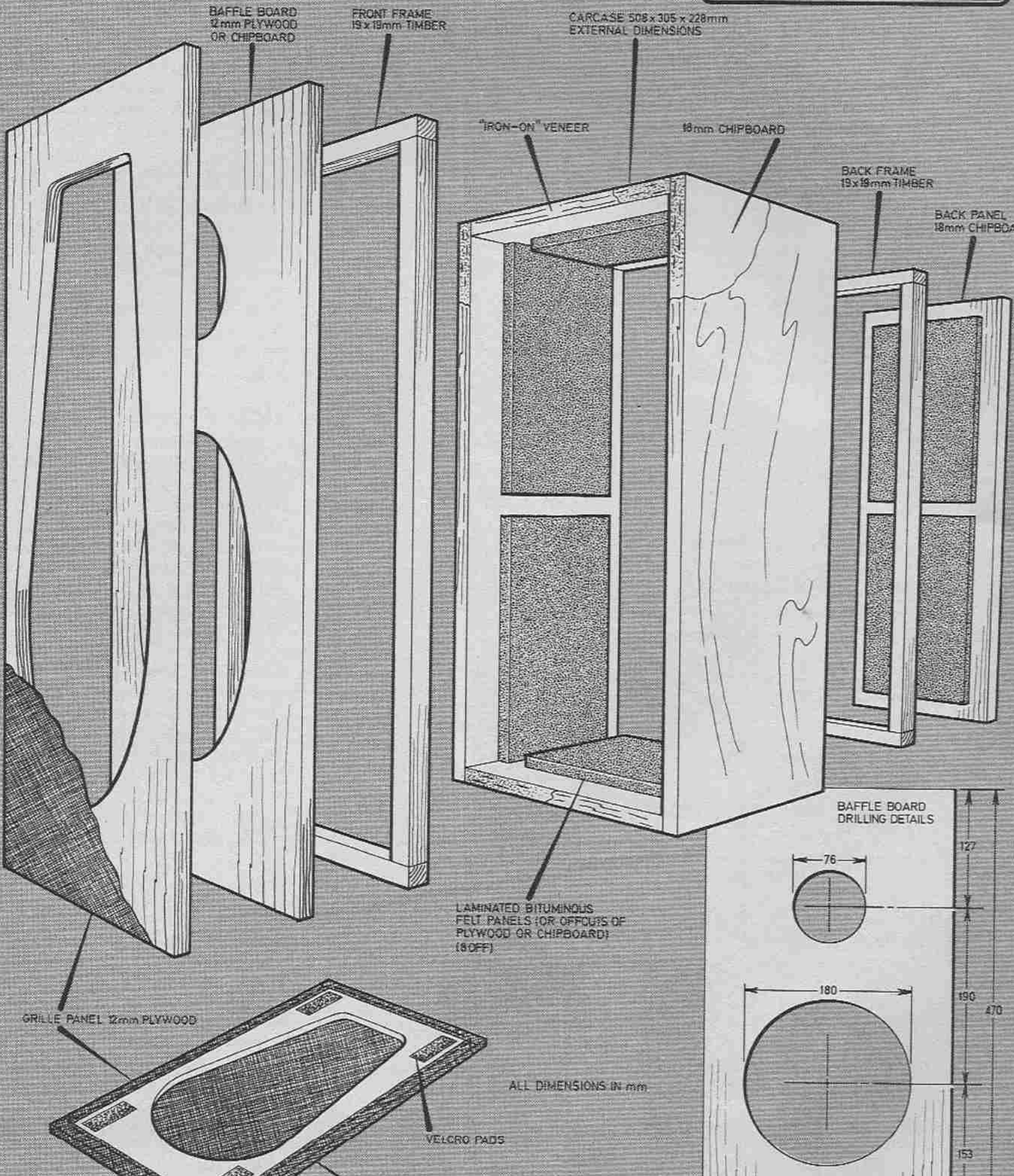


Fig. 1. Construction details of the EE20 Loudspeaker Enclosure.

Both drive units are fitted from the front of the baffle board so that both baffle board and cabinet back can be fixed permanently in place after the cabinet has been lined with the felt panels (or wood offcuts) and the crossover network fastened in the bottom of the cabinet. The cabinet is then lined with BAF wadding which can be inserted through the bass unit aperture in the baffle board. The drive units are fixed with "T" nuts and bolts.

Sufficient glue should be used in all joints to ensure an airtight seal. Remember that no one is likely to see the surplus glue that squeezes out inside the cabinet! The actual method of cabinet construction is dependent on the skill of the constructor and the workshop facilities available. The exploded view illustrates the simplest "butt jointed and battened" construction, but mitred corners or tongue and groove joints are possible if the necessary facilities are available.

CROSSOVER NETWORK DETAILS

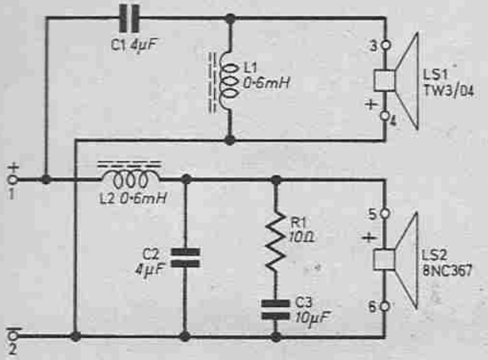


Fig. 2. Circuit of the EE20 crossover network.

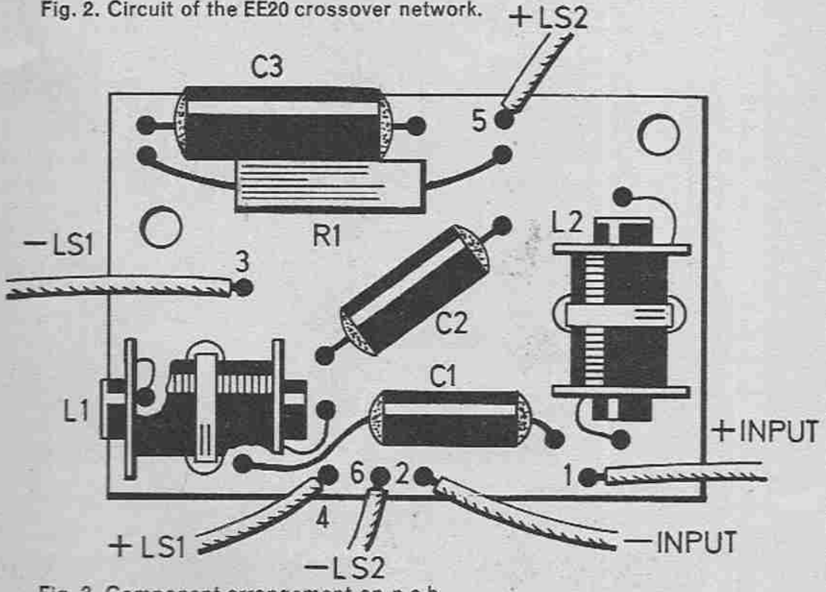


Fig. 3. Component arrangement on p.c.b.

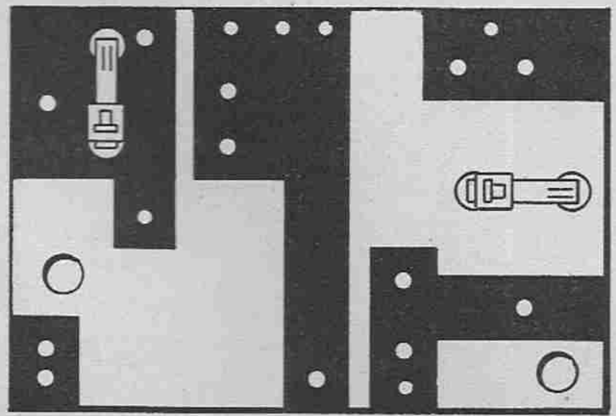


Fig. 4. Printed circuit for crossover network.

CABINET FINISH

The kind of finish applied to the cabinet is a matter for personal preference and really outside the scope of this article. The author has obtained very good results with "iron-on" veneer, but there are many Formica, cork and hessian finishes which could be used.

THE CROSSOVER NETWORK

The crossover network, which integrates the response of the bass and treble units is a very important part of a loudspeaker system. The crossover frequency and rates of roll-off chosen should complement the response of the drive units so that the overall result is a "flat" response curve from the whole speaker system.

A nominal 4,000Hz crossover point was chosen as this is a good octave away from any irregularities in the top-end response of the bass unit and similarly an octave up from the effective "bottom-end" response of the treble unit, Fig. 5.

Standard, easily available, component values are used in the 12dB/Octave network, Fig. 2. C1 and L1 form a high-pass filter which feeds the tweeter drive unit LS1. A low-pass filter, L2, C2, feeds the bass drive unit LS2. The additional components R1 and C3 are for the purpose of reshaping the curve in the important midrange region, as will be seen from the accompanying curve, Fig. 6.

The crossover is simple enough to assemble onto a piece of stripboard (Veroboard), however, a printed circuit is provided in this article, see Fig. 4. The one important fact to remember when assembling these components is that the two inductors L1 and L2 are mounted with their axes at right angles to each other.

Secure the board to the base of the cabinet, and then wire up to the loudspeakers in accordance with Fig. 2.

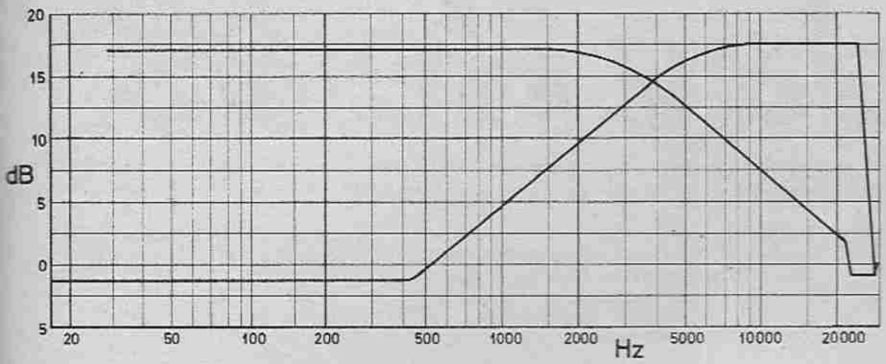


Fig. 5. Crossover network characteristics.

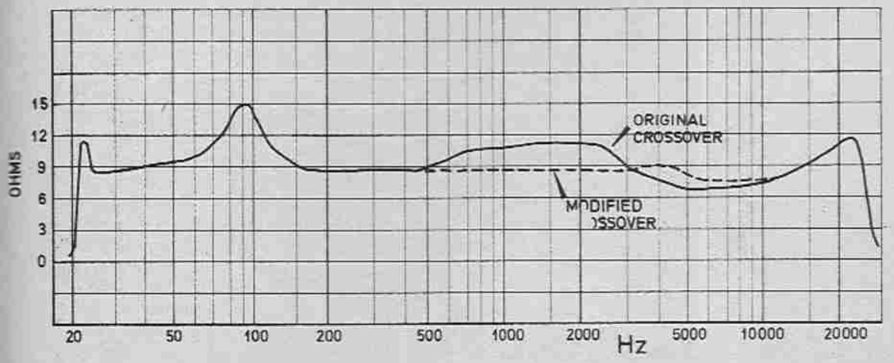


Fig. 6. Impedance/Frequency curve showing effect of equalising network.

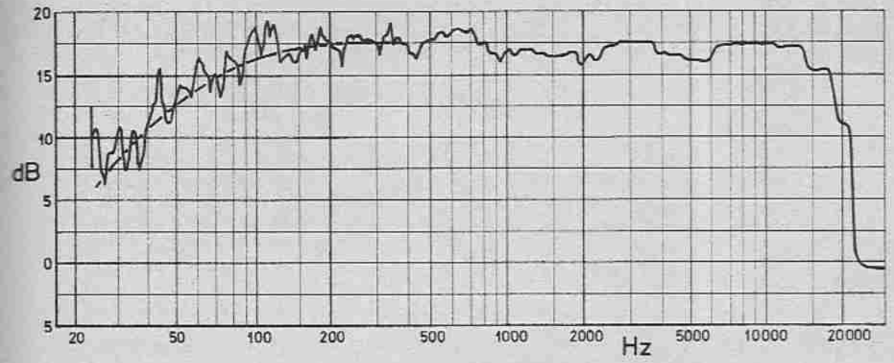


Fig. 7. Frequency response of EE20 Speaker System.

CONNECTING THE SPEAKERS

There are several types of connectors on the market suitable for use on loudspeaker cabinets. Screw terminals, recessed panels fitted with DIN or 4mm sockets, and spring-loaded connectors are three popular alternatives. Mark the terminals "+" and "−" to correspond with the connections made to the crossover unit.

The speaker leads should be of reasonable conductor size, particularly if the amplifier is sited some distance from the speakers—say 0·75 sq mm. Two-core 6A flexible mains cable, with 24/0·2mm conductors, will meet this requirement.

USING THE SPEAKERS

The EE2020 loudspeaker system produces 90dB for 1 watt at 1 metre. This means that under normal domestic conditions it will be possible to achieve whatever sound pressure level is required well within the amplifiers rated output.

Best results will be obtained, generally, with the base of the enclosures about 330 to 500mm from the ground. Using the speakers placed directly on the floor will increase the apparent bass output, as also will placing a speaker near to a side wall.

As with any stereo loudspeakers it is worthwhile spending some time and trouble in siting the pair of enclosures to give:

1. The best stereo image.
2. The best (not the boomiest!) bass response.
3. The least interference from room resonances.

JACK PLUG & FAMILY...

BY DOUG BAKER

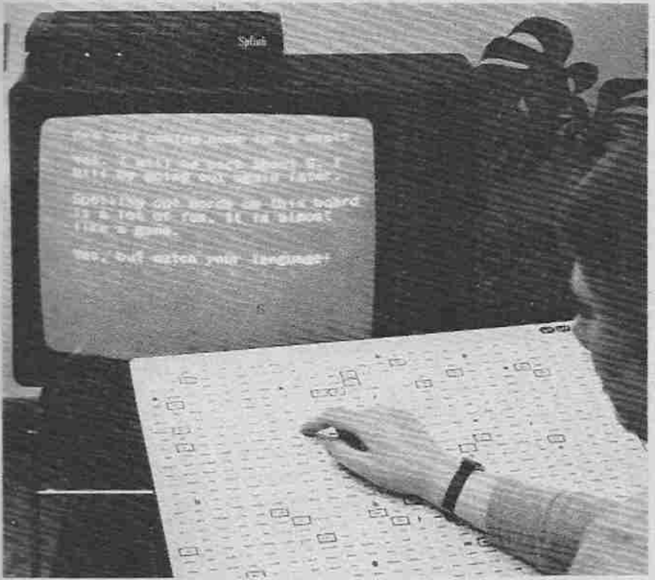
Everyday News

MICROS FOR THE HANDICAPPED

ONCE AGAIN another area where microprocessors are improving the well being of todays society, without creating any redundancies, is highlighted by a new aid for speech-handicapped persons.

Combining the words "speech" and "link", "Splink" is the name of a new electronic system designed to bridge the communication gap between the speech-handicapped, the deaf and their families and friends.

Activated by a microprocessor, it consists of a keyboard alphabetically printed with 950 of our most commonly used words. The user has merely to depress the required words on a keyboard and build them into sentences which immediately appear on an ordinary domestic television screen linked to the unit by the aerial socket.



Initial letters on the keyboard make it possible to build any word or name desired and some of the keys short-circuit the process by automatically printing out such basic phrases as "I want a", "Can you tell me?" and "What did you say?".

Invented by a Woking doctor, Splink has been developed with a view to commercial production by the Queen's Award-winning firm, Medelec Ltd, of Woking, who manufacture highly specialised electronic medical equipment.

Clinical trials have proved the practical usefulness of Splink and families which have had pilot systems on loan for experimental purposes have confessed to feeling lost after returning them.

QUEEN'S AWARD

Among the winners of this year's Queen's Awards for Export Achievement and Technological Achievement is a joint award to BDH Chemicals Ltd, the Solid State Physics & Devices Dept, of the Royal Signals and Radar Establishment and the Department of Chemistry of Hull University.

The award is for outstanding work in research, development and now large scale commercial production of liquid crystals for digital displays in calculators, watches, etc. BDH Chemicals is currently exporting 98 per cent of production, almost all to Japan and the US.

Britain is now claimed to be the world leader in liquid crystal technology.

A £100,000 order for a computerised print composing system has been placed by Waterlow (Dunstable) Ltd., with Ferranti for the C570-20 system.

The system is based on an Argus 700G minicomputer and will be linked to a Linotron 404 phototypesetter.

MPU car seat

For the motorist who has nearly everything, a programmed seat-adjuster should have appeal. A system developed by National Semiconductor and Recaro allows driving seat rake, height, backrest and other parameters to be motor driven to suit the physique of the driver.

Once the best position is programmed in, it is held in a memory. Positions for two different drivers can also be stored.

STOP THIEF!

Electronic tagging of merchandise is expected to reduce the £650 million worth of goods per year lost to British retailers through shoplifting. A system developed by Parmeko of Leicester raises an alarm if the electronic tag has not been removed by the shop assistant using a special tool at the time of purchase.

All customers leave the store through concealed detection zones and a shoplifter carrying a tagged item is immediately detected. The special tags which re-radiate a signal in the detection zones are, of course, reusable.

A system to protect, say, 6,000 garments would cost the store some £7,000 but could quickly repay its initial cost.

CRIME DETECTION BREAKTHROUGH

The latest crime detection aid is searching for fingerprints undetectable by present methods by using a laser beam. The new technique, developed by Control Laser Corporation of Orlando, Florida, is said to be so sensitive that it can detect fingerprints on human skin, thus opening up the possibility of discovering a murderer in a case of strangulation or other bodily assault.

MULTI-SCOPE

A new oscilloscope from Tektronix has a built-in autoranging digital multimeter. The scope is dual-trace with 5MHz bandwidth and the DMM has 12 ranges of d.c., a.c. and resistance measurement. It is fully portable, battery-operated and designed for the field service engineer.

Export to Japan

ITT Semiconductors, Footscray, expects to sell more than £5 million worth of devices to the Far East this year with 80 per cent going to Japan. Products in demand are ITT's range of i.c.s for TV applications and 4K and 16K random access memories.

GIGA VALVES

The thermionic valve is not dead though severely maimed by its modern semiconductor successor. The Mullard Valve factory, recently celebrating its 40th anniversary, claimed that over the period of its history in Blackburn it has produced 1,000 million of them.

IRISH MPU

The US Mostek Corporation is setting up a manufacturing unit for i.c., memories and MPUS, at Blanchardstown, near Dublin. Eventually about 1,100 jobs will be created. It is expected that most of the output of the new plant will be exported to Europe.

. . . from the World of Electronics

—ANALYSIS

WIND OF CHANGE

Once upon a time the electronic hobbyist was a true home constructor, winding his own coils and transformers and wire-wound resistors, fabricating his breadboards and panels out of plywood or ebonite, perhaps even making his own wet-cell batteries although, of course, the thermionic valve was beyond his capabilities.

In the modern world of specialisation we have all become assemblers, even buying in our matrix board and ready-made panels and enclosures. There is nothing wrong in this. Mass production has provided us with a rich supply of components better and cheaper than we could make ourselves and our home projects today have a professional touch.

The same pattern can be seen in the electronics industry. The equipment manufacturer may also be a circuit designer but basically he is still an assembler of components bought from specialist component firms. So, traditionally, there has always been a fairly well-defined demarcation between firms supplying the end-user with completed equipment and firms supplying the equipment people with components. Altogether a nice business relationship with each depending on the other to make a living.

Over the past few years there has been a wind of change, at first a gentle breeze but now approaching gale force, which is threatening to destroy the once-happy balance in the industry structure.

It all started with the integrated circuit and the wind of change has accelerated with VLSI and, most notably, the microprocessor. The equipment firm used to design the circuit and wire up all the components. Today, quite a few semiconductor manufacturers (i.e. component companies) have MPUs emerging from their factories which are as operationally powerful as some of the mid-range mini-computers built by equipment companies.

There is, of course, no law determining who sells what to whom in an open market and so it is quite logical for the MPU manufacturer to sell his systems direct to the end user rather than through an intermediate manufacturer and this is now happening.

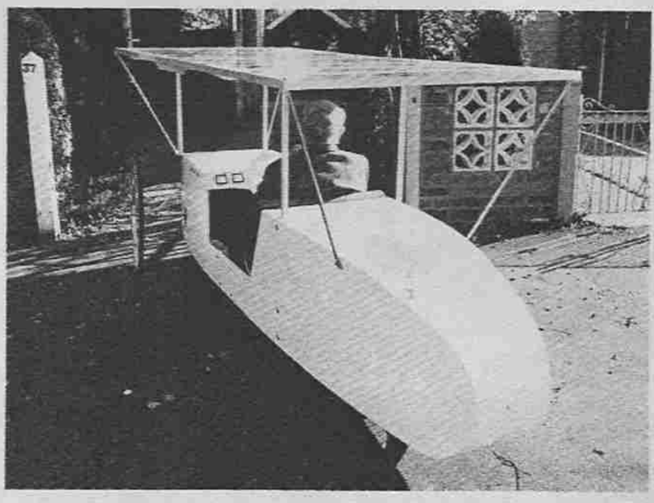
But another important factor also comes into play and this is that the pace-setters in the technology are the semiconductor manufacturers themselves so they have the advantage of technical edge, at least for the time being. The computer manufacturers are fighting back by setting up their own semiconductor research units in an attempt to gain technical independence.

It is difficult to foresee how the new pattern of trade will evolve over the next year or two. Fortunately the data processing market is still expanding at a rate sufficient to absorb new entrants and the "war" is more a matter of reconnaissance and small-scale infiltration by the MPU makers rather than full frontal assault. **Brian G. Peck.**

A fold-away 50-inch screen and a colour picture said to be viewable in ordinary daylight by up to 100 people at a time, is the latest TV set offering from Mitsubishi. The UK selling price is to be about £3,500.

Britain's first electronic telephone exchange to be produced on a commercial scale, the TXE2, celebrated its thousandth installation in the UK at Hagley, West Midlands. The TXE2, built by Plessey, has also enjoyed export successes.

Citizen's Band Radio is still big business. South Korea is now the world's largest manufacturer of CB sets after the USA and Japan despite the fact that CB is illegal in South Korea. This disproves the theory that a strong home market is essential for business success.



SOLAR POWER

The instrumentation for an experimental vehicle powered by solar energy is provided by the new 440 series of meters from Ernest Turner Instruments.

The car (above), capable of 15 m.p.h. was designed and built as a private research project by Mr. Alan Freeman of Rugby and is driven by a 120W permanent magnet motor with power derived from a canopy of Solar cells.

CLUB NEWS

BAEC

The next get together of the British Amateur Electronics Club will be at their 14th annual Exhibition, at the Shelter, The Esplanade, Penarth, South Glamorgan, from July 21 to 28.

On show will be members constructional projects and all proceeds from the exhibition will be donated to the Cancer Research Campaign.

SYPCG

News this month of a computer club in South Yorkshire formed to cater for the growing interest in do-it-yourself home computing.

Known as the South Yorkshire Personal Computing Group (SYPCG), the initial programme of events is to meet on the second Wednesday in every month at The Central Engineering Lecture Theatre, Floor D, St George's Building, University of Sheffield, St George's Square, Sheffield 1.

At each meeting a person will take along and give a profile of some computing equipment; there will also be a short talk on a specialist topic followed by an open forum / discussion, part of which will be a computing problem solving session.

Readers who would like further information on the SYPCG should write to: Mr. T. Rycroft, SYPCG Secretary, 88 Spinneyfield, Moorgate, Rotherham, S. Yorks.

COURSES

Two one-day courses on microprocessors are being held at the University of Salford this month. They are "Industry and the Microprocessor" on June 28 (cost £35) and "Fundamentals of Microprocessors" on June 29 (cost £55).

The first course is a general awareness teach-in for non-technical managers and the second is a review of the basic principles of digital systems and microprocessor architecture, including "hands-on" sessions.

The two courses together can be attended for a reduced fee of £80 and further information is obtainable from the Administrative Assistant (Short Courses), Room 110, University of Salford, Salford M5 4WT.

RADIO WORLD

By Pat Hawker, G3VA

Broadcasting and Short Waves

REGULAR listening to world-wide broadcast stations on "short waves" (h.f.) between 3 and 30MHz is something which appeals in the main (at least in the UK) to a rather special type of enthusiast whose numbers have never been large by broadcasting standards. Many of these listeners are far more interested in identifying and "logging" distant or unusual or low-power stations than in the information or entertainment content of the programmes.

One could quote a variety of reasons why this should be the case: the great difficulty on h.f. of tuning the run-of-the-mill "all-band" domestic receiver to a specific frequency; the impossibility of remembering all the many frequencies; the loss of interest among most radio amateurs due to their use of "amateur-bands-only" communications receivers; receiver-performance problems of "image" and other spurious responses, as well as oscillator drift; the need for an effective outdoor aerial to achieve good results; the deep fading and consequent distortion; above all, the complexity and difficulty of understanding the constantly changing propagation conditions and the need to change bands at different times of the day and night which the average listener finds quite baffling.

Finding and holding a programme you want on short-waves has undoubtedly always needed a degree of skill and expertise and the cultivation of "safecracker's fingers" for tuning.

On the other hand, there are of course the expatriates who are prepared to learn the tricks of h.f. in order to keep in touch with their home countries, and the many listeners in tropical countries where static ruins medium-wave reception and distances are often too great for v.h.f./f.m.

H.F. Stations

There are now thousands of h.f. broadcasting stations hopefully spraying powerful signals to all parts of the world, largely funded by governments and religious organisations and motivated by the wish to achieve national prestige, to convert listeners to particular ideologies or religions, or occasionally for commercial purposes (how many listeners recall the "commercials" on American short-wave broadcast stations for a period before the "Voice of America"?). Some provide excellent programmes but at the same time they have helped to reduce large portions of the h.f. spectrum to a shambles, due to attracting the "jammers".

Will it always be so? There is an increasing range of general-coverage receivers now available, including a number with ingenious "triple-mix" tuning systems and some with digital frequency readout that make it easy to tune to any required frequency and provide the necessary sensitivity and selectivity, although mostly at a cost appreciably higher than what the average listener has been used to paying for a broadcast set. In effect these are virtually "communications receivers" and have already led to something approaching a boom in short-wave listening in Japan.

Clearly someone who feels there is an increasing interest in short-wave listening is Mitch Murray who has recently brought out a long-playing disc *Long Live Short Wave!* (Trans-Island Productions Ltd, P.O. Box 24, Douglas, Isle of Man). One side of this record is devoted to useful advice on short-wave listening as a hobby, including a short section by Henry Hatch, G2CBB whom many enthusiasts will know from his regular participation in the BBC's *World Radio Club* programmes (0745 G.M.T. Sundays, 1115 G.M.T. Mondays, 2100 G.M.T. Tuesdays and 2315 G.M.T. Wednesdays on BBC World Service).

The other side of this record consists of tapes explaining and helping to identify a number of the h.f. broadcast services. In my view the most useful items are those which cannot be effectively described in print, such as the identification not only of broadcast stations but of various types of communications signals such as radio teleprinter and facsimile signals, and how to tune stations using single-sideband.

But here again one feels that Mitch Murray is aiming his record at those who have already caught the bug and may only confirm to the majority of broadcast listeners that this is a hobby of undoubted fascination to the initiated but something quite apart from normal entertainment radio.

I must admit to having rather jaundiced views about the large demands which are being put forward, with an eye to the World Administrative Radio Conference this September, for a vast increase in frequencies for h.f. broadcasting, including the use by European stations of the bands normally reserved for "tropical" use only.

As I have written elsewhere: "Broadcasters and governments must come to grips with one simple, overwhelming fact of life—much of the present mess in radio allocations is due to expanding external broadcasting, while pretending this does not affect domestic broadcasting and other services: such a policy is possible only by allotting more and more of the precious frequencies to broadcasting at the expense of other services."

The Museum Amateur Stations

For many people, the first time they ever see an "amateur radio station" is the impressive GB2SM installation at the Science Museum in Kensington, London where the number of visitors exceeds a million a year. Sometimes, I must admit, I do wonder whether the very elaborate set-up may tend to suggest to some of the visitors that amateur radio must be an excessively expensive hobby. This in fact need not be the case (my own present equipment on which I can work the world cost me well under £100). But GB2SM has undoubtedly for many years set an example for other museums to follow.

I occasionally hear, for example, NN3SI, the amateur station established a few years ago at the Smithsonian Institution's National Museum of Technology in Washington, DC, USA. When I visited this station a couple of years ago, it included a pretty full complement of the latest American and Japanese h.f. and v.h.f. equipment. The station is manned by volunteer operators from the Washington area. There are two operating consoles, one for h.f. and the other for v.h.f., with an impressive h.f. rotary beam on the roof.

The latest museum station is VK2-BQK at the Museum of Applied Arts and Sciences, Sydney, Australia. This has a number of Yaesu h.f. and v.h.f. transceivers and an FRG7 general purpose h.f. receiver donated by the Dick Smith Electronics Group. Over 300,000 people visit the museum annually and the Australian amateurs believe that the new station will help recruit more enthusiasts to the hobby as well as educating the public generally about radio communication.

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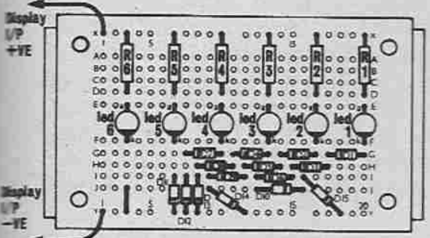

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R1 to R6 – From 120-270 ohm resistors ¼ watt.
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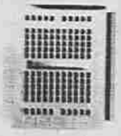

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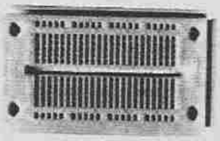

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550 contacts with two 40-point bus-bars.
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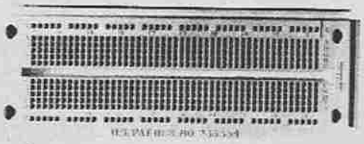

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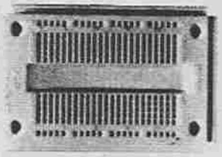

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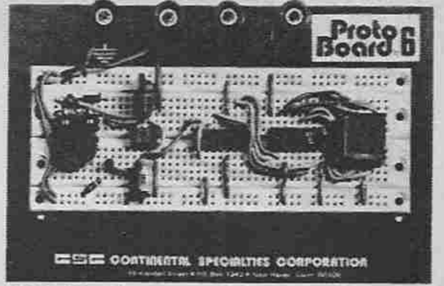

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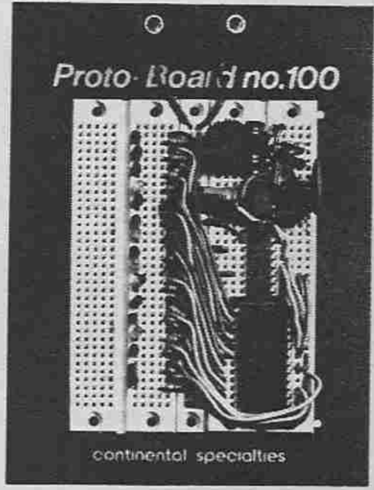

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MICROPROCESSOR BASICS

5

By R. W. Coles

IN PART 2 we saw how the microprocessor chip is able to FETCH instructions from memory and then EXECUTE them. In Parts 3 and 4 we examined the ROM and RAM chips in which the instructions can be stored. It is now time to consider the sort of instructions which are available to the programmer, and how these can be strung together to form a useful program.

It is the "programmability" of the microprocessor chip which gives it the power and flexibility to do almost any kind of control job which we need done.

With one program, a microprocessor system could be used to control motorway signals. With a different program, it could be carrying out scientific calculations, playing children's games, or winging its way to the outer planets on board a space probe. In each case, the same microprocessor could be used. All that changes is the program and the peripheral hardware.

MACHINE CODE

The instructions which the microprocessor needs in its ROM or RAM are called "Machine Code" instructions, because they directly modify the operation of microprocessor chip facilities such as registers and the Arithmetic & Logic Unit (ALU). These instructions are stored in binary form in the ROM or RAM chips, and binary is really the only language a micro' chip understands.

HEXADECIMAL CODE

To make life a little easier for us humans, who find binary a clumsy and difficult coding system, a useful shorthand code called "Hexadecimal" (hex) has been developed. Hexadecimal code is just another way of writing binary but it is much easier to use. It relies for its success on the fact that microprocessor word lengths are usually multiples of four bits (such as 4, 8, 12, 16).

To convert a binary number into its hex equivalent, just chop up the binary into four-bit chunks, starting at the righthand, or least significant, end. With four bits there are 16 possible combinations (i.e. 2^4), and the next step is to replace each group of bits with a single character from the set 0-9 and A-F. In this way 0000 Bin. becomes O Hex, 1111 Bin. becomes F Hex, and 1010 becomes A Hex. To convert Hex to Bin you simply reverse the process, using a table like Fig. 5.1.

Eight-bit words now reduce to two hex digits and are therefore much easier to use and remember. We can't use decimal numbers in the same way of course, because there is no grouping of bits which gives us exactly ten combinations. Three bits have eight combinations and four bits have 16 and so on.

After a little practice hex code is quite easy to use, and most small hobby microprocessor systems are supplied with a *resident* program called a monitor, which allows you to enter your *own* programs in Hex rather than in binary.

DIFFICULT

Let's not kid ourselves, writing machine language programs for a microprocessor is a difficult and at first frustrating, business. Why then do people bother to do it at all? Well, I think, it's true to say that there is no better way to appreciate and learn about the exciting field of microprocessing than by learning how to make that hobby system actually *do* something useful under the control of your own machine code program. Once you have taken the plunge, it all seems to get much easier, and before you know where you are, you will be a dedicated micro'-nut!

Machine language programming is quite difficult because you have to understand the hardware of the system and what it can do before you can write a list of instructions to make it do it. You may have done some programming on a large computer which runs one of the so-called high-level languages like BASIC, and if you have, you may be thinking that "big" computers are much easier to program because they let you say things like:

LET X=A+B

in your program.

Programming a microprocessor in machine code to carry out the same task would mean keying in a string of hexadecimal characters, so obviously there's a big difference, or is there?

Well, no actually. The big computer has a primitive machine "language" just like the micro's only with a larger repertoire of instructions. To get it to accept English statements like:

IF X=5 THEN GO TO 20

someone has had to spend long hours writing a large program in machine code which then interprets the "High-level" instructions which you write in say, BASIC or FORTRAN.

Just the same thing can be done for a microprocessor, and the new microprocessor-based home computers have BASIC interpreters available which are themselves written in machine code. Trouble is, systems with these facilities are very expensive, and they may not be the best way to start out anyway.

BASIC is great for programs to solve mathematics problems and to balance business accounts, but try and cook up a program to control a model train layout or your central heating system and things can get a bit tricky. To do these jobs you really need to write your programs in machine code, and you'll also have to put together some simple electronic interface circuits to handle your points, signals, or gas boiler controls.

If you are an electronics enthusiast, which I expect you are then this sort of thing could be just what you are looking for, and it has the big advantage of being cheap—you can buy a micro' system for machine code programming for less than £50.

So there you are, machine code programming is a real challenge, but it's well worth the effort of learning how to do it, and as an electronics enthusiast you'll appreciate the close association with hardware which machine code programming gives you.

INSTRUCTION SET

One problem with machine code programming is that each machine (microprocessor) has its own unique instruction set, and you'll have to study the internal architecture and associated instructions of the micro' you decide to buy. There are lots to choose from. Some you may have already heard of are the National SC/MP, the Intel 8080, the Motorola 6800 and perhaps the RCA 1802 COSMAC.

All have different instruction sets and are quite different in so far as the number and types of internal registers and control bus signals are concerned.

The SC/MP has about 50 instructions available, which means that it is quite a simple microprocessor and fairly easy to use. Other microprocessors have much longer instruction sets which makes them more powerful, but in some cases a bit more confusing for the beginner.

You can take a look at the SC/MP instruction set in Fig. 5.2. Confusing, isn't it? One reason the action of some of the instructions is not immediately obvious, is because you need to appreciate the internal facilities of the SC/MP chip first (Part 2 of *Microprocessor Basics* could help here). Don't hope to understand all of the instructions at once though. Start with a few obvious ones like ADD or LOAD. The significance of the others will come slowly once you start to try out sample programs.

Notice that Fig. 5.2 describes an instruction in three ways. The *Opcode* column shows the hex code which converts directly into binary when you load it into memory. The *Mnemonic* column contains a short "name" for the instruction to make it easy to remember and quite compact when written down as a program. The *Operation* column gives a brief description of the effect of the instruction, and this is sufficient information for only the experienced programmer.

To appreciate what "Pulse H-flag" really means, we need to refer to a more detailed description, and this can be found in the SC/MP manual.

The other thing the manual will tell us is that the entries in the *Opcode* column don't tell the whole story. As listed in Fig. 5.2, all the opcodes consist of a single byte (eight bits) but many SC/MP instructions use two bytes. The extra byte is actually data or address information which may be needed to make the instruction make sense, and this will be different every time the instruction is used.

INSTRUCTION TYPES

To make more sense of an instruction set it is useful to divide it up into various "classes" of instruction. Some manufacturers do this for you in their manuals, and they don't all agree about what classes to use. I have chosen a fairly typical selection of titles, so let's have a look at them one by one.

DATA TRANSFER GROUP

Apart from the automatic instruction-fetch operation a micro' chip performs, it also needs to

HEX	BINARY			
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

Fig. 5.1. Hex to binary conversion table.

Opcode	Mnemonic	Operation
00	HALT	Pulse H-flag
01	XAE	Exchange AC and Extension
02	CCL	Clear Carry/Link
03	SCL	Set Carry/Link
04	DINT	Disable Interrupts
05	IEN	Enable Interrupts
06	CSA	Copy Status to AC
07	CAS	Copy AC to Status
08	NOP	No Operation
19	SIO	Serial Input/Output
1C	SR	Shift Right
1D	SRL	Shift Right with CY/L
1E	RR	Rotate Right
1F	RRL	Rotate Right with CY/L
30	XPAL	Exchange Pointer Low
34	XPAH	Exchange Pointer High
3C	XPPC	Exchange Pointer with PC
40	LDE	Load from Extension
50	ANE	AND Extension
58	ORE	OR Extension
60	XRE	Exclusive-OR Extension
68	DAE	Decimal Add Extension
70	ADE	Add Extension
78	CAE	Complement and Add Extension
8F	DLY	Delay
90	JMP	Jump
94	JP	Jump If Positive
98	JZ	Jump If Zero
9C	JNZ	Jump If Not Zero
A8	ILD	Increment and Load
B8	DLD	Decrement and Load
C0	LD	Load
C4	LDI	Load Immediate
C8	ST	Store
D0	AND	AND
D4	ANI	AND Immediate
D8	OR	OR
DC	ORI	OR Immediate
E0	XOR	Exclusive-OR
E4	XRI	Exclusive-OR Immediate
E8	DAD	Decimal Add
EC	DAI	Decimal Add Immediate
F0	ADD	Add
F4	ADI	Add Immediate
F8	CAD	Complement and Add
FC	CAI	Complement and Add Immediate

Fig. 5.2. Opcode index of instructions for the National SC/MP.

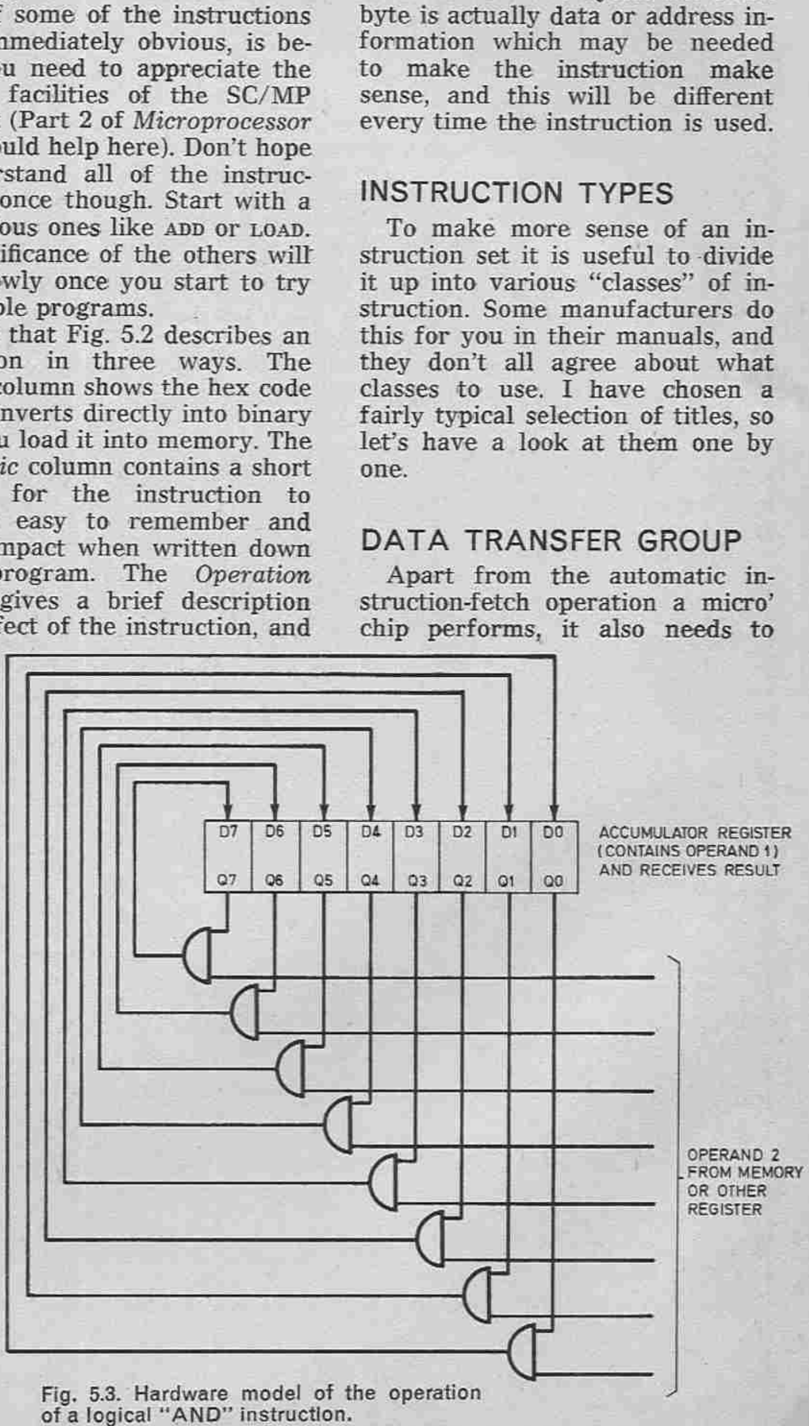


Fig. 5.3. Hardware model of the operation of a logical "AND" instruction.

MICROPROFILE:
PRACTICAL PROGRAMMING

Let's assume that you have taken the plunge and bought one of the simple micro' kits now available. You have great fun wiring it up, but now comes the tricky bit—what do you do next?

READ THE MANUAL. It looks daunting at first, but it has to be done. You need a familiarity with the hardware, the instruction set of the micro-processor chip, and with the basic monitor program supplied by the manufacturers which allows you to enter your own programs.

After studying the manual you can try out some of the example programs which are usually given. You may find it difficult at first to see just how some of these programs operate, but by persevering and making sure you understand each line before moving on, the use of instructions and addressing modes should eventually become clearer.

Now what? At this point the manual can let you down, you are on your own, and you begin to realise that writing and running your own programs is very different from running the example programs in the manual!

The best way to get started is to follow some sort of method, and until you work out a better method of your own, you may like to try mine.

STEP ONE

The flow chart. I always find a flow chart a very useful program design aid because it can be drawn up very quickly, and it helps you to visualise the sequence of program steps required. You can modify flow charts easily, and you can make successive generations of them, each more detailed than the last, as you zero in on the desired program.

There's no need for lots of fancy shaped boxes, you don't even need a stencil. I use three shapes—circles for the beginnings and endings of programs, square boxes for activities, and diamonds for decision points.

The first flow chart should be very general in nature, you can write things in the boxes like "turn light on" or "set up count register." The final flow chart should take into account the actual instructions and hardware available. You can even write the mnemonics you intend to use in the program, in the boxes if it helps.

STEP TWO

The listing. With a good idea of how the program will work derived from the flow charts, you can now start to list the sequence of mnemonics which will eventually become the program proper. For this step a pad of machine code programming sheets can be useful, but these are not easy to come by, so you can make up your own as shown in Fig. 5.4.

Each line on the sheet corresponds to one location in memory, so for two-byte instructions you will have to use two lines of hex code. To start with you should list your program in mnemonic form only, multi-byte instructions should have the mnemonic on one line followed by an appropriate number of blank lines for the address or data which can be entered later.

Locations which will be destinations for jumps can be given names, and these can be listed in the label column. Instructions which *are* jumps can use the appropriate label in their mnemonic column.

The comment column is there for you to write in as much plain English as possible to explain the action of your own program—ignore it at your peril!

Always fill out these sheets in *pencil.* You will need to modify them at some stage, and writing it all out again is a pain.

STEP THREE

The coding. With all the mnemonics and labels now listed, the time has come to translate the listing into its equivalent hexadecimal form, ready for use.

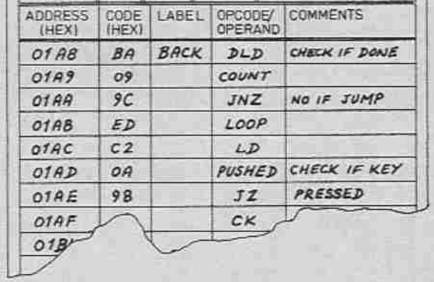
To do this you need the opcode listings in the manual, you will also need to code any immediate data into hex, and look up the label destination addresses on your sheets before entering them in the proper place in the hex column.

STEP FOUR

Try it out. It probably won't work at first, (they hardly ever do!) but using the monitor program in conjunction with your listings you should be able to pinpoint the problems fairly quickly. Modifications, if they are required, can be difficult to implement due to the need to move whole blocks of instructions around if an extra line is needed. There are two things you can do to ease matters.

(i) Start with *short* programs.
(ii) Sprinkle NOP instructions around in your program. These can be replaced by the extra instructions required without a substantial rewriting job.

If you feel that there must be a better way, well, there *is* a better way. On larger, more expensive systems, a program known as an "assembler" can be used to take the difficulty out of programming in machine language. With an assembler you don't have to worry about absolute addresses or hex code, and the machine code is replaced with what is known as assembly language—but that's another story!



MACHINE CODE PROGRAMMING SHEET

TITLE SWITCHCHECK

PAGE No 6 DATE 05 04 79 INITIALS RWC

ADDRESS (HEX)	CODE (HEX)	LABEL	OPCODE/ OPERAND	COMMENTS
01A8	BA	BACK	DLD	CHECK IF DONE
01A9	09		COUNT	
01AA	9C		JNZ	NO IF JUMP
01AB	ED		LOOP	
01AC	C2		LD	
01AD	0A		PUSHED	CHECK IF KEY
01AE	98		JZ	PRESSED
01AF			CK	
01B				

Fig. 5.4. An example of a listing of instructions, which will eventually constitute the program. Sheets like the one shown should be drawn up by the individual for his own use. Fill in entries in pencil to permit alterations.

"fetch" data from memory or "put" data to the memory under the control of the instructions themselves. This is done during the execute portion of an instruction cycle. Instructions which move data around, whether to and from memory or between internal registers, can be called "data transfer instructions."

Examples from the SC/MP instruction set include:

- XAE Exchange the contents of the accumulator register and the extension register.
- LD Load data from memory into the accumulator.
- ST Store data from the accumulator into memory.

ARITHMETIC & LOGIC GROUP

We all know that microprocessors can do sums, but it comes as a bit of a surprise to find out that they aren't very good at them! It's not that they get the wrong answers, it's just that they can only do very simple sums when you buy them, the sort of sums you could do when you were six.

With most microprocessors arithmetic precision is limited to eight bits, and there are no multiply or divide instructions at all, so really they are pretty dumb. Their strength lies in the speed with which they operate.

By stringing together a series of eight-bit addition operations to form a program segment or "routine", it is possible to make your pet micro' carry out arithmetic to any desired precision. Similarly, by using a different "routine" it is possible to perform multiplication and division.

If you have to, it *is* also possible to write programs to generate SIN, COS, TAN, LOG and other functions, but notice the operative word *program*, you don't get these goodies as part of the instruction set! Examples of arithmetic instructions from the SC/MP set include:

- ADE Add the contents of the extension register to accumulator.
- ADD Add the contents of a memory location to the accumulator.
- CAD Complement the contents of a memory location and add it to the accumulator. (Performs subtraction.)

Logical instructions work just like gates, only since the micro' works with eight bits at a time, one instruction is similar to a collection of eight gates. The logical instructions work on a pair of words at a time, so using the gate analogy they are actually two-input gates (Fig. 5.3). Examples from the SC/MP set include:

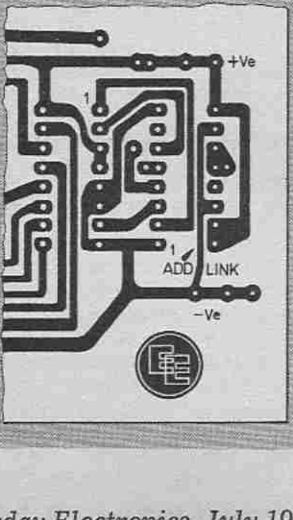
- ANE Carry out a logical AND function between the contents of the accumulator and the contents of the extension register.
- OR Carry out a logical OR function between the contents of a memory location and the accumulator.
- XRI Carry out an EXCLUSIVE-OR function between the contents of the memory location following this instruction, and the accumulator. **To be continued**

PLEASE TAKE NOTE

ELECTRONIC DICE (May 1979)

We apologise for the following errors that occurred in this article:

Components List, page 274
R4 *should read* 100kΩ
IC1, 4 *should read* 74C193 CMOS 4-bit . . . counter The p.c.b. (page 274) should be amended as shown below.



EE2020 TUNER AMPLIFIER (December 1978 to May 1979)

We apologise to readers for some errors that have occurred in the course of this 6 Part Series. They are not serious, and constructors will probably have already detected and rectified these mistakes.

Page 878 (Dec. '78)
FIXED RESISTORS
should read:

1kΩ	24
4·7kΩ	15
330kΩ	12

CAPACITORS
Polyester, Mullard type C280
add: 250V
first item should read: 0·01μF 2
Electrolytic, Printed Circuit type
delete the entry: 22μF 63V 1

Page 879 (Dec. '78)
Fig. 1.2b Circuit Diagram, Power Amplifier and Power Supply.
The lower end of R101 should be disconnected from the line to "TD3" and taken instead to the TD2a line, as correctly shown on the practical layout diagram Fig. 3.2.
(*Already covered in NOTE to caption for Fig. 3.2*).

Page 37 (Jan. '79)
Fig. 2.2 (lower r.h. corner)
R17 *should read:* R19

Page 38
Capacitors, *should read:*
C1 2·2μF 63V elect.
C19 *or* 470pF

Page 39
Capacitors, *should read:*
C65 0·047μF

Page 102 (Feb. '79)
Fig. 3·3 Printed Circuit Board B. Unfortunately, two holes have become obliterated during printing.
(i) Immediately above the central bus bar, about ⅜inches to right of "TB4", the large pad requires a second hole, just below existing one. This is for the wire link (see Fig. 3.4).
(ii) One hole for C38a may not be clear, this is the mid one of three on the long "vertical" pad, about 1 inch to the right of "TB3a".
Capacitors, *should read:* C35a,b 0·047μF

Page 242 (April '79)
Fig. 5.5. Pushbutton switches.
The letters "c" and "d" on switch S2 should be transposed. Connection is made to S2c, at the underside (p.c.b.) only.
S2d is not used at all. (*Already covered by Erratum on page 309*).
Stereo Decoder IC2
Motorola MC1310 is a pin-for-pin replacement for the type specified, and may be more readily available.
(*Already covered in Part 6, page 309*).

Simply ahead!

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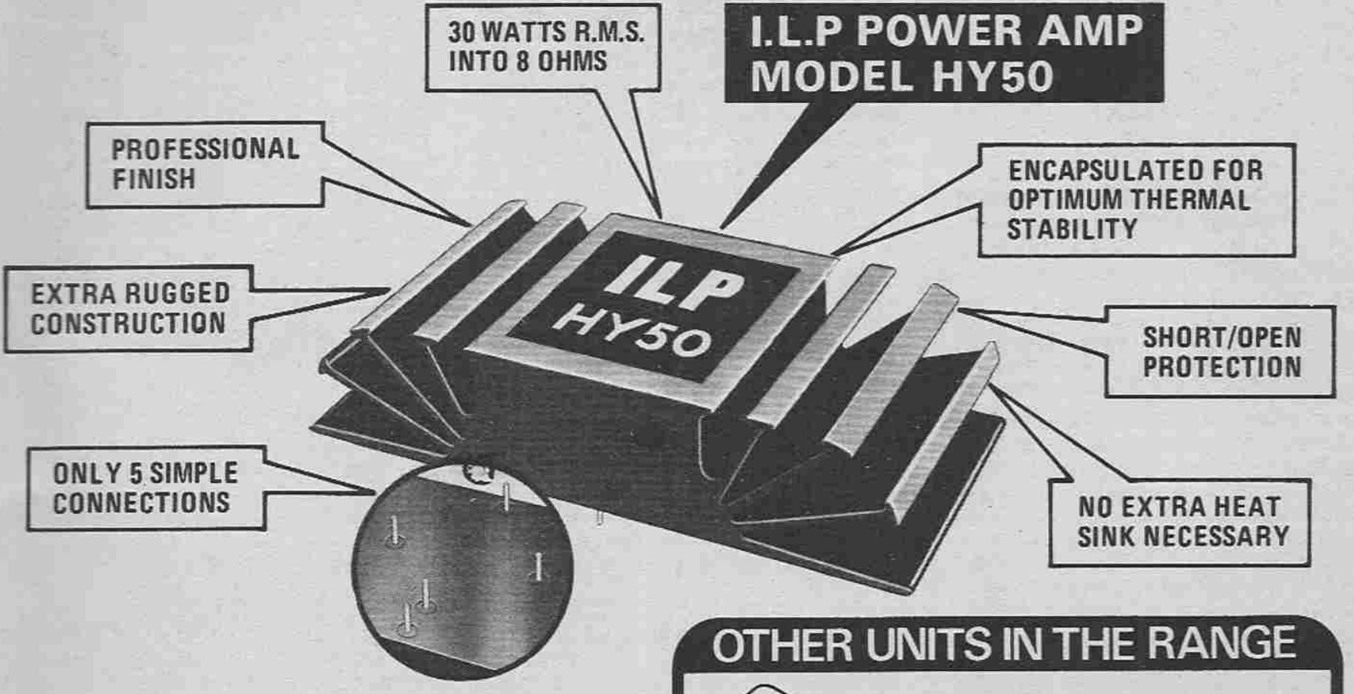
MODEL HY50



Of all the purpose-built power amplifier modules by I.L.P., the HY50 is understandably the most popular with those wanting to build or up-grade a hi-fi system, run a small high quality P.A. system, amplify a musical instrument (say for practise or small range use) or use it for lab work. Its useful 30 watts RMS output into 8 ohms, its rugged construction and freedom from heatsink worries make HY50 the ideal all-purpose quality power amp—and it is unconditionally guaranteed for five years. Ten of thousands are in use throughout the world

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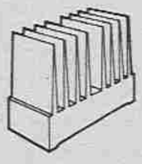

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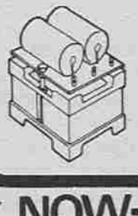

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PSU70	for 1 or 2 × HY120	£14·70
PSU90	for one HY200	£14·70
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WORKSHOP MATTERS

By Harry T. Kitchen

Choosing a Multimeter

For the beginner undoubtedly the biggest single cash outlay involves the purchase of a multimeter. This is essentially a moving coil meter movement with a number of resistors, rectifiers and batteries, which by suitable selection will enable you to measure d.c. and a.c. voltage, d.c. current certainly, and possibly a.c. current also, and resistance. A few instruments permit the measurement of capacitance as well.

Basic multimeters start at around £10, whilst the more comprehensive, accurate, and reliable instruments cost around £100. How do you select a suitable multimeter? There is, in my view, no simple, categorical answer; it all depends on your bank balance, ambitions and your priorities.

Draw up a list somewhat as follows: cost; d.c. and a.c. voltage; d.c. and a.c. current; resistance; possibly capacitance; d.c. and a.c. input resistances. Shuffle it around, try to arrive at a balanced compromise. Then look at brochures.

Sensitivity

Still unsure? Be of good cheer! It's not too difficult. Let us look first at input resistance, which invariably is quoted as an "OPV" figure. This stands for Ohms Per Volt, and denotes the sensitivity of the instrument, its goodness factor if you like.

The higher the OPV factor the more useful the instrument for electronics workshop use. The norm now is 20kΩ/V, though 10kΩ/V is acceptable. A few instruments offer 100kΩ/V.

This method is in my view illogical. What ought to be quoted is the meter sensitivity, the current it consumes for full-scale deflection or f.s.d. Ohm's law shows that for the above cases this will be 50μA, 100μA, and 10μA respectively.

These figures apply to the measurement of d.c. voltages only. Measurement of a.c. voltages requires the use of a rectifier interposed between the range resistors and the meter. Due to the characteristics of the rectifiers, the a.c. input resistance is less than the d.c. input resistance. A factor of x4 to x10 is usual; thus a 20kΩ/V meter may have an a.c. rating of between 5kΩ/V and 1kΩ/V.

The f.s.d. rating is for full-scale deflection. This can have two meanings: the current required for full-scale deflection of the meter movement, or the voltage or current that has to be applied to the terminals for meter f.s.d. The first is the basic figure; the second takes into account series or shunt resistors. A basic 50μA movement could thus measure virtually any voltage or current; the limiting factor would be the series (voltage) or shunt (current) resistors.

Measurement of Resistance

Measurement of resistance is effected simply by connecting a battery in the circuit, in one of two ways; series or shunt.

In the series mode the battery, meter, and resistance to be measured are connected in series; the current to the meter being limited by the unknown resistance. Since the current is dependent on the resistance, the meter can be scaled directly in ohms. Zero ohms corresponds to maximum meter deflection, Maximum (open circuit) ohms corresponds to zero meter deflection.

In the shunt mode the unknown resistor is connected directly across the meter, and the opposite conditions apply. Generally, the series mode is used for high resistances, shunt for low. It is usual for the better class instrument to be provided with several ranges, accompanied by a change in battery voltage.

Current is measured by connecting resistors in parallel with the meter for d.c., and these shunt excess current away from the meter. For a.c. work it is usual to employ a transformer, the primary being tapped to suit the ranges required. The secondary then feeds into a rectifier as for voltage measurements.

Capacitance measurements usually invoke the use of the mains. In effect the reactance of the capacitor is measured, but the meter is scaled in terms of capacity. Since the frequency is fixed the range is small, and the facility is of very limited use.

Important Features

We agreed, earlier, that a multimeter should have as high an input resistance as possible; 10kΩ/V minimum, 20kΩ/V desirable. 100kΩ/V instruments are available, but are more fragile; incorporating a lighter movement for increased sensitivity.

The advantage of the 20kΩ/V instrument is that the majority of circuit diagrams are annotated with voltages obtained by such an instrument. Meaningful comparisons can therefore be drawn whilst trouble shooting.

The upper voltage limit of most instruments is 1kV d.c. and a.c. Some allow voltages up to 5kV to be measured, some are limited to 500V. Apart from the mains, there will be little necessity to measure above 250 volts. Thus 500 volts f.s.d. is quite adequate. Lower down, base/emitter voltages or diode voltage drops may have to be measured; 150mV for germanium, 700mV for silicon. Thus a meter minimum f.s.d. of 1 volt is essential.

Transistor currents can be very minute, in the microamp or nano amp region. For these a 50μA f.s.d. scale is essential. Power amplifiers can consume several amps, so a 2·5A or 5A f.s.d. scale is essential, though 1A f.s.d. may serve at a pinch.

Resistance ranges should enable low value resistors to be accurately measured, and should enable reasonable accuracy to be obtained in the megohm region. A maximum of 10MΩ is typical for a 20kΩ/V instrument, though at this extreme, faith is required, since calibration marks are very cramped.

Scales and Accuracy

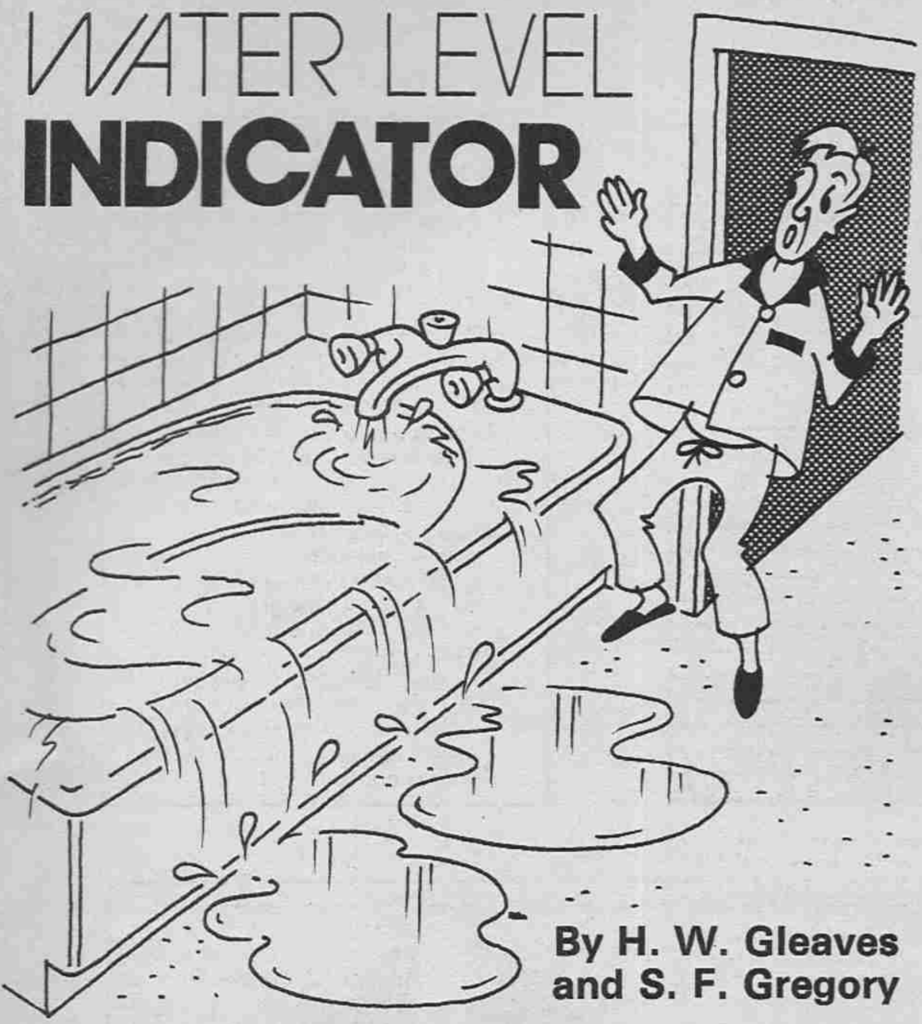
Scales should be clear and totally unambiguous. A plethora of scales may look impressive, but closely spaced, multitudinous scales, aid and abet inaccuracy. Clear, widely-spaced scales, are infinitely superior.

Limits of accuracy, more accurately inaccuracy, should be specified. Thus d.c. voltages can be $\pm 2\frac{1}{2}$ per cent, d.c. currents ± 3 per cent, resistance ± 5 per cent and so on. Note, however, that this is the f.s.d. accuracy, and as the pointer drops down-scale so accuracy is degraded accordingly. At one-tenth f.s.d. our 3 per cent accuracy is now ± 30 per cent, a not-insignificant degradation. This is why multimeters have multiple scales so that the pointer can be kept as far up the scale as possible.

Crossword No. 17–Solution

^{1}R	I	N	^{2}G	C	^{3}I	R	^{4}C	U	^{5}I	T	■	■	■	^{6}W
O	■	■	E	■	N	■	A	■	N	■	^{7}K	I	T	E
^{8}C	O	N	N	E	C	T	S	■	B	■	N	■	■	A
K	■	■	E	■	H	■	^{9}T	U	R	N	O	N	■	K
^{10}E	V	E	R	■	A	■	■	■	E	■	B	■	^{11}R	E
R	■	■	^{12}A	G	R	O	U	N	D	■	^{13}S	P	I	N
■	^{14}S	■	T	■	G	■	■	■	■	■	■	■	D	■
^{15}A	M	M	E	T	E	R	■	^{16}P	^{17}A	C	^{18}K	A	G	E
■	A	■	■	■	■	■	■	■	V	■	I	■	E	■
^{19}T	R	I	^{20}M	■	^{21}A	I	R	C	E	L	L	■	■	^{22}T
^{23}H	T	■	Y	■	N	■	■	■	R	■	^{24}O	V	E	R
R	■	^{25}T	A	R	I	F	^{26}F	■	S	■	W	■	■	A
O	■	■	R	■	M	■	^{27}A	G	I	T	A	T	E	D
^{28}A	T	O	M	■	A	■	C	■	O	■	T	■	■	E
T	■	■	■	^{29}A	L	T	E	R	N	A	T	E	R	S

WATER LEVEL INDICATOR



By H. W. Gleaves and S. F. Gregory

THE PROJECT to be described here is a very simple device, which indicates when the water in a bath reaches a certain level. Although the device was designed initially for use in one of the author's bathroom it can have many other uses such as a rain or snow alarm with an appropriate probe plugged in.

CIRCUIT CONSTRUCTION

The circuit of the Water Level Indicator is shown in Fig. 1, and consists of an astable multivibrator connected in series with a Darlington pair, the input to the latter being connected to the probe.

When the probe is dry, i.e., open circuit, the base of TR1 will also be open circuit and the Darlington pair will have a very high resistance between collector and emitter. In this state the multivibrator will be inoperative as it is effectively disconnected from the negative side of the battery.

However, when the probe is bridged by water, TR1 will have a small base current flowing which will be amplified to an extent equal to the product of the individual gains of TR1 and TR3. The result is that TR3 will be turned hard on and 9 volts will appear across the multivibrator. Transistors TR2 and TR4 will now begin to turn on, but due to component tolerances either TR2 or TR4 will begin to turn on faster than the other.

Assume that TR4 turns on the faster. As it does so the collector voltage will tend to fall in value. This negative signal is fed via C2 to the base of TR1. This has the effect of turning TR2 off, hence its collector voltage will rise. This positive signal is applied via C1 to the base of TR4 which will conduct even harder.

Eventually TR4 will saturate, thus its collector voltage will fall to near the negative supply, and the negative signal being fed back C2 via to TR2 base will cease.

Capacitor C2 will now commence to charge via R4 until about 0·6V is present on the base of TR2, whereupon TR2 will now begin to turn on. As this happens a negative signal will be applied via C1 to the base of TR4 which will now tend to turn off. The collector will now go positive and this positive signal will be applied via C2 to the base of TR2 thus turning it on even harder.

Transistor TR2 will eventually saturate whereupon C1 will begin to charge via R3 until about 0·6V is present at the base of TR4. This transistor will now commence to turn on again. This regenerative action will continue as long as the supply voltage is present.

COMPONENTS
approximate cost £4

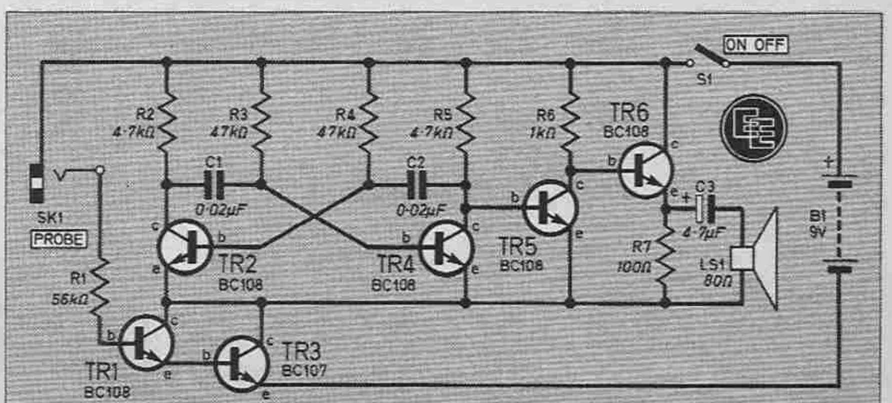


Fig. 1. Complete circuit diagram of the Water Level Indicator.

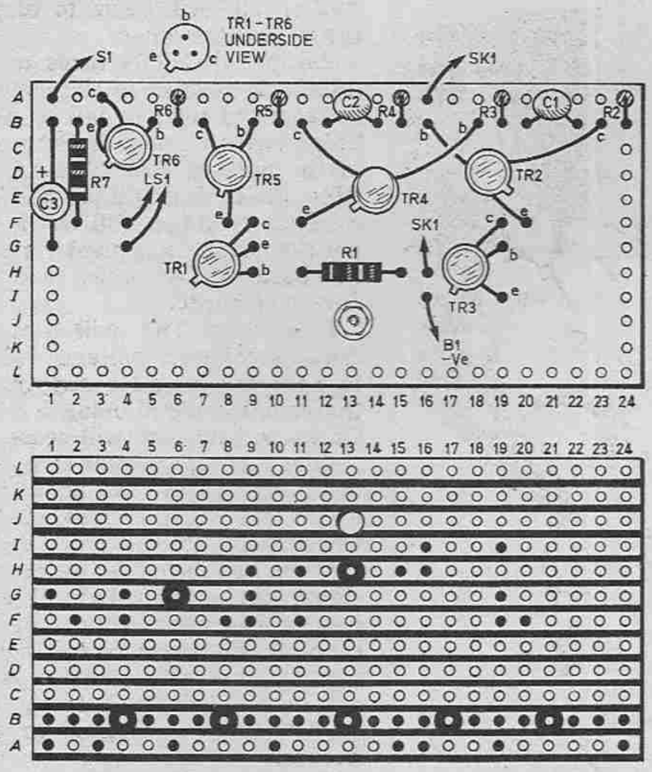


Fig. 2. (above) Stripboard layout also showing the breaks to be made. (Below right) The remainder of the wiring is completed as shown here.

COMPONENTS

Resistors

R1	56kΩ	R5	4·7kΩ
R2	4·7kΩ	R6	1kΩ
R3	47kΩ	R7	100Ω
R4	47kΩ		

All ¼W ±10%

Capacitors

C1, 2 0·02μF disc ceramic (2 off)
C3 4·7μF 10V elect.

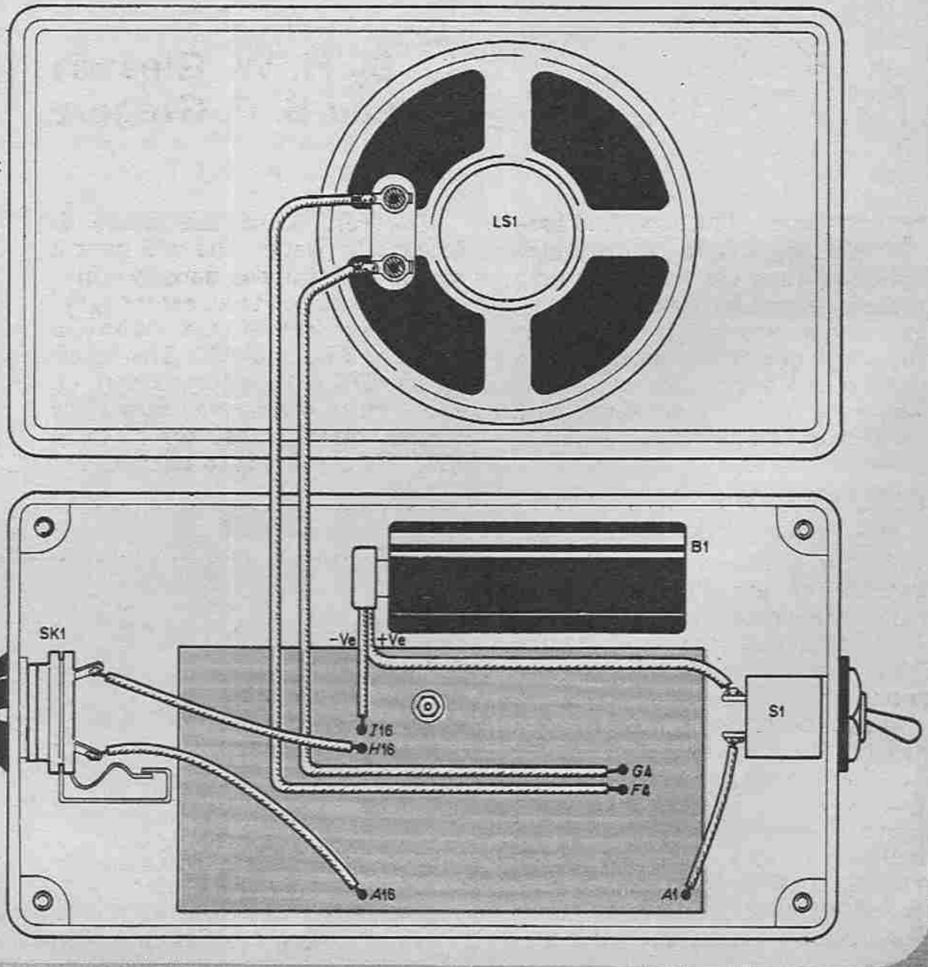
See Shop Talk page 426

Semiconductors

TR1, 2, 4, 5, 6 BC108 silicon *npn* (5 off)
TR3 BC107 silicon *npn*

Miscellaneous

SK1 3·5mm jack plug
LS1 80Ω 50mm loudspeaker
S1 s.p.s.t. miniature toggle
B1 9V PP3 battery
Stripboard, 0·1 inch matrix 24 holes by 12 strips; plastic case, size 110 × 60 × 30mm or similar; connector to suit battery; 4BA hardware; materials for probe; connecting wire.



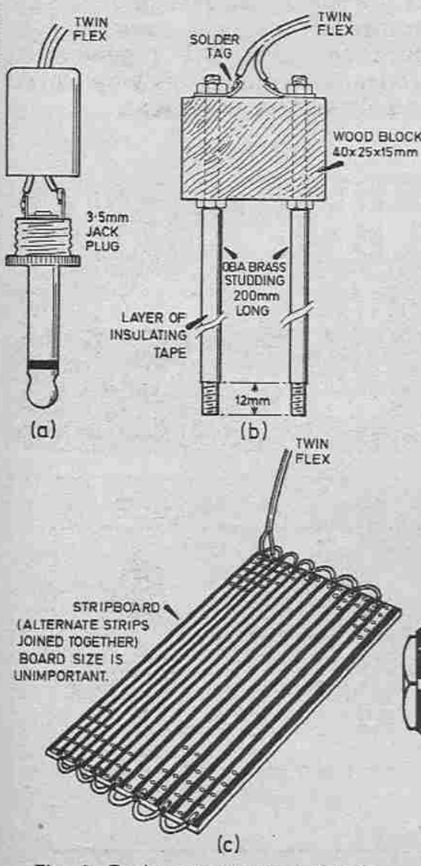


Fig. 3. Probe construction details. Only one needs to be made depending on application invisaged.

This type of multivibrator is said to have quasi-stable states, i.e., there are two states which the circuit may be in at any instant: TR2 saturated and TR4 off, or TR4 saturated and TR2 off.

The output from the multivibrator is amplified by transistors TR5 and TR6 and is heard in the loudspeaker.

CONSTRUCTION starts here

Most of the components are mounted on a piece of 0·1 inch matrix stripboard, having 12 strips by 24 holes. The first step is to make the required breaks on the underside of the board. The component assembly and general wiring can now be made according to Fig. 2.

The resistors should be soldered first, followed by the capacitors, care being taken to ensure that C3, which is an electrolytic type, is inserted correctly.

Finally, the six transistors can be soldered in. It is advisable to use a heatshunt on the lead-out wires since semiconductors are easily damaged by excess heat. The loudspeaker, battery and other flying leads can now be soldered on to the board. For neatness the wires to the loudspeaker and jack socket can be twisted together.

CASE

The case used in the prototype was made of plastic and has overall dimensions of 110 x 60 x 30mm, although any larger size case can be used. A 4BA bolt and two nuts were used in the prototype to secure the stripboard to the case, one of the nuts acting as a spacer.

Suitable holes should then be drilled for the jack socket and on/off switch.

TESTING

Before fitting the board into the case it should be thoroughly checked for dry joints etc. If all is well the battery may be connected and the unit switched on. At this stage there should be no sound from the speaker, however as soon as the probe is bridged, say, by inserting it into a liquid, a tone should be heard.

The frequency of the tone is approximately 760Hz.

PROBES

The unit as described is really very versatile in that it can be used for a variety of purposes. For example, a rain alarm, a snow alarm, a steam alarm, etc, simply by plugging in an appropriate probe. Three probes which could be used with the unit are shown in Fig. 3.

The first (a) is the "standard" probe used for detecting the level of water in a bath, and is simply a 3·5mm jack plug. The second type of probe (b) may be used with the unit as a soil moisture monitor. The last probe (c) shown can be considered as a "universal" or all purpose probe, consisting of a piece of stripboard with alternate tracks joined together. This one can be used for detecting rain etc.

IN USE

The finished unit can be fitted to a bath in a number of ways, the exact method is left to the reader. For example, with a metal bath the unit can be attached to the side near the top by means of a small magnet.

For a non-metallic bath, fibreglass for example, providing the surface is reasonably smooth and flat, a rubber sucker could be the means of fixing the unit. Another possibility is to use a long strip of aluminium bolted to the unit and bent to suit the edge of bath used. ⌑

EE CROSSWORD No 17

BY D. P. NEWTON

ACROSS

1 Loopy household wiring.

7 A bird that was Benjamin's aerial.

8 Makes contact.

9 Get going to switch (4, 2).

10 The ready battery is always there.

11 Concerning.

12 Washed high and dry in an earthy sort of way.

13 Rotate the pins (Anag.).

15 Currently a measurer.

16 Parcel of items, sometimes a deal.

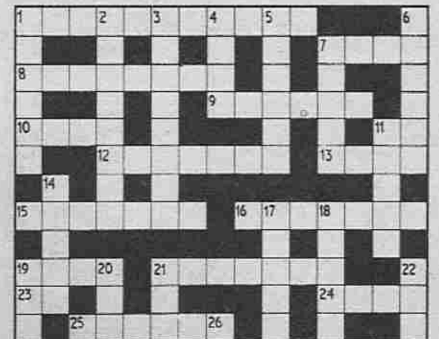
19 A neat, little variable capacitor.

21 Battery unit having gaseous electrolyte? (3, 4).

23 Large electrical stress.

24 Call before out.

25 Electrical charging rate.



27 A gate ditched in the beginning makes disturbed (Anag.).

28 Dalton was happy with it!

29 Pulsing to and fro.

DOWN

1 A switch, to be really hep or off it.

2 Bringing electricity into existence.

3 The controller, not unlike accumulator refuelling (2, 6).

4 Iron of high carbon content.

5 If two fast-breeder reactors got together, would this be their closely related offspring?

6 Losing strength.

7 Devices for facilitating rotation of variable components.

11 Mountainous area from the latter part of a pick-up.

14 Clever or quick-witted.

17 Dislike another tale.

18 4 16A at 240V.

19 Mike might be at it.

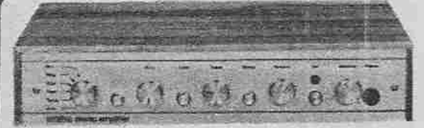
20 I might not chance it (2, 3).

21 Once thought to be a kind of electricity, in a faunal way.

22 Wind treads about in the tropics (Anag.).

26 A front on an inter basis giving access.

Solution on page 441



20 x 20 WATT STEREO AMPLIFIER

Viscount IV unit in teak simulate cabinet. Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic. magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features two mains outlets DIN speaker and input sockets plus fuse 20x20 watts RMS 40x40 watts peak. For use with 8 to 15 ohm speakers.

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RUMMAGING AROUND

with Keith Cadbury

About thirty years ago, when I was a snotty little village lad, with knee-length shorts and a side-parting, my father took it into his head to build a television set. An engineer by trade, but a confirmed do-it-yourself man (before they invented the term), he made this wondrous machine from war-surplus components.

When it was finished, the whole village would troop into our cottage living-room whenever something important happened (like Boat Race Day), to watch the eight-inch green screen. Yes, *green*. The colour of the cathode ray tube, taken from a wartime radar display unit.

Just *one* channel, and about four hours' transmission a night. Days of Gilbert Harding, and *Cafe Continental*, and the most frequently-seen image was "Normal Service will be Resumed as Soon as Possible."

I mention this childhood memory, following a conversation with an older electronics enthusiast, who wished for a return of the days of "War Surplus" yards.

WAR SURPLUS

I remember travelling on the village bus with dad, when he went to buy components. Two hours of meandering over bumpy narrow roads that connected the villages and small towns of our part of Surrey, in a rickety old 1928 single-decker, that finally arrived in Kingston-Upon-Thames.

We always went to Proops Bros, which was then just a wooden shack and about half-an-acre of mud, on which was piled thousands of racks of ex-War Department equipment. Stacked about eight feet high, and vaguely covered with tarpaulins when it rained, the racks of valve equipment (no transistors in 1948, remember) would be prodded and poked, and when his selection had been made and extricated, my dad and I would struggle back to the bus stop.

Sometimes he would have to make more than one journey, leaving me at the bus stop guarding piles of grey-panelled electric boxes that no-one else would have dreamt of touching anyway.

(At the time I refer to, dear younger readers, Vandals were people that we had read about in our history books, who destroyed works-of-art, just as the Crusaders did, if they were not clearly "Christian". Damage to other people's property was unthinkable, just after the Second World War, and all the damage *that* had caused.)

There was an inevitable argument with the driver of the bus. He didn't like us taking up all the luggage-rack space, *and* half of the gangway with stuff that took ten minutes to load and as long to unload at the other end. Sometimes the driver refused us entry, and we would sit on the equipment and wait an hour for the next bus, hoping that it would be a driver who lived in our village. He would have heard about dad's "machine", and would be looking forward to calling on us to see it working.

When dad finally got the contraption working, we would quite often have to turn it on during the day, when there were no transmissions—just so that some visitor could see the 405-line raster, all green and blank (like me on January 1, every year).

THE GREEN-EYED MONSTER

The "Machine" took pride of place in our tiny living-room. About twelve cubic feet, it was encased in three-ply, and painted ex-War Department battleship grey, with rows and rows of black knobs of various sizes and designs. With an oil-filled glass magnifier strapped to the front of the miniscule green screen and dad mostly round the back of it, making adjustments with screwdriver and torch, it was nevertheless the first television in our village (excluding the squire's, whose splendid pre-war device, with a mirror inside the lid, had been described by a neighbour who cleaned for him).

The total cost of this (just) post-war example of ingenuity was something like eight pounds—a good week's wages in those days. And forever more there were boxes of valves, rack-handles, condensers (now called capacitors), rotary switches, etc, everywhere.

TODAY

What, in this day and age, would draw a whole "village", to wonder and admire? Perhaps, if I could afford it, I could be the first in my small town to construct a chess computer that plugs into the television receiver. There would be some callers, but only to ask where they could buy such a device (with a credit card), and can you get one that works in colour, as if chessmen have ever been anything but black and white.

The pioneering spirit has not disappeared completely, perhaps, but the days of a little man-in-the-street impressing those around him have gone, I fear. It's not what you have done, or what you can do, that impresses nowadays, but how much money you have made out of it.

GOODY BAGS

The surplus stores have gone, but there *is* a seventies-equivalent. Firms often seem to go into liquidation these days, and the vast amounts of stock they held are auctioned-off. Electronic components from such sources often end up in "Goody Bags" that can be bought from many electronics shops. A good source of cheap components.

A couple of weeks ago I walked down Tottenham Court Road, calling into various electronics shops. I visited Proops Bros' shop, and told the Irish manager of my childhood visits to Kingston-Upon-Thames, to which he laughed, and said it was before his time.

Although mass-production and modern marketing methods have given us (relatively-speaking) fantastic bargains, I think back, and feel that it must have been exciting to buy the complete electronic innards of a Halifax bomber for a pound (get it out yourself).

SELF SERVICE

Our local Tesco store recently got a new manager, who had ideas on shop-layout quite different from his predecessor. Whilst my wife, along with a thousand other housewives, complained bitterly at being unable to find things in their new positions, her old man was gleefully scrabbling about inside a skip at the back of the store.

Having obtained permission from the new man, I found and took away assorted sheets of white-enamelled aluminium (once used as shelves), a couple of double eight-foot fluorescent tube fittings, two eight-by-four laminated bench-tops, and an assortment of chromium-plated grills.

The grills can be used to protect loudspeaker apertures on cabinets that are lugged-about a lot, by groups or discos, for example. Sheet aluminium is always useful to electronics workers. The fluorescent tube fittings would be useful to me in my workshop, if seeing what I am doing would help me understand. (I swear that I could make half of my experimental circuits blindfolded, and my hands are guided from above, by that great Designer of infinite PCB's.) Anyway, a lot of useful stuff from just one skip of "rubbish."

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.

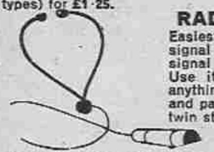
WINDSCREEN WIPER CONTROL

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.**

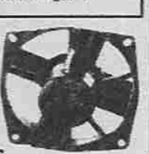
MULTISPEED MOTORS

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 ⅜ 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 **37p** 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. **£5, £6.**

MAIN RELAYS

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

BURGLAR ALARM ITEMS

(Circuit free on application)

Trigger mats 24" × 18"	£2·45
13" × 10"	£1·95
Relay 24 volt	95p
9-12 volt	95p
Alarm Bell 24 volt	£7·50
9-12 volt	£2·25
Mains	on application
Reset, Switch, ordinary	45p
Secret type with key	95p
Wire—100 metres	£1·50
24v Power unit mains operated	£5·35

MERCURY BATTERIES

Bank of 7 Mercury cells type 625 which are approx. ⅝in. diameter by ⅜in. 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. × 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.**

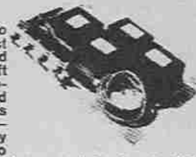
ROTARY PUMP

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

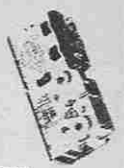
Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 10, 25, 29, 31 metre bands. Kit contains chassis front panel and all the parts **£1·94—**crystal earphone **55p** including VAT and postage.

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.

HUMIDITY SWITCH

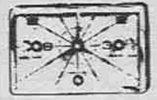


American made by Ranco, their type No. J11. The action of this device depends upon the dampness casusing a membrane to stretch and trigger a sensitive micro-switch adjustable by a screw, quite sensitive—breathing on it for instance will switch it on. Micro 3 amp. at 250V a.c. Overall size of the device 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 ouput **£2·90**

EP 9001 twin channel or stereo pre-amp **£2·90.**

G.P.O. HIGH GAIN AMP/SIGNAL TRACER

In case measures 5½ × 3½ × 1½ extremely high gain (70 DB) solid state amplifier designed or use as a signal tracer on GPO cables etc. Functions very well as a signal tracer for fault finding in radios etc. etc. By connecting a simple coil to the input it becomes a useful mains cable tracer. Uses standard 4½v battery and has input, output sockets and on-off volume control mounted flush on the top. Many other uses include general purpose amp, cueing amp etc. An absolute bargain at only **£2·25.** Suitable 80 ohm earpiece 60p + 5p.

THERMOSTATS

Refrigeration as illustrated with 36" capillary **£1·62.**

Limpet Stat must be mounted in close contact calibrated 90°-190°F 15 amp contacts **£1·62.**

Appliance Stat fix like a volume control—15 amp contact 30°-80°F **85p.**

ditto but for high temps **£1·25.**

Over Stat—with Serson and capillary **85p**

Wall Mounling by Satchwell	£3·00
Boiler Stat with control 20°-80°C	£2·16

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

Amazing, deluxe pocket size precision moving coil instrument jewelled bearings—1000 opv—mirrored scale.

11 instant ranges measure:—
DC volts 10, 50, 250, 1000
AC volts 10, 50, 250, 1000
DC amps 0-1mA and 0-100 mA
Continuity and resistance 0-150K ohms.

Complete with insulated probes, leads, battery, circuit diagram and instructions.

Unbelievable value only **£6·50 + 50p** post and insurance.

FREE Amps ranges kit enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one send **£1·50p.**

TERMS: Cash with order—but orders under **£6** must add **50p** to offset packing, etc.

BULK ENQUIRIES INVITED. PHONE: 01-688 1833.

ACCESS & BARCLAYCARD ACCEPTED.

J. BULL (ELECTRICAL) LTD

**(Dept. E.E.), 103 TAMWORTH RD.,
CROYDON CR9 1SG**

IT'S FREE

Our monthly Advance Advertising Bargains List gives details or 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.

TELEPHONE ANSWERING MACHINES To be broken up or at least not used for their original purpose. Secondhand but so far as we can see they are complete and quite possibly in good working order. We do not test them but guarantee to replace any part should it be missing or faulty. Prices as follows: very good condition **£16·75 + £1·24,** and top grade machines, our very best almost perfect **£2·60 + £2·50** carriage either model.

NOTE The items listed under SPARES FOR TELEPHONE ANSWERING MACHINES are not included with the basic machines.

SPARES FOR TELEPHONE ANSWERING MACHINES Mostly available ex stock.

MAINS POWER PACK IN PLASTIC CASE Price **£4·86.**

LEAD WITH PLUGS To your machine and power pack. Price **£1·08.**

CASSETTE Which gives first message to caller. Price **£4·86.**

MICROPHONE With inbuilt pre-amp for recording cassette. Price **£5·90.**

THIS MONTH'S SNIP Is a brand new two piece intercom. Far East manufacture complete with 50ft plug ended inter connecting lead. Master station and sub station can call each other. Set in neat cream coloured case that are very suitable for office or home or as a baby alarm etc. new stock but some may need attention, a bit of re-soldering perhaps. Offered at half regular price only **£3 + 24p.** Post 50p.

PORTABLE FLUORESCENT LAMP Ideal for camping but really a must for the motorist. You never know when you need a light and unlike the average torch the light from this lamp is not beamed and it will illuminate the whole engine area. Another point, this has a lead which you can plug into the car lighter socket thus its saving internal batteries. A real bargain complete with 9" tube ready to operate. Price **£7·95.**

SETTING UP A WEATHER STATION? We have two only professional Anemometers. Quite complete i.e. the generator with its rotating cups, weather proofed for mounting on a mast, and the main intrument which directly indicates wind speeds of up to 100 mph. Furthermore there is a facility for setting off an alarm should the wind speed reach a pre-determined level (adjustable) say 80 mph. These are brand new and complete with handbook. Price **£189.**

ENAMELLED COPPER WIRE Available on one pound reels or four ounce reels. We keep a stock of even numbered sizes but will also get odd numbered sizes to order. Price for 10, 12, 14, 16, 18 SWG **£2·70** per pound, **81p** per quarter pound. 20, 22, 24, 26, 28 SWG **£2·97** per pound, **97p** per quarter pound. 30, 32, 34 **£3·24** per pound, **£1·08** per quarter pound. 36, 38 and 40 **£3·78** per pound, **£1·26** per quarter pound. Thinner sizes also available to order price on request.

SOLENOIDS WITH SLUG We have quite a range of these from 12 volts to mains volts. A new one arrived this month, suitable for 24 volts D.C. or 10 volts A.C. very compact size only 1½" long × ½", coil resistance 140 ohms has protruding screws for fixing and the slug is also threaded. Price **81p.**

WANT A CHEAP ELECTRIC FAN We can offer the ½" stack motortion motor with a 6" 5 bladed fan, mount this on a stiff wire frame or a piece of handy angle and you will be able to keep yourself cool this summer? A real bargain price **£3·20.** Plenty of extractor fans and blowers in stock please let us have your enquiries.

WANT A MILLION RESISTORS These are ½ watt, 1 watt and 2 watt carbon types, all neatly packed in boxes with value clearly marked. Resistors themselves are colour coded and are perfectly standard, not every value of the range is included but they are reasonably spread over and not an unreasonable quantity of any one value. Ideal stock for retail shop or service depot. Price **£1000 + £125.**

SERVICE ENGINEERS ASSORTMENT I.F.'s AND OSC COILS Standard for many Jap and Hong Kong portable radios and cassettes etc. 100 assorted price **£5·60.**

HEATING PAD 11" × 8½", wafer thin 250 watt. Price **£1·16.**

HEAT AND LIGHT LAMP 500 watt tubular, like a short fluorescent tube, ideal for paint drying also for radiant heating in workshops and stores where overall heating is too costly. Lamp complete with mounting clip and connector. Price **£3·75.**

RADIOMOBILE CAR RADIO 12 volt L & M push button operation. Price **£28.**

CAR RADIO L & M and with F.M. good quality, Far Eastern make, 12 volts. Price **£22/25.**

MAINS TRANSFORMER 30 volts 2 amp secondary upright mounting, primary and secondary would on separate bobbins for additional safety. Price **£3·84.**

RELAY Plug in, 3 changeover in clear plastic case 12 volt D.C. or 25 volt A.C. Price **£1·08** each. 11 pin bases to suit **39p** each, or 6 volt A.C., or 3 volt D.C. same price.

MERCURY OPERATED SWITCH Glass encapsulated, 15 amp with 12" very flexible leads. Price **£1·62.**

SPECIAL MULTI CORE CABLES Heavy duty types 14 0076 cores. PVC insulated and colourcoded and each core with metal braided screen, all cores laid together and PVC covered. The following types in stock, 4 core **25p,** 6 core **30p,** 7 core **35p,** 12 core **50p.** All prices are per foot and subject to 8% Vat. Cut to any length, carriage extra if order under **£6.**

0–1 mA PANEL METER Flush mounting and in a waterproof case made for American equipment, scale divided into zones but not numbered. Price **£2**

TAPE HEAD CLEANERS Suitable for any cassette or reel to reel machine, special fluid (isoproypl alcohol) in felt tipped dispenser. Price **35p.**

UNISELECTOR Base mounting Tamsa 9 pole 12 way 50 volt operation. Price **£4·86.**

PLUG IN UNISELECTOR Ref. No: AP 212958 definitely a piece of precision equipment, it measures approximately 5" high × 1½" wide × 1" thick, plug into a 20 pin base, or pins could be used as solder tags. Probable cost would be at least £20 each. We have only a few. Price **£5·40.**

REDOING YOUR LIVING ROOM? If you are thinking of making a log effect fire place, we have the fibre glass tops, which when lit up give the full log effect. Size approximately 17" × 10½". Price **£1·37 +** Post **£1** on any quantity.

UP TO 5 MIN TIMER mains motorised, the dial calibrated in 1/10th of a minute up to 5 mins—its motor is a slipping clutch type i.e. after being switched on it takes the present time to travel to its stop, then it slips until the motor is switched off. A micro switch operated at the end of its travel. This micro switch could be used to operate auxiliary switched to make the time repeat, switch off etc etc. American made—ex equipment—believed unused. Price **£3·20.**

MAINS STOPPER 24 way stud switch two mains solenoids. First ratchets the switch arm around one stud per impulse second solenoid returns the switch arm to position 1 on metal chassis size approx. 4½" × 3" on which is also mounted a double changeover mains relay. Price **£4·86**

MINIATURE MAGNETIC CIRCUIT BREAKERS trips faster than fuse can blow, use it to control your service bench and it will save you the trouble of renewing fuses, or replace your fuse box with a line of these. Available as follows: 1 amp–5 amp 10 amp–15 amp–25 amp. All same price **£2·16** each.

BOOKS AND COMPONENTS

BOOKS BY BABANI

244	Beginners Guide to IC's	£2·75†
BP6	Engineers & Machinists Ref. Tables	40p†
BP14	2nd Book Transistor Equivs & Subs	£1·10†
BP22	79 Electronic Novelty Circuits	75p†
BP24	52 Projects Using IC741 (or Equiv)	75p†
BP26	Radio Antenna Book Long Distance Reception & Transmission	85p†
BP27	Giant Chart of Radio Electronic Semiconductor & Logic Symbols	60p†
BP32	Build Metal & Treasure Locators	85p†
BP34	Practical Repair/Renovation C/TV	95p†
BP35	Handbook of IC Audio Preamplifier & Power Amplifier Construction	85p†
BP36	50 Cicts use Germ/Sil/Zener Diodes	75p†
BP37	50 Projects Using Relays/SCR/Triacs	£1·10†
BP39	50 Field Effect Trans Projects	£1·25†
BP40	Digital IC Equivs & Pin Connection	£2·50†
BP41	Linear IC Equivs & Pin Connection	£2·75†
BP42	50 Simple LED Circuits	75p†
BP43	How to make Walkie-Talkies	£1·25†
BP44	IC 555 Timer Projects	£1·45†
BP45	Projects on Opto-electronics	£1·25†
BP46	Radio Circuits Using IC's	£1·35†
BP47	Mobile Discotheque Handbook	£1·35†
BP48	Electronics Projects for Beginners	£1·35†
BP49	Popular Electronic Projects	£1·45†
BP50	IC LM3900 Projects	£1·35†
BP55	Radio Stations Guide	£1·45†
BP160	Coil Design & Construction Manual	85p†
BP202	Handbook of Integrated Circuits Equivalents & Substitutes	75p†
BP205	1st Book Hi-Fi Speaker Enclosures	75p†
BP213	Circuits for Model Railways	85p†
BP215	Shortwave Circuits & Gear for Experimenters & Radio Hams	85p†
BP216	Electronic Gadgets & Games	85p†
BP217	Solid State Power Supply Handbook	85p†
BP221	28 Tested Transistor Projects	95p†
BP222	Short-wave Receivers for Beginners	95p†
BP223	50 Projects using IC CA3130	95p†
BP224	50 CMOS IC Projects	95p†
BP225	A Practical Intro to Digital IC's	95p†
BP226	Build Advanced Short-wave Receivers	£1·20†
BP227	Beginners Guide to Building Electronic Projects	£1·25†

NEWNES BOOKS

216	Transistors 3rd Ed.	£1·00
217	Integrated Circuits	£1·00
218	Radio & Television	£1·25
219	Electronics	£1·15
220	Colour TV 2nd Ed.	£1·15
221	Hi-Fi	£1·15
222	20 Solid State Proj. for Car	£1·95
223	20 Solid State Proj. for Home	£1·95
224	110 Int. Circ. Proj. for Home	£2·95
225	110 Thrysistor Projects	£2·50
226	Operational Amp. Proj. for Home	£2·50
227	110 Practical IC Proj. for Home	£2·75
228	Electricity	£1·15
229	Beginners Guide to Electronics	£2·25
230	Beginners Guide to Television	£2·25
231	Beginners Guide to Transistors	£2·25
232	Beginners Guide to Electric Wiring	£2·25
233	Beginners Guide to Radio	£2·75
234	Guide to Colour T.V.	£2·25
235	Electronic Diagrams	£1·80
236	Electronic Components	£1·80
237	Printed Circuit Assembly	£1·80
238	Transistor Pocket Book	£3·90
239	50 Photoelectric Circuits	£1·80
240	Semiconductor Handbook Part 1	£5·25
241	Semiconductor Handbook Part 2	£4·28
242	Electronics Pocket Book	£3·90
243	Radio Value & Semiconductor Data	£2·40
244	Beginners Guide to Integrated Circuits	£2 75
209	BI-PAK TTL Data Book	50p
	BI-PAK CMOS Data Book	45p

OPTOELECTRONICS

NEW INCREASED RANGE—ALL 1ST QUALITY

LED'S (diffused)

O/no.	Type	Size	Colour	Price
1501	ARL209 (TIL209)	·3mm (·125)	RED	£0·10
1502	MIL3232 (TIL211)	·3mm (·125)	GREEN	£0·15
1503	MIL3331 (OPL212A)	·3mm (·125)	YELLOW	£0·15
1504	ARL4850 (FLV117)	·5mm (·2)	RED	£0·10
1505	MIL5251 (TIL222)	·5mm (·2)	GREEN	£0·15
1506	MIL5351 (MV5353)	·5mm (·2)	YELLOW	£0·15
1509	FLV111	·5mm (·2)	CLEAR (Ill. Red)	£0·11

SUPER 'Hi-Brite' Type

1521	MIL32	·3mm (·125)	RED	£0·10
1522	MIL52	·5mm (·2)	RED	£0·10
1514	ORP12 Light dependent resistor			£0·55
1520	OCP71 Photo transistor			£0·35

LED CLIPS

1508/125	pack of 5 125 clips	£0·15
1508/2	pack of 5 2 clips	£0·18

DISPLAYS:

DL703 7 segment D.P. left (·30" height) Common Anode
RED Single Digit O/NO. 1523 £0·70
DL707 7 segment D.P. left (0·3" height) Common Anode
RED Single Digit O/NO. 1510 £0·85
DL527 7 segment D.P. left (·50" height) Common Anode
RED Two-Digit Reflector O/NO. 1524 £1·70
DL727 7 segment D.P. right (·510" height) Common Anode
RED Single Digit Light Pipe O/NO. 1511 £1·70

OPTO-ISOLATORS

Isolation Breakdown—Voltage 1500—continuous fwd current 100mA

CIL74 Single-Channel 6 pin DIP standard type—optically coupled pair with Infra-red LED Emitter and NPN Silicon Photo Transistor O/NO. 1497 £0·50

CILD74 Multi-Channel 8 pin DIP Two Isolated Channels O/NO. 1498 £1·00

CILQ74 Multi-Channel 16 pin DIP Four Isolated Channels O/NO. 1499 £2·20

MEL 11 (TIL81) NPN Light Detector
Silicon Photo Darlington Amplifier—VCBO:40V VCEO 30V VECO 10V Ic 100mA
Ptot: 300mW IL Min 0·5 Typ. 2mA ID 100mA nA

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0·15
DPDT standard slide	1974	£0·16
Toggle switch SPST 1½ amp 250V a.c.	1975	£0·37
Toggle switch DPDT 1 amp 250V a.c.	1976	£0·47
Rotary on-off mains switch	1977	£0·56
Push switch—Push to make	1978	£0·15
Push switch—Push to break	1979	£0·20

ROCKER SWITCH	Colour	No.	Price
A range of rocker switches SPST—moulded in high insulation. Material available in a choice of colours ideal for small apparatus.	RED	1980	£0·33
	BLACK	1981	£0·33
	WHITE	1982	£0·33
	BLUE	1983	£0·33
	YELLOW	1984	£0·33
	LUMINOUS	1985	£0·33

Description	No.	Price
Miniature SPST toggle 2 amp 250V a.c.	1958	£0·78
Miniature SPST toggle 2 amp 250V a.c.	1959	£0·84
Miniature DPDT toggle 2 amp 250V a.c.	1960	£0·90
Miniature DPDT toggle centre off 2 amp 250V a.c.	1961	£1·06
Push-button SPST 2 amp 250V a.c.	1962	£1·01
Push-button SPST 2 amp 250V a.c.	1963	£1·06
Push-button DPDT 2 amp 250V a.c.	1964	£1·35

MIDGET WAFER SWITCHES

Single-bank wafer type—suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactive 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	£0·54
2 pole 6 way	1966	£0·54
3 pole 4 way	1967	£0·54
4 pole 3 way	1968	£0·54

MICRO SWITCHES	Order No.	Price
Plastic button gives simple 1 pole change over action Rating 10 amp 250V a.c.	1970	£0·27

AUDIO LEADS

No.	Type	Price
107	FM Indoor Ribbon Aerial	£0·67
113	3·5mm Jack plug to 3·5mm jack plug. Length 1·5m	£0·84
114	5 pin DIN plug to 3·5mm. Jack connected to pins 3 & 5. Length 1·5m	£0·96
115	5 pin DIN plug to 3·5mm. Jack connected to pins 1 & 4. Length 1·5m	£0·96
116	Car aerial extension. Screened insulated lead. Fitted plug & skt.	£1·41
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0·77
118	5 pin DIN phono plug to stereo headphone jack socket	£1·18
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0·2m	£1·01
120	Car stereo connector. Variable geometry plug to fit most car cassettes. 8 track cartridge & combination units. Supplied with inline fuse power lead and instructions.	£0·67
123	6·6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1·69
124	3 pin DIN plug to 3 pin DIN plug. Length 1·5m	£0·84
125	5 pin DIN plug to 5 pin DIN plug. Length 1·5m	£0·84
126	5 pin DIN plug to Tinned open end. Length 1·5m	£0·84
127	5 pin Din plug to 4 Phone Plugs. All colour coded. Length 1·5m	£1·46
128	5 pin DIN plug to 5 pin DIN socket. Length 1·5m	£0·90
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1·5m	£1·18
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0·77
131	5 pin DIN plug to 3 pin DIN plug. 1 & 4 and 3 & 5. Length 1·5m	£0·93
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1·10
133	5 pin DIN plug to 2 phono plugs. Connected pins 3 & 5. Length 1·5m	£0·84
134	5 pin DIN plug to 2 phono sockets. Connected pins 3 & 5. Length 23cm	£0·77
135	5 pin DIN socket to 2 phono plugs. Connected pins 3 & 5. Length 23cm	£0·77
136	Coiled stereo headphone extension lead. Black. Length 6m	£1·97
178	AC mains lead for calculators etc.	£0·51

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	£1·35
156	11in	6in	3in	£2·29
157	6in	4½in	1½in	£1·40
158	9in	5½in	2½in	£1·90

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	£0·57
160	4in	4in	1½in	£0·67
161	4in	2½in	1½in	£0·67
162	5½in	4in	1½in	£0·76
163	4in	2½in	2in	£0·69
164	3in	2in	1in	£0·48
165	7in	5in	2½in	£1·12
166	8in	6in	3in	£1·43
167	6in	4in	2in	£0·93

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 0BA	839	£1·29	½in 4BA	846	£0·34
½in 0BA	840	£0·81	¼in 4BA	847	£0·27
1in 2BA	842	£0·70	1in 6BA	848	£0·43
¾in 2BA	843	£0·48	½in 6BA	849	£0·22
½in 2BA	844	£0·56	¼in 6BA	850	£0·27
1in 4BA	845	£0·47			

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

Type	No.	Price	Type	No.	Price
0BA	855	£0·77	4BA	857	£0·32
2BA	856	£0·51	6BA	858	£0·25

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

Type	No.	Price	Type	No.	Price
0BA	859	£0·15	4BA	861	£0·13
2BA	860	£0·13	6BA	862	£0·13

SOLDER TAGS—not tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
0BA	851	£0·43	4BA	853	£0·23
2BA	852	£0·30	6BA	854	£0·23

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0·18
1¼in x ¼in chassis mounting	507	£0·13
1¼in car inline type	508	£0·18
Panel mounting 20mm	509	£0·22
Panel mounting 1¼in	510	£0·36

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	6p	1A	615	5p	3A	619	5p
250mA	612	5p	1:5A	616	6p	4A	620	10p
550mA	613	5p	2A	617	5p	5A	621	5p
800mA	614	8p	2·5A	618	6p			

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 8p each

QUICK BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 8p each

Type	No.	Type	No.	Type	No.
1A	635	2·5A	638	4A	641
2A	637	3A	639	5A	642

All 6p each

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	£1·01
2022	9V-0-9V 100mA	£1·01
2023	12V-0-12V 100mA	£1·26

MINIATURE MAINS Primary 240V with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V, 0-6V RMS	£1·80
2025	MT150-0-12V, 0-12V RMS	£1·80

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	£2·70	P. & P. 45p
2027	9V-0-9V 1 amp	£2·16	P. & P. 45p
2028	12V-0-12V 1 amp	£2·80	P. & P. 55p
2029	15V-0-15V 1 amp	£2·97	P. & P. 65p
2030	30V-0-30V 1 amp	£3·87	P. & P. 85p

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	£3·82	P. & P. 85p
2032	1 amp	£4·95	P. &. P. 85p
2033	2 amp	£6·13	P. & P. £1

2035 240V Primary 0–55V @ 2A Secondary £3·00 + £1 P. & P.

SPECIAL OFFER

2042 240V Primary 0–20V @ 2A Secondary. By removing 5 turns for each volt from the secondary winding any voltage up to 20V @ 2A is easily obtainable. Ideal for the experimenter. £1·50 + £0·65 P. & P.

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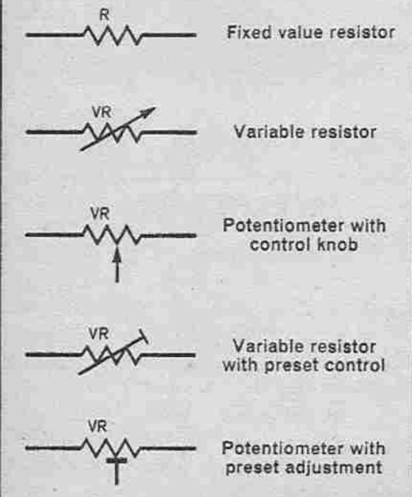
COMPONENTS SHOP: 18 BALDOCK STREET, WARE. HERTS.

SQUARE one

Every constructional article (and many other articles) appearing in Everyday Electronics contains a circuit diagram. This shows how the components must be interconnected to achieve the required function. The components themselves are for clarity, simplicity and standardisation, represented by "circuit symbols".

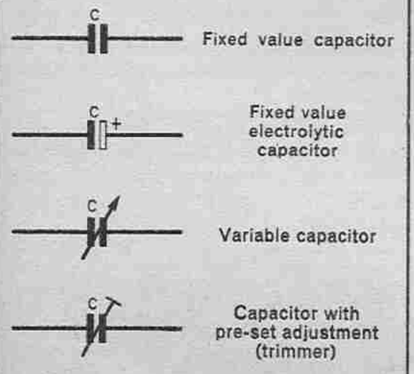
This month's beginners page is devoted to the basic and most common types of circuit symbols used in EE.

RESISTORS AND POTENTIOMETERS



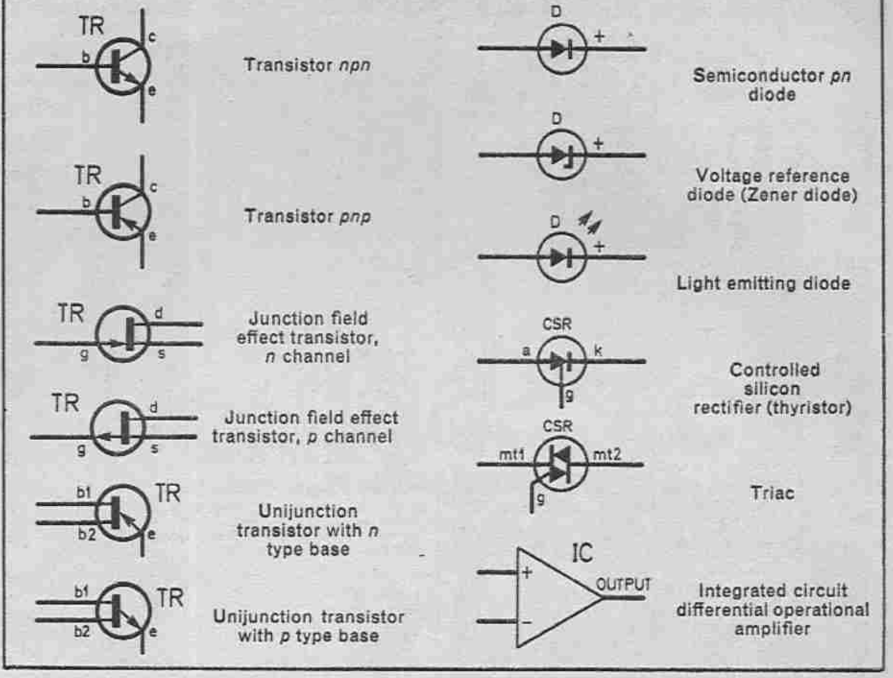
- Fixed value resistor
- Variable resistor
- Potentiometer with control knob
- Variable resistor with preset control
- Potentiometer with preset adjustment

CAPACITORS



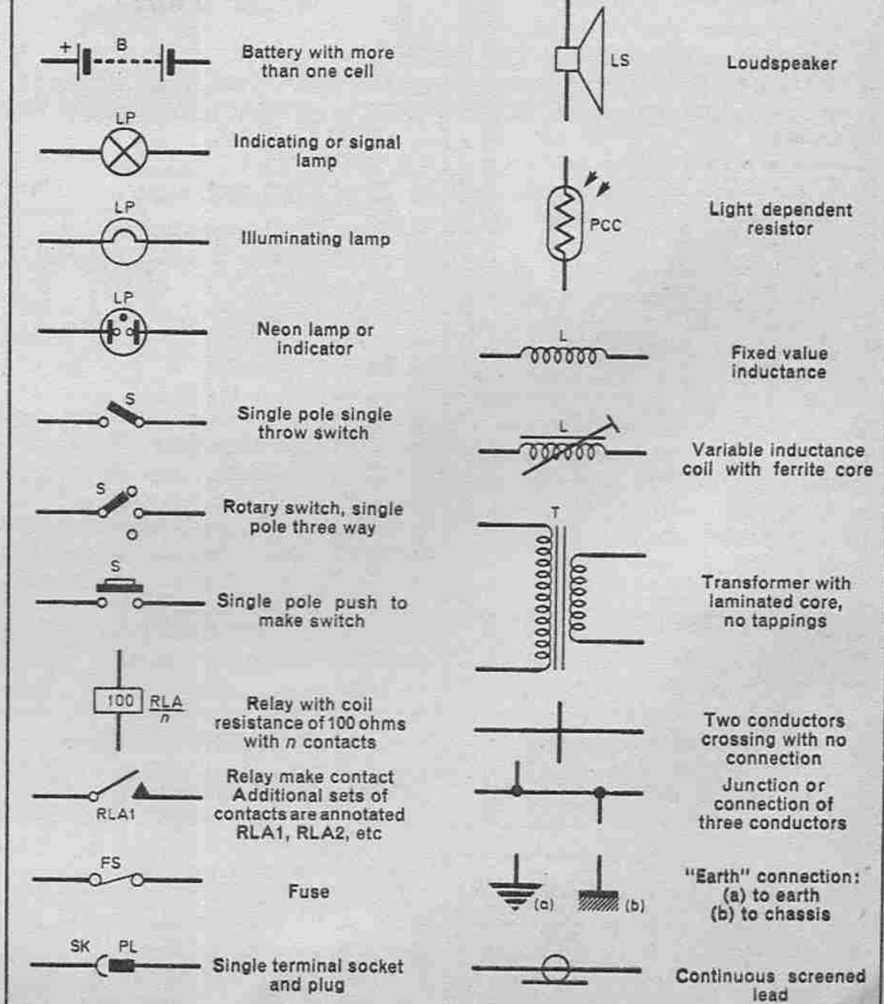
- Fixed value capacitor
- Fixed value electrolytic capacitor
- Variable capacitor
- Capacitor with pre-set adjustment (trimmer)

SEMICONDUCTORS



- Transistor *npn*
- Transistor *pnp*
- Junction field effect transistor, *n* channel
- Junction field effect transistor, *p* channel
- Unijunction transistor with *n* type base
- Unijunction transistor with *p* type base
- Semiconductor *pn* diode
- Voltage reference diode (Zener diode)
- Light emitting diode
- Controlled silicon rectifier (thyristor)
- Triac
- Integrated circuit differential operational amplifier

MISCELLANEOUS



- Battery with more than one cell
- Indicating or signal lamp
- Illuminating lamp
- Neon lamp or indicator
- Single pole single throw switch
- Rotary switch, single pole three way
- Single pole push to make switch
- Relay with coil resistance of 100 ohms with *n* contacts
- Relay make contact Additional sets of contacts are annotated RLA1, RLA2, etc
- Fuse
- Single terminal socket and plug
- Loudspeaker
- Light dependent resistor
- Fixed value inductance
- Variable inductance coil with ferrite core
- Transformer with laminated core, no tappings
- Two conductors crossing with no connection
- Junction or connection of three conductors
- "Earth" connection: (a) to earth (b) to chassis
- Continuous screened lead

The Extraordinary Experiments of Professor Ernest Eversure

by Anthony John Bassett

BOB has asked the Prof. to tell him more about possible uses for electronically produced beams in space. They are inside the Prof.'s giant experimental vacuum chamber where, dressed in "space suits", they can carry out experiments in a simulated space environment.

"Before you can begin to comprehend the vast range of possibilities and uses for these beams in the vacuum of space, and other environments such as may be encountered on and near the planets, asteroids, comets and clouds of gas and dust in some regions, it is best to learn something of the properties of the beams themselves, and of their sources."

ENERGY CARRYING BEAMS

"One of the fundamental properties of these beams is that they carry energy. The energy is carried in various forms according to the nature of the beam. Each type of beam emanates from a source which must have an adequate supply of energy with which to produce the beam.

Because the beam takes energy away from the source, it may be necessary to replenish the source with energy where a continuous beam is required. For instance, where an electron-gun is used as the source of an electron beam, it must be fed with electrical energy from a power supply in order to maintain the beam."

SOURCE EFFICIENCY

"Prof., we learned a little about electron-guns at school, and some electron-guns are better than others. Early electron-guns were not very powerful, then by using a heated cathode, it was found that a more powerful electron beam could be produced. By coating the cathode with chemicals, electron emission was improved further.

But even with the most modern electron guns, some of the power is wasted and does not go into the electron beam. Some of it goes in heat lost by radiation from the hot cathode, some is wasted when electrons are absorbed by the beam-forming electrodes of the electron-gun instead of joining the main beam. There are a number of sources of inefficiency in the system which produces the electron-beam.

Prof., "what I want to know is, how important is the source efficiency of the various types of beam producing apparatus?"

"This is a very important consideration, Bob. Many types of beam producing apparatus are inefficient and only a very small percentage of energy supplied actually goes into the beam."

LASER SURGEON

But the properties of the beam itself may be so highly important that it is worth while. An example of this may be given in the use of laser-beams in eye-surgery and many other delicate operations. Here it is obviously more important that the laser surgeon should have available a finely focused and controllable beam, and the fact that a few joules of energy are wanted in its production is a lesser consideration in this case.

HIGH POWER BEAMS

It is in the production of high-power beams that efficiency becomes a major consideration. Here even a small change in efficiency means a large loss or gain in power, and the design of high efficiency beam-producing apparatus will be more and more at a premium.

ENERGY CRISIS IN SPACE?

Also, the "wasted" energy which does not go into the beam does not simply disappear. It is

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MONO SYSTEM WITH LOUDSPEAKERS

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- ☐ Top grade components
- ☐ Suit most mixers

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SA608 8 ohms 60W 65V **£15.50** + £1.24
Supply for 1 or 2 modules **£14.95** + £1.20
SA1204 4 ohms 120W 75V **£17.50** + £1.40
Supply for 1 module **£14.95** + £1.20
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- ☐ Bass/middle/treble/master controls

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- ☐ Automatic sound light level
- ☐ Logic circuitry throughout

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COMPLETE WITH LEADS

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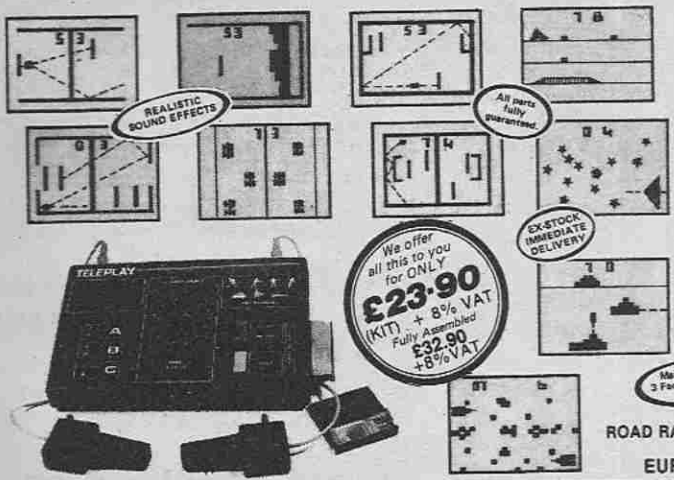

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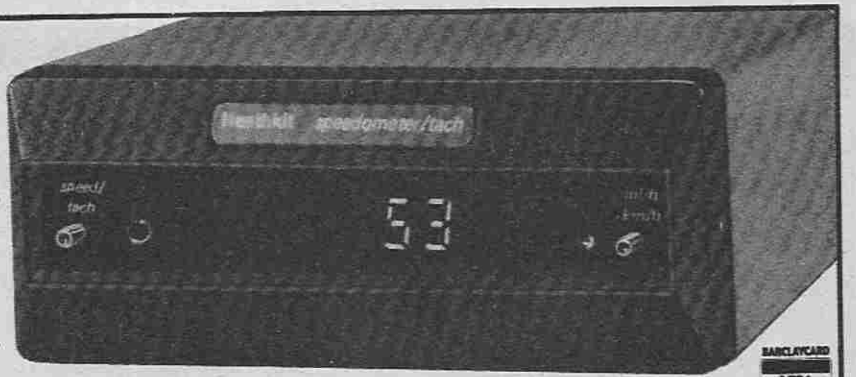

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usually produced as heat, and consequently some part of the apparatus gets hotter. In high-power equipment some arrangement must be made to remove this surplus energy, and cooling systems are very important means of doing so.

High power lasers on Earth are often cooled by feeding in cold water from the nearest tap. Hot water comes out and goes down the drain.

In a spacecraft this would not usually be possible, as the entire water supply might be heated up. The problem then becomes: How to dissipate this surplus energy from the craft.

Suppose for example that a spacecraft carries a microwave beam generator of 95 per cent efficiency, and that the maximum beam power is limited by the ability of the heat dissipators to remove the 5 per cent of the power used, in the form of heat waste.

If the equipment develops a fault which reduces the efficiency to 80 per cent, this would mean that the same full beam power would give a waste heat dissipation nearly five times greater than the permissible level. To keep waste heat dissipation within tolerable levels, it would be necessary to reduce beam power to less than a quarter of its normal strength at maximum. Otherwise, the spacecraft might heat up—or some components burn out.

EFFICIENCY

Changes in efficiency of such apparatus could cause a real energy crisis in space, as such a small change in efficiency as 15 per cent would result, in the example, in a need to reduce full power in a ratio quite out of proportion to safe operation. Maintenance of the efficiency of apparatus in space will obviously be an important task for space-maintenance engineers!

With the expansion of the various space programmes, the design of spacecraft and equipment of higher and higher efficiency will also be an important task for design engineers here on earth."

"Prof. I find this function of beams as carriers of energy in various forms fascinating, I think I'll try to find out more about all the various forms of energy which can be carried by beams!

But do these energy beams have many other interesting properties?"

"Yes Bob, there are lots of interesting things which are really worth knowing about, for instance. . . ."

To be continued

COUNTER INTELLIGENCE

By PAUL YOUNG

Casting Your Vote

As I write we have just elected a lady Prime Minister, the remarkable Mrs. Thatcher, and while anyone in business must not openly express their political persuasions, I naturally wish her every success in the formidable task ahead.

As I cast my vote on May 3rd, I could not help thinking what a cumbersome process it all is. I believe in some parts of the world, including the United States, this is already being done electronically. In other words, the voter goes into the polling booth and is confronted with the names of the candidates and alongside each one is a button. He simply presses the button, against his choice. It must save a few thousand man (sorry) person, hours, and in addition if the last vote is cast at 10 p.m., the result would be known by 10.05 p.m.

But no, cynic that I am, I can just imagine that there would be a couple of dry joints or a burnt-up chip somewhere in the machine and bingo, we would find we had elected the National Front or the Communist Party!

If you think that is far fetched, only last week a chap was drawing some money out from one of these money dispensers; he tapped out £15 on the keys and out came £195!! I understand that the queue that formed up behind him was nearly a mile long. Needless to say, by the time I reached the offending apparatus it had been switched off!

In The Picture

The other day as I was locking up my establishment, a last minute customer rushed up and as usual I asked him what he required, because if it was something simple I would go back and get it. He said he wanted all the parts to build a colour television. I had to break it to him that not only would I not have them all, but doubted whether any supplier could.

He sighed and said "I am wanting to make this by following a series of articles in the magazine *Television*. Wouldn't it be wonderful if there was just one supplier to whom I could send £250 and he would send me all the bits needed?" I agreed with him, and then gently told him the facts of life.

I told him that due to inflation, everyone had to carry smaller and smaller stocks, and therefore tended to concentrate on a smaller and smaller segment of the whole electronic range. It therefore follows, that in order to obtain his requirements he would have to deal with five or six suppliers. What it boils down to is this, knowing where to find suppliers is basic to the successful pursuit of any hobby and this applies particularly to electronics.

Unwritten Law

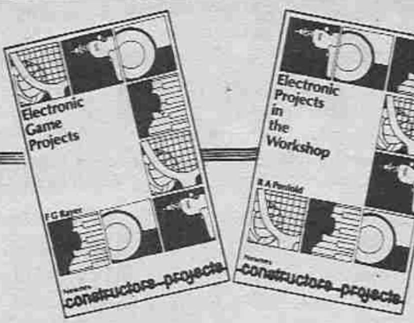
Most of you are familar with Ohm's law and similar laws governing electronics but do you know Murphy's law? Murphy's law states that if anything can go wrong it probably will, and the more serious the consequences, the more likely it is to happen.

I was witness to a splendid example of this when I went to watch my friends at Home Radio move, and give them moral support. The office they were moving into had a peculiar door which was only twenty inches wide. They therefore decided that the only way to get their desks into the building, was to haul them up one flight on ropes and take them through the kitchen window. After partially dismantling the window they managed to do this, only to find the desk was too wide to go up the next flight of stairs. "Ah" they said, we will have to dismantle it.

Now all their desks had specially made formica tops. In the case of this particular desk, the carpenter had screwed on the top and then stuck the formica over the screw heads! They went back to their former premises examined another desk, and found to their astonishment that it all came to bits. They had nine desks in total, out of the nine, only one would not come to pieces and that was the one they tried to move! Murphy strikes again!

Newnes

constructors projects



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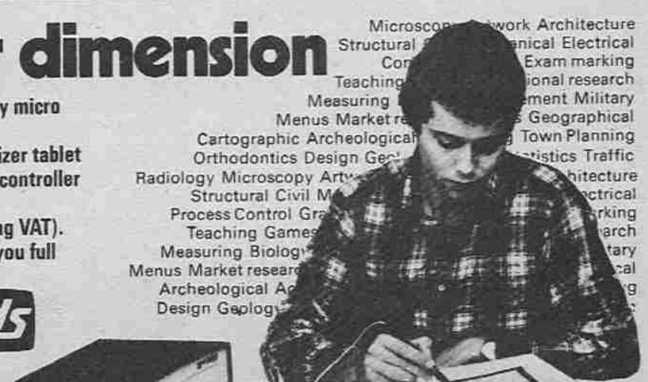

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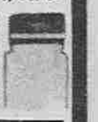

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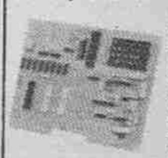

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1. Build an oscilloscope.

As the first stage of your training, you actually build your own Cathode ray oscilloscope! This is no toy, but a test instrument that you will need not only for the course's practical experiments, but also later if you decide to develop your knowledge and enter the profession. It remains your property and represents a very large saving over buying a similar piece of essential equipment.

2. Read, draw and understand circuit diagrams.

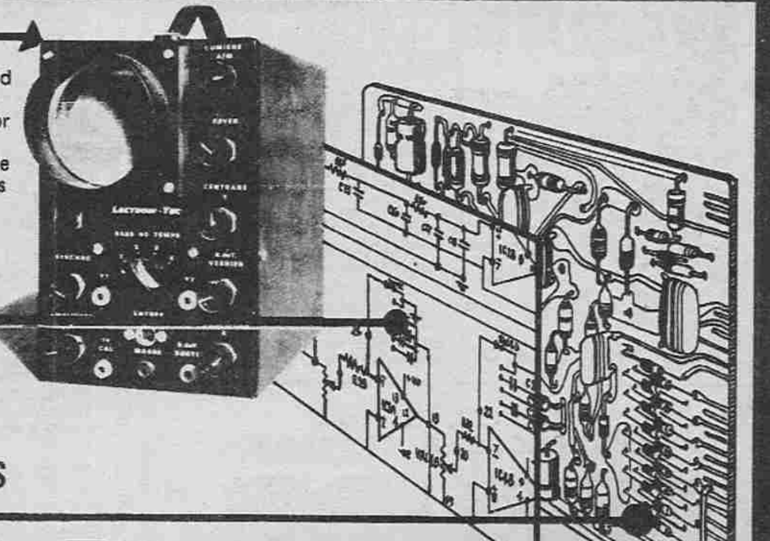
In a short time you will be able to read and draw circuit diagrams, understand the very fundamentals of television, radio, computers and countless other electronic devices and their servicing procedures.

3. Carry out over 40 experiments on basic circuits.

We show you how to conduct experiments on a wide variety of different circuits and turn the information gained into a working knowledge of testing, servicing and maintaining all types of electronic equipment, radio, t.v. etc.

4. Free Gift.

All students enrolling in our courses receive a free circuit board originating from a computer and containing many different components that can be used in experiments and provide an excellent example of current electronic practice.



32 page Colour Brochure

Post now, without obligation, to:-

BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL
P.O. Box 156, Jersey, Channel Islands.

NAME ____________________

ADDRESS ____________________

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EEB/7/79

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443D Millbrook Road, Southampton
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All prices quoted include VAT. Add 25p UK/BFPO Postage. Most orders despatched on day of receipt. SAE with enquiries please. MINIMUM ORDER VALUE £1. Official orders accepted from schools, etc. (Minimum invoice charge £5). Export/Wholesale enquiries welcome. Wholesale list now available for bona-fide traders. Surplus components always wanted.

THE NEW 1978-9 GREENWELD *CATALOGUE*

FEATURES INCLUDE:

- 50p Discount Vouchers
- Quantity prices for bulk buyers
- Bargain List Supplement
- Reply Paid Envelope
- Priority Order Form
- VAT inclusive prices

PRICE 30p + 15p POST

KITS OF BITS FOR THIS MONTH'S EE PROJECTS

JUNE 1979

QUADROPHONIC SIMULATOR
TREMOLO UNIT
METAL LOCATOR
ELECTRONIC CANARY

MAY 1979

ELECTRONIC DICE
S.W. CONVERTER
INTRUDER ALARM

APRIL 1979

SHAVER INVERTER
TOUCH BLEEPER
TRANSISTOR TESTER
TOUCH BLEEPER

MARCH 1979

LABCENTRE

A portable "instant" electronic workshop with tools, power supplies and test equipment for design work in logic (TTL and CMOS), audio, r.f. etc.

CAR DIRECTION INDICATOR

ONE-TRANSISTOR RADIO

Prices not available at time of going to press. Please send S.A.E. for full details.

E.E. 20+20 TUNER AMPLIFIER

We can supply all parts required except the components for the RF unit for approx. £40. Send SAE for detailed list.

NOTE: A more detailed list of parts supplied in these and other kits is available on receipt of a SAE.

Most E.E. Projects back to SEPTEMBER 1978 available.

"DOING IT DIGITALLY"

This new series which started October 1978 is bound to be a big success. We supply a complete set of parts (as we did for last year's 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. £4·50

COMPONENT CABINET IDEAL FOR THE NEWCOMER TO ELECTRONICS

Contains hundreds of brand new resistors, capacitors, transistors diodes and I.C.'s All useful values, carefully chosen to help the new constructor pursue his hobby without finding himself short of some vital parts!

All parts contained in clearly marked bags in a plastic storage cabinet 232 × 121 × 165mm with 9 drawers into which all parts can be neatly located.

If bought individually parts plus case would cost over £45 but we are offering this for ONLY **£29·95 + £1** p & p. Simply send a cheque or P/O for **£30·95** for immediate despatch.

CONTENTS:

200	¼ watt resistors
20	Wire wound resistors
70	Ceramic Capacitors
70	Mylar Capacitors
50	Polyester Capacitors
56	Electrolytic Capacitors
61	Transistors
12	I.C.'s
20	L.E.D.'s
55	Diodes and rectifiers

Altogether 614 components.

Price includes current catalogue and Greenweld pen for reordering supplies. Plus **FREE** surprise gift.

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
W817 11 pin plug in relay, rated 24V ac, but works well on 6V DC. Contacts 3 pole c/o rated 10A, 95p
W846 Open construction mains relay. 3 sets 10A c/o contacts. £1·20
W877 675R 12–27V. DPCO 23 × 20 × 10mm sealed can 86p.
W880 230V a/c DPCO 10A contacts, enclosed case £1·30.
W830 200R 6–12V DPCO, 23 × 20 × 10mm, sealed can 88p.
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

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Size 36 × 18" 200g. Hundreds of uses around the home. 100 sheets for £1·50. Box of 1500 for £19

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Easy to build and great to play.
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High performance, door mounting. 5½ inch units with smart front grill. 10 oz magnet, 12 watts, 4 ohms. In attractive see-through carton. £12·60 + 12½% VAT. per pair.

HEAVY DUTY XOVER 2 WAY 8 OHM

A 2 way 8 ohm H/D Xover suitable for L/S systems up to 100 watt.
Fitted with screw terminals for input and a three position 'HF LEVEL' switch which selects either Flat, —3dB or — 6dB.
ONLY £3·00 + 8% VAT

A CRESCENT 'SUPERBUY'

Goodmans 5" 8 ohm long throw H/D loudspeaker.
Mounting plate is integral with L/S chassis and has fixing holes with centres spaced at 5¼" (diagonally).
ONLY £5·00 + 12½% VAT

LOUDSPEAKERS 90p
2¼" (57mm) 8 or 75 ohm +12½% VAT
(please state impedance req'd)

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All metal, cast base, professional high speed key. Fine adjustment. Mounted on bakerlite base.
Dimensions: (Base) 120 × 75mm
£3·90 + 8% VAT

CR 4110 DESOLDERING PUMP

ONLY £6 + 8% VAT

High suction pump with automatic ejection. Knurled, anti corrosive casing. Teflon nozzle.

3 KILOWATT PSYCHEDELIC LIGHT CONTROL UNIT

1000W lighting per channel, max.
This 3 channel sound to light unit is housed in a robust metal case, with a sensitivity control for each channel i.e. Bass, middle and treble. Full instructions supplied. S.A.E. for spec. sheet. **ONLY £20·00 + 8% VAT**

CR LVI 12v DRILL

£12·00 8% VAT

BRITISH MADE "Versadrill", 12 volts DC. Compact battery operated power tool, sufficiently powerful to perform all the operations associated with 240v drills. Dimensions:—
150 x 50mm (dia.)

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Please add VAT as shown.
S.A.E. with all enquiries please

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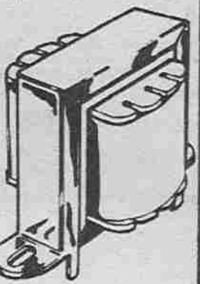
Electronic Components

REGULATORS

78L05	30p	7805	60p	79L05	70p	7912	80p
78L12	30p	7812	60p	79L12	70p	7915	80p
78L15	30p	7815	60p	7905	80p	LM723	35p

HARDWARE

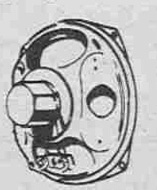
MINIATURE TRANSFORMERS



240 Volt Primary

Secondary rated at 100mA. Available with secondaries of:
6 - 0 - 6, 9 - 0 - 9 and
12 - 0 - 12. 92p. each.

LOUDSPEAKERS

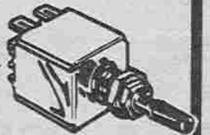


56mm dia. 8 ohms	70p
64mm dia. 8 ohms	75p
64mm dia. 64 ohms	75p
70mm dia. 8 ohms	100p
70mm dia. 80 ohms	110p

TERMINALS

Rated at 10A. Accepts 4mm plug, black, blue, green, brown and red . . . 22p

SWITCHES



Subminiature toggle. Rated at 3A 250V.
SPDT 70p SPDT centre off 75p
DPDT 80p DPDT centre off 95p

Standard toggle
SPST 34p DPDT 48p

Wavechange switches:
1P12W, 2P6W, 3P4W or 4P3W all 43p ea.

Miniature switches (non-locking)
Push to make 15p Push to break 20p

Slide switches (DPDT)
Miniature 14p Standard 15p

CONTROL KNOBS

Ideal for use on mixers etc. Push on type with black base and marked position line. Cap available in red, blue, green, grey, yellow and black. 14p

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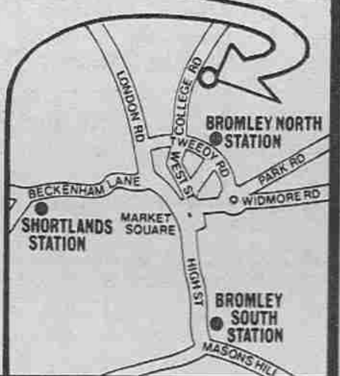
NEW SHOP

We welcome callers at our new premises at the address below (5 mins. from High St.) We are open Mon - Sat, 9am - 6pm. Special offers available.

Express telephone order service. Orders received before 5pm. are shipped first class on that day. Contact our Sales Office now! Tel: 01-464 2951/5770.



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Quantity discounts on any mix TTL, CMOS, 74LS and Linear circuits: 100+ 10%, 1000+ 15%. Prices VAT inclusive. Please add 30p for carriage. All prices valid to April 1980. Official orders welcome.

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TRANSISTORS

				ZTX109	14p
				ZTX300	16p
				2N697	12p
				3N1302	38p
AC127	17p	BCY71	14p	2N2905	22p
AC128	16p	BCY72	14p	2N2907	22p
AC176	18p	BD131	35p	2N3053	18p
AD161	38p	BD132	35p	2N3055	50p
AD162	38p	BD135	38p	2N3442	135p
BC107	8p	BD139	35p	2N3702	8p
BC108	8p	BD140	35p	2N3704	8p
BC109	8p	BF244B	36p	2N3705	9p
BC147	7p	BFY50	15p	2N3706	9p
BC148	7p	BFY51	15p	2N3707	9p
BC149	8p	BFY52	15p	2N3708	8p
BC148	9p	MJ2955	98p	2N3819	22p
BC177	14p	MPSA06	20p	2N3904	8p
BC178	14p	MPSA56	20p	2N3905	8p
BC179	14p	TIP29C	60p	2N3906	8p
BC182	10p	TIP30C	70p	2N4058	12p
BC182L	10p	TIP31C	65p	2N5457	32p
BC184	10p	TIP32C	80p	2N5458	30p
BC184L	10p	ZTX107	14p	2N5459	32p
BC212	10p	ZTX108	14p	2N5777	50p
BC212L	10p				
BC214	10p				
BC214L	10p				
BC477	19p				
BC478	19p				
BC479	19p				
BC548	10p				
BCY70	14p				

DIODES

1N914	3p	1N5401	13p
1N4001	4p	BZY88ser.	8p

Full spec. product.
1N4148 £1.40/100. £11/1000

LINEAR

THIS IS ONLY A SELECTION!

		CA3140	38p	NE555	21p
		LM301AN	26p	NE556	50p
		LM318N	85p	NE565	85p
		LM324	45p	NE567	170p
		LM339	45p	SN76003	200p
709	28p	LM380	75p	SN76013	140p
741	16p	LM382	120p	SN76023	140p
747	40p	LM1830	150p	SN76033	200p
748	30p	LM3900	50p	SN76477	220p
CA3046	55p	LM3909	65p	TBA800	70p
CA3080	70p	MC1496	60p	TDA1022	650p
CA3130	90p	MC1458	32p	ZN414	75p

CAPACITORS

TANTALUM BEAD

	each
0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V	8p
4.7, 6.8, 10uF @ 25V	13p
22 @ 16V, 47 @ 6V, 100 @ 3V	16p

MYLAR FILM

0.001, 0.01, 0.022, 0.033, 0.047	3p
0.068, 0.1	4p

POLYESTER

Mullard C280 series

0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1.	5p
0.15, 0.22	7p
0.33, 0.47	10p
0.68	14p
1.0uF	17p

CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF . . . 2p

RADIAL LEAD ELECTROLYTIC

63V	0.47	1.0	2.2	4.7	10	5p
			22	33	47	7p
	100					13p
			220			20p
25V	10	22	33	47		5p
	100					8p
		220				10p
				470		15p
	1000					23p

CONNECTORS

JACK PLUGS AND SOCKETS

	screened	unscreened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

1mm PLUGS AND SOCKETS

Suitable for low voltage circuits, Red & black. Plugs: 6p each Sockets: 7p each.

4mm PLUGS AND SOCKETS

Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each

PHONO PLUGS AND SOCKETS

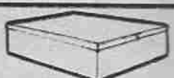
Insulated plug in red or black	9p
Screened plug	13p
Single socket . 7p Double socket	10p

VERO

Size in.	0.1in.	0.15in.
2.5 x 1	14p	13p
2.5 x 3.75	42p	40p
2.5 x 5	52p	50p
3.75 x 5	60p	60p
3.75 x 17	195p	180p

Veropins—single sided per 100
0.1in 35p
0.15in 40p

BOXES



Aluminium boxes with lid and screws

	Length	width	height	
AL1	3	2	1	48p
AL2	4	3	1½	58p
AL3	4	3	2	65p
AL4	6	4	2	70p
AL5	6	4	3	85p
AL6	8	6	2	116p

THYRISTORS

Plastic-cased Thyristors: Texas

	4A	8A	12A
100V	36p	45p	62p
200V	42p	53p	68p
400V	51p	66p	86p

TRIACS

Plastic cased Triacs. Texas. All rated at 400V.

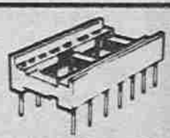
4A	70p	12A	90p	20A	185p
8A	80p	16A	95p	25A	215p

CMOS

		4018	55p	4050	25p
		4023	12p	4066	35p
		4024	40p	4068	18p
4001	12p	4026	90p	4069	12p
4002	12p	4027	30p	4071	12p
4007	12p	4028	48p	4081	13p
4011	12p	4029	50p	4093	45p
4013	28p	4040	60p	4510	65p
4015	50p	4042	50p	4511	65p
4016	30p	4046	90p	4518	65p
4017	48p	4049	25p	4520	60p

FULL DETAILS IN CATALOGUE!

SKTS



Low profile by Texas

8 pin	8p	16 pin	11p	28 pin	22p
14 pin	10p	24 pin	18p	40 pin	32p

Soldercon pins: 100:50p. 1000:370p

OPTO

LED's	0.125in.	0.2in	each	100+
Red	TIL209	TIL220	9p	8p
Green	TIL211	TIL221	13p	12p
Yellow	TIL213	TIL223	13p	12p
Clips	3p	3p		

DISPLAYS

DL704	0.3 in CC	130p	120p
DL707	0.3 in CA	130p	120p
FND500	0.5 in CC	100p	80p

RESISTORS

Carbon film resistors. High stability, low noise 5%.

E12 series. 4.7 ohms to 10M. Any mix:

	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res) 0.5W £7.50. 0.25W £5.70.

METAL FILM RESISTORS

Very high stability, low noise rated at ¼W 1%. Available from 51ohms to 330k in E24 series. Any mix:

	each	100+	1000+
0.25W	4p	3.5p	3.2p

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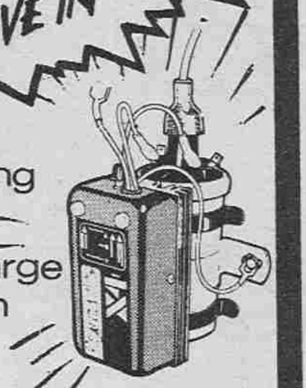
from Sparkrite

Sparkrite - was featured by Shaw Taylor in 'DRIVE IN'



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- **Continual peak performance**
- **Longer coil/battery/plug life**
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Sparkrite X4 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 1/3 mins.

Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). The circuit incorporates a voltage regulated output for greatly improved cold starting. The circuit includes built in static timing light, systems function light, and security changeover switch. All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, bolts and silicon grease. Full instructions to assemble kit neg. or pos. earth and fully illustrated installation instructions.

NOTE—Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.85 inc. VAT. post & packing.

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X4 KIT **£16.65**	
TACHO PULSE SLAVE UNIT **£3.85**	

Send SAE if brochure only required.

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Cheque No.

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for Miniature Soldering Irons & Accessories

		PRICE EACH	P & P Extra EACH
S-R-B	18 watt Soldering Iron available in 12, 110 & 240 Volts, fitted with No. 20 bit	£3.78	+ 22p
SPARE BITS	No. 19 size 1.5mm or No. 20 size 3 mm or No. 21 size 4.5 mm or No. 22 size 6 mm	44p	—
	No. 78. I.C. Desoldering Bit	88p	+ 9p
	No. 1920L Long Life Bit	95p	—
SAFETY STAND		£3.25	+ 65p
SOLDER	Savbit 20'	52p	+ 9p
	Savbit 10'	26p	+ 4p
	Lowmelt 10'	65p	+ 9p

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S-R-B

We also Offer & Recommend for Mail Order & Personal Callers Only

	PRICES EACH including V.A.T. and P & P
Oryx 50 Temperature Controlled Soldering Iron	£10.50
Spare tips for above	£1.10
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Spare tips for above	£2.60
Cable 7/0.2 11 Colours 100 meter reel	£2.25
0.1 Veroboard 3¾" × 11½"	£1.90
0.1 Veroboard 4¼" × 18"	£4.25
Copper Clad board single sided	70p
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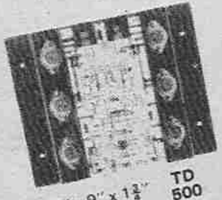
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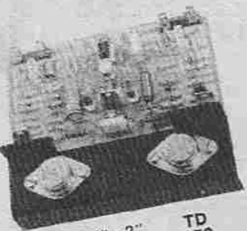
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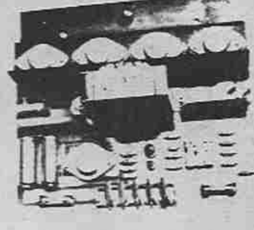

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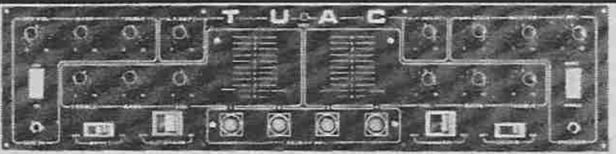

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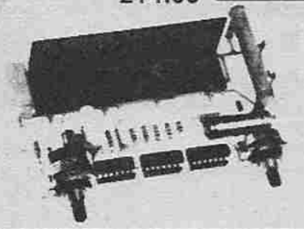

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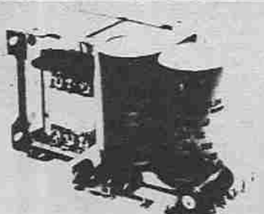

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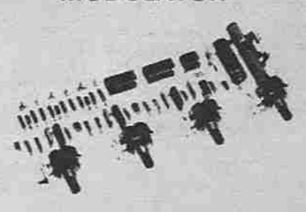

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Mag issue	PROJECT	KIT Ref	PRICES P.C.B.	PRICES KIT	KIT CONTENTS (see key)
Jan 78	Audio Visual Metronome	E001	+ 85	6·40	B.E.H.L.
	Touch Switch	E002	+1·00	2·35	B.E.
	Rapid Diode Check	E004	+ 85	2·80	B.E.H.L.
Feb	Car Alarm	E005	+1·15	6·55	B.E.G.H.L.
	Lead Tester	E006	80	5·10	B.E.H.L.
	Chaser Light Display	E007	2·70	23·95	B.E.H.L.
	A.C. Meter Converter	E008	+1·05	6·70	B.E.H.L.
Mar	Audio Test (2 × Pcb's)	E009	+2·65	18·75	B.F.G.J.
	C.R. Substitution Box	E010	—	9·95	E.H.L.
	Catch-a-Light	E011	+1·40	10·00	B.E.H.L.
	Weird Sound	E012	+1·00	6·45	B.E.H.L.
Apr	Roof Rack Alarm	E013	+1·00	—	
	Mains Delay Switch	E014	+1·25	14·25	B.E.J.L.
	Pocket Timer	E015	+ 95	4·40	B.E.H.L.
May	Flash Meter	E016	+1·10	13·20	B.E.H.L.
	Mains Tester	E17	+ 85	1·90	B.E.H.
	Teach In—Power Amp	E18	—	1·95	E.
	Power Pack	E19	+1·20	7·10	B.E.H.L.
Jun	Tele-Bell	E20	+1·35	12·80	B.E.H.L.
	Insitu-Transistor Tester	E21	+ 95	6·15	B.E.G.H.L.
	Teach In S.W. Receiver	E22	—	3·30	E.
	Power Slave	E23	2·45	—	
	Visual Continuity Tester	E24	—	4·95	E.H.L.
July	Auto Night Light	E025	+1·30	11·25	B.E.G.H.L.
	Short Wave Radio	E026	—	10·25	E.J.
	Quagmire	E027	+1·95	8·80	B.E.G.H.
	Logic Probe	E028	+ 80	3·45	B.E.G.H.L.
Aug	Slave Flash	E029	+ 90	3·55	B.E.
	M.W.	E30	+ 80	6·35	B.E.J.L.
	Audio Freq. Signal Generator	E031	+1·45	14·85	B.E.J.L.
	Chronostop	E032	+2·95	33·95	C.E.G.K.M.P.
Sept	R.F. Signal Generator	E033	—	18·25	E.H.
	Sound to Light	E034	—	6·20	E.H.L.
	Guitar Tone Booster	E035	1·05	5·00	B.E.H.L.
	Car Battery State Indicator	E036	90	2·20	B.E.
Oct	C.M.O.S. Radio	E037	+1·85	12·75	B.E.G.H.L.
	Fuse Checker	E038	—	2·15	E.H.L.
	Treasure Hunter	E039	1·80	18·20	B.E.G.H.L.
Nov	Audio Effects Oscillator	E042	—	3·05	E.H.L.
Dec	Water Level Alert	E043	+ 90	4·65	B.E.G.H.L.
Nov	Subscribers Tele-Tel. Meter	E044	+3·50	24·50	C.E.G.K.M.P.
	Subs. Tele Tel—3rd Digit	E044A	—	3·50	E.
	Combination Lock (2 Pcb's)	E045	+3·45	24·95	B.E.H.L.
	Hotline Game	E046	+1·00	5·50	B.E.H.
Oct	Mini Module-Passive Mixer	E047	—	3·10	E.H.
Dec	Audible Flasher	E048	—	3·00	E.H.
	Fuzz Box	E049	+1·00	6·25	B.E.H.L.
	Vehicle Immobiliser	E050	1·25	5·50	B.E.H.L.
	Mini Module—Microphone Amp	E051	—	3·10	D.E.H.
Jan 79	Mini Module Continuity Tester	E052	+1·05	4·65	B.E.H.
	Lights Reminder	E053	+1·15	6·90	B.E.G.H.L.
	I'm First	E054	—	2·20	E.H.
	Roulette (2 p.c.b.'s)	E055	+4·10	20·45	B.E.H.
	Headphone Enhance	E056	—	2·60	E.H.C.
Dec 78 To Feb 79	EE 2020 Tuner Amp A (inc. R. unit)	E057	3·65	58·95	B.E.G.H.
	EE 2020 Tuner Amp B	E058	3·60	25·95	B.E.H.
	EE 2020 Tuner Amp C	E059	1·45	4·70	B.E.H.
	EE 2020 Tuner Amp D	E060	2·30	18·45	B.E.H.
	EE 2020 Tuner Amp E	E061	1·40	24·95	B.E.G.H.
	EE2020 Hardware & wire	E062	—	13·50	K.
	EE 2020 Kit excl. Case	E063	10·90	135·00	B.E.G.K.
Feb	Long Wave Convertor	E064	+1·20	7·40	B.E.H.L.
	Mini Module Audio Modulator	E065	—	2·00	E.H.
	Power Supply	E066	+1·00	25·45	B.E.H.
	Thyristor Tester	E067	+ 80	4·85	B.E.H.L.
	Sound Adaptor	E068	+1·20	6·95	B.F.H.
Mar	Car Direction Indicator (Neg. 12v)	E069	+1·25	8·45	B.E.G.H.L.
	Time Delay Indicator	E070	+ 90	4·05	B.E.J.L.
	ONE Transistor Radio (inc. Amp)	E071A	+1·00	8·50	B.E.H.
	ONE Transistor Radio (excl. Amp)	E071B	+ 85	7·35	B.E.H.
	Mini Module—Versatile Power Supply	E072	—	5·35	E.H.L.
Apr	Shaver Inverter	E073	+1·00	12·75	B.E.H.L.
	Touch Bleep	E074	+1·15	4·70	B.E.H.L.
	Mini Module Transistor Test	E077	+ 95	4·25	B.E.H.
	Choke Warning	E078	+1·00	9·00	B.E.G.H.
May	Electronic Dice	E079			
	Intruder Alarm	E078	+1·35	25·45	B.E.H.L.
	Electronic Dice	E079	2·15	14·45	B.F.H.L.
	Shortwave Converter	E080	—	17·95	E.J.L.
	Thermostat	E081	+1·25	12·65	B.E.H.L.

+ P.c.b.'s designed by Tamtronic to EE circuit specifications

KEY TO KIT CONTENTS

- **A** Vero-board(s)
- **B** Printed Circuit Board(s)
- **C** With screen printed component layout
- **D** Tag strip
- **E** ALL Resistors, potentiometers, capacitors, Semi-conductors
- **F** As E but with exclusions—Please ask for details
- **G** Dil and/or transistor sockets and/or soldercon pins
- **H** Hardware includes Switches, Knobs, Lamps & Holders, Fuses & Holders, Plugs & Sockets, Microphones, Transformers, Speakers, Meters, Relays, Terminal Blocks, Battery Connectors, etc. BUT excludes nuts, bolts, washers, connecting wire, Batteries and special miscellaneous items.
- **J** As H but with exclusions—Please ask for details
- **K** As H but including connecting wire
- **L** Suitable Case(s)
- **M** Suitable Case with Screen printed facia.
- **N** Full kit to magazine specified standards
- **P** Kit with professional finish incorporating all prime features including screen printed PCB and case where appropriate

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Complete kit E040 **£24·00**

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TELE-TEL

Nov. 78 **Ref. E044**

Subscribers phone call charge meter

A kit with a professional finish

CASE with screen printed facia similar to magazine photograph but includes provision for 3rd digit. An aluminium sub-facia panel is also provided with screen printed hole centres to allow access to preset potentiometers.

PCB designed to incorporate 3rd digit facility and is screen printed for ease of assembly.

Basic kit (2 digits) £24·50
(3 digits) £28·00

BARGAIN CORNER

100 × ¼w 1k carbon resistors	**30p**
10 × 1w 5% 1k5 resistors	**10p**
10 × 1w 5% 7k5 resistors	**12p**
10 × 1w 5% 100R resistors	**12p**
10 × 6w 5% 390R wirewound	**50p**
10 × 47u 10v Axial Elec. Caps	**25p**
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CHRONOSTOP

Aug. 78 **Ref. E032**

SPLIT 6 TAYLOR lap timing modes plus normal start/stop operation.

A kit with a professional finish including

CASE with screen printed facia

PCB with screen printed component layout

Full Assembly Instructions

PRICE INC. VAT £33·95

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" " " 21 (4·5mm)
" " " 22 (6mm)
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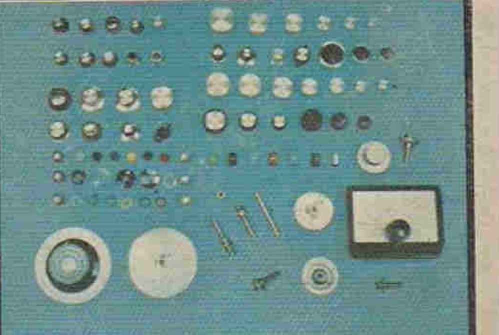

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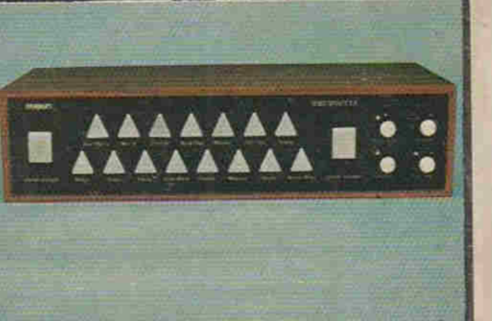

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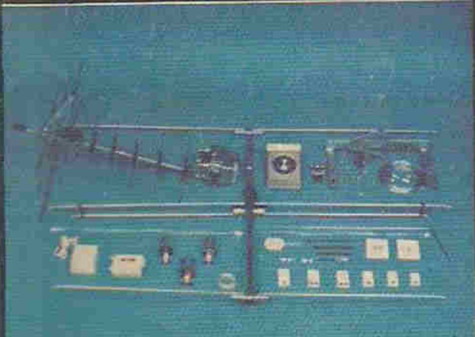

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